"Licence to SHOK?"

External Evaluation of the Strategic Centres for Science, Technology and Innovation

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"Licence to SHOK?" External evaluation of the strategic centres for science, technology and innovation

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This report summarises the results of the evaluation of the Strategic Centres for Science, Technology and Innovation (SHOKs). The SHOKs have, in the last five years, become one of the main instruments of Finnish innovation policy and one of its 'flagship' programmes. Currently there are six SHOKs in operation: Cleen Ltd (in the area of environment and energy), FIMECC Ltd (in the metals industry), SalWe Oy (in health and well-being), Tieto- ja viestintäteollisuuden tutkimus TIVIT Oy (in the ICT and digital services sector), RYM Ltd (in the built environment sector) and Finnish Bioeconomy Cluster FIBIC.

The financing model is based on an average of 60% of funding coming from Tekes and an average of 40% of the research conducted in the SHOKs being co-funded by the companies involved. Between 2008 and September 2012, Tekes funded these SHOK programmes with a total of over 343 million €. Centres are organised as limited companies around clusters of public-private partnerships, with the aim of creating new knowledge and expertise and accelerating innovation processes and industrial renewal through new types of cooperation, interaction and co-creation. Activities are intended to support the emergence of internationally competitive and attractive innovation environments in Finland. SHOK research is based on strategic research agendas (SRA) defined by the partnerships themselves, with both relevance and excellence as the primary criteria, with the objectives of industrial and societal renewal promoted within a five to ten year time span.

The SHOK 'model' has emerged as a popular industry-driven instrument. The Centres have succesfully defined their strategic agendas and by promoting these have produced new instruments for innovation and research policy. There are however a number of challenges with the current SHOK model. These include the multiple and often internally contradictory objectives, often leading to inadequate steering and performance guidance. Tensions can also be identified between the short-terms interests of industry and the longer-term perspective required in the promotion of cutting edge or 'breakthrough' scientific research. Despite the high expectations, the international dimension of SHOk activity has also remained low.

The report's recommendations propose a number of improvements and clarifications, most specifically in selection processes, governance and monitoring.

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Foreword

The Strategic Centres for Science, Technology and Innovation (SHOK) is an innovation policy initiative, launched in 2006 by the Finnish Research and Innovation Council.

Seeking to combine relevant industry-driven and scientific expertise, the SHOK model is currently one of the principal innovation instruments of Finland's innovation policy. A key role of the centres is to increase the competitiveness of our research and innovation system, by developing industry-driven research activities, and by focusing resources on selected sections of industry and research. The aim is to create new knowledge and expertise, to accelerate innovation processes, and to bring industrial renewal through new types of cooperation, interaction and co-creation. Their activities intend to support the emergence of internationally attractive and competitive innovation environments in Finland.

SHOK research is based on strategic research agendas (SRA), jointly defined by industry and the academic community, with the objectives of industrial and societal renewal, promoted within a five to ten year time-span. The centres are organised as limited companies around clusters of public-private partnerships and coordinated by the SHOK companies. Currently there are six SHOKs in operation: CLEEN Ltd (in the area of environment and energy), FIMECC Ltd (in the metals industry), Finnish Bioeconomy Cluster FIBIC Ltd, RYM Ltd (in the built environment sector), SalWe Oy (in health and well-being), and TIVIT Ltd (in the ICT and digital services sector). The first SHOK company was founded in 2007 and the most recent were established in 2009.

The Finnish government is committed to funding these centres and their research through sizeable investments. Between September 2008 and September 2012, the main funding body, Tekes, provided a total of 343 million euros to the SHOK programmes. An average of 40% of the research conducted by the SHOKs is being co-funded by the companies involved. The Academy of Finland has channelled funding to areas of research in which the SHOK companies operate, and has offered special sources of funding for these areas.

After several years of SHOK activities, it has become necessary to carry out an independent external evaluation. As well as offering an assessment of the performance of individual SHOKs, the evaluation provides an analysis of SHOK as a policy instrument, and offers forward-looking conclusions which can be utilised by ministries and the bodies which fund research and innovation policy, and those which implement it on grassroots level in their operational planning.

The SHOK model is considered a welcome promoter of industry-driven research in Finland. The centres have successfully defined their own research agendas and, in implementing these, have produced new instruments for innovation and research policy. The evaluation report however highlights significant challenges with the

current operations model, and with the results and effectiveness of the SHOK centres. These include the multiple and often internally contradictory objectives of the SHOKs, often leading to inadequate steering and performance guidance. Tensions can also be identified between the short-term interests of industry and the longer-term perspective required in the promotion of cutting edge or 'breakthrough' scientific research. Despite the high expectations, the internal dimensions of SHOK activity have also remained low when it comes to achieving internalisation and a cross-scientific, multi-disciplinary presence.

The report's recommendations propose a number of improvements and clarifications, most specifically in the ownership of the centres as a policy instrument, their operational goals, selection processes, governance, implementation and monitoring.

Ministry of Employment and the Economy (MEE) wishes to thank the consortium charged with the evaluation, consisting of Ramboll Management Consulting, Joanneum Research, Gaia Consulting, and individual consultants. The report will provide useful and necessary background material to a MEE-appointed SHOK management group, which will present its own suggestions and initiatives in spring 2013 for developing the operations of the centres.

Helsinki, 29 January 2013

Enterprise and Innovation Department
Ministry of Employment and the Economy

Contents

Executive summary

What are the SHOKs?

The Strategic Centres for Science, Technology and Innovation (SHOKs) were established as a policy concept in 2007 and organised around public-private partnerships. The aim here was to help accelerate the process of innovation and renew Finland's industrial clusters by creating new competences and inducing radical innovations at the system level. In this context SHOK operations sought to apply new methods of cooperation, co-creation and interaction. International cooperation is also intended to play an important role here. Furthermore, the testing and piloting of creative research environments and ecosystems constitutes an additional and essential element of the Strategic Centres' operations. In the organisational context of the Centres, companies and research units are intended to work in close cooperation, carrying out research that has been jointly defined in the strategic research agenda of each Centre. The research produced aims to meet the needs of Finnish industry and society within a five-to-ten-year period.

The Strategic Centres for Science, Technology and Innovation (SHOKs) have, in the last five years, become one of the main instruments of Finnish innovation policy and perhaps even its 'flagship' programme. Currently there are six SHOKs in operation: *Cleen* (in the area of environment and energy), *FIMECC* (in the metals and engineering industry), *SalWe Oy* (in health and well-being), *Tieto- ja viestintäteollisuuden tutkimus TIVIT Oy* (in the ICT and digital services sector) *RYM* (in the built environment sector) and *Finnish Bioeconomy Cluster FIBIC*. In the following report and for practical purposes we will use the short-hand terms to denote these centres: Cleen, FIMECC, SalWe, TIVIT, RYM and FIBIC, though it is worth noting that these are not the official names of the Centres or the companies around which they are organised.

Between 2008 and September 2012, Tekes funded these SHOK programmes with a total of over 343 million €. An average of 40% of the research conducted in the SHOKs is, or will be, co-funded by the companies involved. The SHOKs are also encouraged to apply to the various EU research programmes for additional funding.

What was the evaluation all about?

The main objective of the evaluation has been to provide an independent assessment of the Finnish Strategic Centres for Science, Technology and Innovation (SHOK) policy, strategy and activities, and to present the key findings and outline the lessons learned with a view to improving SHOK strategy, activities and the utilisation of its results while also developing a set of forward-looking guiding ideas and recommendations to support future work undertaken by the ministries. As the SHOKs are each at different stages of maturity and exist in very different fields, the intention of the evaluation has definitively **not** been to compare or rank the SHOK

Centres, rather the evaluation has sought to provide an assessment of each Centre in light of how they have been able to operationalise the policy goals set out at the concept level, while also assessing their 'state of the art' in relation to their Strategic Research Agendas (SRAs). The evaluation has also sought to provide an analysis of how the concept works as a policy instrument and how it could be improved in this regard.

The Ministry of Employment and the Economy commissioned the evaluation of the SHOKs in spring 2012 with the work commencing in April 2012. The evaluation consortium consists of *Ramboll Management Consulting* (Lead, Finland), *Joanneum Research* (Austria), *Gaia Consulting* (Finland). In addition, Terttu Luukkonen from the Research Institute of the Finnish Economy ETLA (Finland) and Luke Georghiou from Manchester Business School have contributed to the evaluation as individual experts.

What does the evaluation report contain?

This evaluation report describes the main characteristics, and the organisational and functional forms, of the Strategic Centres for Science, Technology and Innovation (SHOK), as well as an outline of the evaluation process and findings. In addition, the report describes the main stages, data sources, findings and recommendations formulated by the evaluation group in order to elevate SHOK activity to the level originally envisaged by the Research and Innovation Council (RIC, previously Research and Technology Council) in launching this new policy instrument in 2006/2007. At the same time the evaluation has also sought to address the major changes that have taken place in the operational environment, as well as those changes which reflect on the research- and innovation activity, and indeed upon the needs of industry and society more generally.

In line with the commissioned evaluation work, each of the six currently operating SHOKs has been analysed in order to describe and understand the functions and operations in place and in order to achieve an overall picture of the SHOK instrument, something which we feel is necessary if we want to attain pertinent findings and produce relevant and viable recommendations to improve the functionality of SHOK as an instrument of research and innovation policy and industrial and societal renewal.

What is the knowledge base, data and methodology implemented in the evaluation?

Data-gathering for the evaluation included an extensive documentary analysis of the reporting and monitoring materials provided by Tekes and the individual SHOKs. These materials included both quantitative (e.g. the performance indicators) and qualitative (descriptions of results and outputs) data. In order to assess the perceived utility, effectiveness and value added of the SHOKs to their stakeholders,

an electronic survey was undertaken in June 2012, with a target group complied with the help of Tekes. The target group included over 2000 stakeholders.

In order to build a clearer picture of the relevance and effectiveness of SHOK in the national policy context, 20 in-depth interviews were conducted with persons representing the strategic level of innovation and research policy, within both the innovation system itself and society at large. Here the intention was to address those who *should* be aware of the SHOKs and their activities, even though they may not be placed at the heart of SHOK networks as such. Within the SHOK-specific investigations, approximately 10 individual interviews were undertaken with the SHOK management, shareholders and central stakeholders of the Centres.

During the evaluation process a separate evaluation panel of international experts was organised to assess each Centre. The panels brought together 5 independent international experts who were provided with the necessary materials and who, in addition, were involved in a number of interactive meetings with SHOK stakeholders. In the context of this process almost 100 individual experts and stakeholders were involved in the various presentations and discussions.

To ensure that an international comparative perspective prevailed and that the Finnish experience was placed in a broader context, an international benchmarking analysis was provided by the experts at *Joanneum Research*, Austria. The international comparative context was also included in the drafting of the conclusions and recommendations, where the international experts brought their relevant similar experiences to bear when considering the potential future options available to Finnish policy makers.

How are the SHOKs funded and organised?

The initial investment financing for the SHOKs has, in the main, been provided by Tekes and by private industry. Between 2008 and September 2011, Tekes funded the SHOK research programmes to a total of 234 million €. An average of 40% of the research conducted by the SHOKs has however been co-funded by the companies involved. The Academy of Finland contributes to the strategic centres indirectly by funding leading-edge research carried out in the research areas covered by the SHOKs (EUR 31 million in 2011 and EUR 5 million for 2012–2014).

The original initiators of SHOK activity were Tekes (with the main driving force being the desire to renew the existing model of technology programmes) and the forest cluster (addressing the research needs of the sector in the post-KCL situation). Companies were quite cautious in the early stages, with the industry federations being clearly the more positive proponents of the SHOK concept. The academic community was originally quite ambivalent and has subsequently become largely marginalised from SHOK activity. The SHOKs have therefore struggled to convince the academic community of the value of participation or of the concept as a whole. In many cases the agenda has been based more on a compromise between different actors and goals than on a shared commitment to achieving global excellence.

Research excellence has in part been compromised due to the inability to build bridges between the SHOKs and the Centres of Excellence. The Academy of Finland's role has changed over the evaluation period and while the Academy of Finland does not fund SHOKs directly, they do fund SHOK-related activity, in areas where SHOK research is active (estimated 22 mill€ in 2011, according to Academy of Finland information). While the SHOKs do not necessarily need Academy of Finland funding as such, they do need top researchers and their results in order to gain scientific credibility.

Summary of evaluation findings per evaluation question

Evaluation question 1: Are the general policy goals and premises originally set by RIC in 2005-6 still valid and relevant?

Despite the relevance of the original goals, concerns remain over the concept as a whole, its functionality and its ability to provide 'value added'. One of the main weaknesses here is the contradictory nature of the main objectives, which necessitate clear strategic choices between the goals. There may thus be a need here to revisit the original SHOK concept and think carefully about the ways in which it could better attract and involve the universities and sector research institutions. The fact that the Academy of Finland has been reluctant to allocate funding directly to the SHOKs has been criticised by the SHOK companies in particular. The main concern of the evaluation team here is that this may have led to a situation where one of the key goals (excellence) was, in effect, compromised from the beginning. A more selective approach is therefore required. In order to improve their societal relevance, the SHOKs could introduce thematic cross-SHOK programmes addressing key topics of societal relevance (e.g. smart city, economic efficiency, preventive health, digital solutions for wellbeing etc.). This issue needs however to be closely coordinated with the reform of the public research institutes.

Evaluation question 2: Are each individual SHOKs' strategy and SRA relevant, focused and challenging enough to achieve the original policy goals?

The individual SRAs are highly relevant, though their ability to steer the programme content – and by so doing the overall RDI activity within the SHOKs – is not sufficient.

The SHOKs are, for the most part, still at quite an early stage in their development and thus have not reached maturity in terms of the outputs and effects to be achieved with, perhaps, the exception of FIBIC, which has in a sense moved to the next phase of development ("SHOK 2.0"). The relevance of each SHOK's strategic focus is summarised in turn below:

- The Cleen SRA is seen as relevant and up-to-date, though it may also be too all-encompassing. The SRA places the focus of Cleen activities on joint applied research, though in individual cases more fundamental research or

more market-oriented research can also be undertaken. This provides a solid ground upon which to build on the activities of this SHOK. The possibility of involving more societal perspectives and stakeholders should however be utilised more actively. The main stakeholder criticisms relate to the logic and philosophy of Cleen's activity and strategy: the combination and balance of addressing both research relevance and excellence in equal measure is seen by some of the partners in the Cleen network as an impossible circle to square. In addition, concerns remain over the breadth of the strategic focus: are the selected priorities those where Finland has most to give internationally, where research is most cutting edge and societal relevance the highest? The strategic focus has, moreover, been seen to be rather more consensual than actually priority-creating or selective.

- The relevance of FIBIC SRA is high. A particular strength here has been the fact that industrial renewal has been very much the focal point from the start and therefore the focus has been seen as correctly selected. FIBIC's SRA is excellent from the renewal point of view and it is clear from all the data gathered in this analysis that it has had a seminal role to play in the renewal of forest industry research. At the same time however it appears that the value added created may be diminishing over time.
- The relevance of the FIMECC SRA is estimated to be high. More focussed programmes (with more room for risky projects) may however be required.
- RYM SRA is seen as relevant, though it provides relatively little support for making choices. The broad shareholder and stakeholder bases make it difficult to make pre-selection and the actual strategic choices are thus often left to the programmes themselves.
- In the case of SalWe, an SRA update is under way, with a sharper focus being placed on brain disease, lifestyle diseases and internationalisation. It has, moreover, been seen as particularly positive that SRA is genuinely based on recognised Finnish strengths.
- In the case of TIVIT, the SRAs are drafted for the programmes rather than vice versa. The lead companies have had a very positive experience of the SRA process, and value the support and guidance provided by TIVIT.

While the individual SRAs are perceived to be relevant, there are however a number of areas that need to be addressed further. These include interdisciplinarity, cross-sectoral opportunities missed and internationalisation.

Inter- and multi-disciplinarity have not been sufficiently incorporated into the SRAs. Across the SHOK partnerships and industries involved there is a perception that the SHOKs have succeeded in formulating strategic visions that bring added value to the partners involved. It is also the perception within the partnerships that these SHOKs have succeeded in channelling the needs of their shareholders into the SRAs. It may however be that this has in some cases led to the favouring of stability over dynamism in terms of the choices made. At the same time, a certain discrepancy

can be observed between the SRAs and the actual operations on the ground, the latter not necessarily having clear links to the SRAs.

In addition, the SRAs have in some cases become too all-encompassing, not making bold or sharp enough choices as to what may be the future success sectors and research fields in Finland and how the SHOKs could promote these more vigorously. A sharper focus is required in most SHOKs (and particularly as regards RYM, TIVIT, Cleen and SalWe). The company shareholders are happy enough with the current state of affairs while the universities and other research organisations do not see the agenda as being sharply enough focused. In addition, the policy actors and strategic respondents also view the focus quite critically, which was also visible in the peer review panel assessments. There is however little evidence here of strategic alignment, i.e. of SHOK strategies influencing the strategic choices of their shareholders, universities or companies.

The potential for internationalisation is found in areas where there is interest in the international sphere and where the Finnish RDI profile is competitive enough to be internationally appealing. The high profile of the Finnish innovation policy 'brand' provides a good starting point for activities of the "bridging" type – both across SHOKs and between communities etc.

Both the panels and the evaluation team found that public sector decision-makers and consumer groups are among those stakeholder groups that should be better integrated into many of the SHOK's activities. In only a very few cases are public sector agents (e.g. cities) shareholders in SHOK activity, though future city/smart city -related topics in particular could easily accommodate areas of research from many SHOKs and in particular provide a platform for cooperation and multi-disciplinary research between and across them.

In light of the e-survey, issues that need to be addressed more actively if the SHOKs are to achieve their ambitious targets of igniting structural change and technological breakthroughs include:

(i) Internationalisation in various ways, e.g. ranging from attaining international quality status in research, attracting international participation into RDI in Finland, making industries internationally competitive or methods used for international benchmarking.

(ii) cross-SHOK collaboration (with the potential for cross- and trans-disciplinary openings and interfaces) and

(iii) The cultural shift that is expected from both industry and academia and building up a professor infrastructure across the industries.

The SHOK e-survey respondents view the EU research funding instruments rather negatively which leads us to conclude that the SHOKs could be a competitive and attractive alternative option for internationalisation in this regard. The EU instruments are seen as exhibiting the heaviest administrative burden and least flexibility, while they are clearly also seen to be weakest in terms of the degree of technological and scientific risk. In addition, the research respondents perceive EU

funded research activities to be furthest away from the core competence area. For research organisations a similar distance exists in terms of industrial collaboration in relation to the SHOKs.

In light of the survey, research infrastructures and testing and piloting facilities are also areas where considerable untapped potential seems to lie, not least in the challenging areas where the potential interfaces between industries and disciplines could be more fully explored. TIVIT and Cleen have however been more active in this area than have other SHOKs hitherto. This is also an area where closer collaborative efforts between the SHOKs should be promoted.

Unresolved IPR issues have been identified as a major problem in utilising some of the SHOK results. Though the evaluation team may conclude that the rules involved here are clear, the perception that they are not nevertheless remains. While in some cases it has been argued that commercialisation is not among the main objectives to be attained, in some of the SHOKs (e.g. TIVIT) it has clearly and unambiguously been set as a goal. As common results are usable by every programme partner across the SHOK programmes, there seems to be very little incentive for commercialisation. Some promising results may not even be utilised. IPR issues should thus be resolved immediately to increase the incentive to commercialise, and to increase the general commitment to commercialisation. Benchmarking cases where open innovation has been the rule and where it has proven to work should also be identified.

In some sectors the catalysing role of SHOK activity has been essential (e.g. RYM and FIMECC). This entails the bringing together and gradual building of a research ecosystem in a new RDI area that has previously not existed. Both RYM and FIMECC are seen to have helped to create more systematic R&D -intensive activity and networking and the utilisation of available resources and, as such, the SHOKs are also said to have created value added which would not otherwise have been available and which would disappear without SHOK support.

The results as monitored and observed in terms of the key performance indicators are modest. This is, in part, explainable by the picture remaining blurred due to the lack of comparative data. While some SHOKs show real promise (e.g. FIMECC), others are less impressive or have not succeeded in reporting their results. This is also indicative of the lack of a consistent and systematic monitoring model, which would bring the SHOKs useful (benchmarking) information while also providing the funding agencies and SHOK steering and management on the national level with a means to assess the progress made. Benchmarking should be implemented in a more systematic fashion – perhaps through thematic benchmarking or through peer reviews with other European and international models of the SHOK type (the UK Catapult or the German and Austrian examples in the benchmarking undertaken in the context of this evaluation).

In sum, thus far the SHOKs have not been able to address topical areas stretching beyond their sectoral boundaries (between programmes or between the SHOKs) to any significant degree with perhaps FOREST turned BIOECONOMY being the

primary exception here. Nevertheless, we cannot get away from the fact that one of the main hopes in respect of the SHOKs was to ignite trans-disciplinary, field-transgressing activities. Instead of the traditional clusters, it might have been better (and is perhaps still worthwhile considering) to organise the SHOKs along different thematic lines (e.g. new technology areas, new markets or societal demands).

The interfaces, which are potentially interesting for all SHOKs and where such activity has been launched by individual SHOKs include, for instance, digital services, smart city and well-being (TIVIT, SalWe and Cleen).

Evaluation Question 3: What is the strategic position of the SHOKs as a policy instrument in the Finnish economy and R&D&I system?

The position of the SHOKs, situated among traditional Tekes technology programmes and Academy of Finland research programmes, is not clear. The interviews and survey show that this lack of clarity exists among both the stakeholders and the potential SHOK beneficiaries. While the ambition is to make SHOK the instrument that best combines industrial and academic interests in excellence and takes risks to discover future sources of innovation and growth for Finland, in some cases it ranks lower than Tekes programmes in terms of innovative results, testing new solutions and commercial potential and in most cases (with the possible exception of FIBIC) lower than the Academy of Finland's funding programmes in terms of scientific excellence.

SHOK as an instrument does not seem to have a sufficiently strong scientific profile and has not fulfilled its potential in light of the excellence criteria. On the strategic level the programme clearly remains in search of a "political champion", as ownership of the SHOK concept remains unclear. While the Ministry of Employment and the Economy and Tekes are reluctant to take on this responsibility, perhaps it is the Confederation of Finnish Industries that would be the most natural "owner"? Such a 'solution' may however be at odds with ensuring the fuller involvement of the academic community. If the desired outcome is to be attained, the involvement and centrality of the academic community needs to be more fully ensured and this may instead require a model based on co-ownership, also involving the Ministry of Education and Culture more fully.

In order to ensure the fuller involvement of the scientific community, issues relating to the excellence criteria and openness need to be specifically addressed. In order to strengthen the quality standards and criteria for excellence such that they are on a par with the high relevance criteria, quality assurance processes are welcomed by those stakeholders currently concerned with the inability to achieve credibility in terms of the academic excellence of SHOK research. These types of peer review processes have thus far only been introduced in a few cases (e.g. Cleen) and a similar model would thus be welcomed across the SHOKs more generally.

The significance of building stronger ecosystems with the help of co-location should be investigated more thoroughly. The SHOK companies have already

co-located, which supports the flow of information and ease of contact, but there may be grounds for investigating the possibility of "SHOK campuses" or similar. The significance of testing facilities, Living Labs and testing platforms has thus been seen as a useful way of sharpening the societal relevance and value added of the programme. FIMECC Factory is an interesting example of such initiatives.

Evaluation Question 4. To what extent have the general strategy, policy goals and premises set by the RIC in 2005-6 been achieved?

The concentration of resources in the selected areas has been achieved to some extent, the excellence and renewal aspects less so. As argued above, this is due to the conflicting nature of the objectives, which makes it rather difficult to achieve the desired results. Perhaps therefore one should choose which of the three targets one most specifically wants to address or at least in which order and in which logic the different objectives could be achieved. The whole impact model thus needs to be thought through more systematically.

The SHOK-specific starting points vary greatly and this is something which is clearly reflected in terms of goal attainment. The point of departure varies greatly and therefore within some SHOKs even more modest results can be seen as somewhat revolutionary. In some cases the mere fact that RDI activity has been developed more systematically has been viewed as an achievement (in particular RYM).

There seems also here to be a clear lack of internationalisation and of global dimensions. In their current state, the SHOKs neither serve as attraction foci for talented researchers nor as research intensive RDI. The international dimension of their activities is certainly not given enough thought while their presence in respect of EU programmes and initiatives remains low. TIVIT is, for instance, the only SHOK with a coordinating function in a European research programme. No internationalisation strategy exists on the concept level, or within the individual SHOKs. It is hard therefore to see how the SHOKs can attain the goal of achieving breakthroughs without sufficient international linkages, though internationalisation as such should not be the main target.

Many of the other aspects are, moreover, simply impossible to assess, due to the fact that a functioning and transparent evaluation and monitoring system was not put in place to trace the outputs, inputs, results and effects. The KPIs have, crucially, not been systematically defined and perhaps also a more interactive model *should* now be put in place as regards monitoring.

As limited companies SHOK companies are accountable to their shareholders in terms of standard business indicators, such as turnover and financial performance. Yet as far as the SHOKs use considerable amounts of public funds, they need to report on more than simply these business indicators. Thus far the SHOKs have interpreted the KPIs in various ways and reported on what they have felt best reflects their strategy. Perhaps this could be a model for the majority of activities, but since a considerable amount of public funding is used, the indicators used must

be carefully selected. The SHOKs should be involved in selecting the indicators that best reflect their strategies while for the shared indicators, a bank of indicators could be developed where the SHOKs could select the 3–5 that best reflect their own activities. The facilitating and networking functions should also be included in the indicator package, reflecting the character of SHOKs as bridge-builders and facilitators within the innovation system or innovation ecosystems.

Monitoring systems have to be built into programme design and be used as a basis for continuous quality assurance, performance assessment and overall evaluation. Similarly to some of the international benchmarking cases introduced, in the SHOK context the timeframe should also be carefully considered (e.g. 3–4 years, bearing in mind that the overall timeframe set is 5–10 years). Peer reviews could be used as an additional resource here, especially in deciding on new programmes, focus areas, cross-SHOK initiatives etc.

Evaluation Question 5. To what extent have the goals and objectives outlined in the SRAs been achieved? How central are the SHOK activities in promoting these goals, when compared to the other policy instruments that the shareholders and programme actors have at their disposal?

The goals have been achieved when it comes to committing the shareholders and industries, yet the results are less impressive when it comes to the academic community. The SHOKs were unable to provide the panels and the evaluators with sufficient information on their concrete overall results. This cannot be explained by confidentiality or IPR issues, as all the panellists and experts were bound by a confidentiality agreement. In light of all the evaluation data the SHOKs are seen as being central to the shareholder companies and their RDI. They are, on the other hand, relatively invisible among the academic community and in the society at large. This is, in part, due to the long lead time originally required to get the SHOKs up and running. In addition, evidence on their results and effectiveness remains insufficient. This may be more a function of the poor standard of monitoring and assessment than anything else, yet nevertheless it is an issue that needs to be addressed, both within the individual SHOKs and across the SHOK governance structure as a whole.

The indicator picture is fragmented. There are numerous Key Performance Indicators (30 in total) being reported, though without a transparent logic model making clear the linkages between outputs, inputs and results. Some of the core issues that could make the SHOKs truly unique and highly relevant are not however included or are not sufficiently covered by the KPIs. One such issue is the focus on cross-disciplinary and sector-transgressing themes and research substance. This is welcomed in the original goal setting and rationale of the SHOKs, and could be a way of focusing on the future success areas, in line with "grand challenges" thinking. These challenges should be identified from a Finnish perspective, in the sense that they should be areas

where Finland already has a track record of potential global excellence, which could be nurtured further into an international level area of excellence.

There are indications that the SHOKs have enabled the integration of new partners and broader consortia and partnerships. Sometimes however the breadth of the partnerships has been won at the expense of the depth and intensity of the collaboration. Often, the SHOKs seem simply to have even become too large to allow for efficient collaboration.

Based on the interviews and survey findings, the SHOKs are seen to fill an important gap in the repertoire of research and innovation instruments, yet the profile of the instrument is low. The survey reflects the perceptions of the stakeholders and shows that in many cases the SHOK instruments are seen as very close to the Tekes programmes. The perception here is that there is no clear / transparent process or criteria to indicate why some topics end up as Tekes programmes, others as Academy of Finland programmes and only some, as SHOK programmes. This is undoubtedly a negative indication of the fact that the basic SHOK position has simply not been defined, clarified and communicated clearly enough.

Evaluation Question 6. Is the SHOK concept an appropriate and effective way of organising R&D&I collaboration (in comparison with other well-known instruments nationally and across international benchmarks)? What are the strengths and weaknesses of the SHOKs compared to other funding and networking instruments? (Tekes and Academy of Finland programmes, EU FP7, competence clusters, Centre of Expertise etc)?

The KPI data available, benchmarking analysis, interviews and the survey each witness a low attainment level. The intensity of collaboration is perceived positively however and seen as qualitatively more advanced than in previous programme contexts. There are however some indications that the preconditions for future success may – in some cases at least – be in place, in particular when it comes to industry-based RDI. The survey provides a rather revealing picture in this regard, where the intensity of collaboration is clearly highest among the SHOKs (both company and research respondents feel this way).

There is a clear contradiction between the perceptions of appropriateness and effectiveness between the different stakeholder groups. Industry respondents are most positive as to the suitability of SHOK as a way of organising RDI collaboration. For the industry respondents, SHOK activities importantly exhibit the highest degree of risk, scientific complexity and best quality selection mechanisms, when compared to Tekes or EU research instruments. For research respondents the SHOKs represent the weakest quality and transparency of selection criteria, which is seen as critical. The selection issue thus needs to be addressed as swiftly as possible. Contrary to the perception among the academic community, for industry respondents, the SHOKs are perceived as the best instrument of profiling oneself among the academic community. For industry respondents SHOK supports best the involvement of well-established

researchers. For research respondents, SHOK is equal to Tekes programmes as an instrument for doing research, for company respondents it is the best approach.

Even for company respondents to the evaluation survey, Tekes funding has an important role to play in supporting applied research, more so than the SHOKs. According to the research respondents, Tekes funding has the most transparent selection process, while the company respondents perceive the process as least transparent! Certain perceived advantages with the Tekes instruments undoubtedly exist for industry respondents, as most testing takes place here and the funding mechanisms are seen as being least bureaucratic.

For research respondents the Academy of Finland instruments have remained most positive and appropriate. In the interviews many described the SHOK model as too 'closed' and uncommunicative and felt that it was more of a closed club than an open forum for innovation. In order to assess this challenge a major shift in the prevailing culture of SHOKs and in the selection processes implemented is required.

In addition, there are important lessons to be learned from the numerous international benchmarks available. One question that has been actively discussed during the evaluation was that of ownership. The lessons to be learned from the benchmarking exercise undertaken by Joanneum are relevant here, for instance in relation to ownership and governance models:

- The benchmarking analysis concludes that the identification of clear responsibilities for programme owners is a key prerequisite for success here. In the current model programme management is outsourced and this seems to be a well-functioning model.
- Areas of shared responsibility between stakeholders have to be outlined, with the ministries/public authorities being responsible for the definition of priority areas for the intervention and the key expected outcomes and impacts of the programme, and the programme management setting up performance contracts with networks (tasks, responsibilities, reporting periods of the networks/centres), as well as setting up an electronic Monitoring system including key performance indicators (outputs, intermediate outcomes) which are reflected in an intervention logic of the programme.
- Steering committees/advisory boards which provide guidance on the overall strategy of the networks and participate in performance reviews. Well-functioning programmes include all relevant stakeholders, particularly the Scientific Research Community.
- The Centres and their networks have, as their main function, the definition of a strategic research agenda, which delineates a medium and long term R&D strategy for the networks (Common problem: the creation of Short term, demand-oriented R&D solutions) while, in addition, seeking to ensure coordination and commitment among industrial partners and academia. (See the benchmarking appendix for more examples.)

Evaluation Question 7. How appropriate is the SHOK approach to governance? Sub-questions including: How do the management and governance processes used facilitate the making of such decisions? How does SHOK level cooperation work? How efficient is the management, leadership and administration? Which particular bottlenecks or problems have affected goal-achievement? How have these problems been solved? What were the facilitating factors in goal-achievement? How have these been mainstreamed?

The SHOK leadership and management are generally seen to be professional with the SHOKs on many occasions praised for their 'lean' management approach. In some SHOKs there may even be understaffing issues. Yet sometimes this 'efficiency' and lean character has come at the expense of openness and open competition. It is therefore essential that SHOK management practice is developed to ensure the inclusion of, and access to, the best research groups and established researchers. One should also carefully assess which functions are most central for the SHOKs to deal with on their own, and thus also which could be outsourced. A more considered model in respect of the key functions of the SHOKs and their collaborative networks could thus bring considerable value added to the SHOK model as a whole. This would, for instance, involve making sure that the programme management is organised in the most efficient way possible. Senior researchers and professors are involved as Principal Investigators and only the programme and project management is left to the SHOK management, who concentrate on undertaking the most professional and efficient portfolio management possible.

The necessary move to strengthen the utilisation of excellence criteria also requires further attention in relation to governance mechanisms. One way of supporting this is the introduction of international peer review as a method, following the example of Cleen. Open competitions, transparency and high-profile research groups, as well as the utilisation of top researchers for peer review and planning stages are among the best ways to support the step-change required to move from industry-driven relevant, but safe and often not path-breaking research to high-profile international research where future research areas are only now being defined and articulated. This is where the SHOKs should be active and all governance innovation that can support such a change is to be welcomed.

Evaluation Question 8. How appropriate is the SHOK concept for business renewal?

In some cases (most notably FIBIC) renewal has been achieved in an exemplary fashion. Yet in most cases the SHOKs have not been able to help in the renewal of business to the degree originally intended. This is due to the agenda and activities being, in the main, driven by the large incumbent companies. There is e.g. little incentive for participants to promote spin-offs and new companies and new business with the current IP practice and rules presenting significant barriers here. It is unrealistic to expect large companies to choose research topics that are beyond

their current core competence and that do not serve their medium- or short term interests in the context of this type of instrument (large collaborations / platforms).

Evaluation Question 9. What kinds of impacts have been achieved and can be further expected? What are the impacts in the participating companies?

The societal impacts are not measured nor are they available. Clearer metrics and a systematic logic model should be developed in order to provide such an assessment. As noted previously, such metrics need to be defined in close collaboration and dialogue between the SHOK management, shareholders and steering bodies and financing organisations. This would help all parties to make more informed choices between the options available.

There are few indications that the participating businesses would be better off because of their involvement in SHOK activity, though in some cases SHOKs have clearly been a means of investing in RDI even in the difficult economic circumstances and as such valuable. Company strategies have not been influenced by SHOKs, which tends to suggest that SHOKs have been more of an additional resource for RDI than anything else.

Based on the panels and interviews, it seems that many of the opportunities for promoting societal impacts need more attention. In many cases the research content is such that the societal interests can easily be identified and promoted, though this connection remains invisible, as the targets and goals have not been set in a way that would chart the impact chains in this regard. The evaluation team acknowledges the difficulty of such an endeavour, but at the same time insists that the effort needs to be made in order to be able to assess the rate of progress and the value added for the investors, financing organisations and, in the last instance, for the tax payers.

Evaluation Question 10. What is the added value of the SHOKs? Does it make Finland more attractive as a research and business / innovation environment? Does the SHOK concept bring more or less potential value added to the stakeholders than do other policy instruments? How can such differences be explained?

It is clear that the qualitative leap to global leadership and excellence still remains to be attained in this regard and that the much vaunted societal effects are not yet visible enough. There is also a notable absence of international activity, international staff and partners.

On the most basic level the question of value added can be posed as a question of what is missing from the innovation system and what research would not find funding if it was not for the SHOK instrument. The principal achievement of the programme is the promotion of industry-driven qualitatively more ambitious, open and committed research. This alone may not however warrant such high level public sector intervention and investment.

The SHOKs have experienced a rather slow start in terms of putting a fully-fledged portfolio management structure in place, while the consortia and activities as such have emerged quite rapidly. Delay here was due, primarily, to the time it took to form the consortia and to sort out expectations and the various roles of the participants. This may be due to the difficulties in communicating and explaining a novel approach, but it may also reflect inherent problems in respect of the instrument itself. Even now, some years into the programme, ambiguities and uncertainties clearly persist among the participants. There are concerns that if the programme is in need of further explanation after years of discussion - and in fact operation - this is due to a significant design fault and to the opaque nature of the original goals.

The formation of, and value added produced by, the consortia seem to be something of a double-edged sword. Participation was originally sought by the industrial partners simply 'not to be left out' but, crucially, this was done without a real strategic approach to participation being formulated. Universities were however largely uninterested and in some cases even suspicious of the new instrument. With time some universities did become more engaged (especially the technological universities, Tampere and Lappeenranta), while others in the early stages in particular remained largely absent and felt 'left out', as programmes were not launched as open competitive calls. There seems to be no grounds for this lack of open competition within the SHOK research.

While significantly broader than previous partnerships, there may however be a risk that resources are diluted. Questions may be raised whether the type of instrument (large, multi-actor collaborative pre-competitive R&D) lends itself to the goals (industrial renewal, alignment of R&D strategies, breakthrough innovations) of the programme. Numerous previous evaluations (e.g. of the EU Framework Programmes) have indicated that companies tend to reserve their core-business, centre-of-strategy activities for other settings than large collaborative programmes. The same risk may apply to the SHOKs.

Evaluation Question 11. What are the key results and impacts of a SHOK among its stakeholders (achieved/expected)? Have the SHOKs enabled and/or inspired new forms of collaboration? Have the SHOKs enabled access to partners or knowledge sources previously unavailable?

The SHOKs have not affected the volume of participants' RDI in monetary terms or person years, though this may be an unrealistic expectation in the current economic situation. Importantly, at least in the case of TIVIT, the availability of SHOK resources may have slowed the steep decline in RDI investment.

New partnerships have clearly been forged, though mainly *within* Finland. International collaboration needs much more effort if it is to be forged. Thus far the networks created have been based more on existing configurations than on radically novel combinations.

There is, to date, little indication of RDI impacts, with the exceptions of RYM and FIMECC, where SHOK RDI has reportedly resulted in the development and/or introduction of new-to-the firm products or services.

The SHOK organisations have thus far been unable to solve the problems associated with collaborative RDI. The experience of many respondents and interviewed persons was quite negative in this regard and the openness approach may have led to the most novel and path-breaking research remaining outside the SHOK context. The IPR rules have been clearly defined and major effort has been put into communicating these rules, though it seems that this has been insufficient while the SHOKs remain too open for the partners to engage in highly sensitive research.

In terms of attractiveness, it is important to ensure that the new generation of researchers and business leaders become engaged and were encouraged use the SHOKs as a springboard. Currently it seems that the SHOK networks are, in the main, built around already established mid-career professionals, or in the case of programme management, PhD students.

IMPLICATIONS FOR THE FUTURE AND FUTURE RECOMMENDATIONS

"To whom it may concern"

The following recommendations need to be seen in the context of the scenarios proposed for the redesigning of the SHOK concept and structures. The degree to which this redesign implies a re-organisation within the individual SHOKs however varies. Based on the monitoring data available, one could fundamentally restructure the programme in the next instance, in close collaboration with the SHOK Steering Group. This should be done by focusing on the areas which have proven to work quite well and identifying the positive aspects of SHOK (such as industry-driven large scale collaboration with new partners, SRA process etc.). One may choose to transfer such parts that are worth pursuing to other programme contexts (Tekes Programmes, JTIs etc.).

The recommendations also seek to make concrete suggestions for governance within the SHOK concept, including the dialogue between the research and innovation organisations, from the Research and Innovation Council, SHOK Steering Group, Ministry of Employment and the Economy, Tekes and Academy of Finland, as well as the individual SHOK companies.

In order to ensure the accountability of the SHOK concept, all SHOKs should form a contractual agreement with the MEE. The agreement should entail the few selected KPIs where all SHOKs should report on (annually), as well as SHOK-specific KPIs. This would ensure the accountability that is required due to the high level of public funding involved in SHOK activity, while at the same time, allowing for the freedom that the SHOKs require to pursue their industry-specific strategies.

On top of the overarching assumptions, which should be met by the SHOK as a concept, as well as some generic recommendations, the recommendations

outlined below are likely to result in different levels of implications. Hence, the recommendations for the SHOKs can considered in the light of four alternative development scenarios, as described below. Each of these scenario options should be applicable at the SHOK concept level, at the individual SHOK level, as well as at the individual SHOK Programme level. The decision on which of the alternative development scenarios appear most suitable in each case remains largely in the hands of the SHOK Steering Group and the stakeholders of each individual SHOK.

The summary only includes the brief recommendations as headings, for the more developed argumentation, discussion on who should be responsible for implementation and under which conditions etc., the readers should turn to the full report.

Scenario option	Implications
Continue with minor modifications	Fine-tuning in objectives, focus and strategy. Minor changes in implementation.
Continue with major improvements	Changes in objectives, focus and strategy. Major changes primarily in terms of implementation.
Re-launch with a new approach	More extensive changes in rationale, overall approach and structures / governance.
Phase out	Phasing-out SHOKs, planned transformation into another type of activity (programme, network, etc.)

RECOMMENDATION 1: The SHOK concept, despite certain achievements, contains contradictory elements that need to be clarified. This should be accomplished in a contractual arrangement between the SHOKs and those that steer their publicly financed activity.

RECOMMENDATION 2: The SHOK strategy should reflect a wider set of interests than just those of incumbent large firms.

RECOMMENDATION 3: The SHOKs should have to compete for their status and funding and in order to do so the quality and competitive character of selection processes ensured, while at the same time ensuring sufficient commitment across time (5-year commitment originally set).

RECOMMENDATION 4: Considerably more attention should be given to developing mechanisms to induce more cross-cutting activities within and between them.

RECOMMENDATION 5. The positioning of the SHOKs within the Finnish innovation system (and for that matter also within the system of funding) needs to be clarified, to ensure that the SHOKs are capable of meeting the expectations and generating 'value added'.

RECOMMENDATION 6: The IPR question should be more effectively addressed across the SHOKs.

RECOMMENDATION 7: A funding model ensuring the effective participation of the academic community is required.

RECOMMENDATION 8: In order to promote the participation of innovative SMEs (e.g. new entrants and young firms) in the programmes, more flexible contract models for these firms in SHOK projects need to be introduced.
RECOMMENDATION 9: The SHOKs should also in future be given the opportunity to pursue different strategies, as needs and opportunities vary across industries.
RECOMMENDATION 10: The achievements of each SHOK need to be evaluated at regular intervals. This requires that a logic model and a more selective and flexible monitoring system, with appropriate KPIs, be developed.

Tiivistelmä

Mitä SHOKit ovat?

Strategisen huippuosaamisen keskittymät (jatkossa **SHOK**) ovat innovaatiopoliittinen aloite, joka lanseerattiin 2007, tavoitteenaan lisätä suomalaisen tutkimus- ja innovaatiojärjestelmän kilpailukykyä kehittämällä yrityslähtöistä tutkimustoimintaa ja keskittämällä voimavaroja valituille teollisuuden ja tutkimuksen aloille. Keskittymät on organisoitu julkisen ja yksityisen sektorin välisten kumppanuuksien ympärille ja niitä koordinoivat osakeyhtiömuotoiset SHOK-yhtiöt.

Keskittymien tavoitteena on vauhdittaa innovaatioprosesseja ja teollisten klusterien uudistumista luomalla uutta osaamista ja radikaaleja innovaatioita järjestelmätasolla sekä yksittäisten SHOK-keskittymien ja osakeyhtiöiden tasolla uudenlaisia yhteistyön, yhteiskehittämisen ja vuorovaikutuksen menetelmiä ja muotoja. Uudistumisessa on tärkeä roolinsa myös kansainvälisellä yhteistyöllä. Toiminnassa merkittävän roolin on tarkoitettu olevan myös uutta luovien tutkimus- ja innovaatioympäristöjen kehittämisellä, joiden yhteydessä on muun muassa uudenlaista testaus- ja pilotointitoimintaa. SHOKien tarkoituksena on saada yritykset ja tutkimusorganisaatiot tiiviimpään yhteistyöhön yhteisesti määriteltyjen tutkimusagendojen pohjalta. Tutkimuksen on tarkoitus vastata suomalaisen teollisuuden ja yhteiskunnan tarpeisiin viidestä kymmeneen vuoteen ajanjaksolla.

Strategisen huippuosaamisen keskittymät (SHOK) ovat viimeisen noin viiden vuoden aikana tulleet suomalaisen innovaatiopolitiikan päävälineiksi ja lippulaivoiksi. Kuusi tänään toiminnassa olevaa keskittymää ovat: Cleen Oy (ympäristön ja energian tai ns. “clentech”-alueella), FIMECC Oy (metalli- ja koneenrakennusteollisuudessa), SalWe Oy (terveyden ja hyvinvoinnin alueella), Tieto- ja viestintäteollisuuden tutkimus TIVIT Oy (ICT:n ja digitaalisten palveluiden alueella), RYM Oy (rakennetun ympäristön alueella) sekä Finnish Bioeconomy Cluster FIBIC (ennen kesää 2012 Metsäklusteri Oy). Tässä raportissa käytetään keskittymistä pääosin seuraavia, ei *virallisia* lyhennenimiä: Cleen, FIMECC, SalWe, TIVIT, RYM ja FIBIC.

Ensimmäinen SHOK (FIBIC) perustettiin 2007 ja uusimmat (rakentamisen alan RYM ja hyvinvointi- ja terveysalan SalWe) on perustettu 2009.

Syyskuun 2008 ja syyskuun 2012 välillä SHOKien päärahoittaja Tekes on rahoittanut keskittymiä yhteensä yli 343 miljoonalla eurolla. Noin 40% keskittymissä toteutettavasta tutkimuksesta rahoitetaan yritysten toimesta. Lisäksi SHOKeja kannustetaan kansainvälisten rahoituslähteiden, mm. EU-rahoituksen hyödyntämiseen. Suomen Akatemia ei rahoita suoraan SHOK-toimintaa Tekesin tavoin, mutta se on rahoittanut vuosina 2008–2012 SHOKkeihin liittyviä ja SHOK-aihealueille kuuluvia tutkimushankkeita yhteensä noin 200 miljoonalla eurolla. Summaan sisältyy vuosina 2011 ja 2012 toteutetut SHOK-aihealueille suunnatut erillishaut yhteensä noin 15 miljoonaa euroa.

Mitä arviointi on sisältänyt?

Arvioinnin toimeksiantaja työ- ja elinkeinoministeriö (TEM) on antanut ulkopuolisille arvioitsijoille tehtäväksi koota riippumattoman arvion keskittymistä ja niiden toiminnasta, pohjautuen keskittymien omiin tutkimusstrategioihin ja toimintaan ja näihin kohdistuviin havaintoihin ja päätelmiin. Arvioinnin kohteena ovat sekä strategiat että niille pohjautuva toiminta ja näiden tulokset ja tulosten hyödyntäminen. Yksittäisten SHOKien arvioinnin rinnalla arviointi tarjoaa analyysin SHOK-politiikkavälineestä kokonaisuutena ja kokoaa yhteen tulevaisuussuuntautuneita ajatuksia ja suosituksia, joita sekä ministeriöt että tutkimus- ja innovaatiopolitiikkaa rahoittavat ja käytännön tasolla toimeenpanevat elimet ja organisaatiot voivat hyödyntää toimintansa suunnittelussa.

Toimeksiannon mukaisesti kukin toiminnassa olevista kuudesta SHOK-keskittymästä on analysoitu suhteessa sen omiin strategisiin tavoitteisiin. Arvioinnin tiedollinen päätavoite on kunkin yksittäisen SHOKin toiminnan kuvauksen, analyysin ja ymmärtämisen kautta syntyvä kokonaiskuva SHOKien nykilasta ja lisäarvosta innovaatiopolitiikan välineenä. Analyysin ja laajan tiedonkeruun pohjalta on pyritty tekemään asiaankuuluvia ja oleellisia havaintoja ja suoraan toteuttamiskelpoisia suosituksia SHOK-politiikkavälineen toimivuudesta tutkimus- ja innovaatiopolitiikan ja sen uudistamisen välineenä.

Arviointi on toteutettu ajanjaksolla huhtikuusta joulukuuhun 2012. Arvioinnin toteutuksesta on vastannut konsortio, jota on johtanut Ramboll Management Consulting, yhdessä Joanneum Research:in ja Gaia Consultingin kanssa. Terttu Luukkonen Elinkeinoelämän tutkimuslaitoksesta (ETLA) ja Luke Georghiou Manchesterin kauppakorkeakoulusta (Manchester Business School) ovat toimineet arvioinnissa yksittäisinä asiantuntijoina.

Arvioinnin lähtökohtaisen tietopohjan muodostivat Tekesin ja yksittäisten SHOKien kokoama kirjallinen seuranta- ja raportointiaineisto. Näihin kuului sekä määrällisiä (numeeriset seuranta- ja avainindiakaattorit) että laadullisia (tulos- ja tuotoskuvaukset, menestystarinat jne.) aineistoja. Mukana toiminnassa olevien tutkimus- ja yritystoimijoiden näkemysten ja kokemusten kartoittamiseksi ja SHOKien synnyttämän hyödyn, tulosten ja lisäarvon arvioimiseksi toteutettiin kesäkuussa 2012 laaja sähköinen kysely kaikille SHOK-toiminnassa mukana olleille tai SHOK-alueella tutkimusta toteuttaville Tekesin tietokantaan rekisteröidylle taholle. Kohderyhmän muodosti yli 2000 vastaajaa, joiden tiedot koottiin Tekesin projektitietokannasta. Kohderyhmää täydennettiin SHOKien omista yhteystietorekistereistä ja kysely testattiin SHOK-toimijoiden keskuudessa vastaajaystävällisyyden turvaamiseksi.

SHOKien kansallista merkitystä ja tunnettuutta kartoitettiin lisäksi arvioinnin aikana tehdyissä syvähaastatteluissa innovaatiojärjestelmän avaintoimijoiden keskuudessa. Tarkoitus oli myös täydentää SHOK-verkoston sisäistä kuvaa niiden asiantuntijoiden näkemyksillä, joiden tulisi olla tietoisia SHOK-toiminnasta, vaikka he kenties eivät nykyisellään olekaan verkoston keskiössä. SHOK-kohtaisten analyysien

osana kussakin SHOKissa tehtiin lisäksi pienempi joukko haastatteluja (keskimäärin n. 10/SHOK). Haastateltavien joukko on kuvattu raportin lopussa liitteessä 2.

Tärkeä osa arviointia oli kansainvälisten arviointipaneelien kokoaminen kunkin SHOKin toiminnan laadun ja tieteellisen korkeatasoisuuden arvioimiseksi. Kolmen päivän työskentelyjaksona kokoontuneiden paneelien asiantuntijoiksi koottiin viiden asiantuntijan joukko eri puolilta maailmaa. Paneelien työskentelyä tuki arviointitiimin tekninen avustaja / kirjuri. Asiantuntijoille toimitettiin etukäteen laaja joukko kirjallista materiaalia ja kolmen päivän Helsingin vierailun aikana kukin paneeli tapasi SHOKien johtoa, ohjelmatoimijoita ja muita keskeisiä tahoja. Paneelit kokosivat yhteen n. 100 asiantuntijaa, jotka esittelivät SHOK-toimintaa kaikille SHOKeille yhteisen kysymyspatteriston pohjalta ja kävivät keskusteluja panelistien kanssa paneelin tärkeiksi katsomista asioista.

Kansainvälisen näkökulman ja riittävän laajan vertailupohjan turvaamiseksi koko arvioinnissa, Joanneum Researchin asiantuntijat toteuttivat kansainvälisen vertailuanalyysin neljästä erilaisesta, mutta SHOKien kanssa riittävän paljon yhteisiä piirteitä omaavasta kansainvälisestä politiikkainstrumentista, joita sovelletaan Saksassa, Itävallassa, Kanadassa ja Euroopan Unionin tasolla. Kansainvälinen näkökulma pidettiin myös tiiviisti esillä koko arvioinnin johtopäätöksiä ja suosituksia työstettäessä, kun arviointitiimi hyödynsi kansainvälisiä kokemuksiaan ja tietopohjaansa pohtiessaan tulevaisuusvaihtoehtoja suomalaisten päätöksentekijöiden kannalta.

Arvioinnilla pyritään tarjoamaan riippumaton ja monipuolinen tietopohja ja kokonaisnäkemys strategisen huippuosaamisen keskittymistä, niiden strategioista ja toiminnasta. Jotta tehtyjen havaintojen ja saatujen kokemusten pohjalta voitaisiin parantaa SHOKien strategioita, toimintaa ja tulosten hyödyntämistä, merkittävä osa arviointiraportista ja myös tästä tiivistelmästä koostuu tulevaisuussuuntautuneista kehittämissuosituksista ministeriöille, rahoittajille, SHOKeille itselleen sekä muille niiden ohjauksessa ja käytännön toiminnassa mukana oleville tahoille (Tutkimus- ja innovaationeuvosto, SHOK-johtoryhmä).

Miten raportti on koottu?

Raportti kuvaa strategisen huippuosaamisen keskittyminen (SHOK) arviointiprosessin vaiheet, päähavainnot ja tulokset. Kukin SHOK on analysoitu omassa alaluvussaan ja kunkin arviointipaneelin raportti on liitetty raporttiin sellaisenaan. Lisäksi analyysi sisältää kansainvälisen vertailuanalyysiosion. Raportissa esitellään myös ne toimintasuositukset, joita arviointiryhmä on muotoillut SHOK-toiminnan saattamiseksi sille tasolle, joka parhaiten vastaisi tutkimus- ja innovaationeuvoston ja SHOK-työryhmän alkuperäistä tarkoitusta liikkeellelähtövaiheessa 2006/2007. Arvioinnissa on myös pyritty huomioimaan toimintaympäristössä tapahtuneet merkittävät tutkimus- ja innovaatiotoimintaan sekä elinkeinoelämän ja yhteiskunnan tarpeisiin heijastuvat muutokset.

Arviointiraportti sisältää kuvauksen SHOKien keskeisimmistä piirteistä ja organisatorisista ja toiminnallisista muodoista. Lisäksi raporttiin on koottu kuvaus keskeisimmistä arvioinnin vaiheista, tietolähteistä, havainnoista ja suosituksista, joita arvioitsija on koonnut auttaakseen SHOKeja pääsemään sille kehitystasolle, joka oli tavoitteena 2006/2007 Tiede- ja teknologianeuvoston (sittemmin Tutkimus- ja innovaationeuvosto TIN) alkuperäisissä linjauksissa. Samalla arviointi on pyrkinyt huomioimaan toimintaympäristössä tapahtuneita muutoksia, jotka ovat heijastuneet sekä tutkimus- ja innovaatiotoimintaan että teollisuuteen ja yhteiskuntaan.

Arviointitoimeksiannon mukaisesti kunkin SHOKin toiminta on analysoitu yleiskuvan saamiseksi SHOK-toiminnoista ja tutkimusohjelmista. Laajempi kuva SHOK-politiikkainstrumentista on tarpeen, jotta saadaan riittävä tietopohja sellaisten vaihtoehtojen ja suositusten muodostamiseksi, joilla voidaan parantaa SHOK-politiikkavälineen toimintaa tutkimus- ja innovaatiopolitiikan uudistamisessa.

Millainen on arvioinnin tietopohja, aineistot ja menetelmät?

Arvioinnin toteutusta varten koottiin alkuvaiheessa Tekesin ja SHOKien toimesta laaja kirjallinen aineisto. Tämä aineisto sisälsi sekä määrällisiä (mm. avaintulosdikaattorit, ns. Key Performance Indicators = KPI) että laadullisia (mm. ohjelmien tuotoksiin ja tuloksiin liittyvä kuvauksia) tietoja. SHOK-toiminnan asemoitumista, koettuja hyötyjä ja osoitettuja tuloksia sekä tuloksellisuuden ja lisäarvon välittymistä kohderyhmille ja toiminnan osapuolille kartoitettiin lisäksi kesäkuussa toteutetulla sähköisellä kyselyllä. Kohderyhmä (yli 2000 henkilöä) muodostettiin Tekesin SHOK-hanketietokannan pohjalta touko-kesäkuussa 2012.

SHOK-toiminnan oleellisuuden ja tuloksellisuuden kartoittamiseksi kansallisessa viitekehyksessä ja suhteessa muihin toteutettaviin verrannollisiin tutkimus- ja innovaatiopoliittisiin instrumentteihin, kyselyn lisäksi tehtiin 20 strategista avaintoimijahaastattelua. Haastatellut henkilöt edustivat tutkimus- ja innovaatiojärjestelmää ja laajempaakin yhteiskuntaa. Tarkoituksena haastatteluilla oli kartoittaa sen avainjoukon näkemyksiä, joilla tulisi olla käsitys SHOK-toiminnasta osana suomalaista innovaatiojärjestelmää, vaikka heillä ei olisikaan virallista asemaa tai roolia SHOK-toiminnassa. Kussakin SHOKissa tehtiin lisäksi noin kymmenen avaintoimijahaastattelua.

Yksi merkittävä tiedonkeruun muoto ja menetelmä oli aiemmin mainittu SHOK-kohtainen arviointipaneeli. Näissä paneeleissa kokoontui viisi kansainvälistä SHOK-toiminnasta riippumatonta asiantuntijaa, joille sekä koottiin kirjallinen ennakkomateriaali että kolmen päivän ohjelma SHOK-toimintaan tutustumiseksi ja niiden tahojen kuulemiseksi, jotka ovat avainrooleissa SHOK-toiminnassa (johto, hallituksen edustajat, tutkimusohjelmien edustajat). Paneeleissa kuten muussakin tiedonkeruussa kiinnitettiin huomiota siihen, että sekä yritysten että tutkimusorganisaatioiden ääni saataisiin kuuluviin. Prosessissa kuultiin n. sataa eri SHOK-toiminnassa mukana olevaa asiantuntijaa.

SHOKien kansallisesti keskeisen roolin vuoksi erityisen tärkeää arvioinnissa oli riittävä kansainvälisen vertailunäkökulman sisällyttäminen eri työvaiheisiin. Riippumattomuuden ja kansainvälisen näkemyksen turvaamiseksi kansainvälisestä vertailuanalyysista vastasivat Joanneum Researchin arviointiasiantuntijat Wolfgang Poltin johdolla. Kansainvälinen näkökulma sisältyi myös johtopäätös- ja suositusosioihin omana työvaiheenaan, jossa erityisesti vastaavissa kansainvälisissä toimeksiannoissa mukana olleiden tiimin jäsenien kokemus muista vastaavista politiikkatoimenpiteistä ja -välineistä oli arvokas kun pyrittiin muotoilemaan toteuttamiskelpoisia ja käytännönläheisiä ehdotuksia ja vaihtoehtoisia suosituksia päätöksentekijöille. Arvioinnin tulosten ja suositusten toimeenpano luonnollisesti ei kuulunut toimeksiannon piiriin, vaan tästä vastaa työ- ja elinkeinoministeriö jatkossa.

Miten SHOK-toiminta on rahoitettu ja organisoitu?

SHOKien rahoituksesta vastaavat Tekes ja yritystoimijat. SHOK-konseptin on tarkoitus olla astetta yrityslähtöisempi ja kunnianhimoisempi kuin muiden aiemmin toteutettujen T&K-politiikkavälineiden ja sen tehtävä on pyrkiä sekä tieteelliseen erinomaisuuteen (perinteisesti Suomen Akatemian tutkimusohjelmien tärkein kriteeri) että yrityslähtöiseen relevanssiin (perinteisesti Tekesin yrityshankkeiden tärkein kriteeri). SHOK-toiminnan aloittamisen taustalla vaikuttivat muun muassa globaalisaatioraportin ja muiden vastaavien 2000-luvun alkupuoliskolla tehtyjen selvitysten tunnistamat tutkimus- ja innovaatiojärjestelmän sekä elinkeinoelämän uudistustarpeet. Tekesin alkuperäinen tavoite oli uudistaa teknologiaohjelmiensa toimintamallia ja toisaalta metsäsektorin tutkimustoiminta oli uudelleen järjestymässä. SHOK-konsepti tarjosi oivallisen välineen näiden uudistusten tukemiselle ja toteutukselle.

Vuodesta 2008 vuoteen 2012 Tekes on rahoittanut SHOK-toimintaa yhteensä 343 miljoonalla eurolla. Noin 40% tutkimuksesta rahoitetaan siihen osallistuvien yritysten toimesta. Alkuvaiheessa yritykset suhtautuivat varauksellisesti SHOK-toimintaan, kun taas teollisuusliitot olivat SHOKin vankimpia kannattajia. Akateemisen tutkimusyhteisön suhtautuminen SHOK-toimintaan oli alkuvaiheessa varsin ambivalenttia, edellytys osoittaa SHOKien lisäarvo heille on ollut haasteellinen ja on näyttänyt siltä, että tutkimusyhteisö on osittain marginalisoitunut SHOK-toiminnasta. Tämän voi katsoa heijastuvan akateemisen huippututkimuksen vähäisyyteen SHOK-toiminnan osana ja SHOKien ja Suomen Akatemian rahoittamien huippuosaamisen yksikköjen väliseen sillanrakennuksen epäonnistumiseen.

Suomen Akatemian rooli SHOK-toiminnassa on muuttunut arviointikauden aikana. Vaikka Akatemia ei suoraan rahoitakaan SHOK-toimintaa, se on rahoittanut vuoden 2011 aikana SHOK-tutkimusalueille kohdistuvaa tutkimusta yhteensä 31 miljoonan arvosta. Vaikka SHOKit eivät sinänsä tarvitsisikaan Suomen Akatemian rahoitusta, nykyiset tavoitteet saavuttaakseen ne selkeästi tarvitsevat huippututkijoita ja heidän tutkimustuloksiaan tieteellisen laadun ja akateemisen uskottavuuden turvaamiseksi.

Seuraavassa tiivistetysti vastaus arvioinnin keskeisimpiin arviointikysymyksiin.

Tulokset arviointikysymyksittäin

Arviointikysymys 1: Ovatko Tutkimus- ja innovaationeuvoston asettamat politiikkatavoitteet ja toiminnan lähtökohdat yhä ajankohtaisia ja oleellisia?

Vaikka alkuperäisiä tavoitteita pidetäänkin hyvin oleellisina, arviointi nostaa esille huolen konseptin toimivuudesta ja kyvystä saada lisäarvoa aikaan. Yksi merkittävimmistä heikkouksista tässä suhteessa on tavoitteiden keskinäinen ristiriitaisuus, mistä nousee tarve tehdä selkeitä strategisia valintoja tavoitteiden välillä.

Alkuperäinen SHOK-konsepti on arvioitava vakavasti uudelleen. Huomiota on kiinnitettävä muun muassa tapoihin, joilla SHOKit voisivat tehokkaammin houkutella yliopistoja ja tutkimusorganisaatioita toiminnan pariin ja vastata paremmin tutkimusyhteisön tarpeisiin huippututkimuksen turvaamiseksi. Suomen Akatemian koettu haluttomuus rahoittaa SHOK-tutkimusta on kritiikki, joka nousee usein esille SHOK-yhtiöiden suunnasta. Arviointitiimi näkee erityisen ongelmallisena tilanteen, jossa yksi keskeisimmistä toiminnan kriteereistä (tieteellinen laatu) on kyseenalaistunut jo varhaisessa vaiheessa. SHOK-toiminnassa kaivataan terävämpiä valintoja.

Yhteiskunnallisen vaikuttavuuden parantamiseksi SHOKit voisivat ottaa käyttöön SHOK-rajat ylittäviä monitieteellisiä ohjelmia (esimerkiksi teemoihin älykäs kaupunkisuunnittelu, taloudellinen tehokkuus, ehkäisevä terveydenhuolto, hyvinvoinnin edistäminen digitaalisin ratkaisuin jne.) Toistaiseksi kiinnostavia avauksia tässä suhteessa on saatu aikaan erityisesti TIVITin, SalWen ja Cleenin alueella. Tämä kysymys on arvioitava uudelleen läheisessä yhteistyössä meneillään olevan sektoritutkimuksen uudistustyön kanssa.

Arviointikysymys 2: Ovatko yksittäisten SHOKien strategiat ja strategiset tutkimusagendat riittävän relevantteja, kohdistettuja ja haastavia alkuperäisten politiikkatavoitteiden saavuttamiseksi?

Yksittäisten SHOKien strategiset tutkimusagendat ovat erittäin relevantteja, joskin niiden kyky ohjata tutkimusohjelmien sisältöjä ja tätä kautta vaikuttaa TKI-toiminnan sisältöön on riittämätön.

Useimmat SHOKit ovat varsin varhaisessa vaiheessa suhteessa niille asetettuun 5–10 vuoden aikaikkunaan, eivätkä ne ole saavuttaneet kypsyysvaihetta suhteessa tuotoksiin ja tuloksiin. FIBIC, joka on siirtynyt seuraavan sukupolven SHOK-moodiin on poikkeus tässä suhteessa. Yksittäisten SHOKien tutkimusagendan relevanssi voidaan tiivistää seuraavasti:

- Cleen:
  Strateginen tutkimusagenda on relevanssi ja ajanmukainen, joskin sitä voidaan pitää myös liian kattavana. Strategia asettaa toiminnan pääkohteeksi soveltavan tutkimuksen, joskin joissakin tapauksissa tehdään myös perustavaa

laatua olevampaa perustutkimusta ja toisaalta myös markkinoita lähemmäs tulevaa tutkimusta. Tämä onkin hyvä lähtökohta SHOK-tutkimukselle. Joissakin tapauksissa yhteiskunnallisen vaikuttavuuden vahvistaminen olisi tervetullutta ja myös sidosryhmiä voisi hyödyntää aktiivisemmin tutkimustoiminnan ohjaamisessa. Sidosryhmien kriittiset kommentit Cleenin toiminnassa kohdistuvat useimmiten strategian kykenemättömyyteen vastata samassa määrin sekä yritysrelevanssin että tutkimuslaadun kriteereihin. Myös strategian kattavuus herättää kysymyksiä: onko SHOK-toiminnassa todella keskitytty niihin tutkimusprioriteetteihin, joissa Suomella on eniten annettavaa kansainvälisesti eli joissa Cleen-tutkimus edustaa kansainvälisesti terävintä kärkeä ja/tai joissa yhteiskunnallinen vaikuttavuus on korkeinta? Strategian määrittely on tähän mennessä ollut enemmänkin konsensuaalista kuin valikoivaa.

- FIBIC:
  Strateginen tutkimusagenda on erittäin relevantti. Erityisenä vahvuutena voidaan pitää teollisen uudistamisen keskeistä merkitystä agendalla toiminnan alusta alkaen. Arviointiaineisto osoittaa, että FIBICillä on ollut keskeinen, voidaan jopa sanoa uraauurtava rooli teollisen uudistamisen edistämisessä metsäteollisuuden tutkimuksen alueella. Lisäarvo toisaalta näyttää olevan vähentymässä eli SHOK-elinkaarella FIBIC edustaa loppupäätä.
- FIMECC:
  Strategisen tutkimusagendan relevanssia pidetään arvioinnin pohjalta korkeana. Ohjelmilta sen sijaan toivotaan tarkempaa kohdentamista ja valintoja (myös suurempia riskejä sisältäviä projekteja tarvitaan).
- RYM:
  Tutkimusagendaa pidetään relevanttina, joskin samalla se tarjoaa liian vähän tukea valintojen tekemiselle. Sidosryhmien laajuus tekee valintojen tekemisen strategiavaiheessa vaikeaksi ja valintoja tehdään vasta ohjelmien kohdalla.
- SalWe:
  Strategiaa on uudistettu rinnakkain arvioinnin kanssa ja syntymässä on strategia, jossa tutkimustoimintaa kohdistetaan terävämmin aivosairauksiin, elintapasairauksiin ja kansainvälistymiseen. Myönteisenä on pidetty strategian painottumista selkeisiin suomalaisiin vahvuusalueisiin.
- TIVIT:
  TIVITin strategiaprosessi poikkeaa muista SHOKeista siinä suhteessa, että strategiat muotoillaan ohjelmakohtaisesti. Yritykset kokevat strategiaprosessin erittäin myönteisenä ja onnistuneena ja arvostavat TIVITin antamaa ohjausta.

Kokonaisuutena SHOKien strategioita pidetään varsin onnistuneina, joskin niihin samalla liittyy useita kehittämistarpeita. Näihin lukeutuvat muun muassa tieteidenvälisyys, sektorien rajojen ylittämisiin liittyvien mahdollisuuksien liian vähäinen hyödyntäminen ja kansainvälistyminen.

Monitieteisyys ja tieteiden rajat ylittäminen eivät ole riittävästi välittyneet SHOK-strategioihin. SHOK-kumppanuuksien ja yritysten keskuudessa vallitsee näkemys,

että SHOKIt ovat onnistuneesti muotoilleet strategisia visioita, jotka synnyttävät lisäarvoa toimintaan osallistuville tahoille. Myös osakkeenomistajien näkemysten välittyminen strategioihin on toteutunut myönteisesti. Tämä on saattanut johtaa liian vakiintuneisiin ja helppoihin valintoihin, joka näkyy eräänlaisena dynaamisuuden puutteena SHOKeissa. Myös yhteys strategioiden ja ohjelmatoiminnan välillä on usein jäänyt liian ohueksi.

Joissakin tapauksissa strategioista on tehty liian turvallisia ja kaikenkattavia, eikä ole kyetty keskittymään valintoihin, jotka veisivät toimintaa tulevaisuuden menestysalueille tutkimuksessa ja auttaisivat SHOKeja edistämään näitä mahdollisimman suuressa määrin. Terävämpiä valintoja toivotaan ainakin RYM:n, TIVITin, Cleenin ja SalWen kohdalla. Yritysosakkeenomistajat ovat varsin tyytyväisiä vallitsevaan tilanteeseen, kun taas yliopistojen ja tutkimusorganisaatioiden näkemykset ovat kriittisempiä. Politiikkatoimijat ja innovaatiojärjestelmän strategiset toimijat ovat varsin kriittisiä valintojen suhteen, mikä näkyy vertaisarvioinneissa ja paneelien arvioissa. SHOK-toiminnan vaikutus yliopistojen ja SHOK-toimintaan osallistuvien yritysten omiin strategisiin linjauksiin on marginaalinen.

Kansainvälistymisessä on runsaasti mahdollisuuksia, jo siitäkin johtuen, että Suomen profiili TKI-toiminnassa ja innovaatiojärjestelmän kehittämisen alueella on kansainvälisesti kiinnostava. Suomalaisen innovaatiopolitiikan vahva brändi tarjoaa erityisen hyvän lähtökohdan kehittää erityisesti rajat ylittäviä, SHOKien rajat ylittäviä, tieteenalat ylittäviä, palvelusektorien tai käyttäjäyhteisöjen rajoja ylittäviä avauksia.

Sekä arviointiimi että arviointipaneelit kiinnittivät huomiota tarpeeseen saada julkisen sektorin päätöksentekijät ja kuluttajaryhmät paremmin integroiduksi SHOK-toimintaan. Vain harvoilla SHOKeilla on osakkainaan julkisen sektorin toimijoita (lähinnä kaupunkeja), joskin vahvaa nousua tutkimuksen ja kehittämisen alueella tehneet älykkään kaupunkikehityksen teemat muun muassa voisivat helposti tehdä SHOKit kiinnostavaksi myös tällä alueella, tarkkaan valituilla huippuosaamisen alueilla, joissa monitieteisyys ja SHOKien väliset rajanylitykset ovat luontevia.

Sähköisen kyselyn tulosten mukaan huomiota on lisäksi syytä kiinnittää erityisesti seuraaviin kehittämisalueisiin:

(i) Kansainvälistymisen eri muodot (tutkimuksen kansainvälisestä laadusta TKI-investointien houkuttelemiseen Suomeen ja kansainvälisestä vertaisoppimisesta teollisuuden kansainväliseen kilpailukykyyn)

(ii) SHOKien välinen yhteistyö ja tähän liittyvä teollisuudenalojen mutta myös tieteenalojen välinen rajojen ylittäminen

(iii) Teollisuuden ja akateemisen yhteisön kulttuurimuutos, ml. professoriinfrastruktuurin vahvistaminen teollisuudessa.

Sähköiseen kyselyyn vastanneiden mukaan erityisesti EU:n TKI-rahoitusinstrumentteihin suhtaudutaan varsin kielteisesti: tyypillisesti ne nähdään byrokraattisina, joustamattomina ja hallinnollisesti raskaina. Kyselyn mukaan ne ovat myös heikosti kehittyneitä teknologisen ja tieteellisen riskin suhteen.

Kysely osoittaa, että myös tutkimusinfrastruktuurin ja testaus- ja pilotointiympäristöjen alueella on jatkokehittämisen tarvetta, erityisesti alueilla, joissa edellytetään tieteenalojen rajojen ylittämistä. Cleen ja TIVIT ovat tässä suhteessa kyselyyn vastanneiden mukaan aktiivisempia kuin useimmat SHOKit. Tämä on myös yksi alueista, joissa SHOKien välistä yhteistyötä tarvitaan.

IPR-kysymyksiin liittyy ratkaisemattomia kysymyksiä ja joissakin SHOKeissa ei kyetä kaupallisesti hyödyntämään tutkimustuloksia läheskään riittävästi (erityisesti FIBIC). Vaikka arviointitiimi on tullutkin johtopäätökseen, että säännöt siten kuin ne on määritelty SHOKien je Tekesin toimesta ovat selvät, on ongelma että niihin koetaan liittyvän epäselvyyttä. Useimmissa SHOKeissa kaupallistaminen ei lukeudu SHOK-toiminnan ydintavoitteisiin, mutta poikkeuksiakin löytyy: erityisesti TIVIT on asettanut kaupallistamisen päätavoitteidensa joukkoon. Tilanteessa, jossa tutkimusohjelman tuloksia voidaan käyttää avoimesti kaikkien kumppanien toimesta on vähän kannusteita kaupallistamiseen. Kaikkia lupaaviakaan tuloksia ei hyödynnetä ollenkaan. IPR-kysymykseen tulee löytää ratkaisu mahdollisimman nopeasti, jotta kaupallistamiseen saadaan toimivat kannusteet ja sitoutuminen turvataan. Vertaisoppimista voidaan toteuttaa sellaisten kansainvälisten ohjelmainstrumenttien kanssa, joissa kaupallistaminen on hoidettu onnistuneesti.

Joillakin tutkimus- ja teollisuussektoreilla SHOKeilla on ollut erittäin tärkeä katalysoiva rooli (erityisesti RYM ja FIMECC). Katalysoiva rooli tässä yhteydessä liittyy erityisesti tutkimusekosysteemin rakentamiseen uudelle TKI-alueella, jossa aiemmin ei ole tällaista ekosysteemiä ollut. Sekä RYM että FIMECC ovat auttaneet systemaattisemman TK-intensiivisen toiminnan ja verkostojen rakentamisessa. SHOKit ovat myös synnyttäneet lisäarvoa, jota ei olisi ilman SHOKeja ja joka ei myöskään säilyisi niitä ilman.

Tulosindikaattoreilla mitattuna SHOKien saavutukset ovat tähän mennessä olleet vaatimattomia. Osin tämä johtopäätös on seurausta vertailukelpoisten tulos- ja seurantatiedon vähäisyydestä. Osa SHOKeista osoittaa hyviä tuloksia myös ”virallisilla seurantaindikaattoreilla” mitattuna (esim. FIMECC), mutta toiset ovat saavutuksiltaan hyvin vaatimattomia tai eivät edes ole raportoineet yhteisiä seurantatietojaan yhdenmukaisesti ja johdonmukaisesti.

SHOK-toiminnan seurantaan on saatava johdonmukainen ja systemaattisesti seurattava mittaristo, jotta jatkossa voidaan tehdä järjestelmällistä seurantaa ja vertailuanalyysia SHOKien välillä. Tällainen tieto olisi tarpeen myös SHOK-toimintaa rahoittaville ja ohjaaville tahoille. Vertaisanalyysissa tulisi hyödyntää myös kansainvälisiä vertailukohteita.

Toistaiseksi SHOKit siis eivät ole kyenneet kehittämään riittävästi ratkaisuja SHOKien ja sektorien rajat ylittävässä toiminnassa (poikkeuksena kenties metsäklusterin siirtymä biotalouteen). Tämä on kuitenkin se alue, jolla SHOKeilla on eniten mahdollisuuksia tulevaisuudessa. Tällaisen rajat ylittävyyden tukemiseksi edelleen tulisi kenties pyrkiä entistä enemmän irti perinteisistä teollisuuden toimialoista ja SHOK-yhteistyö (ainakin ohjelmamuodossa) voitaisiin organisoida

temaattisemmin (uusien teknologia-alueiden, markkinoiden tai yhteiskunnallisten haasteiden pohjalta).

Arviointikysymys 3: Mikä on SHOKien asema politiikkainstrumenttina suomalaisessa kansantaloudessa ja TKI-järjestelmässä?

SHOKien asema poliitikkainstrumenttien kartalla Tekesin teknologiaohjelmien ja Suomen Akatemian ohjelmien joukossa ei ole selkeä. Tämä epämääräisyys näyttää tiedonkeruumme valossa liittyvän sekä SHOK-sidosryhmien että toiminnassa tiiviimmin mukana olevien näkemyksiin. Vaikka tavoitteena selvästi on kehittää politiikkainstrumentti, joka kykenee yhdistämään teollisen relevanssin ja tieteellisen laadun ja kykenee ottamaan riskejä tulevaisuuden tutkimus- ja innovaatiosisältöjen ja kasvun lähteiden tunnistamiseksi Suomessa, joissakin tapauksissa SHOKit ovat innovaatiotuotoksissaan, kaupallistamisessa ja testiympäristöjen kehittämisen tukemisessa jäljessä Tekesin teknologiaohjelmia ja miltei kaikissa SHOKeissa (kenties FIBIC pois lukien) Suomen Akatemian poliitikkainstrumenttien jäljessä tieteellisellä laadulla mitattuna.

SHOK-instrumentin profiili on heikko, eikä se ole saavuttanut asetettuja tavoitteita laatukriteerillä arvioituna. Strategisena työkaluna SHOK näyttää edelleen kaipaavan omistajaa. Työ- ja elinkeinoministeriö ja päärahoittaja Tekes ovat molemmat olleet haluttomia tähän rooliin asettumaan, joten kenties luontevampi omistajuus löytyisi vahvimman tukijalan Elinkeinoelämän Keskusliiton (EK) suunnalta. Mikäli tyydytään yrityslähtöiseen malliin, tämä olisi varmasti toimiva ratkaisu, mutta tieteellisen laadun kriteeristölle ja skeptisen akateemisen yhteisön puolelle voittamisen kannalta ratkaisu olisi todennäköisesti riittämätön. Jonkinlainen yhteisomistajuuden tai jaetun omistajuuden malli olisi tässä suhteessa todennäköisesti toimivin ratkaisu.

Tieteellisen yhteisön osaamisen täysimittainen osallistumisen turvaaminen edellyttää lisähuomiota. Laadunvarmennuksen käytännöt (mm. Cleenin käyttöön ottama ohjelmien kansainvälinen vertaisarviointi) ovat tervetulleita ja tarpeellisia laajemminkin käyttöön otettavaksi.

Tutkimusekosysteemien vahvistamista tukevat ratkaisut kuten samoihin tiloihin tai tutkimusympäristöihin sijoittuminen (“co-location”) edellyttävät lisähuomiota. Osa SHOK-yhtiöistä on jo sijoittunut samoihin tai lähekkäisiin tiloihin, mikä helpottaa tiedonkulkua ja yhteydenpitoa, mutta vastaavien ratkaisujen tukeminen laajamittaisemmin myös ”SHOK-campuksien” tms. perustamisen avulla edellyttää lisäselvitystä. Myös yhteisten testausympäristöjen kehittäminen tällaisiin ympäristöihin vaikuttaisi kannatettavalta ja FIMECCin kehittämä uusi FIMECC Factory -konsepti muun muassa on kiinnostava esimerkki tällaisista avauksista.

Arviointikysymys 4. Missä määrin alkuperäiset tavoitteet on saavutettu?

Voimavarojen keskittäminen valituille alueille on toteutunut jossain määrin, tieteellinen huippulatu ja teollinen uudistaminen vähäisemmässä määrin. Kuten aiemmin

on todettu, tämä johtuu paljolti keskenään ristiriitaisista tavoitteista, joka vaikeuttaa tavoitteisiin pääsemistä. Olisikin syytä arvioida tarve vähentää tavoitteiden määrää ja tehdä selkeämpi SHOK-vaikutuslogiikka sen selkeyttämiseksi, millaisia toimia tavoitteisiin pääseminen edellyttää ja millaisia valintoja voidaan tavoitehierarkian selkeyttämiseksi yksittäistapauksissa tehdä. Vaikutusmallien systemaattinen kehittäminen auttaisi myös tavoitteenasettelun kirkastamisessa.

SHOKit eroavat toisistaan myös lähtökohdiltaan, mikä heijastuu tavoitteiden saavuttamiseen. Joissakin tapauksissa jo vaatimattomat aikaansaannokset (tieteellisen tutkimuksen alueella esim.) voivat olla suorastaan vallankumouksellisia. Joissakin SHOKeissa jo TKI-yhteistyön aikaansaaminen sinällään on saavutus (erityisesti RYM).

Kansainvälistyminen ja globaali ulottuvuus ovat erityisen näkymättömiä SHOKeissa tänään. SHOKit eivät arviointiaineiston pohjalta ole olleet erityisen kiinnostavia ulkomaisten investointien kohteita, eivätkä ne ole onnistuneet erityisen hyvin kansainvälisten tutkijoiden houkuttelemisessa. Kansainvälistymiseen ei selvästikään ole kiinnitetty riittävästi huomiota ja jopa SHOKien osallistuminen EU-tutkimustoimintaan näyttäytyy vähäisenä. TIVIT on ainoa SHOK, jolla on koordinaatiorooli EU-tutkimusohjelmassa. Koko konseptin tasolla ei ole minkäänlaista kansainvälistymisstrategiaa, eikä tätä juuri ole huomioitu yksittäistenkään SHOKien strategioissa. Vaikka kansainvälistyminen sinänsä ei olekaan itseisarvoista, on vaikea kuvitella että SHOKit saavuttaisivat kansainvälisesti kiinnostavia uusia tutkimusläpimurtoja ilman kansainvälisiä yhteyksiä.

Monia saavutuksia on mahdotonta tässä vaiheessa arvioida siitä yksinkertaisesta syystä, että SHOKeilla ei ole toimivaa, yhdenmukaista ja läpinäkyvää seurantajärjestelmää, joka tuottaisi tietoa panoksista, tuotoksista, tuloksista ja vaikutuksista. Yhteisiä tulosindikaattoreita ei ole yksiselitteisesti määritelty ja niitä on nykyisellään liikaa. Seuranta saattaa edellyttää myös vuorovaikutteisemman toimintamallin käyttöönottoa. Osakeyhtiöinä SHOKit ovat vastuussa osakkaanomistajilleen normaalien liiketoiminnan kannattavuuden seurannan ja raportoinnin osalta, mutta samalla niillä on tilivelvollisuus (toistaiseksi suuremman osan toiminnastaan kattavasta) julkisesti rahoitetusta toiminnastaan. Tähän mennessä SHOKit ovat tulkinneet indikaattoreita itselleen parhaiten sopivalla tavalla, mutta julkisesti rahoitetun toiminnan osalta on valittava yhteisesti seurattavat mittarit, jotka tulkitaan ja määritellään yksiselitteisesti. Eräänlainen indikaattoripankki voisi olla toimivin ratkaisu, josta kukin SHOK voi valita tietyn indikaattoripatteriston, joilla sen toimintaa seurantaan ja näitä indikaattoreita olisi huomattavasti nykyistä vähäisempi määrä (kenties 3–5). Toimintaa katalysoiva, fasilitoiva ja verkottava rooli tulisi myös sisällyttää laadullisten SHOK-indikaattorien joukkoon, koska SHOKeilla on potentiaalisesti merkittävä rooli sillanrakentajina innovaatiojärjestelmässä tai innovaatioekosysteemien välillä.

Seuranta ei voi olla oma erillinen kokonaisuutensa, vaan se on rakennettava tiiviiksi osaksi toiminnanohjausta ja ohjelmasuunnittelua. Seurantajärjestelmästä (jatkossa) saatavaa tietoa on käytettävä aktiivisesti laadun varmennuksessa, tuloksellisuuden arvioinnissa ja kokonaisarvioinnissa. Samoin kuin useissa kansainvälisissä

vertailukohteissa, SHOKeissakin arvioinnin aikajänne voisi jatkossa olla 3–4 vuotta, ottaen huomioon koko toiminnan aikajänteen (5–10). Vertaisarviointia tulisi kehittää aktiivisesti laadunvarmennuksen voimavaraksi, sekä ohjelmien että SHOKien ja muiden politiikkainstrumenttien välillä.

Arviointikysymys 5. Onko strategisten tutkimusagendojen sisältämät tavoitteet saavutettu ja miten keskeinen on SHOKien merkitys niiden saavuttamisessa verrattuna muihin toimijoiden ja sidosryhmien käytettävissä oleviin instrumentteihin?

Tavoitteet on saavutettu osakkeenomistajien sitouttamisen ja yrityslähtöisyyden osalta, mutta akateemisen yhteisön osalta tulokset ovat vaatimattomampia. Tuloksellisuuden arvioinnissa merkille pantavaa oli, että SHOKit eivät kyenneet tuottamaan riittävää tietoa ja uskottavaa kuvaa tuloksistaan paneelien ja arvioinnin käyttöön. Osin tämä liittyy aiemmin mainittuun seurannan heikkouteen. Selitykseksi eivät kelpaa luottamuksellisuus tai IPR-säädökset, koska luottamuksellisuus sitoi kaikkia arviointipaneeleihin osallistuneita.

Arviointiaineistojen pohjalta SHOKeilla on tärkeä rooli osakasyhtiöidensä TKI-toiminnassa, joskaan uutuusarvo ei kaikelta osin tule näytetyksi ja profiili on huomattavasti heikompi akateemisen yhteisön ja laajempien yhteiskunnallisten sidosryhmien näkökulmasta. Olipa selityksenä sitten seurantajärjestelmän kehittymättömyys tai omistajaohjauksen heikkous, asia on otettava välittömästi lähempään tarkasteluun.

Indikaattorien SHOK-kuva on sirpaleinen. Tietoa kerätään lukuisilla seurantaindikaattoreilla (KPI:t, joita on kokonaista 30 kpl), mutta indikaattorien taustalla ei ole niitä selkeästi perustelevaa ja toimintaan yhdistävää vaikutuslogiikkamallia. Joitakin laadullisia tekijöitä, joissa SHOKien rooli voisi olla ainutlaatuinen, seurataan nykyisellään yhteisillä mittareilla riittämättömästi. Tällaisia ulottuvuuksia ovat muun muassa rajat ylittävyys teemojen, tutkimussisältöjen, tieteenalojen ja SHOKien välisten aloitteiden seurannassa. Joissakin tapauksissa näitä teemoja voitaisiin lähestyä myös ”grand challenges” -haasteiden näkökulmasta, mutta tällöinkin suomalaiset erityispiirteet tulisi huomioida ja mittarit valita alueille, joissa on todellista potentiaalia synnyttää globaalia erityisosaamista.

Arviointi osoittaa, että SHOKit ovat edistäneet uusien kumppanuuksien synnyttämistä ja erityisesti aiempaa laajempien kumppanuuksien ja konsortioiden edistämisestä. Toisinaan konsortioiden laajuus on kuitenkin tapahtunut yhteistyön syvyyden ja intensiteetin kustannuksella. SHOK-konsortiot näyttävät usein olevan liian laajoja tehokkaan yhteistyön ja tulosten hyödyntämisen kannalta.

Kysely ja haastattelut osoittavat SHOKien täyttävän aukon suomalaisten TKI-instrumenttien kentällä, mutta niiden näkyvyys ja profiili on heikko. Erityisesti kyselyn pohjalta SHOKit profiloituvat liian lähelle Tekesin teknologiaohjelmia. Vastaajien näkökulmasta ei ole selvää tai läpinäkyvää, miten / miksi jokin teema päätyy teknologiaohjelmaksi kun taas jokin toinen SHOK-ohjelmaksi. Näyttää selvältä, että SHOKien profiilia ei ole määritelty, asemoitu tai viestitty riittävän aktiivisesti.

Arviointikysymys 6: Onko SHOK-konsepti soveltuva ja toimiva tapa TKI-yhteistyön organisoimiseen (verrattuna muihin kansallisesti tunnettuihin instrumentteihin ja kansainvälisiin vertailukohtiin)? Mitkä ovat SHOKien vahvuudet ja heikkoudet verrattuna muihin rahoitus- ja verkostoitumisinstrumentteihin? (Tekesin ja Suomen Akatemian ohjelmat, EU:n 7. Puiteohjelma, osaamisklusterit ja tutkimuksen huippuyksiköt jne.)?

Käytettävissä olevat indikaattoritiedot, kansainvälinen vertailuanalyysi, haastattelut ja kysely osoittavat kaikki alhaista tulostasoa. Yhteistyön intensiteetti nähdään myönteisenä ja selvästi laadullisesti merkittävämpänä kuin aiemmissa ohjelmaviitekehyksissä. On nähtävissä merkkejä siitä, että menestyksen edellytykset ovat – joissakin tapauksissa – olemassa, erityisesti yrityslähtöisen TKI:n osalta. Kyselyn tulokset ovat tässä suhteessa varsin paljastavat ja SHOKien yhteistyön intensiteetti korkein (sekä tutkimus- että yritysvastaajien mukaan).

Eri sidosryhmien käsitykset soveltuvuuden ja tuloksellisuuden suhteen eroavat suuresti toisistaan. Yritysvastaajien näkemykset SHOkeissa toteutetun TKI-yhteistyön organisoinnin tavoista ja niiden soveltuvuudesta ovat myönteisimpiä. Yritysvastaajien mukaan SHOK-tutkimuksessa otetaan suurimpia riskejä, tehdään monimuotoisinta tutkimusta ja sovelletaan parhaita laadunvarmennuksen menetelmiä, verrattuna Tekesin tai EU:n instrumentteihin. Tutkimusvastaajien mukaan SHOKit edustavat heikointa laadunvarmennusta ja vähiten läpinäkyviä valintamekanismeja, mihin suhtaudutaan kriittisesti. Valintamekanismikysymykseen tulee etsiä ratkaisu mahdollisimman nopeasti. Päinvastoin kuin akateemisen yhteisön edustajat vastasivat, yritysedustajat näkevät SHOKit parhaaksi profiloitumisen välineeksi tutkimusyhteisössä. Yritysvastaajien mukaan SHOK tukee parhaiten kokeneiden tutkijoiden mukaan saamista tutkimustoimintaan. Tutkimusvastaajien mukaan, SHOK on Tekesin instrumenttien kanssa vertailukelpoinen tutkimuksen tekemisen väline, kun taas yritysvastaajille SHOK on paras väline.

Vaikka yritykset ovat tyytyväisiä SHOK-toimintaan, jopa yritysvastaajien keskuudessa Tekesin teknologiaohjelmien rooli soveltavan tutkimuksen alueella on merkittävämpi kuin SHOKien rooli. Tutkimusvastaajien mukaan SHOK-valintakriteerit olivat kaikkein läpinäkyvimmät kun taas yritysvastaajien mukaan prosessi on vähiten läpinäkyvä. Yritysvastaajat näkevät enemmän etuja SHOKeissa kuin tutkimusvastaajat, muun muassa koska SHOKit nähdään hallinnollisesti vähiten byrokraattisina ja niiden nähtiin soveltuvan parhaiten testaustoimintaan.

Sähköisen kyselyn pohjalta vahvistui sama kuva kuin mikä muidenkin lähteiden pohjalta: tutkimusvastaajille Suomen Akatemia on soveltuvin ja mieluisin rahoituslähde. Haastatteluissa nousi usein esille näkemys SHOKin sulkeutuneisuudesta ja monet tutkimustoimijat näkivät SHOKit ennemminkin suljettuna kerhona kuin avoimen innovaation avoimena foorumina. Valintaprosessien läpinäkyvyys edellyttää merkittävää lisähuomiota.

Kansainvälisistä vertailuanalyyseista nousee monia kiinnostavia havaintoja. Yksi aktiivisesti keskustelu teema liittyy omistajuuteen. Joitakin havaintoja vertailuanalyysista olivat mm. seuraavat:

- Ohjelmien omistajien roolien selkeys on onnistumisen edellytys. Tässä suhteessa nykyinen malli, jossa ohjelmahallinto on ulkoistettu vaikuttaa toimivalta mallilta.
- Työnjaon eri sidosryhmien välillä on myös oltava vastaavasti selkeä. Vertailukohteissa sidosryhmien työnjako on useimmiten toteutettu siten, että ministeriö tai rahoitusorganisaatio vastaa tavoitteenmäärittelystä strategisella tasolla, samoin kuin seurannan mittareista, kun taas ohjelmahallinto vastaa tulossopimusten solmimisesta verkostoissaan ja sähköisen seurantajärjestelmän rakentamisesta, jotka kuvastavat yhdessä sovittua vaikutuslogiikkaa.
- Ohjausryhmät tai vastaavat elimet koetaan hyödylliseksi strategisen suunnittelun ja ohjauksen tukena, samoin kuin itsearvioinnin toteutuksessa. Hyvin toimivissa TKI-ohjelmissa näissä elimissä on erityisesti tiedeyhteisön vahva edustus.
- Keskittymien ja niiden sisältämien verkostojen päätehtävä on strategisen tutkimusagendan määrittely, joka sisältää sekä keskipitkän että pitkän tähtäimen tavoitteita, mikä helpottaa akateemisen yhteisön (pitkä aikajänne) ja yritysten (lyhyt aikajänne, erityisesti pk-yrityksillä) usein esiintyvän ristiriidan ratkaisemisessa.

Kansainvälinen vertailuanalyysi nostaa esille lukuisia muitakin havaintoja, jotka ovat SHOK-toiminnan kehittämisen ja ongelmanratkaisun kannalta oleellisia.

Arviointikysymys 7. Miten asianmukainen on SHOK-hallintomalli tänään?

SHOKien johtamista pidetään ammattimaisena ja niiden kevyttä hallinnollista rakennetta myönteisenä. Joissakin SHOKeissa saattaa päinvastoin olla vastakkainen ongelma eli hallintorakenne on toiminnan luonne huomioiden liiankin kevyt.

Toisinaan hallinnollisen tehokkuuden katsotaan toteutuneen avoimuuden ja kilpailun kustannuksella. On tärkeää, että hallintorakenne ja toimintakäytännöt mahdollistavat parhaiden tutkijoiden ja tutkimusryhmien saamisen mukaan toimintaan. On myös tehtävä huolellinen arvio siitä, mitä toimia SHOKien kannattaa toteuttaa itse ja mitä ulkoistaa. Ohjelmajohtajien ulkoistaminen on hyvä ratkaisu, joskin nykyinen malli, jossa nämä funktiot ovat enemmän hallinnollisia ja usein varsin uran alkuvaiheessa olevien tutkijoiden käsissä ei välttämättä anna samanlaista mahdollisuutta verkostojen laajentamiseen ja arvovallan kasvattamiseen kuin jos tehtäviin rekrytoitaisiin ”Principal Investigator” –tyyppisiä ehkä urallaan jo pidemmälle edenneitä tutkimusjohtajia.

Laatukriteerin turvaaminen edellyttää myös hallintomallilta ja hallinnollisilta käytännöiltä uudistumista. Kansainvälisen vertaisarvioinnin tuominen ohjelmiin, avoin kilpailu ja läpinäkyvyys korkeaprofiilisten tutkimusryhmien keskuudessa edistäisi SHOKien profiilin vahvistamista toivotulla tavalla.

Arviointikysymys 8. Miten toimiva SHOK on liiketoiminnan uudistamisen välineenä?

Joissakin tapauksissa (erityisesti FIBIC) teollista uudistamista on edistetty esimerkillisesti. Pääosin SHOKit eivät kuitenkaan ole olleet erityisen tehokas teollisen uudistamisen väline. Pääsyy tähän on ollut suurien vakiintuneiden yritysten johtoasema SHOK-agendan ja toiminnan määrittelyssä ja toteutuksessa. Nykyiset ip-toimintamallit eivät tarjoa riittäviä kannusteita spin-off -yritysten synnyttämiselle. On epärealistista olettaa vakiintuneiden veturiyritysten valitsevan SHOK-tyyppisessä avoimen innovaation ja suurten konsortioiden mallissa tutkimusaiheita, jotka eivät palvele niiden nykyisiä tai keskipitkän aikavälin tarpeita.

Arviointikysymys 9. Millaisia vaikutuksia on tähän mennessä syntynyt ja millaisia on odotettavissa jatkossa? Millaisia vaikutuksia SHOK-toimintaan osallistumisella on mukana oleville yrityksille?

Yhteiskunnallisia vaikutuksia ei ole seurattu, mitattu tai todennettu. Indikaattorien ja seurannan logiikan määrittely ja selkeyttäminen auttaisi myös viestimään hyödyistä yrityksille, jotka eivät vielä ole toiminnassa mukana. Mittaristot voidaan määritellä vuorovaikutteisessa prosessissa, jolloin tiedon lisäksi myös keskinäinen ymmärrys SHOK-verkostossa ja innovaatiojärjestelmässä lisääntyy.

Ei ole näyttöä siitä, että osallistuvat yritykset olisivat paremmassa asemassa niiden SHOK-osallistumisesta johtuen, joskin samalla on syytä huomioida että SHOKit ovat joissakin tapauksissa mahdollistaneet TKI-toiminnan vaikeissa taloudellisissa tilanteissa ja ovat sellaisenaan arvokas lisäresurssi. Yritysten omiin strategioihin SHOK-osallistumisella ei ole ollut vaikutusta, joten SHOK on enemmänkin ollut yksi lisäkehittämisvoimavara.

Paneelien ja haastattelujen pohjalta yhteiskunnallinen vaikuttavuus näyttää edellyttävän lisähuomiota. Monissa SHOKeissa tutkimussisältöjen luonne mahdollistaa yhteiskunnallisten vaikutusten edistämisen, vaikkakin tämä yhteys jää paljolti näkymättömäksi johtuen nykyisistä seurantakäytännöistä. Arviointitiimi ymmärtää näiden yhteyksien osoittamisen mahdollistavan seurantajärjestelmän ja laatimisen olevan vaikeaa, mutta samalla näkee tämän avainkysymyksenä vaikuttavuuden osoittamiseksi jatkossa ja tätä kautta tilivelvollisuuden täyttämisen.

Arviointikysymys 10. Mikä on SHOKien lisäarvo? Tekeekö se Suomesta houkuttelevamman yritys-, tutkimus- tai innovaatioympäristönä? Onko SHOK-instrumentin toimintaan osallistuville tahoille tuoma lisäarvo suurempi kuin muiden vastaavien instrumenttien lisäarvo?

On selvää, että SHOKin tuoma laadullinen harppaus maailmanlaajuiseen johtajuuteen tutkimus- ja innovaatiotoiminnassa jää puolitiehen ja paljon puhutut yhteiskunnalliset vaikutukset eivät ole riittävän näkyviä. Erityisesti kansainvälinen

toiminta, kansainvälinen henkilöstö ja kumppanuudet jäävät vielä varsin näkymättömiksi.

Lisäarvoa etsittäessä peruskysymys on: mitä innovaatiojärjestelmästä puuttuisi mikäli Suomessa ei olisi SHOK-instrumenttia? Merkittävin saavutus on tutkimus, joka on entistä yrityslähtöisempää, kunnianhimoisempaa, avointa ja sitoutunutta. Tärkeydestään huolimatta tämä ei perustele julkisen sektorin korkeaa interventiotasoa.

SHOK-toiminnan liikkeellelähtö on osin ollut varsin hidasta, tarkasteltuna salkunhoidon käytäntöjen vakiintumisella, kun taas konsortiot ja tutkimustoiminta itsessään on lähtenyt varsin vauhdikkaasti käyntiin. Aikaa vievempää on ollut eri osapuolten odotusten selkeyttäminen ja näkyväksi tekeminen. Mikä osin voi heijastaa instrumentin uutuutta, mutta myös sen sisäisiä ongelmia. Vaikka SHOK-toimintaa on ollut jo kuuden vuoden ajan, osallistujien keskuudessa esiintyy monia epävarmuuksia, väärinymmärryksiä ja epävarmuuksia. On huolestuttavaa ja nähdäksemme osoitus instrumentin suunnitteluvirheestä ja tavoitteiden ristiriitaisuudesta, että näin monen toimintavuoden jälkeen SHOK-instrumentti kaipaa lisäselkeytystä.

SHOK-tutkimuskonsortiot ovat kaksiteräinen miekka. Alkujaan monet osapuolet lähtivät mukaan konsortioihin ”varmuuden vuoksi” ja jotta eivät jäisi paitsi mistään, mutta mukaantulo ei edellyttänyt erityisiä strategisia valintoja. Yliopistoja ei saatu täysimittaisesti kiinnostumaan ja joissakin tapauksissa ne ovat olleet epäluuloisia SHOK-toimintaa kohtaan. Ajan myötä joidenkin yliopistojen (erityisesti teknisten yliopistojen kuten Tampere tai Lappeenranta) kiinnostus lisääntyi, kun taas jotkut yliopistotoimijat jäivät toiminnan ulkopuolelle alkuvaiheen ohjelmavalmistelujen vähäisen avoimuuden seurauksena. Ei ole mitään syytä miksi SHOK-ohjelmissa ei voisi olla vahvempaa sisäänrakennettua avointa kilpailua.

Vaikka konsortiot ovat aiempaa laajempia, tämä uhkaa osin vesittää resurssit liian ohuiksi. On perustellusti myös kysytty, onko tällainen (laajoille konsortioille pohjautuva, esikaupalliseen vaiheeseen kohdistuva) tutkimusinstrumentti paras väline edistää asetettuja tavoitteita (teollinen uudistaminen, T&K-strategioiden linjaaminen samaan suuntaan, läpimurtoinnovaatioiden aikaansaaminen jne.). Monissa aiemmissa arvioinneissa (mm. EU-puiteohjelmissa) on todettu yritysten säästävän omaa strategista ydintään lähimpänä olevan tutkimuksen muihin kuin laajaa avointa yhteistyötä edellyttäviin ohjelmiin. Sama riski koskee SHOK-tutkimusta.

Arviointikysymys 11. Mitkä ovat SHOK-sidosryhmille välittyvät tärkeimmät SHOK-toiminnan hyödyt ja vaikutukset (saavutetut/odotettavissa olevat)? Onko SHOK mahdollistanut uudenlaista yhteistyötä ja uuden tiedon saavuttamista?

SHOKit eivät ole vaikuttaneet osallistuvien tutkimuskumppanien TKI:n tasoon henkilötyövuosina laskettuna, joskin tämä saattaa ollakin epärealistinen odotus nykyisessä taloustilanteessa. Merkittäviä poikkeuksiakin esiintyy ja erityisesti TIVITin

kohdalla on korostettu SHOK-voimavarojen osaltaan hidastaneen jyrkkää TKI-investointien tason laskua ICT-sektorilla.

Uusia kumppanuuksia on syntynyt, joskin ne rajoittuvat liiaksi Suomeen. Mikäli kansainvälinen toiminta asetetaan vakavasti tavoitteeksi, se edellyttää jatkossa huomattavaa lisähuomiota. Tähän mennessä syntyneet kansainvälisyyttä edistäneet verkostot ovat rakentuneet enemmänkin jo olemassa oleville kuin radikaalisti uusille yhdistelmille.

TKI-vaikutuksista on vielä suhteellisen heikkoa näyttöä, joskin poikkeuksia esiintyy, mm. RYM ja FIMECC, joissa SHOK on saanut aikaan uusia tuotteita ja palveluita.

SHOK-organisaatiot eivät tähän mennessä ole kyenneet ratkaisemaan yhteistyömuotoisen, avoimeen innovaation perustuvan TKI-toiminnan ongelmia. Kyselyvastaajien ja haastateltujen tahojen kokemus oli tässä suhteessa usein varsin kielteinen ja uhkana on, että avoimuus on johtanut uutuusarvoltaan merkittävimpien ja uraauurtavimpien tutkimussisältöjen jäämiseen SHOK-viitekehyksen ulkopuolelle.

IPR-säännöt on selkeästi määritelty ja niiden viestimiseen kentälle on uhrattu suuria ponnistuksia, mutta tämä ei riitä, mikäli SHOKien avoimuus estää herkiksi koettujen tutkimussisältöjen yhteiskehittelyn.

Houkuttelevuuden näkökulmasta on turvattava tulevaisuuden huippututkijoiden ja yritysjohtajien saaminen mukaan SHOK-toimintaan. Nykyisellään SHOK-verkostot rakentuvat kenties liiaksi vakiintuneiden uransa puolivälissä olevien ammattilaisten ja ohjelmahallinnoinnissa väitöskirjaansa tekevien varaan.

SEURAUKSIA JA SUOSITUKSIA TULEVAISUUDELLE

"To whom it may concern"

Seuraavat suositukset on nähtävä osana SHOK-konseptin ja sen ydinrakenteiden uudistamista. Se missä määrin konseptin uudistaminen edellyttää myös yksittäisten SHOKien sisäistä uudistamista vaihtelee. Käytettävissä oleva seurantatieto osoittaa selvästi tarpeen uudistaa ohjelmarakennetta läheisessä yhteistyössä SHOK-johtoryhmän kanssa. Uudistustyössä on huomioitava ne alueet, joilla jo on saatu tuloksia, onnistumisia ja vaikutuksia aikaan (esim. yrityslähtöinen laajamittainen yhteistyö uusien kumppanien kesken, strategisen tutkimusagendan uudistaminen itsessään). Joitakin onnistuneita toimintamalleja voidaan myös siirtää muihin ohjelmiin (esim. Tekesin ohjelmat tai EU:n *Joint Technology Inititaives*).

Suosituksia kohdistuu myös SHOK-hallintomallin käytännön muotoihin, mukaan lukien tiiviimpi vuoropuhelu tutkimus- ja innovaatio-organisaatioiden välillä (TIN, TEM, SHOK-johtoryhmä, Tekes, Suomen Akatemia ja yksittäiset SHOK-yhtiöt).

Tilivelvollisuuden turvaamiseksi SHOK-konseptiin liittyen, kukin SHOK voisi sitoutua eräänlaiseen tulossopimukseen TEM:n kanssa. Tämä sopimus määrittelisi ne (harvat) indikaattorit ja KPIt, joilla julkisesti rahoitettua SHOK-toimintaa ohjataan. Tällainen sopimusjärjestely voisi sekä selkeyttää tilivelvollisuutta että antaa

SHOKeille vapauden toteuttaa omia strategisia teollisuudenaloittain vaihtelevia tavoitteitaan.

Suosituksista seuraa erilaisia seuraamuksia eri toimijoiden ja vaihtoehtoisten tulevaisuuspolkujen kannalta. Suositukset on rakennettu neljän pääskenaarion ympärille, joista kussakin on eri vaihtoehtoja konseptin kehittämiselle, yksittäisille SHOKeille ja SHOKeissa toteutettaville ohjelmille. Mikä tulevaisuusskenaario kulloinkin on soveltuvin on ennen muuta SHOK-johtoryhmän ja kunkin SHOKin sidosryhmien käsissä.

Tiivistelmän suositukset ovat ainoastaan otsikkotason ehdotukset. Yksityiskohtaisemmat perustelut kunkin kohdalta löytyvät kokonaisraportin englanninkielisestä osiosta.

Skenaario	Seuraukset
Toiminnan jatkaminen vain vähäisin muutoksin	Tavoitteiden ja strategian hienosäätöä, vähäisiä muutoksia toimeenpanoon.
Toiminnan jatkaminen merkittävin muutoksin	Tavoitteiden, painopisteiden ja strategian muutokset, eniten muutoksia toimeenpanoon.
Uudelleen käynnistäminen uudella lähestymistavalla	Merkittävämpiä muutoksia toiminnan perusteisiin, lähestymistapaan ja rakenteisiin / hallintomalliin
SHOKeista luopuminen	Toiminnan alasajo ja siirtäminen kokonaan muihin ohjelmallisiin puitteisiin

SUOSITUS 1: Saavutuksistaan huolimatta SHOK-konsepti sisältää selvästi sisäisiä ristiriitaisuuksia, jotka on selkiytettävä, julkisesti rahoitettavan toiminnan osalta sopimuksellisessa rakenteessa SHOK-toimintaa kansallisesti ohjaavien tahojen ja yksittäisten SHOK-yhtiöitten välillä.
SUOSITUS 2: SHOK-strategian on heijastettava muidenkin kuin vakiintuneiden suuryritysten instressejä.
SUOSITUS 3: SHOK:ien kilpailua on lisättävä, sekä SHOK-statuksen saamisen osalta että ohjelmien ja muun toiminnan prosessien avoimuuden ja laadun turvaamiseksi, samalla kun toiminnan on oltava riittävän vakaata sitoutumisen mahdollistamiseksi (alkuperäinen 5 vuoden aikajänne).
SUOSITUS 4: Toiminnan rajat ylittävään luonteeseen ja tämän mahdollistaviin mekanismeihin on kiinnitettävä enemmän huomiota.
SUOSITUS 5. SHOKien asema Suomen innovaatiojärjestelmässä (ja rahoitusjärjestelmässä) on selkeytettävä, jotta SHOKit kykenevät vastaamaan niihin kohdistuviin odotuksiin ja synnyttämään lisäarvoa.
SUOSITUS 6: IPR-kysymys on otettava haltuun tehokkaammin kaikissa SHOKeissa.
SUOSITUS 7: Rahoitusmallin on turvattava paremmin tiedeyhteisön osallistuminen SHOK-toimintaan.
SUOSITUS 8: Innovatiivisten ja uusien pk-yritysten osallistumisen turvaamiseksi ohjelmissa, SHOKien on kehitettävä näille yrityksille paremmin sopivat sopimuskäytännöt.

SUOSITUS 9: SHOKIen tulee jatkossakin voida tehdä omat strategiset valintansa, koska teollisuudenalojen tarpeet vaihtelevat niin merkittävästi.
SUOSITUS 10: SHOKien saavutukset on arvioitava säännöllisesti. Tämä edellyttää riittävän joustavan ja valikoivan vaikutuslogiikan ja avainmittarien sekä seuranta-käytännön määrittelyä.

1 Introduction

1.1 The evaluation task

The Strategic Centres for Science, Technology and Innovation (SHOKs) are one of the main instruments of Finnish innovation policy today. Currently there are six SHOKs in operation: Cleen (in the area of environment and energy), FIMECC (in metal and engineering industry), SalWe Oy (in health and well-being), Tieto- ja viestintäteollisuuden tutkimus TIVIT Oy (in the ICT and digital services sector) RYM (in the area of built environments) and Finnish Bioeconomy Cluster FIBIC. In the following report and for practical purposes we use the short-hand terms to denote these centres: Cleen, FIMECC, SalWe, TIVIT, RYM and FIBIC, though it is worth noting that these are not the official names of the Centres or the companies around which they are organised.

The concept, which was established in 2006 and organised around public-private partnerships, aims at speeding up innovation processes and renewing the Finnish industry clusters by creating new competences and radical innovations at the system level, SHOK operations apply new methods for cooperation, co-creation and interaction. International cooperation is also intended to play an important role for the Strategic Centres. Furthermore, testing and piloting creative research environments and ecosystems constitute an essential part of the Strategic Centres' operations. In the Centres, companies and research units are intended to work in close cooperation, carrying out research that has been jointly defined in the strategic research agenda of each Centre. The research aims to meet the needs of Finnish industry and society within a five-to-ten-year period.

Between 2008 and September 2012, Tekes has funded the SHOK programmes by a total of over 343 million €. An average of 40% of research conducted in the SHOKs will be co-funded by companies. The SHOKs are also encouraged to apply for EU research programmes for funding.

The evaluation will provide an independent assessment of the Centres and their strategies and activities, based on analysis of findings and lessons learned to improve SHOK strategy, activities and utilization of results. An important part of the evaluation will consist of developing a set of forward-looking guiding ideas and recommendations to support the ministries, funding organizations, SHOKs and other innovation policy stakeholders in their work.

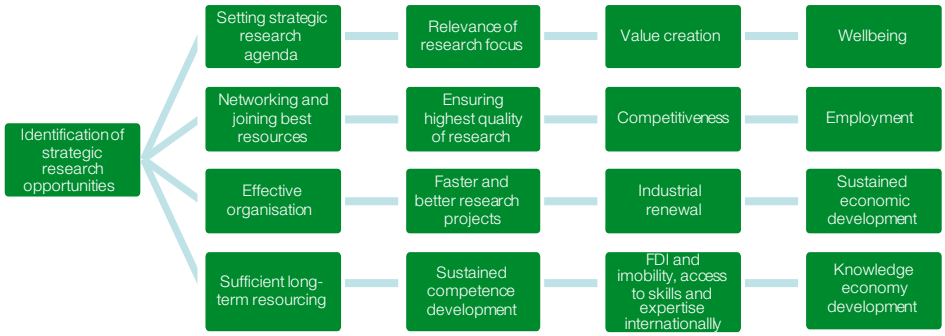
Ministry of Employment and the Economy commissioned the evaluation of the SHOKs in spring 2012 and the work started in April 2012. The evaluation consortium consists of Ramboll Management Consulting (Lead, Finland), Joanneum Research (Austria), Gaia Consulting (Finland). Terttu Luukkonen from the Research Institute of

the Finnish Economy ETLA (Finland) and Luke Georghiou from Manchester Business School have contributed to the evaluation as individual experts.

The main objective of the evaluation has been to provide an independent assessment of the Finnish Strategic Centres for Science, Technology and Innovation (SHOK) policy, strategy and activities, to present key findings and lessons learned to improve SHOK strategy, activities and utilisation of results, and to develop a set of forward-looking guiding ideas and recommendations to support the ministries. As the SHOKs are at different stages of maturity and in very different fields, the intention of the evaluation has not been to compare or rank the SHOK Centres, rather to provide an assessment of each of them in light of how they have been able to operationalise the policy goals set on the concept level, as well as to assess their state of the art in relation to their Strategic Research Agendas (SRAs). The evaluation has also sought to provide an analysis of how the concept works as a policy instrument and how it could be improved in this regard.

A tentative impact model of the evaluation of the Strategic Centres is described in the figure below.

Figure 1. Tentative impact model



This was a working hypothesis of the evaluation to be tested. The impact model has not actually been formally drafted and presented by the SHOK programme management in a systematic fashion and the evaluation provides the first model for actually doing this.

In developing the impact model the international benchmarks can be used as a comparative base to which to SHOK model can be compared. Each of the steps will require certain monitoring data, partly compiled by the SHOKs on SHOK level, partly on programme and working package or even task level. (For comparison see Leading Edge Cluster Competition – Spitzenclusterwettbewerb benchmarking case in the chapter 5.)

The evaluation steering group that has supported the team in its endeavors has been chaired by Hannele Pohjola from the Confederation of Finnish Industries, with Timo Kolu and Leena Treuthardt from Academy of Finland and Jussi Kivikoski and

Pekka Pesonen from Tekes as members. Essi Heinänen has been an expert member representing the SHOKs.

1.2 A brief summary of the methodology

The data gathering was based on documentary analysis of annual reports, monitoring data and other relevant materials compiled by Tekes for the purposes of the evaluation. This material was also made available to the international evaluation panels that were compiled for the purposes of peer review in September 2012. Each panel had five members and the work was facilitated by the consultants.

In addition to the documentary analysis and evaluation panels, interviews were undertaken per SHOK and across them, on strategic level (with policy makers and stakeholders in the know about the early intentions of the SHOK in 2006/2007). Approximately 20 strategic semi-structured interviews were undertaken in order to shed light on the original intentions and subsequent perceptions of the SHOK as a innovation policy instrument.

An electronic survey was undertaken in June 2012 in order to explore the expectations, perceptions and experiences with the SHOK instrument among the companies and research organizations involved. The sample was compiled from the project database of Tekes, complemented by the contact details made available by the SHOKs. Pre-test was done between 1st and 4th of June, with the questionnaires adapted in the following week and implemented between the 11th and 21st June, with an extension to the 29th June.

A benchmarking assessment was undertaken by the experts at Joanneum Research. The benchmarking analysis provides information on the selected international comparative cases following a structure consisting of the programme features and framework conditions, characteristics of networks, market / systemic failure the programme wants to address, governance mechanisms, performance measurement systems and main achievements and challenges. The international cases selected included the four following cases deemed interstsing and sufficiently comparatiuve to be used as inspiration and benchmark:

1. The Austrian Competence Centre Programme (Austria)
   - Key issues similar to SHOK: groundbreaking research, fostering of collaboration (Science-Industry), Internationalisation of Austrian R&D
   - Wealth of information on key performance indicators, evaluation, governance structure, and management issues
2. The Networks of Centres of Excellence Programme (Canada)
   - Commonalities with SHOKS: business led networks, focus on private sector innovation and social benefits
   - Clear intervention logic and performance measurement system
3. The Leading Edge Cluster Competition (Germany)

- Core Commonalities with SHOKS: focus on international excellence, thematically openness, industry driven R&D activities with high degree of self-governance (research agenda), elaborated evaluation system

4. The Joint Technology Initiatives (EU Level)
- Commonalities with SHOKS: strongly industry-driven, aiming at international cooperation and development of leading edge technologies.
- Self selected governance system of JTIs may provide inspiration for SHOK governance, funding management and performance measurement system.

The benchmarking analysis is provided as a separate chapter in this report.

1.3 The context for the SHOK

The background for establishing new centres of excellence was changes both in the Finnish industry structure and in global competition, documented in the final report of the Finland in Global Economy -study, dubbed "the globalization report"[1]. The study concluded that Finland as a small open economy has the best chance to create added value and sustain its welfare by engaging in knowledge-based competition in the global markets, by using its traditional strengths including high and even standard of education and strong innovation system.

The globalization report noted that in order to capitalize its knowledge assets, Finland should develop education and move from science and technology policy to integrated innovation policy. In other words, the innovation system structures should be geared for not only knowledge creation but enable smooth commercialization of accumulated knowledge assets e.g. through opportunities for multidisciplinary translational research, venture capital and new innovation platforms that enable collaboration of different actors. Following the globalization report, Prime Minister's Office published a memorandum entitled "The Government's resolution on development of the structures of public research system in Finland"[2], which follows the globalization report and a RIC study on the challenges of Finnish public research system[3] in concluding that Finland should focus on innovation as a source of growth, employment and welfare.

The roots of the SHOK concept can be dated back to the years of deep economic recession in Finland in early 1990s. For understandable reasons, in decision-making, at that time priority had been given to urgent short-term solutions of the economy. The Science and Technology Policy Council of Finland (1993)[4] considered

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1 Prime Minister's Office, 2004. Osaava, avautuva ja uudistuva Suomi: Suomi maailmantaloudessa -selvityksen loppuraportti (eng. Capable, opening and renewing Finland: The final report of the Finland in global economy -study), Prime Minister's Office Publication Series, 19/2004

2 Anon. 1.4.2005 Valtioneuvoston periaatepäätös julkisen tutkimusjärestelmän rakenteellisesta kehittämisestä. Available at: http://www.minedu.fi/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/erillisraportit/?lang=fi

3 Steering group fo the evaluation of public research system, 25.1.2005. Julkisen tutkimusjärjestelmän rakenteelliset haasteet, (eng. The challenges of the public research system), Research and Innovation Council

4 Towards an Innovative Society: A Development Strategy for Finland.

it appropriate to highlight that the recession must be overcome in a way which will preserve Finland's knowledge-base and create new, sustainable development prerequisites for the future.

As central means to these ends the Council recommended that the Academy of Finland, together with universities, should establish international centres of excellence in universities. In addition, the council suggested that in fields of central relevance to industrial development, measures must be taken to develop research of the highest international level. Top-level research is needed in rapidly progressing generic technologies, but research needs in technology should also be considered from the perspective of the clusters in Finnish industry. As the most important clusters the council listed forest, mining and basic metal industries, energy, telecommunications, environment, welfare, transportation, construction and the chemical industry.

These recommendations lead to rapid expansion of the Centres of Excellence of the Academy of Finland, and to starting eight national cluster programs in 1997 in the fields of forestry, food products, telecommunication, transport, well-being, environment, and development of working life (Science and Technology Policy Council of Finland 1996). The coordination of the programs was delegated to sectoral ministries. The cluster programs were initiated with ambitious aims and high expectations, but the results remained more modest than expected (Prihti et al, 2000). The last cluster program, Environmetal Cluster Program ended in 2009.

After establishing the Centres of Excellence, the development of new arrangements for world-class R&D and innovation remained topical. The need for boosting innovation in fields most relevant to the Finnish economy and societal development became an increasingly topical issue in Finland in early 2000. Globalization with various implications to productivity and competitiveness of the private and public sectors demanded more decisive actions to step up education, research, technological development and the utilization of their results (The Prime Minister's Office, 2004). On the other hand, because of smallness of the country with limited human and material resources Finland was considered to be forced to specialize, concentrate, join forces, internationalize, and to raise the scale of operating units more and more systematically than had been done before.

This created a favorable general atmosphere for the elaboration and design of a new concept for development of top-level competence in nationally significant sectors of research and innovation. The Science and Technology Policy Council of Finland set in May 2005 a working group for preparing establishment of strategic centres for science, technology and innovation and as a result of this process the government resolution of structural development of the public research system.

One important source of inspiration for the formation of the SHOK concept has naturally all along its development been the model of Tekes technology programs. The first (national) technology programs were launched soon after the establishment of Tekes in 1983, and over the years Tekes has initiated, organized, financed

and managed a great number of programs based on close national cooperation between firms, universities and research institutes or the major stakeholders of current SHOKs. From the point of view of Tekes, SHOKs do not only represent a new generation of old technology programs, rather an approach which differs in many ways from existing practices. These characteristics of the SHOK concept are described in more detail next.

The Centres were established in 2006 as public-private partnership instruments aiming at speeding up innovation processes and renewing the Finnish industrial clusters by creating new expertise and achieving an enhanced level of internationally competitive competence, as well as radical innovations. The Centres SHOK operations apply new methods for cooperation, co-creation and interaction. International cooperation is also intended to play an important role for the Strategic Centres. Furthermore, testing and piloting creative research environments and ecosystems constitute an essential part of the Strategic Centres' operations. In the Centres, companies and research units are intended to work in close cooperation, carrying out research that has been jointly defined in the strategic research agenda of each Centre. The research aims to meet the needs of Finnish industry and society within a five-to-ten-year period.

Table 1. Overview of SHOK, some basic information

	CLEEN	FIMECC	FIBIC	RYM	SalWe	TIVIT
Sector	Energy and Environment	Metal and engineering	Forest industry / Bio economy	Real estate and construction	Health and well-being	ICT
Established	2008	2008	2007	2009	2009	2008
Number of shareholders (the three figures summarise the total made of companies + research organisations + other public sector parties, such as cities)	45 (28+17)	35 (19+15-1)	19 (8+10+1)	53 (43+4+6)	33 (19+14)	46 (28+18)
Number of staff reported by the SHOKs	4[1]	4[2]	4[3]	2[4]	1[5]	9[6]
Programmes (2011/2012)	MMEA (Measurement, Monitoring and Environmental Efficiency Assessment) SGEM (Smart Grids and Energy Markets) CCSP (Carbon Capture and Storage Program) FCEP (Future Combustion Engine Power Plant) EFEU (Efficient Energy Use) Launched in 2012: DESY (Distributed Energy Systems)	Demanding Applications Energy and Life Cycle Cost Efficient Machines Energy and Lifecycle Efficient Metal Processes Future Industrial Services Innovations & Network Light and Efficient Solutions GP4Variants User Experience and Usability in Complex Systems Competeveness through digitalisation (started 2012)	EffNet - Efficient Networking towards Novel Products and Processes (2010 – 2013) EffFibre - Value through intensive and efficient fibre supply (2010-2013) FuBio Joint Research 1 (2009-2011) and 2 (2011-2012) FuBio Cellulose - FuBio Products from Dissolved Cellulose (2011-2014) RAMI-Radical Market Innovations (ended in 2011)	Built Environment Process Re-engineering (PRE) (2010 - 2013), Indoor Environment (2011 – 2014), Energizing Urban Ecosystems (EUE) (2012 – 2015)	Intelligent Monitoring for Health and Well-being; Mind and Body	Future Internet; Devices and Interoperability Ecosystem; Cooperative Traffic; Cloud Software; Next Media New programmes in 2012: Data to Intelligence Digital Services Internet of Things

1 In addition 5 programme managers, who are not employed by Cleen but sub-contracted.
2 In addition 8 sub-contracted programme managers.
3 In addition 3 sub-contarcted programme managers.
4 In addition 3 sub-contracted programme managers.
5 In addition CFO-programme manager, 1 programme manager and 2 programme draftsmen subcontracted.
6 Including the SHOKs' common legal counsel. In addition there are 5 subcontracted programme managers in the programmes.

This brief historical context is important to understanding how central the SHOK concept has been on the national level and how high the expectations to be met. The programme-based model is indeed being replaced, though the transition is a slow and gradual one.

2 SHOKs, their organisation and key activities

When the SHOK instrument was founded in 2005, Science and technology policy council set a steering committee from its members to work on a strategy for the centres. The output of the steering committee is the paper on "Competitive strategic centres for science, technology and innovation" that has been the basis for establishing the present Strategic Centres for Science, Technology and Innovation (SHOKs[5]). The instrument's mission is outlined thusly:

> *"**High-quality research units and R&D and innovation clusters and programmes must be created** for Finland that are internationally visible and interesting. This enables us **to strengthen the sectors of research and technology important for Finland** and **create new national areas of expertise** as well as improve the way we respond to the needs for new knowledge, competence and innovation activity in society and business life. **The aim of the centres is to promote the growth and renewal of the economy** and employment." [6] [authors' emphasis]*

To fulfill the mission, the following objectives were set: [7]

1. **Leading companies, universities, research institutes** and funding organisations operating in Finland **will commit** to the activities and objectives of SHOKs and target **their resources in the long term to strategically selected, high-quality, international-level clusters**.
2. **The clusters will engage in dynamic and interactive research, development and innovation activities**, the results of which will then be exploited broadly and effectively. **Research activity carried out by the centres will anticipate the needs of society and business life with a timespan of 5 to 10 years**.
3. **High-quality expertise and a reputation in science, technology and innovation activities will attract innovative companies, global market leaders and international-level top experts to Finland**.

The steering committee appointed separate team called literally the "Working group on centers of expertise" (later WG) to prepare a briefing on different models for centers of excellence/expertise/competence and their governance. The WG recommended based on the analysis of Finnish corporate and university law and the intended activities of the SHOKs that they would be organized either through

5 SHOK is a Finnish acronym, from Strategisen Huippuosaamisen Keskittymä, literally Strategic Centre of Expertise
6 RIC, 2006, Competitive strategic centres for science, technology and innovation, p. 3, translated from Finnish by Tekes, May 2012.
7 RIC, op. cit., p. 7.

mutual agreements between the stakeholders or as limited liability companies[8]. The rationale presented for choosing a corporate form was that administration of mutual agreements would be expensive and opaque for outsiders, which would raise a barrier for entry. Further, corporate form would enable the SHOKs to own property and act as a partner in agreement.[9] Limited company was the chosen form of the SHOKs.

The RIC also proposed the following criteria for the choice of SHOKs, which mirror the instrument's objectives closely[10]:

- **Strategic Centres for Science, Technology and Innovation must be highly significant in terms of their potential to impact society and the national economy and they must involve significant investments in research and development.**
- **The centres must be sufficiently large in terms of personnel and financial resources.** After the establishment of their operations, the total financial volume of centre activities must reach an annual level of €50 M to €100 M, depending on their area of focus and activities.
- **The centres must be constructed around applications central to the future of the sector in question.** An application-driven approach means that the research, development and innovation activities carried out by the centre must be based on the combining of several different types of expertise. The central role of innovation activities also requires the creation of environments in connection with the centres where new, application-driven ideas can be piloted and tested in use situations that are as realistic as possible.
- **The core expertise for the centres must come from Finland. Each centre must have the potential to be among the best in the world.** The centres must have international credibility and visibility and be able to attract the most qualified experts and best companies in the field on a global scale. To achieve this, the centres must be internationally networked and actively engage in international cooperation.
- **The centres must be based on the strong commitment of the central companies, universities, research institutes, funding organisations and ministries in the field in question.** The activities and funding of the centres must be long term in order to achieve a permanent competitive advantage. The centre and the actors committed to it must have a clear, goal-oriented vision and a targeted strategy.

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8 Ltd., in Finnish law Osakeyhtiö (Oy), lit. Stock Company, i.e. limited company, a corporation which owners' liability is limited to their investment through shares or guarantees. See: Limited company. (2012, October 16). In Wikipedia, The Free Encyclopedia. Retrieved 09:37, October 17, 2012, from http://en.wikipedia.org/w/index.php?title=Limited_company&oldid=518142802; Osakeyhtiö. (2012, May 6). In Wikipedia, The Free Encyclopedia. Retrieved 09:37, October 17, 2012, from http://en.wikipedia.org/w/index.php?title=Osakeyhti%C3%B6&oldid=490932431

9 Karlqvist, H., Mähönen, J., Sarkio, J. 2006. Osaamiskeskittymien hallintomallit (eng Governance models for centres of excellence), A report to the steering group for centres of science technology and innovation, 2.3.2006.

10 RIC, op.cit. p. 8

With reference to these criteria, the steering committee proposed five focus areas: Energy and the environment; Metal products and mechanical engineering; Forest cluster, Health and well-being; and Information and communications industry and services. These sectors have been identified as the Finnish lead value creators already in early 1990s in ETLA's Research Programme on Industrial Economics and International Business[11].

The original proposals for the SHOK areas have been carried over to the present SHOKs almost to the letter. Additionally the steering committee recommended that there would be strategic analyses and foresight to identify the key areas for future SHOKs. The addition of the built environment SHOK to the portfolio was clearly a bottom-up initiative, as the Built Environment industry network succeeded in convincing SHOK decision-makers to allocate SHOK status also to them.

The practical arrangements started before official establisment as Tekes and The Academy of Finland appointed teams in spring 2006 by RIC's request to assess the state of the art in capabilities and potential readiness to establish the SHOKs. The first SHOK was FIBIC, which was legally established 2007. Forestcluster was followed by Tieto ja- ja viestintäteollisuuden tutkimus TIVIT Oy. And Finnish Metals and Mechanical Engineering Competence Cluster Oy FIMECC.

During the establishment, the steering committee established under RIC was instituted as a governing council for the SHOK instrument under the aegis of the Ministry of Employment and the Economy (MEE). The governing council monitors and evaluates the SHOK instrument based on the early reported key performance indicators (see below for details) and evaluations. Its primary objective is to follow how the mission set in the SHOK strategy is fulfilled.[12] The monitoring data is gathered each year by the April 15th, processed in the governing council, whose chair gives a report on the progress of the SHOK strategy for RIC.

The practical arrangements have been largely the responsibility of the Finnish Funding Agency for Technology and Innovation – Tekes, by virtue of Tekes being the main funding agency.

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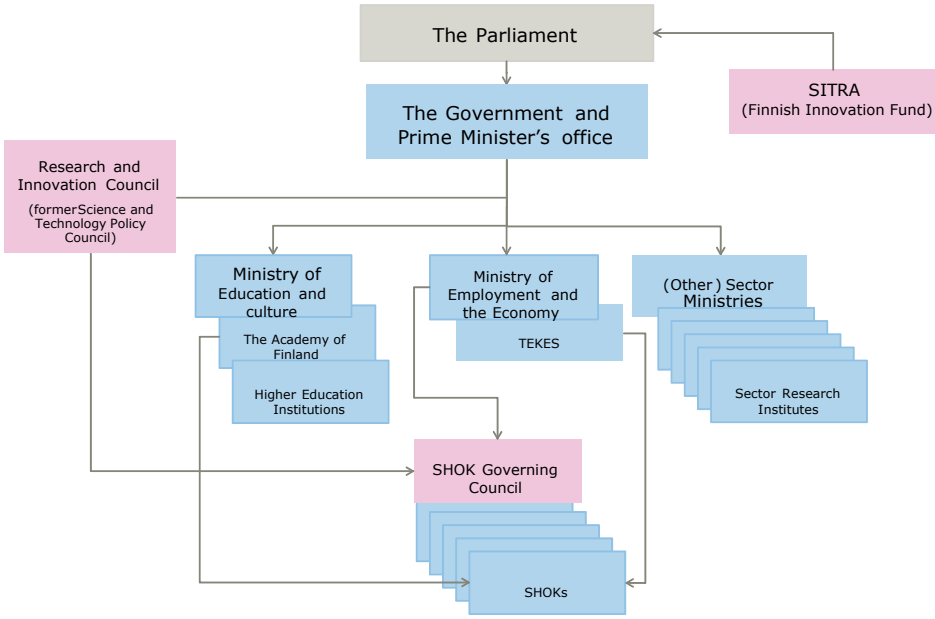
11 see e.g. Vartia, P. & Ylä-Anttila, P. 1996. Technology Policy and Industrial Clusters an a Small Open economy – The Case of Finland, ETLA Discussion Papaers 550; Ylä-Anttila, P. 1994. Industrial Clusters – A Key to New Industrialisation, KOP, Economic Review, 1994:1.

12 Anon. 8.6.2009. Ohje strategisen huippuosaamisen keskittymän raportoinnista (seurantajärjestelmä), (eng. A guide for yearly reporting for Strategic Centres of Science, Technology and Innovation (monitoring system))

Figure 2. Overview to governance of the SHOK instrument



So far the SHOKs have been the object of great interest, both within Finnish academia and industry and internationally, as a potential benchmark.[13] While the establishment of the SHOK concept in itself was as such based on needs identified in studies and evaluations, many of the central characteristics identified at the outset when undertaking this evaluation, had already been tentatively pointed out or proposed in the analysis provided by numerous previous studies. Below we summarise some of the central aspects identified in such studies.

The international evaluation of the Finnish innovation system for instance already pointed out some of the central issues emerging with the SHOK concept in the Finnish innovation system and policy. Such issues involved for instance the centrality of large companies in outlining the research agenda, the variety of processes of coming up with project ideas (based either on bottom-up and/or top-down procedures depending on the programme), the relative closeness of the early stage of research undertaking, i.e. the fact that external parties may only become involved once the programme agenda has been formulated. The procedures under which the projects will be evaluated by the funding agencies will by and large be similar to those used by the agencies for their proposal evaluation in general. However, it may be the case that SHOK status could bring with it shorter procedures,

13 Veugelers et al. (2009): Evaluation of the Finnish National Innovation System – Full Report: www.evaluation.fi. Kotiranta, A., Nikulainen, T., Tahvanainen A-J., Deschryvere, M., & Pajarinen, M. (2009). Evaluating National Innovation Systems – Key Insights from the Finnish INNOEVAL Survey. ETLA Discussion papers, 1196. – Nikulainen, T., & Tahvanainen, A-J. (2009). Towards Demand Based Innovation Policy? The Introduction of SHOKs as Innovation Policy Instrument. ETLA Discussion Papers, 1182.

which would imply that, to some extent at least, the proposal selection would be outsourced to the SHOKs.

The international evaluation also had proposed an analysis of some of the potential weaknesses of the concept, such as the fact that by focusing on the incumbent large firms and by seeking to remedy the problem of new start-ups not finding an partner with industrial and marketing competencies that could bring the innovation into large scale industrial production and distribution. In as far as SHOKs tried to remedy the lack of such a partner (function), SHOKs were seen as potentially essential complementary assets required in the commercialization process and as such geared at promoting specific assets in the commercialization process (Luukkonen and Palmberg, 2007 cited in op.cit.). It was in fact already from early on awknowledged that SHOKs are not mainly designed to deliver revolutionary new knowledge, potentially making existing knowledge base and skills of the large firms redundant. Rather the SHOKs were not intended to fulfill the need to promote new, path-breaking and revolutionary avenues of research.

Other issues pointed out in the international evaluation of the Finnish innovation system related to SHOK concept at its early stages of development included for instance internationalisation, where the evaluation recommend that the international dimension should be more strongly aligned with the new SHOK programmes and their procedures.[14] In addition, the international evaluation involved a networking study, where the position of SHOK was notably marginal (Kotiranta et al. 2009, cited in ibid, 24).

The evaluation undertaken by the Confederation of the Finnish Technology Industries (Teknologiateollisuus) was an important source of analytical insights into the industrial partners' perceptions and views into the SHOK. Due to the relative short time-span at the time of the evaluation, only four "first ones" of the six SHOKs were included in this evaluation. [15]

While the Teknologiateollisuus evaluation identified a number of salient points in areas such as strategic value for the industry partenrs, ways and means of achieving excellence in broad and relatively open consortia, as well as administration (notably the role of Tekes as the main funding organisation within it) and the challenges associated with IPR in broad-based SHOK consortia, there were a number of recommendations proposed in order to improve the functionality and effectiveness of the concept.

The evaluation recommended a number of improvements and changes in implementing the SHOK activity and further developing the concept. Some of these have since then already been addressed in the SHOK governance networks and in research activity. The re-organisation of the SHOK management and steering group was one such reorganizational activity, which was called for. In the 2011 evaluation it was proposed that the ownership issues could be at least partially addressed by

14 Ibid, 32.
15 Annala & Ylä-Jääski (2011): The Strategic Centres for Science, Technology and Innovation (SHOKs) Cleen, FIMECC, Forestclusterand TIVIT from the Company Perspective, Federation of Finnish Technology Industries.

the establishment of the current national steering group very much in line with the TEK evaluation proposal. Other recommendations included a closer and better organised dialogue between the funding organisations and the SHOKs, as well as regular high-level reviews of the activity. Various ways of ensuring a sharper focus for SHOK activity were also proposed, including board membership, commitments of the companies to ensure the best and highest level involvement in SHOK activity, as well as strengthening the international dimension of SHOK activity. It is undoubtedly the case that while many of the governance issues identified in the evaluation have been put into practice, the more principal issues connected to the strategic focus and internationalisation for instance will need a broader portfolio of actions and a longer timespan to be remedied.

Yet another issue identified in previous literarure involving characteristics that have been seen as drivers in SHOK activity and have been identified as areas requiring further attention have included e.g. industry-driven nature and IPR issues, the new rationale for allocating funding are also amongst these previously identified key characteristics, where SHOKs differe and have implemented slightly different strategies, e.g. allocation strategies based on expected economic and societal impact, corporate strategies, and the existing knowledge base, rather than more politically driven agendas and the commitment that co-financing models entail. (Nikulainen & Tahvanainen 2009, p. 15).[16] Many of the tensions and challenges identified in this report have already been pointed out in the previous studies. Amongst these are issues relating to the coоperation between companies and universities, where the incentives for top researchers for participating in SHOK research might be lower than expected, as the potential returns from other types of industry sponsored projects outside SHOKs are much higher. It has rightly been pointed out by Nikulainen and Tahvanainen for instance that these top researchers would need to identify stronger nonmonetary incentives in participating in the SHOK collaboration (ibid, p. 18).

Within SHOK governance the breadth of networks has been noticeable, as has the need for champions in the SHOKs and their programmes and the potential openings offered by the gaps in the strategic level governance (e.g. possible need for including intermediaries or societal and public sector partners)[17]. Also peer learning possibilities have been pointed out as possible ways of dealing with some of the governance challenges that SHOKs as broad-based networking instruments face.[18]

2.1 Funding terms and conditions

Besides the indirect governance from the governing council, the SHOKs enjoy a great deal of independence as independent limited liability companies. Important indirect

16 Tuomo Nikulainen – Antti-Jussi Tahvanainen (2009): TOWARDS DEMAND BASED INNOVATION POLICY? – The introduction of SHOKs as an innovation policy instrument. ETLA Discussion papers, 1182.
17 Lähteennäki-Smith et al. (2011): Network Governance and the Finnish Strategic Centres for Science, Techmology and Innovation, Tekes Review, 280.
18 Ibid, 48.

influence is also exerted by the funding organisations. In principle the SHOKs as independent legal entities are free to work within the borders set by the governing council, but are subject to rules, or Terms and Conditions for funding, which mount to indirect governance. In practical terms Tekes funding criteria and programme monitoring play a large role in day to day management of SHOKs. Tekes has been involved in the inception of the SHOKs and monitors them through their programme funding applications and associated reporting. Looking at the figures, the bulk of SHOK operations are funded by Tekes, which has committed a considerable share of its budget to SHOK programmes.

The projects proposed for Tekes are subject to general Tekes funding criteria and specifically to SHOK specific qualitative criteria, as well as the general terms and conditions. Tekes grants funding for projects that potentially create most added value for the economy and society in the long-term. The project's impacts on other companies and society are taken into account in the evaluation of applications, and the applications are evaluated as a whole along the following dimensions[19]:

- intended business or other utilisation
- technology, innovation or know-how to be developed
- resources to be used
- cooperation to be developed or utilised
- societal and environmental wellbeing factors to be promoted
- impact of Tekes' funding and expert work

The criteria specific to SHOKs are split to three dimensions as follows[20]:

1. Quality and relevance
    - **a)** The projects' fit to the SHOK's vision, objectives, strategic research agenda/programs and research themes
    - **b)** Impact to development of industry; broadness of applicability
    - **c)** Impact to radical renewal of the industry and/or national economy
    - **d)** Scientific and technical excellence and contribution of the project compared to international standards
    - **e)** Contribution to internationally acclaimed capability development and breakthroughs; multidisciplinary nature of projects.
    - **f)** Quality of the technical research proposal
2. Resources and collaboration
    - **a)** The competence, capabilities and broadness of the consortium
    - **b)** Contribution to the collaboration of the participants, and their joint competence/capabilities and collaborative research and development platforms
    - **c)** Long-term commitment of the consortium members

19 Tekes funding principles, Tekes, available at http://www.Tekes.fi/en/community/Funding_principles/551/Funding_principles/1422

20 Qualitative evaluation criteria for SHOK research programs (Tekesin käyttämät SHOKien tutkimusohjelmien laadulliset arviointikriteerit – in Finnish), 2010, Tekes, available at http://www.Tekes.fi/fi/community/Osaamisen%20keskittym%C3%A4t%20%28SHOK%29/505/Osaamisen%20keskittym%C3%A4t%20%28SHOK%29/1379/

3. Value-added

- **a)** Overall value-added from the SHOK-model compared to existing models
- **b)** Contribution to the national research agenda and to national pool of expertise in the area of the SHOKs
- **c)** Impact to the visibility and interest of the thematic areas in the eyes of industry and talented individuals
- **d)** Contribution to the development of the innovation systems and dissemination mechanisms of research results

The general terms and conditions for SHOK programmes sets the grounds for project management and budgeting. The main requirements for governance are that a programme must have a steering group, and an accountable programme leader/manager. Otherwise consortium structure is not specified.

The programmes are funded based on an application detailing programme plan and consortium, which are confirmed by the programme steering group in the programme inception. The funding is granted in periods, and paid based on periodic reports and cost statements. Eligible costs include working time and associated indirect costs, materials, as well as machinery and equipment and their depreciation. Also services purchased from other companies, such as studies and research work, are eligible with limitations or requirements for foreign companies and purchases from within company groups and associated companies. In principle, "in kind"[21] contributions are not eligible unless they are paramount to programme implementation and their value can be reliably determined. However, in kind contributions from enterprises can be considered.

During the programme Tekes will monitor the progress of the programme as well as evaluate the results and their potential impact. Tekes requires that the participants divulge all programme-related information and provide access to current financial reports and audit documents upon request. The programmes' accountable leaders are responsible for providing four kinds of reports, interim, periodic, final and a follow up report. The reporting schedule is agreed in the programme plan, but in practice a funding period is one or two years, which sets the schedule for the periodic reports. The follow up report is to submitted three years after the respective programme has closed. Any participant leaving a programme has to provide a (final) cost statement and accounting for any in kind contributions within four months of termination of project activities. Changes to programme substance, consortium and budget distribution will be approved by Tekes based on an amended programme plan, preferably in the form of periodic report. Tekes has the rights to suspend or deny further funding in case key personnel or participants leave the programme or the programme deviates from the original goals.

Interim reports report the progress of the programme and detail the actual costs incurred at actual value by cost category and participant from the beginning of the

21 In kind, payment in kind, is contribution for programme implementation provided at no cost by the partners, including work, facilities, systems, machinery or other equipment

project. Periodic reports are essentially the same as interim, but they must also contain accounting for in kind contributions. Administratively they are also a basis for a decision for the next phase of the programme. In case the costs deviate from the funding decision, programme leader has to present what measures will be taken to correct the situation. A credible plan for correction is a key to securing the funding for the next period, and have to be implemented by the next interim report. The final report will again include cost statements and an overview of the content. A follow up report should compare the impact forecasts and anticipated benefits to the realised impacts and analyse the differences.

The results of the programmes will be public after completion of the programme, either under wide or limited publicity model specified in the funding agreement. In wide publicity model all the participants shall release all results of the programme, under limited publicity model, research organisation will have to publish all results, while enterprises shall need to publish only project/work package name, amount of public funding, research intensity and an overview to the substance and results. However, results materials, such as laboratory diaries, measurement results or source codes are not public. The exceptions to the rule are that immediate publication may be delayed for e.g. reasonable period to allow for protection by registering IPR or industrial rights if it is in conflict with the owners "direct, legitimate interests". Publicity of the results is also subject to case by case consideration in individual cases for "extremely pressing reasons". If a participant leaves, its access right to IPR will remain in force, but it will lose preferential treatment in access to background or results materials owned by other participants.

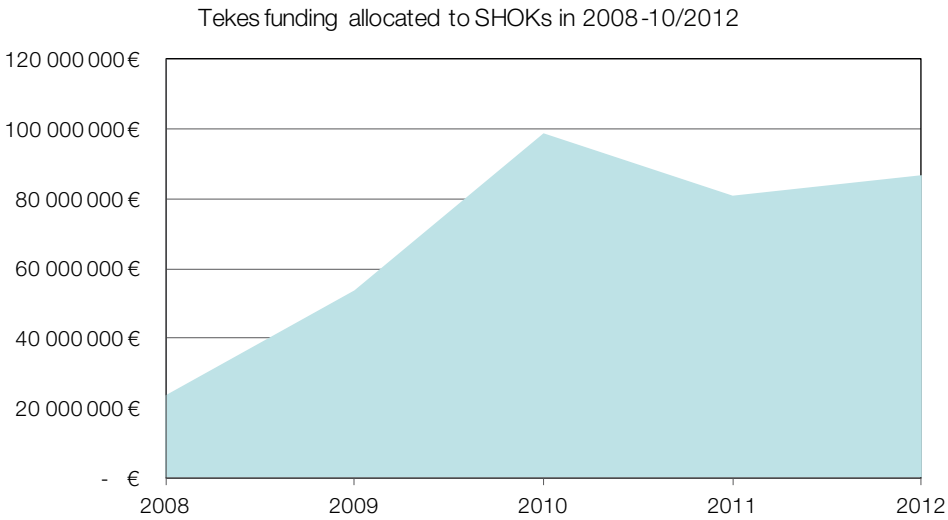
One of the interesting features in of SHOK programmes is the ideal of open innovation, upon which it is built. There is in principle open access to results and IPR, shared by all parties involved in the research (programme, project or task) in question. The open innovation is the norm in wide publicity model programmes and when both the company who has subcontracted the work and the research organization, which has been subcontracted are parties to the research programme in question. In such cases the ownership of and title in the results and IPR remain with the inventor regardless whether they are shareholders of the SHOK company. In case of a public sector participant, title and ownership is retained if the entity has generated the results while subcontracting for enterprises. The inventor has the right to protect its IPR, but has to bear the associated costs. The novel feature of the SHOK model is that while the material and immaterial rights remain with the inventor, it is obliges to grant an unlimited and perpetual access right to the results and IPR to all participants of the programme where they are generated. Further, the access rights will cover all companies within the same group of companies as the participant of the research programme. While all the programme participants have an access right, they cannot sublicense the results or IPR unless they are the owner. The background necessary to implement the research programme has to be also shared during the programme for the purposes of the work within the programme without separate

compensation, while ownership and title will remain with the original owner. Again the exceptions are research organisations, which can sublicense the results and IPR created under wide publicity model for for other research organisations for research purposes. In limited publicity model a foreign entity shall not be eligible for access without separate compensation to the results or IPR created by a public entity.

Foreign companies, that are enterprises who are not registered in Finland, are eligible to join the programmes, but cannot receive funding from Tekes. However, Tekes may fund Finnish individuals work in foreign enterprises with the condition that they receive rights to the IPR they create in accordance with the Terms and Conditions. Non-Finnish companies can naturally participate in programme activities, though have done so very seldom and according to our interviews have not done so largely due to the open innovation model implemented in SHOK research activities.

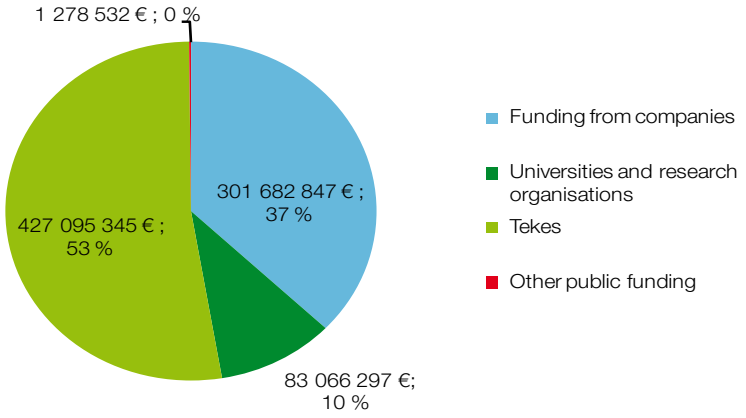
The financing model is summarised in the figure below.

Figure 3. Financing model. Information source: Tekes



The figures below depict the funding information provided by the SHOKs themselves. According to SHOKs the estimated total volume of all SHOK activities will add up to roughly 813 millions of Euros. The division of this funding per funding source is indicated in the summary figure below. 53 % of the total volume is financed by Tekes, 37 % by private companies and 10 % is financed by universities and research organisations. However, it must be noted that the figures are based on the SHOKs estimations on future funding and are volatile to changes in the Tekes' funding share and changes in the SHOKs' operating enviroments. According to Tekes, the total funding volume of the SHOKs during years 2010-2012 was nearly 152 millions of Euros, of which Tekes funded 58 %.

Figure 4. Estimation of the division of total financing as reported by the SHOKs.



In addition to Tekes, the Academy of Finland has also published directed calls in the topic areas and themes covered by the SHOKs. Differing from Tekes, the decision is based on a recommendation of an international peer review board, which ranks the proposals according to the following criteria[22]:

1. Research plan
   - **a)** Scientific quality and innovativeness of the research plan
   - **b)** Feasibility of the research plan
   - **c)** Ethical questions (as far as relevant)
2. Competence of applicant and quality of research environment
   - **a)** Competence and expertise of the applicant(s)
   - **b)** Research team and environment
   - **c)** Significance of research collaborations and researcher mobility
   - **d)** Research consortium (if relevant)
3. Overall assessment
   - **a)** Main strengths and weaknesses of the project. Additional comments and suggestions.

The funding of the Academy is similarly tied to a programme/project proposal, but the results are reported only in the end of the funding period. While the funding criteria are similar, the large qualitative difference is that the Academy funding is tied to decisions of people who consider the importance of a project and capability in academic terms, while Tekes evaluations are directed more to the impact side. Academy of Finland funded projects are not SHOK projects in the sense that the results are not linked to SHOKs as such, rather Academy of Finland funds research activities taking place in the SHOK related areas.

22 Academy of Finland, Application evaluation form 2012 Research Projects. Available: http://www.aka.fi/Tiedostot/Tiedostot/Arviointitoiminta/Proposal_evaluation_form%202012_Projects.pdf

2.2 SHOKs and sub-programme activities

As mentioned above, Tekes (the main national funding agency for innovation) has funded the SHOK research programmes with a total of 334 million € (between 2008 and September 2012). An average of 40% of research conducted by the SHOKs is co-funded by companies. The SHOKs may also apply to EU research programmes for funding. (For more information on the SHOK concept and the individual SHOK companies, see: http://www.shok.fi/en/)

Currently there are six SHOKs in operation: FIBIC[23]), Information and communication industry and services: TIVIT, Finnish Metals and Engineering Competence Cluster: FIMECC, Energy and the environment: Cleen, RYM Built Environment Innovations, and Health and well-being: SalWe. Each of the Centres is presented in its own individual sub-report and the synthesis of the evaluation is summarized in the final report.

There is a pool of shared Key Performance Indicators (KPI), which the SHOKs are expected to report to the Ministry of Economy and the Economy (MEE). The metrics have clearly not been developed in a systematic way and the fact that very few SHOKs actually use them consistenly and systematically as part of their own monitoring and reporting seems to suggest that the KPIs are not necessarily those most suitable and useful for steering the centres and their activities. There are a total of 30 indicators, with great variation across SHOKs as to which of these they monitor (and report upon). There is also a perceived difficulty in all understanding the KPIs in the same way, and there is no shared or systematic logic model developed. The suitability of targets depending on SHOK and the contradictory nature of the objectives is reflected in the lack of using shared KPIs. As for the evaluation, the team soon released that due to the lack of shared information base and the relatively early stage in the "5-10 years" timeframe originally set for the SHOKs, the monitoring and evaluation should be seen as a baseline measurement and interim evaluation, which can be used in developing a systematic monitoring and evaluation benchmark and methodology for the next years.

In the tables below we have summarised the KPIs, taking these more as an illustration of the way in which they are used today, rather than a systematic comparison as such. In connection to each individual indicator, we have selected the highest level reported, bareing in mind that many indicators are only reported upon by a minority of SHOKs.

23 In August 2012 Forestcluster s expanding its activities from research focused on the forest industry also towards other areas of the bio-based economy. As a result of the metamorphosis it is now Finnish Bioeconomy Cluster FIBIC.

Figure 5. KPI examples

SOCIAL AND ECONOMIC SIGNIFICANCE	HIGHEST
Launched 5-year program volume, M€	238 (FIMECC)
Total volume of activities (person years)	605 (FIBIC)
Proportion to total r&d&i activities in sectors involved (%)	9,5 (FIMECC)
Number of national connections/partnerships	127 (FIMECC)
Launched 12-month volume, M€	50,9 (FIMECC)
Human and financial resources	
Funding from businesses, M€ commitment	25,8 (TIVIT)
Investment (person years) by companies	252,1 (TIVIT)
Funding from universities, M€ commitment	12,3 (TIVIT)
Investment (person years) by universities	190 (FIBIC)
Funding from research organizations, M€	5,3 (FIBIC)
Investment (person years) by research organizations	120 (FIBIC)
Infrastructure made available for SHOK, M€	400 (FIMECC)
Funding secured through public competitive tendering, M€	63,3 (FIBIC)

Figure 6. KPI examples, continued

KEY INNOVATION OUTPUTS	HIGHEST
Number of invention announcements and patents secured	34 (FIBIC)
(Number of) Licences sold	46 (FIMECC)
Results leading to development projects within companies	19 (FIMECC, most not reported)
Number of spin-off companies generated	3 (FIMECC)
Number of pilots generated	20 (RYM)
Number of scientific disciplines participating	30 (RYM)
Number of sectors participating	23 (TIVIT)
Number of refereed published articles	174 (FIMECC)

Figure 7. KPI examples, continued

INTERNATIONAL LINKS	HIGHEST
Participation in EU projects (“including role”)	19 (TIVIT)
Proportion of EU funding in total budget	5,4 (FIBIC, most SHOKs have not reported on this KPI)
Number of international partners	68 (FIBIC)
Proportion of international partner organisations in total budget, %	10 (FIBIC, most SHOKs have not reported on this KPI)
Person years contributed by international researchers	13 (FIMECC)
Researcher mobility (person years, country of origin and destination)	16 (FIMECC)
Future objectives for participation in EU research programmes (M€ shareholders / M€ total budget (target year))	20 (RYM, most SHOKs have not reported on this KPI)
Future objectives for participation in EU research programmes (person years)	144,4 (TIVIT, most SHOKs have not reported on this KPI)

The tables above reflect notably low level of internationalisation and level of accomplishment in innovation and academic output terms. The picture is only a partial one and will be omplemented by the SHOK specific analysis and reports to follow.

2.3 Strategic Centre for Science, Technology and Innovation in the Energy and Environmental sector Cleen

Cleen was established in 2008 to bring together the interests and highest quality R&D excellence from the industry and research, as well as to meet the grand challenges facing the societies of today. In 2010, three programmes were in operation (MMEA, SGEM and FCEP) and a total of 6 programmes under preparation. Currently there are 6 programmes running. Three more were prepared but not funded by public funding organization.

Cleen is well positioned to meet the challenges of moving beyond the traditional clusters and putting into practice the horizontal ambitions of SHOK. There are 14 industrial sectors present among the stakeholder companies (ranging from agriculture, forestry and fishing and mining and quarrying to electricity, water supply and construction) and the research content requires an in-built broad horizontal approach.

There are currently 45 shareholders (28 companies, 17 research organizations) and six research programmes with a total annual research volume of 38.4 million euros being implemented today:

- Smart Grids and Energy Markets (SGEM), 12.0M€
- Future Combustion Engine Power Plants (FCEP), 9.6 M€
- Measurement, Monitoring and Environmental Efficiency Assessment (MMEA), 11.7 M€
- Carbon Capture and Storage Program (CCSP), 3.2 M€
- Efficient Energy Use (EFEU), 1.9 M€
- Distributed Energy Systems (DESY), 1.0 M€.

There are significant business opportunities and needs for R&D&I in the field of climate and energy. According to a recent report (Kohl et al. 2012), significant untapped potential lies in the global markets for renewable energy production, associated technologies and energy efficiency, as well as in the area of climate mitigation. As argued in the report,

> *Renewable energy sector in Finland has many key elements for successful export, such as advanced innovation system, strong traditional competences in bioenergy sector developed within pulp and paper industry, and versatile research and development activities and advanced innovation system and related policies. The knowledge and knowhow level in bio energy and*

> *technology in Finland is high but the current state of other renewables is more diffused in industry, patenting as well as in Tekes programs. In general the promotion of renewable energy requires a clear national policy will and public debate but also regional and national level guidance and concrete measures (ibid. p. 14)*

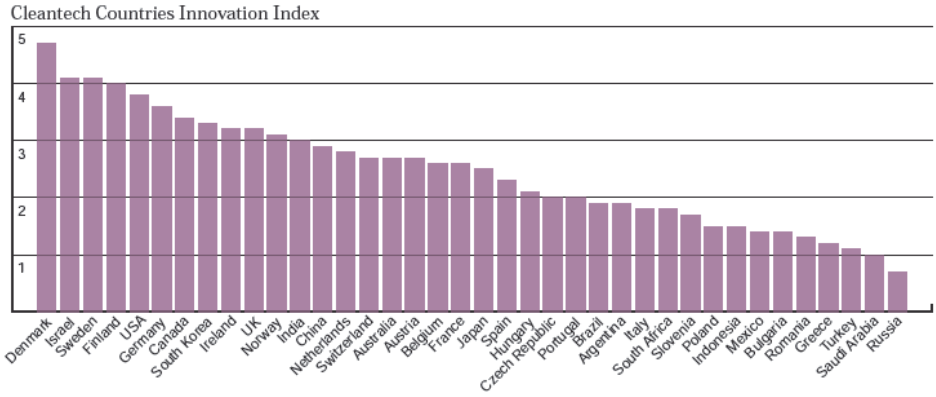
The energy and environment issues are also high on governmental agenda, with ecologically and socially sustainable economic growth been one of the stated objectives and within this objective there is an ambition of making Finland a global forerunner in developing eco-friendly, resource and material efficient economy and sustainable consumption and production patterns. (The governmental programme of Katainen government and its strategic document of 5th October 2011, p. 18). In order to promote this goal further the government also launched a strategic programme for the promotion of cleantech in February 2012 (http://www.tem.fi/index.phtml?s=4834).

> *The market potential and opportunities for competitive R&D&I are particularly interesting sources of innovation and business growth today, as the market share of renewable is still considerably lagging behind the actual potential, with only 12,8% of energy production being covered by renewable energy sources globally (IEA 2010). In Finland the equivalent share in 2008 was 28,5% and the Finnish strategy is to meet the European goal of 38% share of renewable energy by 2020.* (Ministry of Employment and the Economy, 2008, p. 36. For the EU targets see also Communication from the Commission to the European Parliament and the Council Renewable Energy: Progressing towards the 2020 target.)

The figures indicating the current business situation and potential vary depending on the source and definition used for energy and environment / cleantech sector. There are numerous figures reported on the size and potential of Clentech industry. According to the figures of the MEE's strategic Cleantech Programme, the size of the global market is around 1600 billion euros (approximately 6 % of global GDP), with an estimated growth of 10% annually. In Finland there were in 2011 over 2000 businesses involved in the cleantech sector broadly speaking. According to the Ministry of Employment and the Economy, there are today over 2000 companies in this area in Finland, with a turnover of 20,6 billion eurs and an export value of 12 billion euros (approximately 20% of total experts).

This business potential is clearly a driver also for the Cleen activities, though equally important driver is the innovation capacity and potential that underlines the cross- and inter-discipline work on-going in the environment and energy sectors. Finland has developed based on a high R&D intensity and is amongst the top countries in many international comparisons on innovation in the cleantech sector.

Figure 8. Cleantech country ranking (Source: Clentech Group and WWF 2012: COMING CLEAN: The Global Cleantech Innovation Index 2012, p. 16).



Finland's ranking provides a positive starting point to pursue R&D&I in this field in ways that can be cutting edge and internationally significant. While we will not go deeper into the innovation index and its elements or analysis, suffice to say here that according to international comparative analysis, Finland is amongst the best placed (coming second) in the "inputs to innovation" factors, as well as scoring well for emerging cleantech companies. When compared to the leader Denmark, Finland's position is relatively stronger in its over-all innovation policy support, while Denmark in turn leads in "cleantech-specific innovation drivers" and "evidence of commercialised cleantech innovation". The Finnish policy in this sector has remained quite conservative, i.e. Finland has not sought to set market trends like Denmark (in wind power) for instance has done. (See for instance Hjelt et al. (2010): the Lead Market Initiative, Helsinki; MEE) Denmark also scores second for fostering emerging cleantech companies. This seems to imply that Finland is well placed to be actively involved in international cooperation and an attractive partner for both business and research, though its potential in commercialisalisation activities still seem to lag behind its main competitors. These issues are referred to also amongst the goals of Cleen activity, which we will present next.

2.3.1 Cleen organization

Similarly to the other five SHOKs, Cleen has status as a private owned limited liability company. Similarly to the SHOK concept in general, also the Cleen organization is considerably lean in its structure and resources. The actual company organization consists of Chief Executive Officer, Chief Technology Officer, Controller and Communications Manager. Together with the other Strategic Centres, Cleen also employs a common Legal Counsel, which ensures the availability of common corporate practice.

Partnership is at the core of the governance model. In planning the work and operationalising the objectives, industry, research institutes and universities plan the research programmes together. The goal is to develop and accelerate the whole innovation process in order to facilitate globally competitive technology and service products. The novelty of the academia-industry interface in the SHOK context described here needs to be particularly addressed, as it is as stated in the international evaluation of the Finnish innovation system[24] mongst other sources considered to be one of Finnish strengths. Thus the question has been posed, what does the SHOK concept bring into this collaborative equation that would otherwise not be there. One potential answer in this regard has been the more long-term commitment of the industry (often seen as a more short-term partner in specific innovation initiatives, to be considered case-by-case rather than as an institutional commitment). Another alternative value added could be the closer collaboration of the third and fourth legs in the triple/quadruple helix constellations, i.e. a stronger presence and role of the public sector authorities (e.g. cities as problem owners) or users and end users of R&D&I products and services (even citizens and consumer groups).[25]

The topic of environment and energy is clearly a hot one, also internationally. The initial strategic research agenda for the Energy and environment Strategic Centre for Science, Technology and Innovation was published in April 2008. In this document, the importance of the energy and environment sector was highlighted and its importance described in two ways. First, by developing new technological solutions to overcome the over-dependence on fossile fuels and non-renewable energy sources and secondly, by boosting further the economic potential that is already considerable: even today businesses working in the energy and environmental sectors generate around one quarter the total industrial output of Finland.

The intention of Cleen is to ease, amplify and make faster innovation process, with industry being more involved in defining the research agenda to benefit their own interests. A large network of resources is made available and a major share of the available public research funding is committed to a shares research agenda. The intention for this research is to be long-term in nature. SHOK with it resources is also seeking to attract the best available personnel for production, research and development. One of the novelties of this policy instrument lies in its extensiveness: it covers the whole range of R&D activity from basic research to applied and beyond (though with the main focus on applied); it is in fact unique in Finland in this regard. The Cleen can choose to introduce different kinds of programmes that is deemed necessary in order to pursue these goals; some concentrating on more long term strategic research, while others will focus on much more immediate applied goals.

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24 Evaluation of the Finnish National Innovation System – Full Report, 2009, p. 39

25 If the SHOK programmes sought to improve their societal impacts, it might be considered worthwhile that in addition to the input and output indictaors, Tekes as the funding organisation could also include in its Key Performance Indicators some societal indicators such as the share of funding allocated to activities promoting the energy efficiency or sustainability targets.

The level and mix of participation is expected to vary on a case by case basis. The governance model will be described in more detail later in relation to the programme preparation.

Funding available for Cleen activities from Tekes in 2012 is approximately 20 million, which amounts to about 55.5% of overall funding. The financial share of the industry is about 33% and the remaining (approximately 11.5%) comes from research organisations. There is relatively little variation across the programmes as to the funding structure, where it does exist it relates to the availability of SME funding (and therefore also SME presence). The overall SME share of the resourcing is about 10%.

2.3.2 Cleen's SRA and programmes

The mission of Cleen is to create value for global companies and research institutes by offering a continuously evolving but solid and trustworthy open innovation ecosystem between industry and academia. The vision guiding the work is one **of becoming leading companies and research institutes in the world that consider energy and environment aspects as a major success factor for their operations, realizing their joint R&D&I on Cleen platform, and by so doing creating breakthrough innovations with global impact**. (Annual Report 2011)

In its original SRA from 2008, the mission for the Energy and Environment SHOK was formulated as being "an essential means to leverage the Finnish competitiveness to top international level in global energy and environmental markets through common, long-term and networked strategic research and development" (SRA 2008: Energy and Environment Strategic Centre for Science, Technology and Innovation (EnYm-SHOK), Strategic Research Agenda (SRA), dated 29.4.2008, p. 8). The vision at that point was defined in more multi-faceted fashion, i.e.

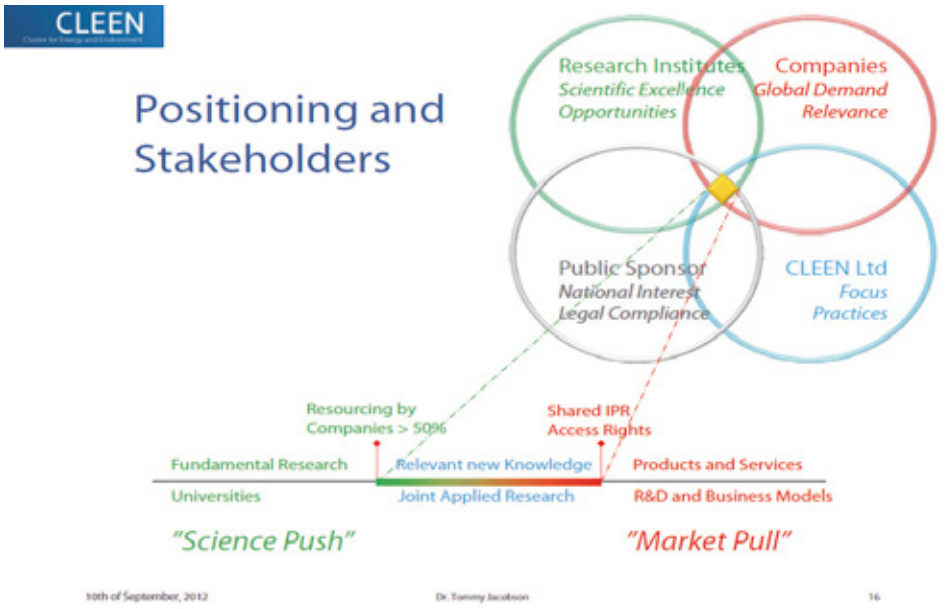
> *In 2050, energy and environmental industry is a leading industry in Finland and a global market leader in selected business areas. The turnover of this industry has increased in 2020 from the present 32 milliard € level (2007) to 100 billion €. Based on its superior know-how and innovative production systems, the energy-intensive and environmentally sound industry in Finland has a remarkable global competitive advantage.*
>
> *In 2020, Finland is well on its way to the sustainable society of 2050. All the energy policy targets will be reached ahead of time.*
>
> *The joint research and development has increased from 70 M€/a in 2010 to 120 M€/a in 2015 and 160 M€/a in 2020. (Ibid, p.8).*

One can easily observe that the business environment described in the context section was addressed from the start, though perhaps the broader societal dimensions are less explicitly visible in the current SRA. In light of the major economic changes of recent years, concentrating on making Cleen and its partners competitive may be a wise and manageable goal. We may however consider the relative absence of linkages to societal problem solutions and problem owners as a weakness within the SRA.

In all the Cleen activities it is the shareholders who define the focus, targets and practices of the activity. The targets are realised in the form of wide and open joint research programmes and the targets and scope of the research programmes are defined by the research consortiums, which are in many cases very broad. The current focus areas are described in the SRA.

The SRA places the focus of Cleen activities on joint applied research, though in individual cases there can also be more fundamental research undertaken and closer to a more market-oriented research. This focus also explains why in the e-survey undertaken as part of the evaluation, new products and services and business models were not seen as particularly relevant when the expectations of programme stakeholders were gauged.

Figure 9. the positioning of Cleen research in the science push – market pull continuum (Source: Tommy Jacobson, Cleen evaluation panel on the 10th September 2012).



In its strategy, Cleen has certain standards of its own for the operations, such as the operations being

- based on a global demand rather than simply a local resource driven supply,
- structured around novel, clear, transparent and trust-worthy R&D&I-practices,
- based on ensured commitment of globally convincing Cross-Industrial and Multi-disciplinary shareholder base, built around the best and/or most convenient research consortia.
- built around clear shareholders' and consortium members' roles (rights, value added and responsibilities),
- based on the thematic focus (of SRA) and practices of research activities, but neither having exclusive rights, nor exclusive obligations in research activities.

Critical Success factors identified by Cleen include efficiency and agility.[26] These principles cited above are actually quite a suitable assessment point in this Cleen case, especially in areas where they coincide with the SHOK evaluation assessment criteria.

While the SRA is clearly important for the whole Cleen activity in terms of setting the overall objectives, it is the programme activity that provides the main lever in achieving the identified goals and targets.

There are currently six programmes being implemented:

1. MMEA (Measurement, Monitoring and Environmental Efficiency Assessment), focusing on issues such as environmental information systems to monitor, evaluate and prove the environmental efficiency of various processes and products; interoperable environmental measurement systems and new online and remote sensing technologies. The estimated volume in research activity for 2010-2013 is 9.4 M€, with share of Public funding being approx. 70%.
2. SGEM (Smart Grids and Energy Markets), focusing on issues such as smart grid architectures and distribution infrastructure, intelligent management and operation, active resources and market integration and new business models. The estimated volume in research activity for 2010-2014 is 12M€, with share of public funding being approx. 75%.
3. CCSP (Carbon Capture and Storage Programme), focusing on issues such as CCS in CHP systems, CCS technology related to multi-fuel and BioCCS, CCS solutions for oil and gas and for iron and steel industry and Acceptability of CCS. The estimated volume in research activity for 2011-2015 being 3 M€, with approx. 75% public funding.
4. FCEP (Future Combustion Engine Power Plant), focusing on issues such as combustion process, energy efficiency of the engine itself and auxiliaries such as heat recovery systems and power conversion technologies, emission control, fuel flexibility and automation and control for optimized power plant usage. The estimated volume in research activity for 2010-2014 is 9.5 M€, with share of public funding being approx. 65%.

26 Source: CEO presentation in the Cleen panel, 10th September 2012.

5. EFEU (Efficient Energy Use), focusing on issues such as methods, tools and technologies to enable step-wise increase in energy efficiency beyond what can be achieved by constant improvement and application of BAT-technologies, and ultimately to move economical and technical efficiency boundaries of process and energy systems through system integration, optimisation and technology development. (Source: Factsheets available at http://www.cleen.fi/en/material_about_cleen_and_research_programs).

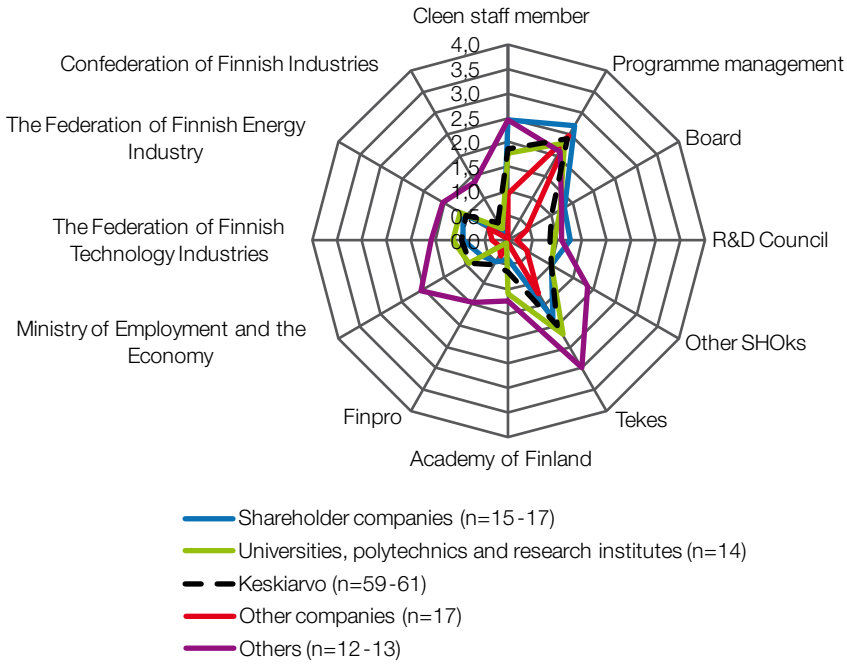
The sixth programme on distributed energy systems (DESY) was at such an early stage of implementation when the evaluation panel met, it was not included in the programmes presented.

Each of the programme networks is a network in its own right, while there is also a meta structure the Cleen network and in fact many of the expectations relating to the novelty of the operational model and strategic focus relate to the management of networks in a way that achieves interaction and dynamic processes across the programmes. These relate to substantive value added of the network, while the governance value added relates more specifically to the strategic renewal, innovation process and strategic leadership.

Some of the key functions that are achieved in the meta structure where a common strategic agenda (SRA) is the first step of value added in network management, followed by more operational benefits and expectations. The window of opportunity in terms of opening up the innovation process and achieving transformative characteristics and content within the network is mainly in the early stages, in the phase of drafting the SRA and getting new input into the programme structure. This is the stage when the innovation ecosystems can be built or renewed and therefore it is seen as significant in terms of the communications and brand management. In our study we have identified the brokerage role as a potential means of strengthening this transformative potential.

The amount and nature of contacts naturally varies. Programmes are central actors also in the network. In a previous study on Cleen network management, they were second in the assessment of cooperation and contacts within the network, only with Tekes was there more contact among the network partners.

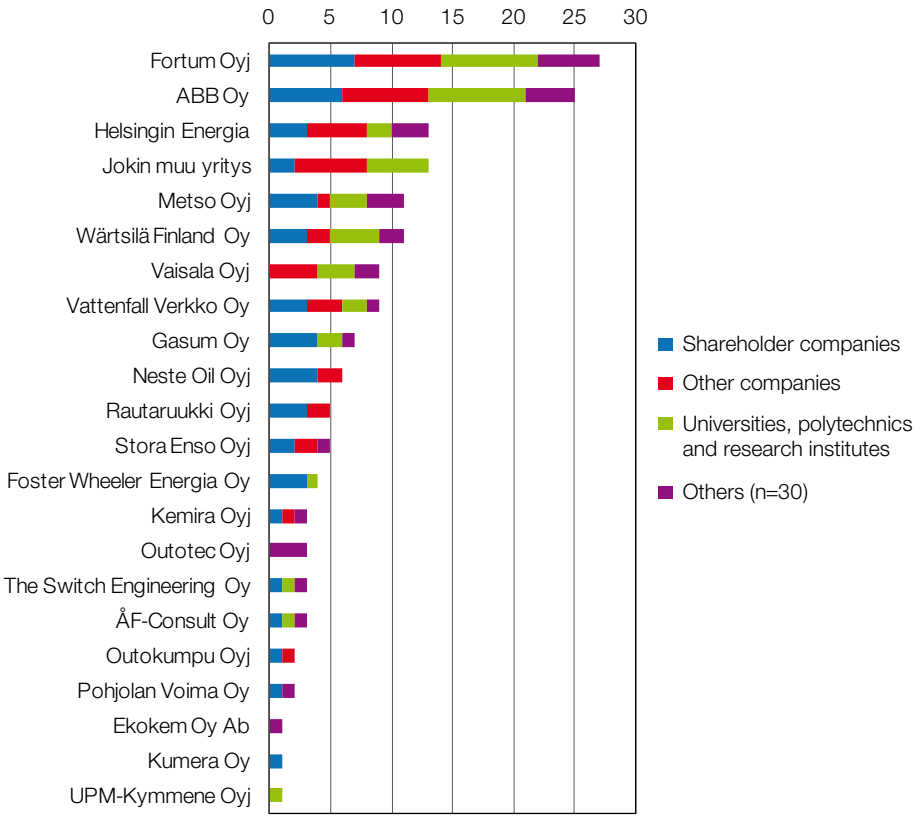
Figure 10. Amount of Cleen cooperation within the network source: ibid[27]



The companies involved in Cleen activity are either involved as shareholders, in programme activity or both. In the network study referred to previously, the centrality of the companies was assessed through the e-survey (independent of the roles of the companies). The analysis revealed that while the largest shareholders do have a key role, other than shareholder companies involved in programme activity also play a highly important role.

27 The survey question here was "how much cooperation do you have with the following Cleen network members? Assess in a scale from 0 to 4, where 0=none and 4) = considerable amount).

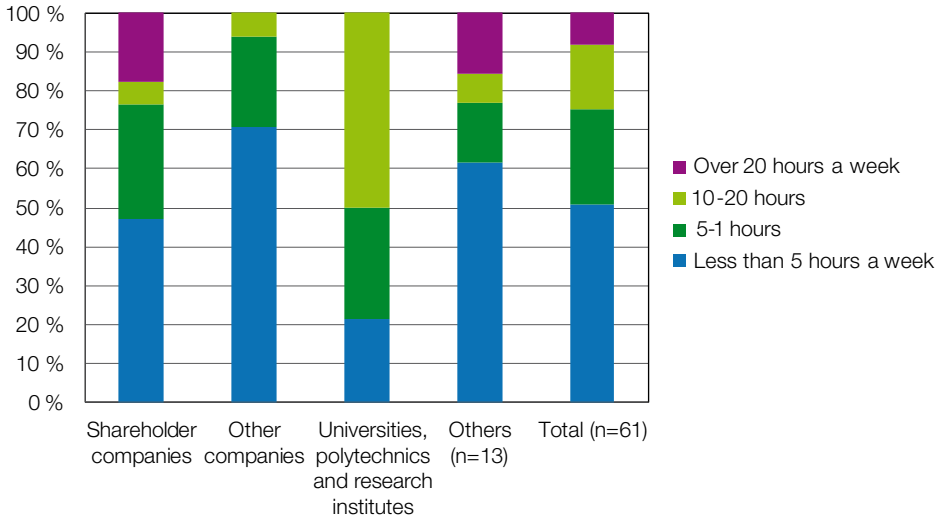
Figure 11. The intensity of cooperation within the core network and partners, source: ibid[28]



Cooperation is naturally not a value in itself, rather it is an instrument in achieving the strategic goals. In the previous network study referred to above, also the concrete forms and the amount of time allocated to Cleen activities were investigated. An interesting picture emerged. The time used for Cleen activities within the network and its partners varied considerably, as is apparent in the figure 12 below.

28 The survey question here was "which of the following are your main cooperation partners in Cleen activity, select 3 most important ones".

Figure 12. The amount of cooperation within the core network and partners, source: ibid[29]

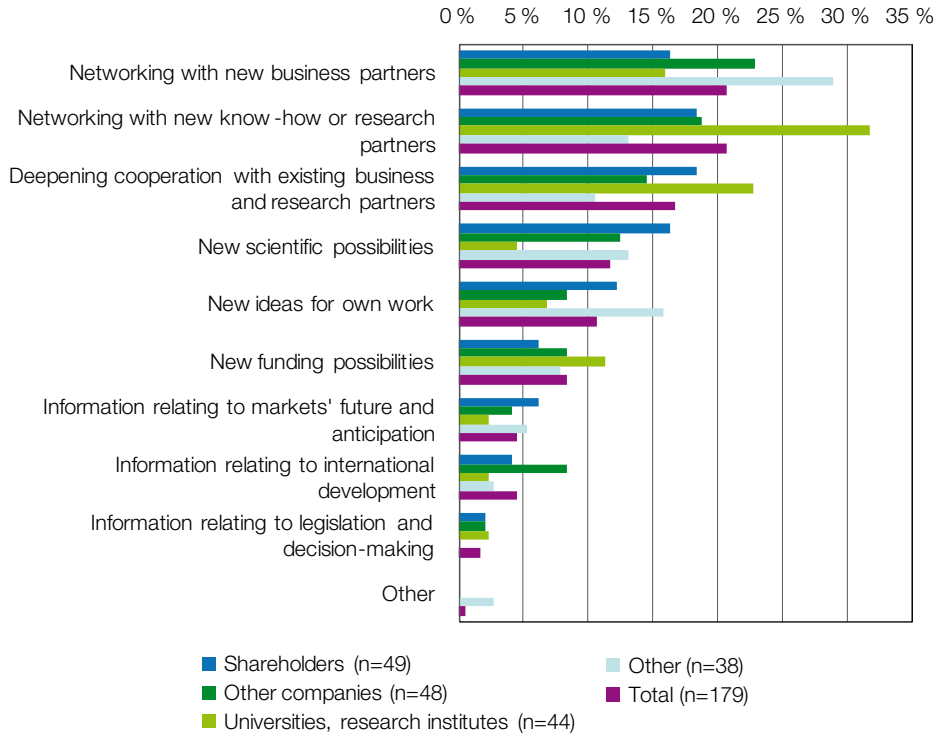


What the different partners are looking for in the SHOK activities is an issue that was extensively investigated in the e-survey undertaken as part of the evaluation. Some aspects were also included in the network study referred to above. In the survey undertaken here during autumn 2012, a picture emerged where for businesses the main value added varied depending on the actors and his or her role in the network. Companies, that are also shareholders (and therefore in the core of Cleen activity), felt that networking with new research partners was most valuable, while non-shareholder businesses tended to value networking with new business partners highest. Universities and research organizations on the other hand valued networking with new research partners highest and were clearly less interested in the business cooperation possibilities that the network provides. It may be interesting thus for the evaluation to assess closer whether this asymmetry still persists, with business looking for more cooperation first and foremost with research partners, while research organizations still are more concentrated on identifying new opportunities in the area of research, rather than business. "Other" respondents / network partners representing the public sector, such as ministries and state authorities look first and foremost for contacts with businesses and new inspiration and ideas for own work. More internationally focused issues such as market information and information on international developments were low on the list of Cleen collaboration interests amongst all respondents. This is an interesting point for comparison also in the evaluation, as the SHOK concepts and perhaps also individual SHOKs have been criticised for the low priority put on international

29 The survey question here was "how much time do you use in Cleen cooperation per week?".

activities and degree of global focus, at least in the public debate. Bearing in mind the high international relevance and global potential of the cleantech sector, it would be highly worrying if this was not a high priority topic all across the activities.

Figure 13. The substance of Cleen cooperation, according to type of respondent, source: ibid30



Against this functional and governance backdrop, we now investigate the tentative findings of the interviews and e-survey of the evaluation.

2.3.3 Relevance

First observation has to relate to the governance, organisation and working practices within the Cleen SHOK. There seems to be an agreement amongst almost all actors that the governance and organization is run professionally, effectively and efficiently. Governance and management runs smoothly and the day-to day operations and overall functioning of the Cleen is supported by a professional staff and management structure. There is a strong commitment, both from the Cleen personnel and the

30 The survey question here was "what do you see as the main benefit of Cleen collaboration today?".

main governance bodies and their representatives, which provides a good starting point for organizing the activities effectively.

The main criticisms from the stakeholders relate to the logic and philosophy of Cleen's activity and strategy: the combination and balance of addressing both research relevance and excellence in equal measure is seen by some of the partners in the Cleen network as an impossible equation. At least in some cases one cannot simply accept the multiplicity of perspectives, i.e. one might have to choose either relevance (industry perspective) or excellence (research organisation's perspective). Some respondents and interviewed persons see that for the time being at least, traditional Tekes funding is more effective and efficient (and "easier to use") for relevance-driven research, while the Academy of Finland funding suits best the interests of excellence. There is however at the same time a perception that Cleen SHOK has not reached its full potential yet and it may be that with some changes it could provide a more suitable instrument. There are also those who perceive the relevance and excellence goals are impossible to reconcile, no matter what the instrument.

There is little to show that Cleen would have influenced the strategies of its partners, be it universities or companies. This is perhaps not a realistic expectation either: companies follow their own strategy, where SHOKs are only one element of implementation and one network (even if an important one) among many. Universities and research organisations on the other hand are clearly even less influenced by the SRA: the participating research groups and units naturally align their strategic focus with main funding sources, but even here is has been proposed by the interviewed persons that only a part of the strategic agenda of the research organisations is aligned with SHOK strategies in general and perhaps also within research organisations most sensitive future topics are developed in more closed research activities rather than the broad collaborative endeavours that Cleen promotes. As has been identified on the level of universities' overall strategies, very few universities have integrated SHOKs at the core of their own strategies (Lappeenranta and Tampere University of Technology and University of Vaasa being notable exceptions in this regard.)

2.3.4 Cleen stakeholder views on Cleen policy goals

There seems to be a natural industry-drive and embeddedness with Cleen that may explain why the usual criticisms associated with research policy instruments seeking to promote industry-driven collaboration in Finland are largely absent. The companies involved in the activities are both committed and deeply involved in the Cleen activity. This does not imply however that the policy goals are embraced without criticism.

The main criticism here is targeted towards the broad approach selected: as is the case with SHOK concept as a whole, also within the Cleen case, the strategy seeks

to encompass all potential areas, rather than focusing on most strategic ones. This may lead to resources been divided too thinly. The goal of promoting internationally high quality research and expertise is seen as valuable by all stakeholders, while the two other objectives of enhancing industrial renewal and targeting the resources to strategically selected clusters are viewed more critical: firstly because industrial renewal goal, as set amongst the overall objectives of the evaluation is more inherent to the businesses and their strategy-setting and secondly because no actual strategic choices have been made, rather all areas are targeted and too broad a strategy has been selected. This very broad strategic focus is also identified as a weakness within the programmes, e.g. the MMEA's scientific advisory board (SAB) and the SHOK evaluation panel identified this as a potential weakness in an area where the Finnish expertise is internationally high in some areas, but not in all the areas that the programme seeks to address. A more selective focus ensuring that choices are made both within companies and research organisations to ensure the high quality and relevance is an often raised wish. The broad focus necessarily implies that the strategy provides little actual guidance or steering. This is a criticism that is targeted both at Cleen and the SHOK concept as a whole.

2.3.5 Relevance of Cleen strategy and SRA

"SRA accurately reflects the industry focus" - Over 80% of respondents share this opinion

The SRA and the process of preparing it have largely been seen as relevant and appropriate. In fact the e-survey shows a very positive assessment from the industry side, with over 90% of Cleen-respondents from firms reporting agreement with the statement that the SRA represents "cutting edge". Significantly over one third of the research orgsanisation respondents disagree with this view. This tension between the industry-driven nature of SHOKs (and Cleen) and the scientific excellence runs through the whole evaluation materials. There are concerns over the breadth of the strategic focus however: are the selected priorities the ones, where Finland has most to give internationally, research is most cutting edge and societal relevance the highest? Doubts have been expressed and the strategic focus has been seen more consensual than actually priority-creating or selective.

There should be choices made, while at the same time bearing in mind that the consensus-driven decision-making and mode of operation may in itself be inherent to the Finnish SHOK model. In this regard Finland is well advised to expert its competence and excellence in triple helix based practice and industry-research interaction, but in order to sharpen the individual SHOK's strategic focus, it may at times need to reconcile this mode of operation with a less consensual one.

For the research organisations in particular, the industrial collaboration of research organizations in Tekes programmes and projects was already well

functioning prior to SHOKs and it is not entirely clear what the value added was that Tekes hoped to achieve. The companies seldom have individuals who could take such a strategic stand. The funding organization should be able to identify and assess the priorities and if necessary, develop them in broader collaborative efforts, e.g. in conjunction with new programs being introduced. It is however seen as highly valuable to maintain the transparency and openness of this process, rather than outsourcing the strategic thinking to SHOK companies and by extension to large companies that act as industrial engines.

The original goals of SHOK concept, promoting internationally high quality research and expertise, enhancing industrial renewal and targeting the resources to strategically selected clusters are still seen as valid, though the nature of the clusters / concentrations of competence has shifted from a (predominately) sector-specific focus to a more comprehensive, horizontal, both cross-sectoral and multi-disciplinary focus. In the case of Cleen this was naturally already the case from early on, as the energy and environment are inherently multi-industrial sectors (currently a reported total of 14 main industrial sectors are present in Cleen activities, source: CTO presentation at the Cleen panel 11th September 2012).[31]

There are however critical views on the other two original SHOK objectives: industrial renewal and scientific excellence.

Industrial renewal is seen as a valid goal and it is even seen as been promoted, if one operationalises this goal in terms of utilizing research results in the industry. In this regard Cleen respondents viewed the results of SHOK activity more positively than average. Here the qualitatively closer and more open collaboration is seen as making a significant difference for the partners involved. The fact that the largest industrial incumbents are quite dominant across the programmes has lead to some concerns that the results are most relevant and available for the already most dominant partners. The counter-argument here is that Cleen has more than average SMEs involved, though these are largely representing the value chains of the largest companies.

Renewal in terms of creating completely new business or spin-offs have been seen as a low priority however, though in the original Science and Technology Policy Council memo setting the SHOK concept (in 2006) it was included as an area in its own right (some of the benchmarking cases had commercialization as a separate function of the Centres). Expectations amongst the Cleen survey respondents are higher than average on issues such as creation of new products and services, as well as international visibility and image and scientific reputation. Lower than average expectations were found in the areas of developing attractive technology and new

31 According to the standard industrial classification (TOL 2008) by Statistics Finland: A Agriculture, forestry and fishing, B Mining and quarrying, C Manufacturing, D Electricity, gas, steam and air conditioning supply, E Water supply; sewerage, waste management and remediation activities, F Construction, G Wholesale and retail trade; repair of motor vehicles and motorcycles, H Transportation and storage, J Information and communication, K Financial and insurance activities, M Professional, scientific and technical activities, O Public administration and defense; compulsory social security, P Education, S Other service activities, According to the standard industrial classification (TOL 2008) by Statistics Finland.

production processes at the firm level. Relatively positive expectations amongst the Cleen respondents were also identified in relation to opening or creating new markets and developing Living Labs and testing facilities with SHOK resources. Expectations in commercialization activities, e.g. patenting were low amongst all SHOK respondents. This expectation was further confirmed by the interviews and panel hearings, were only few examples of patenting or spin-off activity thanks to Cleen were identified, though this was clearly seen as holding potential.

The Cleen research is perceived in a positive light in the network, as indicated for instance by the fact that the Cleen respondents were more positive than average on issues such as access to co-operative R&D, initiation of new contacts (outside the SHOKs), internal selection processes, new partners and ability to meet milestones. Also the interviews reflected the satisfaction with the professional standards and results of the activity. In terms of the outputs and results, the monitoring and reporting system has proven insufficient, i.e. the data gathered and the monitoring materials do not provide the evaluation a clear enough picture of the expected outputs and results and the picture is patchy.

A high level of survey respondents (over 80%) view the SRA as realistic and interesting to all parties. The view is more critical when it comes to international parties or the impact the SRA has in turn had on the company strategies. As reported in relation to the interviewed persons, there may be an issue with the broad nature of the SRA however: approximately half of the company respondents feel that the SRA is too broad and over 80% of the research respondents feel this way. Large share of the respondents agree that the problem may also be the lack of trans-disciplinary focus: the SRA does not facilitate or require crossing of borders and boundaries, or "new multi-disciplinary combinations". This view is shared by both business and research respondents. Approximately 40% of the Cleen company respondents feel that it is impossible to reconcile the interests of the research organizations and companies (agree completely or to some extent), though research organization see this in more positive light (over 80% not agreeing with this statement).

The view on quality of Cleen research is positive, as is the view on the governance mechanisms introduced to improve the scientific quality. The survey thus confirms the positive assessment of those interviewed in this regard.

Over 80% respondents agree that the SRA accurately reflects the industry focus. The perception of Cleen as a credible research partner is quite positive: 50% disagree with the assessment that the SHOK companies are too small to act as credible counter-parts of major companies. This may reflect the number and centrality of small companies in the cleantech field, though the large industry engines have thus far played a key strategic role in Cleen.

The processes of SRA and of assessing programme proposals, as well as later on in the process of the quality and results are considered to be well developed, professional and appropriate. The fact that in the last year the new governance innovation of Science Council was introduced, with an accompanying peer review

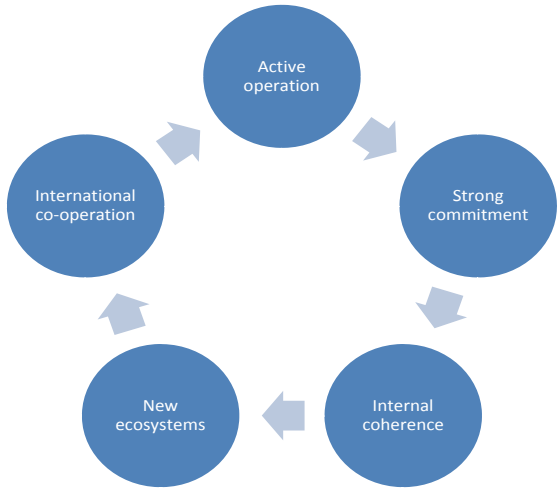
process of all research programmes in the form of Scientific Advisory Boards (SAB) has been warmly welcomed by all. The peer review process took place in September 2012 and the summary reports were made available for the evaluation team, though only in the case of MMEA were they undertaken early enough in the process to be available for the SHOK evaluation panel. Two SAB members were also interviewed as part of the evaluation.

The fact that these international peer reviews are also a means of raising the international profile and reputation of Cleen should not be overlooked either and may also bring new inputs into the strategic process, though this is naturally only a secondary outcome of the process, which has excellence as its main assessment criteria.

2.3.6 Effectiveness: SHOK as a part of Finnish innovation ecosystem

Cleen has reported the following as their main achievements in the period of establishing their activities in 2008–2011:

Figure 14. The process of ensuring results within the Cleen network



First achievement consists of the establishment of a limited company (reg. 16.7. 2008) for SHOK-operations in the fields of energy and environment, with a total shareholders' investment equity of 2540000,00 €. The partnership consists of 28 major global companies which have a significant stake in energy and environment related R&D&I in Finland and a total of 17 most essential Finnish research institutes in this field. There is a clear shareholders' Agreement and a strategic research agenda, which provide guidance and define the focus areas of research activities in an area which is clearly among the major global challenges and opportunities of humankind today.

The governance structure has been established and shareholders have maintained their commitment by resourcing various Cleen's activities annually, including the R&D-Council having 2 full day annual meetings with approximately 50 persons, as well as 4 R&D-council working groups with 5 annual meetings per group, with 10 persons in each group. Board of directors with 9 persons has held seven to nine annual meetings. Science Council of 5 persons has held 5 annual half-day meetings.[32]

Amongst key results for instance: New ecosystems for shared research infra and demonstrations by cross-industrial consortia including SMEs, **SGEM** – Kalasatama smart grid city demonstration, **MMEA** - Coud platform allowing for easy access to environmental real-time data sources, **FCEP** – unique test engine.

Strong commitment to research activities is visible in the amount of financing made available by the shareholders and programme actors. In 2012 this amounted to 20.6 M€ of company funding and an equivalent of 17.8 M€ of research organization resource allocation.

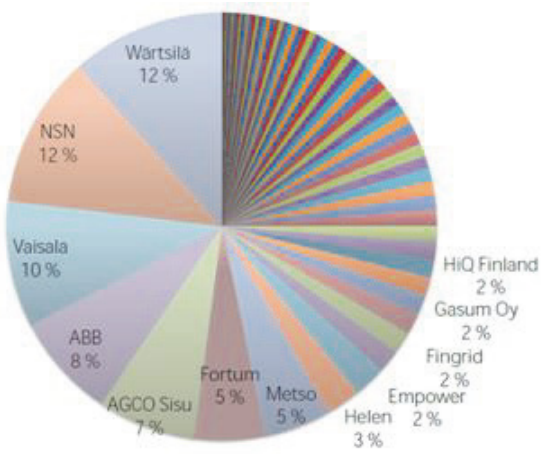
The size of the partnership is significant, with 67 companies (of which 20 SMEs) and 18 Research Institutes being committed to 6 research programmes for 5 years, with a total resource allocation for 2012 for these programmes being 39 M€. The companies that are shareholders are a major asset in themselves, e.g. the total turnover of companies that are shareholders in Cleen being 70 billion (2011). A significant number of hours have been invested in Cleen activities, also on a voluntary basis in preparing the research programmes. The fact that also other than shareholders are free to get involved in programme activities is important, as the "closed club" approach would be poorly explainable in an open innovation and high societal relevance context that the SHOKs provide.

Several world market and technology leaders representing various industries and discipline are involved and the funding allocated provides a significant input into Cleen activities. There have been doubts expressed however whether the degree of multi-disciplinary collaboration is sufficient. The evaluation panel and some of the interviewed persons for instance felt that the multi-disciplinary character was still under-developed and in particular non-engineering sciences, from social sciences and economics to humanities needed to be more activated (e.g. to better involve, closer analyse and better address consumer behavior and economic efficiency and feasibility of various service options).

Annual growth has exceeded in average 50% / year and is limited by Tekes funding allocation (20 M€/2012).

32 Source: Annual report and the CTO evaluation panel presentation of 11th September 2012.

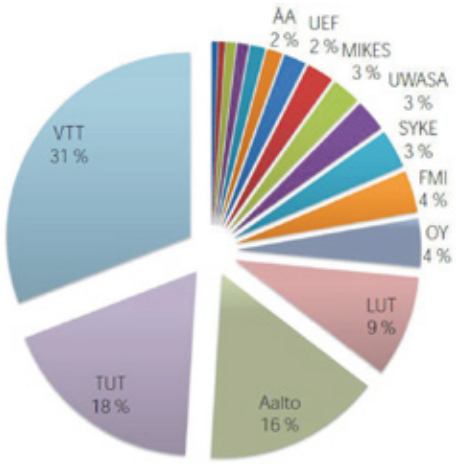
Figure 15. Resource commitment in Cleen research 2012 (total 20.6 Million Eur, companies)



The largest companies have clearly become firmly committed through their resource input in the programmes. The centrality of the largest companies has been at times expressed as a concern, though the Cleen network survey undertaken in winter 2011 also showed that SMEs have a central role in Cleen activities. It is also significant that in the SHOK e-survey, Cleen respondents responded more positively than average on many innovative partnership aspects, such as "satisfaction with initiation of contacts to relevant actors external to SHOK", as well as new partners. In this regard Cleen is not only a "closed cub" for the incumbents, rather it provides a platform for broader collaboration with actors and companies of various kinds.

Below one can see the distribution of financial inputs of the research organizations. Here the picture is more centralized and VTT actually accounts for a third of the resource allocation. The three universities where Cleen activities are particularly significant are Aalto, Tampere University of Technology and Lappeenranta University of Technology. This picture has been confirmed by the interviews, where major differences were identified in the ways in which research organizations and universities prioritise SHOK activities. When considered from the point of view of performance guidance for instance, it has been seen that very few universities place their most strategic research substance within the SHOKs. Only very few universities have placed SHOK activity at the core of their research strategy (the exceptions to this rule seem to be Tampere University of Technology, Lappeenranta University of Technology and University of Vaasa). The interviews have expressed a view that most often universities have become involved in the SHOKs (overall, not only in the case of Cleen), with their second tier of research activities, i.e. not quite the most ambitious and cutting edge.

Figure 16. Resource commitment in Cleen research 2012 (total 17.8 Million Eur, research organisations)



Governance innovation and best practice:
Scientific Advisory Board warmly welcomed

In the interviews, a dual picture emerged. While some were of the opinion that the mere financial commitments and the visible commitment in both the management and the programme activity by the companies are important results and impacts in its own right, others questioned the degree of ambition and excellence of the research undertaken. The fact that the research has been strongly industry-driven has in some cases lead to the scientific level of ambition been compromised. Some of the partners have expressed a view that due to the broad spectrum of activity and the all-encompassing nature of the strategy, resources are too thinly spread. The quality assurance process of the Scientific Advisory Boards (SAB) have been warmly welcomed as a potential way of addressing these limitations. Cleen is one of the leaders in developing these quality assurance processes within the SHOKs.

The Scientific Advisory Boards (SAB) were established to improve the scientific quality of Cleen programme work in 2011 and have had their first meetings in 2011. They are made of three international scientific experts, in most cases one from the Nordic countries and two outside the Nordic area, with the task of providing support at various stages of programme work. The role of the SABs is intended as quality assurance at various stage of programme preparation and implementation, from an ex ante evaluation support to final evaluation (and if deemed necessary in interim stages as well). Questions addressed range from the level of ambition and novelty to suitability of methods and resources, the degree of internationalization and capacities available etc. Evaluative dimensions include multidisciplinarity, international quality and relevance, benchmarking, novelty and value added. (Source: Cleen 2011: Tutkimusohjelmien laadunvarmennus / *Quality assurance of research programmes*.)

Are the expectations of the stakeholders high (enough)? Or are they perhaps even too high? While some of the interviewees criticize the level of ambition (in particular those from the academic community), the survey shows that in a number of dimensions Cleen stakeholders hold higher than average level of expectation (in relation to the value added and effectiveness). Examples of effectiveness dimensions where Cleen stakeholders have higher than average expectations include Development of Living Labs or Improved access to external research infrastructures.

There are very few areas where Cleen respondents' expectations are lower than average. Exceptions include new production processes achieved as a consequence of SHOK activity.

Amongst the ***company stakeholders***, the ***higher than average*** expectations relate to the following aspects of SHOK activity:

- Developing the research capabilities of the firm (similarly to FIBIC)
- Gaining access to external research infrastructures
- Bundling of research infrastructure (testing facilities, labs etc., similar level of expectation to FIMECC and SalWe)

The ***lower than average*** expectations amongst the company respondents of Cleen of our e-survey include:

- Improved international visibility of the firm (both among the firm and research organization respondents)
- Helping the firms to achieve their long-term R&D strategies
- Entering new markets
- Securing or enlarging current markets
- More public research funding
- Improving the scientific reputation of the firm amongst the research community
- Commercialisation and IPR
- Deepening the core competences of the firm
- New product and business innovations
- Development of process innovations

When it comes to perceived results and outputs, Cleen respondents of the e-survey were more positive than average in the following dimensions:

- Increase of visibility and reputation of the firm as a competent partner in R&D
- Increase of scientific reputation due to academic publications of SHOK activity
- Overall technological competitiveness

Similarly to the other SHOKs, Cleen stakeholders do not hold expectations of new venture capital emerging through SHOK activity and the perceived outcome in terms of patents and spin-offs were low across the board. Similarly negative perception and experience is reported on recruitment, especially international recruitment. The SRA is viewed more critically by the research respondents, with nearly half of them feeling that the SRA is unable to make Finnish cleantech and Cleen collaboration more attractive to international partners. Here SHOK activity should certainly look for new tools and ways of working.

Built Environment SHOK (RYM), Health and Wellbeing SHOK (SalWe) and Cleen share some commonalities, such as their more than average positive perception of SHOK results in the area of prototypes, demonstration activities and piloting. Similarly to SalWe, also Cleen respondents felt that there had been positive impact on increased collaboration between companies in Finland around SHOK activity. Similarly to most SHOKs, also Cleen respondents did not report equally positive impact in collaboration with international firms however.

Importantly, Cleen respondents report a higher than average impact on R&D investments in the companies, linked to SHOK activity. Also in the development of Living labs Cleen respondents report positively. The research respondents report an increase in scientific excellence (in the form of scientific conferences and publications). Most academic respondents report an increase in scientific quality in terms of peer reviewed publications and thesis / papers related to SHOK topics, but are less optimistic about the new areas or research or trans-disciplinary openings. The views of survey respondents are quite similar for the Cleen, SalWe and FIMECC respondents in this regard. Here the survey respondents seem to be more positive than the panel and interviewed persons, though this may be explainable by the fact that those that are involved in Cleen activity are largely happy, but there is important untapped potential in the academic community outside the current Cleen network. Importantly, Cleen respondents from research are more positive that average on spin-offs and new businesses.

When the Cleen stakeholders are interviewed, the industry-driven nature soon becomes evident. Many interviewed persons are however skeptical about the value added in terms of excellence for the research community, especially universities. The SHOK instrument is perceived to be less transparent and administratively more demanding than other national funding instruments. Due to the large consortia agreements prioritized in the Cleen collaboration, researchers opt for easier funding sources (Tekes programmes for instance or in the case of basic research Academy of Finland instruments). It seems unjustified that the SHOK instruments should be more demanding than normal Tekes collaboration. The European collaboration is generally seen as administratively more demanding or with a particularly high administrative burden and in this regard the SHOK activity could have a value added as an attractive form of collaboration, with a light bureaucratic burden. Yet the SHOK activity clearly should be able to provide the necessary guarantees and quality criteria required for the most ambitious and cutting edge research initiatives to be pursued. Today this is not necessarily the case, from the point of view of research organizations participating in the Cleen activities.

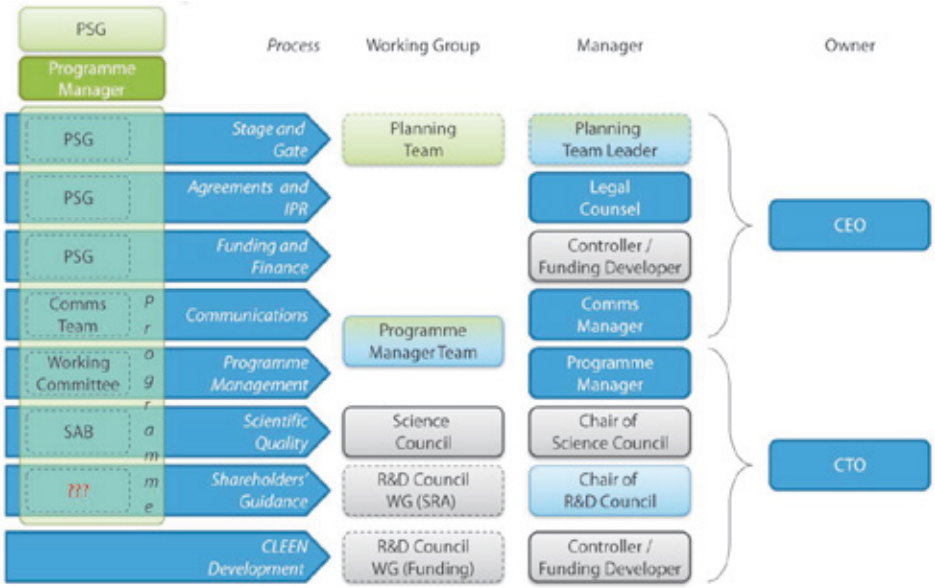
2.3.7 Practical R&D&I work in Cleen programmes

There is a prevailing view among the stakeholders interviewed and surveyed during the evaluation that the practical running of the programmes, as well as Cleen is professional and of high standard.

Cleen programme structures and programme management

The organisational model of Cleen is described as an important part of the whole concept. All partners participate in the planning on equal footing. This way the industry will set the needs and goals of the research (driven by "relevance"). The academia and research institutes will have the main role in providing an important part of the resources, facilities and researchers (driven by "excellence"). There are in total 45 shareholders. All types of partners can have a say in the planning of the programmes. A research programme that is mutually agreed upon will help to determine the developmental path for research infrastructure in the field. This is expected to ease the process of planning the international side of cooperation.

Figure 17. Cleen programme structures and programme management



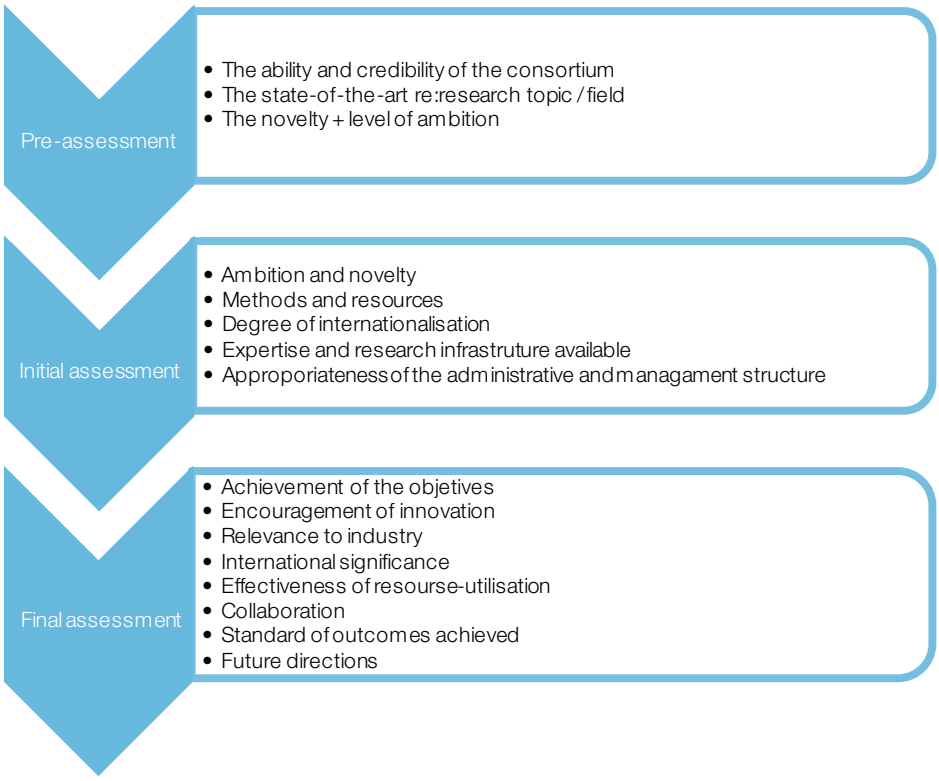
The formulation of programmes involves a process where both relevance and excellence are strived. In order to ensure the fit between the relevance and excellence criteria, the organs described above are involved in the formulation of the SRA and subsequently of programmes. The shareholders are always in the driving seat in the initial stages, with control over the SRA and decision to launch a new programme. Within a research consortium everyone is equal (shareholders and non-shareholders alike), with all consortium members having the right to use the results achieved and with the results being public in principle.

The bodies described in the figure above each have their role in drafting and updating the Strategic Research Agenda (SRA). The objective of the R&D Council is also to initiate discussions of new research programmes and to follow up the realisation of the SRA by giving feedback on ongoing research projects. In identifying

new areas for programme activity and research, thematic working groups are also used to ensure strategic accuracy, relevance and excellence (including for instance in 2010–2011 themes such as Business Objectives, National Goals, Quality and Scientific Excellence, as well as more method-oriented Cleen Policies and Procedures).

Each programme has a small appointed body for the assessment of quality and scientific excellence, i.e. Scientific Advisory Board (SAB). The role of the SAB remains advisory and supportive: the experts in the SABs assists Cleen management in order to ensure that the SAB candidates proposed by programme PSGs are independent and scientifically recognised, acts as an observer member and supports at the SAB meetings, draws executive conclusions of SABs' findings and refines them to concrete proposals for Cleen and PSGs to enhance the scientific excellence. Science Council on the other hand makes a pre-assessment of the research programmes in their early preparation phase. While the Science Council makes the initial assessment, next assessment stage in undertaken by the SAB, who also takes the final assessment. The functions of the SAB in the various stages of programme preparation and implementation are summarized in the figure below.[33]

Figure 18. The programme preparatory process, assessment steps



33 Source: Internal evaluation of Cleen programmes, memo of 10th November 2011.

No one quality assurance body can ensure that all aspects are developed to a sufficient degree, as important a role as they may have. The quality of monitoring and evaluation data is also significant in this regard. The evaluation panel organized in conjunction with the SHOK evaluation for instance could only provide a partial assessment of the programme value added, due to data gaps and concerns were raised whether this may also be the problem in SAB work. The picture on programme activities is still too fragmented to provide a complete analysis and the evaluation panel work did not provide a sufficiently deep and detailed picture of the activities, in particular in terms of the results and effects.

2.3.8 Cleen governance model

The governance model is seen by all the interviewed persons and experts involved in the SHOK evaluation panel as professional, inclusive and effective. The recent initiatives such as the Scientific Advisory Boards per programme have been welcomed by most stakeholders. Most of the criticism is targeted at the funding organizations, in particular Tekes, who in some cases has been unclear and ambivalent in its guidance and positions taken. This has lead to some disappointments in the programme preparation, which are deeply felt by the Cleen stakeholders. This was also reflected in the survey, where Cleen respondents were more critical than average on time spent on processing proposals and of the selection process.

2.3.9 Utility and sustainability

Among the topics where value added is emerging through Cleen activity is its industrial embeddedness. This is also the point where most disagreement emerges amongst the Cleen stakeholders. Most tend to agree that the impacts on society and making Finland more attractive as research environment are too early to judge. Some of the perceptions on the results and potential impacts have been tentatively explored in the e-survey and were reported above in the section on effectiveness.

Almost everyone we have spoken to agrees that more needs to be done in the area of internationalization, both in terms of SHOKs becoming more active in international consortia and in terms of launching collaborative activities abroad. Another dimension of internationalization, which is still very under-developed is the promotion of attractiveness of the Finnish research environments. Some of the interviewed persons called for more activity to attract the young talent to Finland and to SHOK activity. Research schools, internships, industrial PhD programmes were mentioned amongst the initiatives of potential relevance, which should be investigated more closely.

In the internationalisation area, Cleen cooperation in China is welcomed by the interviewees as an important step in two regards: both as an example of cross-SHOK cooperation, which is still largely missing or weakly developed on the level of the

research (FIBIC and Cleen research programme collaboration in the bio energy sector provides another exception to this) and in terms of the weak international dimension of SHOK, which needs to be considerably strengthened. While the consortia have been very broad, they should perhaps be broadened in a more selective fashion, ensuring that gaps of potential significance are filled and cross-disciplinary and international coverage ensured. This could be done similarly to using the number of industrial sectors involved as an indicator (e.g. number of relevant, previously missing academic disciplines covered, countries of significance for the research area in question included etc.)

The sustainability of the results and outputs need to be investigated more fully. The interviewed persons and those that responded the e-survey tend to be of the opinion that the choices made have not been enough and there should be a higher level of ambition and a sharper focus, rather than the broad focus of the current SRA.

2.3.10 Conclusions and implications for the future

The positive effects of the Cleen activity relate to the qualitatively more advanced and committed collaboration between the industries and the academia. The industry-driven nature of the SRA and programme activity has lead to a situation however where relevance is more important than excellence and where too broad an agenda is pursued. There needs to be more clear and exclusive choices made in relation to which topics and themes are pursued both in terms of programme choices and in terms of activities and Working Packages within the programmes.

The interviews, panel and survey all see the management as both lean and professional. While the governance structure has improved over time and the quality assurance mechanisms in particular are warmly welcomed by the stakeholders and by those who are concerned about the quality aspects of the SHOK methodology, there is still a view that too few choices are made in terms of what topics and themes are not included in the SRA. A central criteria in making these choices is quality and excellence, but importantly also (and indirectly connected to the excellence criteria) the Finnish competitiveness: the SHOKs are intended to concentrate resources in the absolute most critical themes of Finnish research. Within Cleen programmes there are clearly such topics, but not all, or perhaps even majority of themes are of such critical significance. The use of external experts (such as SAB) is welcomed in this regard, but also the Finnish public sector stakeholders could be integrated into the governance and steering structures to ensure that the end user perspective is well integrated and the latest policy developments are also closely integrated into the agenda-setting in the future.

There is still insufficient evidence on the results and effectiveness. This may be more a function of the poor standard and insufficient level of monitoring and assessment, but it is nonetheless an issue to be addressed, both within Cleen level and in particular on SHOK governance level as a whole. The fact that the societal effects in an area such as environment and energy are of critical significance for

processes such as Europe 2020 and more importantly for sustainable development as a whole, the monitoring and indicator work needs to address also final (in many cases indirect) societal effects. This relates to energy efficiency, costs savings etc. This could be the role of the national funding agencies or SHOK steering group in the overall monitoring system.

The industry-driven nature of the Cleen activity has been welcomed in the business community, though is seen considerably more critically amongst the research community. The shareholders are very committed to the Cleen activity and perceive it in very positive light. The value added of Cleen activity thus far has been related to a longer-term commitment of the industry, but at the expense of commitment of the academic community. For the research community the value added of SHOK as compared to Academy of Finland or previous Tekes programmes remains by and large unclear.

There are indications that a broader collaboration has enabled the integration of new partners, but there still remains room for improvement for making strategic choices which types of networks and partners should be involved.

The noticeable absence of the societal actors (government on local and national level, as well as third sector) as problem-owners has been pointed out by the external evaluation panel, who expressed a concern over the lack of public sector presence amongst the problem-owners and key stakeholders. Through-out their assessment exercise there they felt there was a notable absence of clearly stated societal targets and explanations of how these are worked towards (i.e. what the research does in terms of the emission reductions, energy security, affordability, international competitiveness etc.) It would perhaps be most suitable indicator for the national level agencies to monitor, as part of the overall SHOK monitoring (the societal targets set in collaboration between Tekes and MEE, as well as Academy of Finland and Ministry of Education and Culture for instance). This might also help to address the perceived lack of (national level) ownership of the SHOK concept. Another stakeholder group that could be better integrated into the Cleen activities are the consumer groups.

Cleen's own standards for quality and value added are compatible with the overall SHOK standards: global demand rather than local supply, transparency and credibility of R&D&I practices, commitment to cross-industrial and multi-disciplinary value added, as well as clear roles and responsibilities in the governance structure are all relevant for the SHOK concept as a whole. The evaluation analysis thus far provides us with only a partial answer to whether these criteria have been met however. Some of the Cleen principles (e.g. shareholders defining the thematic focus) need to be qualified further (in order to ensure that choices and made and priorities set, rather than integrated everyone's wishes into the SRA and programme agendas).[34]

34 Here the issue of smart monitoring and selecting the most appropriate indicators could be addressed.

The fact that the SHOKs are still in relatively early stages of development is raised by many in the data gathering stages (2009 onwards). The first years have been a kind of learning process and much has been achieved in terms of organizing the partnership, creating processes of governance, management and programme implementation. Quality assurance processes have improved recently and this suggests potential improvements in areas where more attention is required. The level of ambition and sharper focus are sometimes called for.

On the most basic level the question of value added can be posed as a question of what would be missing from the innovation system and what research would not find funding if it was not for the SHOK instrument or Cleen as the coordinating function of the research network. In most cases the answer remains that most of the activities would still take place, though with different sources funding and in different partnerships. The qualitative leap to global leadership and excellence still remains to be attained in this regard. This may not be surprising considering the short period of implementation, but it does raise the question of what needs to be done and by whom in order to ensure that the potential lying in Cleen and SHOK activity is not lost.

Governance innovations such as the Science Council and the programme-specific Scientific Advisory Boards, with the peer review that they entail have been welcomed. The work of the Cleen management with the network governance is appreciated by the stakeholders.

The most critical objective for the respondents of the survey and the interviewed persons was the "internationally high quality research". The current SHOK structure and incentives seem unable to sufficiently support this goal, due to the strong industry-driven nature of the SHOK concept. Many of the interviewed persons felt that it may be unjustified to expect the industrial partners to put the scientific quality first: industrial relevance is always first on their agenda, rather the concern with "good enough scientific quality" criteria than with "excellence" criteria. The programme preparation process is unable to meet this level of ambition and as the programmes are prepared in broad consortia with the main industrial partners in a central role, they do set the tone for the preparation. If scientific quality is to come first, the process should be modified accordingly and more genuinely open calls with a bottom-up approach should be introduced. This however would bring the programmes closer to the other programmes already in operation, both Tekes and Academy of Finland and then the question of value added would need to be posed. It seems that more open competition is required to strengthen the quality aspects in any case. Another means of strengthening the quality and the credibility is the quality assurance and peer review process, which has been strengthened with the introduction of Scientific Advisory Boards by Cleen for programmes implemented.

The balance between industry relevance and scientific excellence is seen as a clear improvement and the industry-driven nature of the research agenda has been strengthened. There are still those who see the two perspectives as irreconcilable and in this regard Cleen does propose a major change in thinking, innovation system and

culture. If excellence is amongst the main criteria, it needs to be taken seriously. As argued already, this is now under way through the Science Council and the peer review system. There are more deeply embedded problems in the debate on science vs. industry or applied vs. basic research however that equally requires closer attention. If both parties are expected to remain equally committed, both parties' concerns need to be addressed.

Issues that should be addressed more actively include internationalization, cross-SHOK collaboration (with potential for cross- and trans-disciplinary openings and interfaces) and the cultural shift that is expected from the industry and academia in order to work in a open innovation mode.

Also the role of the SMEs in Cleen activity was raised by some of the interviewees, though on the other hand there seem to be a fair number SMEs involved in the concrete programme collaboration.

Research infrastructures and testing and piloting facilities are also an area where considerable untapped potential seems to lie, not least in the challenging areas where the potential interfaces between industries and disciplines could be fully explored, notwithstanding the fact that Cleen has been more active in this area than many other SHOKs have thus far been. This is also an area where closer collaborative efforts between the SHOKs should be introduced.

Strengths	**Weaknesses**
Scientific Advisory Boards as an instrument of Quality Assurance and peer review Process of renewing the SRA and programmes Broad shareholdership and partnerships in the programmes International interest and a selected strategic spearhead in the Finnish RDI policy	Perception of relative closeness of the "club" Lack of flexibility in transferring resources within SHOK, e.g. between programmes In the "stage and Gate"-process, external scientific expertise has in the early stages used too late in the process As with other SHOKs, simple and user-friendly system of on-going monitoring and clear criteria from the funding organisation missing (smart metrics and internal reviews to be developed)
Opportunities	**Threats**
Incentives for patenting and creating new business International visibility (though activities exist, they are not developed systematically enough) SRA (from a broad "big-army strategy" to a more focussed "guerilla strategy"), focussing more sharply on what is the "uniquely Finnish value added" Interdisciplinary work in the programmes Involvement of government stakeholders as "problem owners" Role and functions of the Cleen personnel should be clarified as the funding expands The depth and focus should be improved and the breadth of the corporate process reduced. More visible linkages between the SRA and programmes created. Doctoral prgorammes (industrial) Ensuring entry and incubation of new research groups and new companies Competence / competition review (how does the current programme / project activity relate to the global cutting-edge, best competitors etc.) Internal review	Too lean a management model Over-reliance on Tekes funding Insufficient cross- and interdisciplinary capacity Internationalisation potential missed

2.4 Finnish Bioeconomy Cluster FIBIC

2.4.1 Forestcluster Ltd history and cluster characteristics

Forestcluster Ltd (FIBIC from 07/2012) is the SHOK of the Finnish forest industry cluster. It was founded in 2007 as the first SHOK with the idea of renewing the forest cluster by new forms of networking and boosting high quality research and innovation.

Forest industry and its value chains have traditionally been one of the pillars of Finnish industry. The Finnish forest cluster has a leading position in the global market. Its share of Finnish GDP is around 10 percent, it accounts for 30 percent of industrial production and its share of total exports is as much as 30 percent.

The cluster´s R&D investments amount to about EUR 350–400 million in Finland annually. As can be seen from the figures in chapter 1, Forestcluster Ltd is among the smallest SHOKs in terms of funding and participating businesses.

Unlike in the fields of many other SHOKs, in forest industry the cluster and its value chains have existed a long time, key players are multinational companies, research infrastructures and professorships exist, research traditions are strong (but traditionally rather efficiency related R&D topics due to the fierce competition in the traditional forest industry markets than far sighted basic research) and research funding considerable. In this sense, the role of the SHOK is fundamentally different compared to e.g. RYM or TIVIT: whereas these SHOKs even have to struggle with cluster formation and research infrastructure creation, the key challenges in forest industry are related to the profitability of the existing industry and secondly to the renewal of the forest sector, business reorientation and consequently research reorientation. In practice, this means learning away from the past: new networks and breaking traditional ways of working.

Preparations for founding Forestcluster Ltd took place during 2006-2007. Based on preliminary reports, a high-level working group with representatives from the Forest industries federation, the forest industry, Tekes, Academy of Finland and State research centre VTT formed a consensus on the founding and transferred the preliminary results to the companies who then founded the SHOK. In the beginning there were only four shareholder universities, and deep debates on whether a university can be a partner in such a company were carried out. Despite rather fundamental practical problems in coordinating university habits and company policies it soon turned out that the arrangement works. Later on in late 2009, when Metso acquired Tamfelt, Tamfelt's share in Forestcluster Ltd was sold to four more universities.

At the time of establishing Forestcluster Ltd, there was a crucial challenge in the Finnish pulp and paper industry research. The research at the Finnish Pulp and Paper Research Institute, KCL, a central Finnish pulp and paper research facility, owned by the forest industry companies was considered insufficient with respect

to the need for renewal. Founding Forestcluster Ltd and redirecting the majority of the joint research work through it was seen as a good solution. In the beginning, much of the Forestcluster Ltd research work was performed by KCL. When KCL was acquired by VTT Technical Research Centre of Finland, VTT became a major player in this research area. In this sense, the founding of Forestcluster Ltd was seen as a near perfect solution to multiple already identified structural problems in the field of forest cluster research.

2.4.2 FIBIC organization

FIBIC is a privately owned non-profit limited company, as all SHOKs. It is owned by a group of Finnish key companies (five pulp and paper producers, two equipment suppliers and one chemical supplier), VTT Technical Research Centre of Finland, the Finnish Forest Research Institute (Metla), and eight universities. Altogether, the SHOK has 19 shareholders, which is a lot less than e.g. RYM with its 52 shareholders. It should be noted that wood product industry is not present in the SHOK. This is partly due to rather different actors, value chains, customers and processes outside FIBIC's mandate.

FIBIC itself has four employees: CEO, research director, senior advisor, communications manager and a common legal counsel of all the SHOKs. The board of the SHOK consists of 7 members each with a personal deputy member. The SHOK has a research committee whose task is to prepare research programme proposals with the FIBIC personnel for the board that makes decisions at pre-defined "gates" on whether programme initiative or plan is accepted into FIBIC programme portfolio.

For new programme activities, Research Committee appoints in the first meeting each year a working group to plan and develop them. The programme initiatives are collected into a database created in the FIBIC's portal. The management of FIBIC will, based on the proposals in the database, select and propose 2-3 programme initiatives for the Board. The Board selects 1-2 programme initiatives for further processing, taking into account the overall programme portfolio, strategic needs and funding opportunities. Decisions are normally made once a year. However, if an important programme initiative is proposed by a group of shareholders, decisions can be made also at other times. The actual preparation of a research programme is initiated after the board's decision.

A research programme is led by a Management Group. The research is done in work packages. The members in the Management Group include one representative from each of the industrial partners, scientific coordinator, a representative from Tekes, SHOK's Research Director, the programme manager, and the WP coordinators. The programme manager acts as the executive leader of the program. He or she is supported by research director and coordinators, which will form the programme core group. Communications manager supports in all communications related matters.

The responsibilities of the Management Group are:

- To confirm the objectives of the programme
- To follow up and evaluate the progress of the programme
- To report to the Research Committee
- To steer and re-direct the research
- To improve the working methods
- To approve publication permissions and plan other PR related matters
- To identify gaps and, if necessary, bring these to the attention of the Research Committee and the Board.

The Management Group will assess both the scientific progress and techno-economical feasibility of projects regularly in its meetings. The most important evaluation criteria are:

- Progress made in comparison to the objectives set in the national forest cluster research strategy and programme plan
- Value creation potential of obtained and detected opportunities
- Opportunities to strengthen environmental sustainability
- Improved knowledge and competence of participating research groups
- The possible risk factors detected and avoided during the progress of the programme
- Media visibility, participations in seminars and conferences
- Generation of IPR
- Reports and publications.

Each programme is assessed according to the criteria established by the Research Committee in a mid-term evaluation and final evaluation. The criteria are as follows:

- Strategic potential
- Value creation potential
- Scientific challenges
- Implementation potential
- Bioeconomy potential.

The same criteria will be used in all programs and these will be combined to a portfolio assessment with the target to understand whether the decided programs will contribute to the overall strategic targets stated in the FIBIC research agenda.

2.4.3 The national research agenda (NRA)

The industry led Finnish forest cluster National Research Agenda was published in 2006 as a Finnish application of research agenda of the European Forest Sector Technology Platform. The aim was to support the renewal of the forest industry by offering suitable topics for research that could yield results also rapidly for the unique Finnish forest cluster which comprises the forest industry, strong equipment industry and chemical industry supported by research institutes and universities.

The goals of the NRA were

- to double the forest cluster production by 2030
- to double the cluster's R&D
- to increase the use of domestic wood by one-fourth.

Research priorities of the first NRA were

1. Smart wood and fiber products
2. new products made from wood based materials
3. Forest products biorefinery
4. Sustainable forest management
5. Increased value for wood biomass
6. Intelligent, resource efficient production technologies
7. Customer solutions for the future.

The NRA was updated in 2010. Once the work had been started with an NRA facilitating good kick start, the update was more focused on challenges from the companies, which in turn meant a shift in research contents.

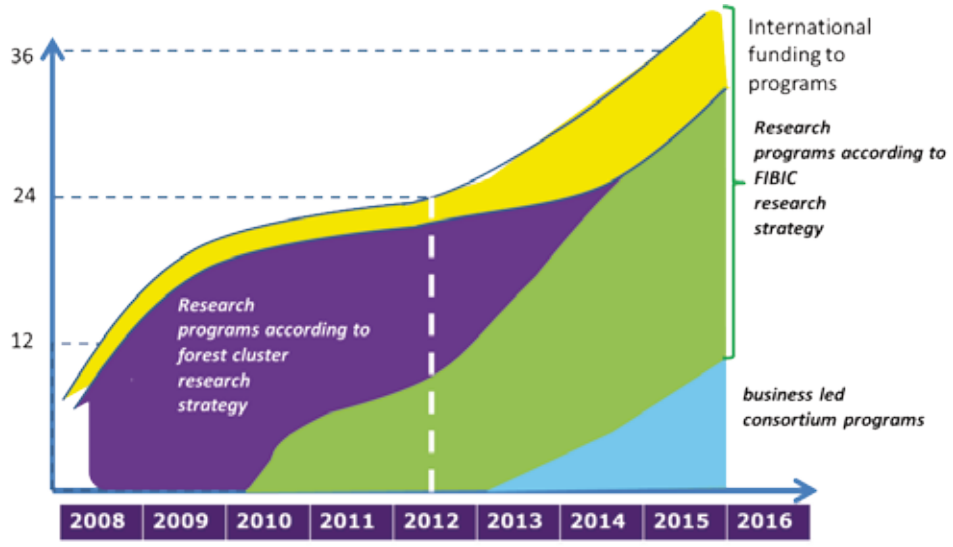
The SHOK concept fitted extremely well into the realization of the NRA and Forestcluster Ltd was selected and formed as one of the main implementer of the NRA. The main focus areas, Efficient Technologies, Future Biorefinery and Customer Solutions were selected by the Forestcluster Ltd Board from the start as the focus areas for implementation. These research topics were the corner stones of the Forestcluster Ltd SRA.

After a successful start the SHOK research management had more time to coordinate the contents to steer the research. Essentially the goals were the same as earlier, but rapid changes in the operating environment required that focal points were examined and the strategy be reformed. Another goal was to establish a successful, constantly growing forest cluster in Finland with attractive world class quality products. The focal points of forest cluster research were as follows:

- Customer and user as the drivers of development (focusing on housing, packaging, and media)
- Possibilities offered by new materials, services and business models
- The forest cluster as a builder of a sustainable bioeconomy (focusing on bioenergy, biorefinery operating models and sustainable development methods)

In 2012, Forestcluster Ltd changed its name into Finnish Bioeconomy Cluster FIBIC. The research agenda is at the moment essentially the same, but it is evident that the focus will be moved to bioeconomy in the next revision of the SRA. Future developments of FIBIC are clear. In the most recent strategy update, increase in research volume is sought through new partners, research portfolio is gradually updated to match the FIBIC mission, and the volumes of business led consortium programmes are increased significantly. This development is depicted in figure 19.

Figure 19. Near future planned developments of FIBIC (Source:FIBIC).



2.4.4 Current and planned programmes

FIBIC implements the research strategy by designing and launching programmes in different areas based on the plan approved by its owners.

The first programmes formed on the basis of the 2006 SRA of Forestcluster Ltd were

- **Efftech**: Resource- and energy-efficient technologies
- **FuBio**: Future biorefinery
- **FoCUs**: Customer solutions for the future.

EffTech was the first research programme of Forestcluster Ltd. Its aim was to improve the competitiveness of the cluster as a whole by developing radically new energy and resource-efficient production technologies and by finding means to reduce the capital intensity of the cluster. New technologies and solutions are developed to mitigate climate change and reduce the costs of emission trading, and thus promotes sustainable development. Also ensuring the availability of wood in a sustainable way and improving the profitability of the forest industry is in the focus of the programme.

The objective of Future Biorefinery – **Fubio** – the second research programme of Forestcluster Ltd, was to develop new methods enabling fractionation of wood into cellulose, hemicelluloses, lignin and extractives in their native-like form and further, to upgrade these fractions into chemicals and materials. The structure of the programme was designed to match the new value chains also to current pulp mills as well as to emerging biorefineries producing transport biofuels as a by-product. The programme consisted of six themes. The key deliverables of the programme were new knowledge and competences (general and IPR) in respect to the utilization

of different wood and fiber-based raw materials as basis for completely new value chains.

When the EffTech programme ended, certain themes were continued in another two programmes; EffNet (Efficient Networking Towards Novel Products and Processes) and EffFibre (Value Through Intensive and Efficient Fibre supply). Decision to split the programmes into two separate entities was done to sharpen the focus of work and to be able to add new participants in a flexible manner.

The **EffNet programme** focuses on developing radically new energy and resource efficient web production technologies and on reengineering the product concept of fiber based products with nanocellulose. The target is to develop and demonstrate new types of products, which can be produced from wood based fiber materials and can be included in the product portfolios offered by forest cluster companies. Special attention will be paid to the specific energy and raw material consumption and to the sustainability of processes and products. Work packages of EffNet are

- WP1 – Efficient production technologies for new furnishes
- WP2 – Expanded properties for paper and board products
- WP3 – Fiber-based products for new applications
- WP4 – Sustainability and feasibility assessment
- WP5 – Production system concepts management
- WP6 – Novel web production modules with new components, materials and processing methods
- WP7 – Management of web uniformity based on imaging measurements
- WP8 – Expanded operating window for heat set web-offset printing process enabling efficient use of newly engineered fiber-web substrates
- WP9 – Optimizing structures and operation of entire production systems
- WP10 – Pilot and full-scale demonstrations of production system concepts.

The goals of the EffFibre programme are to increase availability and supply of high quality sustainable cost efficient raw material from Finnish forests, to improve the competitiveness on the forest cluster by developing energy and resource efficient production technologies and by finding ways to reduce the capital intensity the cluster. EffFibre programme focuses on competitiveness and quality aspects of forest based raw materials and on development of radically new energy and resource efficient production technologies for chemical pulping and biorefining. The work packages of the programme are

- WP1 – Functional Genomics of Wood Formation
- WP2 – Potential and feasibility of intensive wood and biomass production
- WP3 – Operational efficiency of intensified wood production and supply
- WP4 – Novel two-stage Kraft oxygen-alkali process
- WP5 – Virtual chemical pulping model
- WP6 – Future pulp mill development.

FuBio's descendants are FuBio Joint Research 2 and FuBio Cellulose (FuBio Products from Dissolved Cellulose).

FuBio Joint Research 2 focuses on R&D on biomass based materials, studies lignin and fiber usage as structural materials, and researches the development of wood based chemicals. Also possibilities to produce functional food ingredients are studied.

FuBio Cellulose focuses on promoting the use of wood cellulose in novel product areas. The programme has three goals: to develop sustainable process to produce cellulose staple fibers, to develop new product platforms for regenerated cellulose and to develop novel processes to produce cellulose based water chemicals by developing novel synthesis routes for mainly cationic cellulose derivatives.

Focus is an umbrella of programmes aiming at marketing and business model innovations. programme is smaller than the two other programme families. Whereas the Eff programme family focuses on incremental innovations and FuBio family to disruptive innovations, Focus aims at combining technological and business research and development. The Focus umbrella is smaller than the other two programme families.

The most important programme under Focus was **RAMI – Radical Market Innovations**. It aimed at producing radical innovations outside the forest cluster's current core business to find new and different business, open innovation and to look behind the current industry definition. Objectives of the programme have been to produce new business ideas and concrete commercializable development projects. Other aims were to describe commercialization capabilities, widen the innovation networks and commit and educate key persons. The programme has had projects dealing with capabilities, practices, value network and customer processes.

RAMI programme was followed by the preparation of a programme called "Radical Service Innovations". However, the programme was declined after a preparation of one year.

Currently there is a programme "**Innovative Bioenergy Solutions of Tomorrow**" under preparation. The programme is a joint effort with Cleen, and quite unique as such. The programme is to focus on bioenergy related scientific and technological challenges and business opportunities for the Finnish industry. Currently the drafted work packages are

- WP1 - Increased and deeper understanding of the global and local business environment: a scenario summary to start the programme
- WP 2 - Radical improvement of bioenergy supply chains: New sources as algae, different energy crops, and synthetic biomass are developed to fulfill the increasing demand of bioenergy raw material sources.
- WP 3 - Advanced integrated concepts and new markets: Bioenergy in decentralized and urban environments –"smart heat".
- WP 4 - Enhanced business opportunities through securing sustainability: Practical sustainability assessments and applications are integrated in working packages 2 and 3.

Another programme under preparation is related to **packaging industry**. The aim is to establish a new way of working together as a packaging value chain in order to benefit from the global growth. There will probably be a demonstration lab for bringing together the whole value chain, consisting of materials, design, business concepts and consumer research.

2.4.5 Relevance: stakeholder views on SHOK policy goals

Forestcluster Ltd was the forerunner in strategy work, as it was the first SHOK to formulate its SRA, and it has already been able to update it. Overall, the interviewees assessed the general SHOK policy goals as relevant and valid. The SRA has also supported the start-up of the SHOK: the first SRA was formulated to facilitate rapid research work ramp-up and to demonstrate SHOK's ability to produce research results. The updated SRA then took a more problem oriented approach and has aimed at aligning the research more with industry's anticipated future needs. In the following, we assess the SHOK in terms of three SHOK policy goals set originally for the SHOKs:

1. Promoting internationally high quality research and expertise
2. Enhancing industrial renewal
3. targeting the resources to strategically selected focus areas.

Promoting internationally high quality research and expertise

As stated above, the SHOK operates in a cluster with an existing research culture and infrastructure, which is considered as globally leading within the sector. Reflected against this background the goal is possibly somewhat self evident to the SHOK. Perhaps the main driver in this particular goal is to tie the academic world and industry more closely to each other. Also the survey of the overall evaluation is in line with this; the company respondents see that increasing the visibility and improving scientific reputation, international cooperation and new company cooperation are not significant for FIBIC, most likely since they are already there.

Some interviewees were skeptical on whether a SHOK as an instrument is capable of influencing research quality. Nevertheless, for a SHOK it is always possible to promote internationally high quality research by selecting and incorporating the researchers already doing high quality research. By having a look at the researchers involved in FIBIC's research programmes it is easy to conclude that this is exactly what FIBIC does. It should also be noted that FIBIC per se, as an instrument, generates international reputation and value, which is yet another way of promoting internationally high quality research.

Enhancing industrial renewal

From the point of view of Finnish forest cluster renewal, research producing new knowledge as a basis for innovations is in the focal point. Relevant long-term research

work paves the way for new directions, products, and production technologies. The whole FIBIC has put a lot of effort in showing the renewal opportunities for the cluster. Besides industry work, there have also been presentations, articles in newspapers and interviews in the media.

Almost everyone interviewed stated clearly that FIBIC has played a major role in the renewal and targeting of research. In this respect, FIBIC has succeeded excellently.

> "Six years ago nobody talked about the structural change in the forest industry. Forestcluster Ltd has enabled the change" - Interviewee

In the industry itself, actual industrial renewal at its early stages is hard to measure and quantify. Often the signs of the renewal of whole companies and an industry are first weak. Also here the influence of the SHOK on the industry seems to be of mental, opinion building, kind; Forestcluster Ltd has been able to open industry's eyes and to enhance novel ways of thinking. Also the research organizations and responsibilities in companies have been changed to better connect to the SHOK.

At this stage it would be too early to assume significant changes in the behavior of the whole industry. Against this, it is highly understandable that the forest industry companies have not changed their strategies, as stated by the interviewees. An interesting sign of the significance of FIBIC is that during strategy updates some companies reflect their strategies against the research done in FIBIC. It also seems that the research in FIBIC has produced new product development initiatives. This topic is, however, somewhat hard to elaborate, as the companies' commercialization plans are often confidential. Also the connections from SHOK research to the change in the company behavior are often implicit and untraceable.

According to the interviews, one of the most important issues related to industrial renewal is that also machinery suppliers - and even forestry and plant genomics - are in the same research pool. This is indeed a powerful benefit when one thinks about the bioeconomy leap the cluster is facing and its research implications throughout the value chain. On the other hand, it seems that machinery suppliers have a hard time finding their place especially in biorefinery related research since the production needs – and equipment needs – for companies are not even known yet. This makes the commitment of machinery suppliers challenging.

To summarize, Forestcluster Ltd has had an important part in the change and renewal of forest industry. It has gathered long value chains into a common table, and as will be seen later, it has oriented industry and research closer to each other. No clear signs of the renewal itself are yet to be seen in the actual behavior of the companies, but given the time frame, this is not surprising. Most likely we will soon see at least some products and services that have their roots in FIBIC cooperation.

Targeting the resources to strategically selected focus areas

This goal was generally seen relevant for FIBIC. The selection of the focus areas crystallizes in the SRA that is found to be very relevant and a good guidance for research targeting (see below). The interviewees considered it to be very positive that with SHOKs the targeting of the resources and funding within the SHOKs is based on all stakeholders, especially industry, decisions. Companies with other stakeholders form the R&D programmes themselves and then apply for funding. Therefore, the strategic steering comes from the companies, not from Tekes or other public funding bodies. Receiving funding through SHOKs has thus increased the strategic steering power of the companies. Nevertheless, the length of the value chain necessarily means that companies have different views on what should be done. Piecing different needs together is important.

In practice, the research programmes have served slightly different focus areas. Eff programme group serves the focus areas of production efficiency and incremental development, whereas FuBio and Focus programmes aim at focus areas of radical innovations and strategic leaps. Both approaches are in line with the SRA.

It should be noted, however, that some interviewees pointed out that the connection of SHOK research to the research processes of stakeholder companies is not as deep as has been expected. Substantial research work (presently about 10 % of the overall R&D work is done in the SHOK programs) is done also outside FIBIC, and in a sense FIBIC's research must carefully choose the right focus areas.

2.4.6 Relevance of FIBIC's strategy and SRA

Being the first SHOK, FIBIC has already had some history in the development of its SRA. The development of the SRA by forming a Finnish version of the European research agenda was well based and seems to be widely accepted among the interviewees. Also the international evaluation panel found the SRA very ambitious but still based on in-depth scenario analysis and market studies, and well suited to the Finnish forest products industry.

In the survey, half of the industry respondents agree, too, that the general research aim and focus of the Strategic Research Agenda (SRA) is "cutting edge" and future oriented. For the majority of researcher respondents, however, SRA is not "cutting edge" or "future oriented". This result contradicts with the opinions of the international evaluation panel and those presented in the interviews and other sources. Either the question is misunderstood, or the small number of respondents gives a biased estimate on the true opinion of the researchers.

2.4.7 Effectiveness: SHOK as a part of Finnish innovation ecosystem

Overall, the interviewees were pleased with the SHOK concept. In general, SHOKs have found a place in the innovation ecosystem where they complement some gaps that have existed there. Also other instruments have adapted to SHOKs; for example, Tekes programmes have become thematic instead of being cluster or industry specific.

The interviewees were mainly able to compare Tekes funding and SHOK funding. From the company perspective, SHOK funding was found less bureaucratic but equally rigid as Tekes funding. This is not surprising, as the same rules are applied in all Tekes funding. The positioning of Tekes funding was considered to be less risky and closer to commercialization than SHOK funding. It was also stated that Tekes funding makes it possible to restrict the attending companies more clearly than the currently used SHOK funding scheme does. The consortium projects, where only a limited number of SHOK shareholders attend, would be a good solution for restricting the project attendants, but the current number of shareholders in FIBIC is so small that every shareholder must attend the consortium projects, too. Here, one should also think carefully, whether FIBIC is the correct place for a large number of confidential consortium projects.

It should be understood that SHOKs are not instruments for internationalization. FIBIC does affect internationalization by pursuing its own research agenda and getting the best, possibly international resources to do the research, but FIBIC is not an internationalization organization. FIBIC has utilized other instruments, such as the FiDiPro grant co-managed by the Academy of Finland and Tekes, in the practical internationalization, and in the Efftech Programme there was a small slice of funding for research exchange, but these mechanisms purely aim at serving the goal and the SRA of FIBIC. The shareholders of FIBIC are multinational companies and universities with their own internationalization agenda. Also the researchers have their own international networks. Thus, internationalization as such in FIBIC would be rather futile. In the short term, company focus and internationalization even seem to contradict each other, as commercialization and openness are contradictory goals.

SHOK as an instrument draws industry and academia closer to each other. Totally new aspects and openings as well as the true quality of research can be left in the shadow of how appropriate the results are for the industry in the short term. As a strategically focusing operator, FIBIC cannot have totally open research, but relevant blue sky research –research relevant to the SRA with no specific goals, might be useful. More funding to blue sky research was recommended also by the international evaluation panel.

2.4.8 Practical R&D&I work in FIBIC's programmes

Programme preparation

Forestcluster Ltd has had two different ways of programme preparation. In the start of the Efftech programme, ideas of relevant research were gathered from the researchers. A rapid prioritization by the industry was carried out, and the programme was started on the basis of this procedure. The starting procedure of the SHOK as the first of the SHOKs with no predecessors is understandable from the risk management point of view. Also Tekes' funding instrumentation was under development; First Eff programme was funded with five different funding decisions. The procedure was very a good choice to commit stakeholders and show rapid and tangible results. Once the SHOK was under its way, there was more time to plan the next phase – FuBio programme – as a more top down exercise that aimed at radical innovations and development.

Currently, the steps in the programme preparation are:

- The coordinator, or the CTO, with a planning team summaries the industrial view, identifies necessary partners and capabilities of the research partners
- The coordinator prepares the application with the planning team under Forestcluster Ltd leadership, as FIBIC the main applicant of the programs. This is similar to all the SHOKs and is due to Tekes rules
- Funding of this programme preparation must be secured from the key funding sources: the programme partners and in most the cases Tekes
- The plan is presented to the Research Committee or partner consortium for approval of the programme content
- Board approves the final content and decides funding to be applied for the programme based on the proposal made by Research Committee, decision gate 2.

The international evaluation panel considered the programme plans quite relevant but was a little surprised as the current state of the art was missing from the plans. According to FIBIC, this is, however, a main part of the early planning process but it has a smaller role in the final programme plan. Overall, the process of programme preparation seems to have been working well, except for the successor of the RAMI Programme that was rejected after significant amounts of planning.

FIBIC learned its lessons from this episode, and programme preparation was improved and clarified. From the SHOK concept point of view, there are some interesting findings:

1. The positioning of the SHOK research: The interviewees found that the topic was, after all, both too big a leap and too close to the markets – in a position where cooperation is not self-evident. Also the international evaluation panel presented a suspicion that cooperation in such issues may be very difficult. Some interviewees pointed out, though, that later there seems to have been some company initiated careful openings in this area.

2. Technology oriented R&D vs. other disciplines: According to the interviewees it is also possible that the company representatives in FIBIC mainly represent

technological R&D while the topics of the planned programme belonged to sales, marketing research and management. This difference may make it challenging to broaden the research of FIBIC to other disciplines.

The international evaluation panel pointed out the modest level of international cooperation in the programme plans. Lack of international openness may adversely affect the quality of research or the way it is being organized. Of course, a SHOK is not an academic exercise, and the main goal must be industry relevance. Introduction of a scientific advisory board might be an interesting compromise here.

Execution of R&D&I activities

The responsibilities and duties of different parties in Programme execution are stated in Consortium Agreement. FIBIC's Legal Counsel (common with other SHOKs) creates the Consortium Agreement. The agreement is the evolution of best practices shared by the SHOKs.

The full-time organization of every SHOK is lean. Also FIBIC positions itself more as an initiator and catalyst of research. Like in other SHOKs, also in FIBIC almost all of the FIBIC programme management is outsourced. Each programme has a programme manager and a programme board. The programmes are divided into work packages that each has a manager. Typically, a programme manager uses about half of her work time for the management of the programme.

The representatives of the companies were generally satisfied with the practical operational work done in the research programmes, especially compared to the practices related to individual Tekes funded R&D projects. The interviewees had rather little knowledge of other funding mechanisms such as EU programmes, and they mainly compared SHOK with the Tekes funded individual R&D projects and programmes.

Some interviewees found SHOK research projects to be more straightforward and less bureaucratic than other R&D projects. On the other hand, the inflexibility of Tekes funding on the programme level was found difficult from the company point of view. Tekes decisions distribute the money to certain parts of certain participating organizations for a certain time. Hence, introducing new ideas or shutting down projects, or changing the expense class in the middle of a programme is demanding and needs a strong programme management group. Also the international evaluation panel pointed out that the programmes project contents are initially broad, and an efficient restructuring mechanism is needed when the programme proceeds. Flexible funding is an essential part of such structures.

The interviewed researchers found the research done in the SHOK valuable. For research groups, SHOK is a new funding mechanism that brings both new funding and a steady flow of industry-relevant research questions that can be turned into publications with the expertise the groups represent. For some research institutes, FIBIC has been able to help in their restructuring and strategic reorientation.

In general, the interviewees shared a view that programme management in FIBIC has been very competent and successful. The international evaluation panel was rather worried with the structure of the programme management that was considered too lean; critical signs on this were, according to them, the missing sub-targets and milestones and positioning of the programmes against them, and the weak interactions within and between programme participants. The criticism is partly justified, but it should also be noted that such structures do exist better both in Eff and Fubio programmes to a better extent than what the international evaluation panel saw during the three intense days that focused on research highlights.

Output thus far: 41 invention reports, 9 patent applications and 2 patents
Difficulties in utilising the results – ipr practice and incentives needs further attention

From the presentations given to the international evaluation panel, it can be concluded that researchers see that the research activity has helped them come closer to the industry. The understanding of industry representatives on the capabilities of the researchers seems to have increased during the programmes. On the other hand, the cooperation has brought insight into relevant industry research problems. Industry also sees that the research is better linked to their problems through the work in the SHOK. Especially the obligation to put in in-kind funding in the form of research work done in the companies has proven useful. Some interviewees find, however, that the commitments to programmes in the form funding or in-kind funding are too big.

Especially in the Eff programmes and their management there is a strong presence of VTT Technical Research Centre of Finland. This mainly due to the historical fact that KCL was integrated into VTT and thus lots of state of the art knowledge is in VTT. VTT is also one of the owners of FIBIC, and VTT's project management as well as the ability to organize foreign funding is widely acknowledged. Nevertheless, the overly presence of VTT was also raised by some interviewees. Possible dominating positions of VTT in the future research programmes should be avoided, where necessary.

Programme results and their utilization

The scientific evaluation of the results as well as their relevance from the substance point of view took place by the international evaluation panel. Here we briefly describe the shareholder focus on the results and their utilization.

The interviewees considered the results of the programmes rather successful. The overall ambition level of research was slightly criticized by some interviewees. The utilization of the results was seen highly problematic due to IPR issues by almost every company interviewee. By definition, according to the applicable Tekes funding rules, all the parties of a programme have an equal user right to the results for

an indefinite time period. Many of the industry interviewees were of the opinion that because of this situation, there is no incentive for companies to commercialize common results, and there is a serious threat that many of the results obtained in the programmes will not be taken further. On the other hand, unclearly perceived and unmotivating IPR issues also hinder new openings in interesting matters – companies do the research rather by themselves. It may also be that the companies have misunderstood that all further developments after and outside a programme would also be common.

At present, the research work within FIBIC has produced 41 invention reports, 9 patent applications and 2 patents. The process to treat these IPR seems indeed at the moment a bit problematic, as there is no clear pathway for these results out of the programmes. One reason for the complications is that according to the funding rules of Tekes, upon transfer of IPR, a market price should be applied. There is very seldom a market that could define the price.

Although commercialization is important, in an instrument like SHOK the shareholders should have also deeper interests than just commercialization. One can ask whether the SHOK concept is somehow misunderstood if such issues are rising at this pace. The goal is, after all, to jointly improve the stakeholders' position and performance in the long term.

One challenge for all the SHOKs is the careful balancing between pre-competitive and commercializable research. The SHOKs must struggle between a rock and a hard place; on one hand, one should focus on pre-commercial research, as coming too close to commercialization dilutes the motivation of rivalries for cooperation (and is prohibited by competition law). On the other hand, results of pre-commercial research produce effects in companies' behavior only with a certain probability and a lag of several years. Company representatives, especially those lower in value chains, seem to find it increasingly difficult to justify the SHOK activities to their top management as year after year there are no tangible results. Therefore, finding or proving the true relevance of the results inside the company is difficult, and the temptation to move to applied research is evident. In fact, the overly accentuated discussion of IPR rights may well be an indication of this kind of shift.

A further problem is that due to the oligopolistic structure of the forest cluster, the competition law must always be considered particularly carefully. Also the decrease in the number of companies due to acquisitions plays a role in this development. All these aspects make cooperation more demanding.

2.4.9 FIBIC's governance model

Overall the interviewees were satisfied with the governance model of FIBIC. The full time personnel as well as the programme managers were widely appreciated. There were some ideas of, e.g., having a joint corporate governance model for all the

SHOKs, but given the variety of environments within which the SHOKs operate this would most likely not bring any added value.

The governance model has been developed for some 3-4 years, and it is considered to work well. Also stakeholders know how decisions are made. FIBIC's governance model and organizational form as a privately owned company were found to give clear structures for the operations, and the organizational structure where companies have an ownership of a SHOK makes them more committed. For forest industry the model was already familiar from the earlier KCL arrangement.

All the owners are represented well in the Research committee (taking care of preparatory work) and industry view is dominant in the board (making decisions). As pointed out in the Survey, a clear majority of FIBIC related respondents is satisfied with the fostering of common strategy and participative decision making.

However, the international evaluation panel raised concern on the insufficient management resources of programmes. Given the volumes of the programmes, their management structures were considered far too lean. Interactions within and between programmes were found weak, although according to FIBIC the presenters and presentations for the panel gave too weak an impression on the interactions within a programme. Leadership and structures enabling leadership and interactions were called for. Partly it may be that the evaluation materials did not give a full picture on the programmes, but it clearly seems that FIBIC should be more than just a catalyst of research.

2.4.10 Utility and sustainability

All the interviewees were asked for the added value of FIBIC, and the summary is presented in this chapter.

Industry representatives find added value in the broad based cooperation in the projects. Most likely the companies themselves would not have been able to put the research consortia present in SHOK programmes together. Thus, FIBIC has been able to bring the same players together in a new way. However, communications between companies have not increased, as the parties, belonging to the same value chain, stay in close touch also through other channels. Also incorporating new companies and especially SMEs is seen scarce and difficult.

Industry representatives think that FIBIC has guided the researchers to cooperate with the industry and to focus their research according to industry needs. This process has both served the industry well and created new kinds of research abilities. The understanding of university researchers on the relevant research topics has increased. Also the fact that long-term research needs become served through FIBIC is a benefit, although pressure for fast results also within this SHOKs is increasing.

Researchers think that the key benefit has been that the researchers have been able to demonstrate and develop their research capabilities in the eyes of the industry. This is producing added value both to the research and its results. Also researcher

education has received considerable value through the SHOK. The international evaluation panel noted, though, that there could be stronger mechanisms to channel young researchers into the owning companies.

For forest industry overall, the most central added value of the SHOK has been its contribution to the catalysis of change in the research in the companies and in the research institutions. The globally unique organizational concept has had a central role in bringing longer value chains together, and in linking research and industry closer to each other. For companies lower in the value chain, the added value is not that evident. However, they see that they have to stay in the SHOK to see what is going on.

2.4.11 Conclusions and implications for the future

FIBIC has been one of the key catalysts in the initiation of the renewal of forest industry research.

It is clear from all the data gathered in this analysis that Forestcluster Ltd has had a seminal role in planting the seeds of the renewal of forest industry research. The build-up of FIBIC aims at further renewal towards true bioeconomy. It remains to be seen how FIBIC is able to bring the industry along to the change.

FIBIC's SRA is excellent from the renewal point of view[35]

Strategic research agenda has been successful in gathering all intentions of the actors and has transformed them into to common goals and actions. Currently FIBIC is serving both incremental development through the Eff programmes and novel disruptive research through the FuBio programmes. Serving the whole value chain, and balancing between tangible and pre-commercial results is, however, challenging, and despite committed industry researchers and representatives, there is a substantial risk of decreasing commitment in the top management of the owners.

Mechanisms for dealing with the IPR of research results are considered insufficient by the companies. This is becoming a major problem in utilizing FIBIC's research results.

It was stressed by numerous interviewees that IPR issues are a major obstacle for the possible commercialization of results. The fact that results are usable by every programme partner indefinitively means that there is no incentive for commercialization. Some promising results may even become not utilized. The problems are accentuated by the diminishing number of companies in the business. On the other hand, it is possible that companies see the added value of the SHOK too narrowly, being only the IPR. It is possible that this conclusion is not FIBIC-specific but more related to the maturity of the SHOK as FIBIC is the oldest of the SHOKs.

35 The programmes were assessed by the international evaluation panel.

Main future challenge for FIBIC is to maintain its strategic research position and the commitment of its owners.

Some interviewees presented a fear that FIBIC may be losing its value in the eyes of the top management of its stakeholders. As an example it was stated that the board members are not any more the strategic decision makers of the owning companies. Also some of the survey results can be interpreted as if the industry might be losing its strategic interest in FIBIC. On one hand, FIBIC has to balance between tangible results and precompetitive research with just possible results that are seemingly hard to commercialize. On the other hand, FIBIC has to balance between huge rivalries that – again due to unresolved IPR issues – are not willing to bring everything to the common table. Third, the markets of the machinery suppliers include the rivalries of the FIBIC owners, which is a dilemma. Fourth, the concept of FIBIC must be sold to old companies, new people in old companies, and new companies. In this balancing, FIBIC should be able to maintain the strategic position it has. There is a clear danger that the participants just hang around in the SHOK and no one takes responsibility.

A substantial challenge of the companies is to sell the SHOK concept to the top management year after year. If no short-term results can be shown, only expectations, the level of management commitment necessarily decreases. The SHOK should, at the same time, maintain a high level of strategic research AND be able to present tangible results.

Realism with expectations is expected.

By definition, SHOKs operate at pre commercialization and precompetitive level. No direct results should be expected, and for commercialization, there should be several years reserved. Furthermore, not necessarily all issues are brought to a common table, which is fully understandable. Thus, it is unrealistic and too early to expect sellable results from FIBIC even though it is the oldest of the SHOKs.

Strengths	Weaknesses
• Has catalysed and is catalysing the renewal of forest cluster research towards bioeconomy • Ability to react: As the oldest of SHOKs FIBIC has already responded to changes in the operating environment • Excellent and focused SRA that aims at renewal • Long tradition for cooperation • Existing world class academic infrastructure at its disposal & willing to cooperate • Shareholders throughout the lower value chain • Has strengthened long-term research-industry collaboration and strategic long-term view of many industry partners • Has been able to open industry's eyes and to enhance novel ways of thinking • Has been able to change the research traditions and foci • Naturally international • Well operating management	• Too small a number of shareholders for present plans (under work) • SME incorporation in programmes difficult • Too lean programme management structures (as in all the SHOKs) • Lack of international aspect in programme planning • IPR pipeline is difficult but also misunderstood (as in all the SHOKs) • IPR issues are taking over the more informal pre-commercial cooperation
Opportunities	**Threats**
• Has full potential to catalyze the development of a world class research ecosystem of forest related bioeconomy • Potential for cooperation with other SHOKs like Cleen and SalWe	• FIBIC is, in its part, turning a big ship. How to make sure that the towline holds? • Several contradictions: – how to position the research far away from commercialisable results and sell the concept in shareholding companies year after year? – shareholders lower in the chain serve also competitors of the shareholders upper in the chain – how to get meaningful research topics for machinery manufacturers if even products are yet not known? – The concept of Finnish industry competitiveness development is oxymoron; shareholding companies and their key managers are international • Partially as a consequence: lack of committed industry partners. Who carries the responsibility? • Problems for incorporating other than traditional technology oriented R&D • SHOK can drift into a just another tool of competitive commercialization

2.5 Overview of FIMECC

FIMECC Ltd. is a SHOK-company of the metal products and mechanical engineering industries. It aims to be a world class innovation platform with a specific emphasis on raising the r&d-intensity of the metal products and engineering industry. The vision of FIMECC is to "create a new international research networks, new top science, new application- driven research contents and new business benefits." According to the vision the research activities are "based on ambitious target-orientation, openness, dynamics, trust, and true internationality." The specific mission of FIMECC is to "boost cooperation between companies and research institutes".

The vision of FIMECC is to be world class innovation platform. More thoroughly this has been described as: "FIMECC creates new international research networks, new top science, new application-driven research contents and new business benefits. The research activities are based on ambitious target-orientation, openness, dynamics, trust, and true internationality".

FIMECC defines its mission as to boost cooperation between companies and research institutes. More specifically the main objective is to "increase added value of innovation activities and R&D investments through FIMECC activities". In FIMECC context cooperation by definition contains cooperation inside FIMECC and cooperation with other SHOKs, EU-bodies and foreign companies and universities as well.
The main targets before 2020 set for FIMECC are:

- Create at least one world class competence centre into all five strategic research areas
- Add value to programme participants through managing programs efficiently and boosting industrial renewal
- Increase the number of international parties in FIMECC programs by factor three
- Create cross-industrial cooperation and joint programs with other SHOKs.

Metals and engineering as a competence area is quite established both in terms of existing relationships as well as organising. There have been several previous Tekes programmes existing in the field. However, these programmes have typically targeted individual sub-areas, such as machinery, ship building or metallurgy. SHOK activity has brought these various sub-fields together, which on one hand may cause conflicts of interest and competition over funding but at the same time enables broader interdisciplinary and intersectoral collaboration. The FIMECC competence cluster has quite broad interest in the development of the Finnish research relevant to their fields, with a lot of interest in long-term "national competence development" (to support both research and education). This is may be the reason that strategic investments to research activities in Finland seem to be relatively high on agenda for many companies.

Metals and engineering as a competence cluster includes many sub-sectors where the markets are more established than in some other sectors, the development paths are more long-term and innovation processes include more incremental development. This makes the sector in many dimensions relatively "stable" despite continual restructuring processes. At the same time the industry has long term experience on R&D collaboration between research institutions but previously the emphasis has been much in rather short-term applied research and development and the focus more on relevance that top level scientific excellence. With this background in mind the positioning of SHOK-research to concentrate on medium term strategic research is justified.

There were several customer and market oriented drivers for change identified in the mid 2000s, when the first discussion on SHOKS and FIMECC (called

MEKO-SHOK at the time) were started. The markets were more and more growing in Asia. At the same time several regulatory and customer oriented drivers were seen that necessitated R&D. Amongst other these included life-cycle management, environmental regulation, changing roles in value chains, increasing move towards service oriented business models, increasing emphasis in user experience etc. The aim of FIMECC was to provide new high level competences that can be used by the companies to better compete globally. The idea was clearly to increase R&D intensity as a means for increased competitiveness. In FIMECC the starting point was especially to mass resources and the rather scattered research activities as well as to move focus to longer term high level (application driven) research that would meet both academically and commercially high standards.

The role of the Federation of Finnish Technology Industries was important in organizing SHOK creation process. The need for creating an efficient platform to promote R&D oriented development was seen as important since metals and mechanical engineering industries are very important for the economy. These sectors were estimated to create around 30 % of the overall industrial output of the country in 2006. The strong focus of facilitating a paradigm change in the industry towards increasing R&D led business development was clear in the original objectives, one of which was to double the industry's R&D investment by the year 2015. Related to this was the aim (through FIMECC) to build a genuinely interactive research community involving the key shareholders from industry, universities and public research organisations.

FIMECC was established in January 2008 as one of the first SHOKs. In the same way as all SHOKs, FIMECC is a private owned limited liability non-profit company. The company has 33 shareholders from the industry, university and public research sectors.

The board of directors together with the CEO is responsible for general management. A separate R&D Council consists of shareholders and selected stakeholders. In 2011 the Board had eight meetings.

R&D Council has the following roles and tasks:

- to operate as a shareholders' platform for open innovation
- to act as a body and persons to be taken into account when management decides on future research directions (e.g. SRA process)
- to secure and proceed cross-cutting research themes in FIMECC portfolio
- to act as an information channel towards shareholders and selected stakeholders (Tekes, Sitra, the Federation of Finnish Technology Industries, Academy of Finland)
- to be available for FIMECC management's support in special tasks

The tasks of the R&D Council are to form the FIMECC Strategic Research Agenda (SRA) and guide all operations related to R&D activities. In 2011 the R&D Council met 2 times.

Additionally each strategic research theme has their own steering group that steers and evaluates programs that are part of the strategic theme. Programs are managed by consortiums and the Programme Managers (PM) selected by these consortiums. The Program Managers are subcontracted by FIMECC Oy. Most of the interviewees see that in practice the effect of SRA on focusing research comes through the programme preparation.

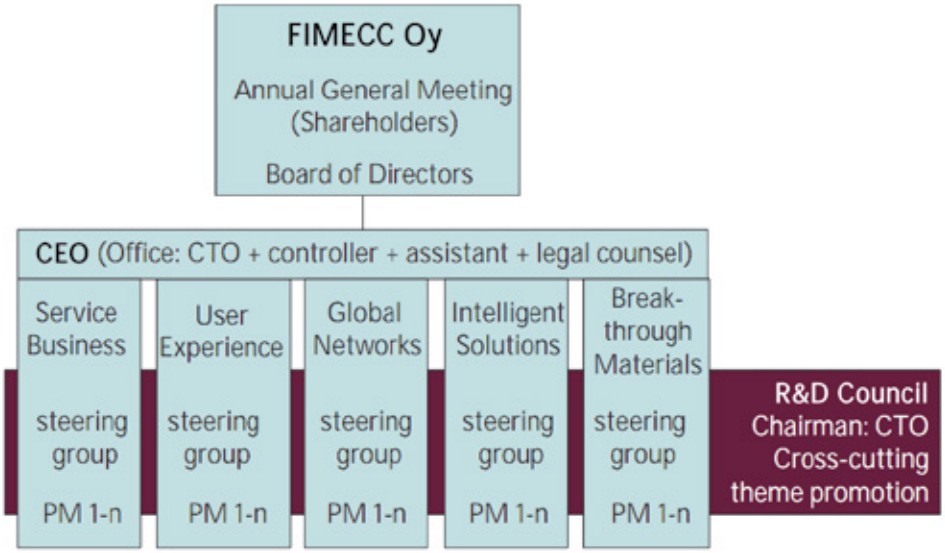
Following the Finnish limited liability company legislation the general shareholder's meeting is the highest decision-making body of FIMECC. The general meeting annually approves the financial statements, the reviews by the board and the auditor´s report, elects board members and makes the key financing decisions regarding the activities of the SHOK. There is also a shared legal counsel between all the SHOKs.

Each programme consists of several multi-stakeholder projects. There are quite strict rules for project selection that aim to ensure that they respond to the SRA, the needs of the shareholders and that the participants agree on the use of results. The requirements are that a project cannot be a part of a research program unless all shareholders have had information in any phase of preparations, if less than two companies participate, if the Steering group or the Board of Directors does not accept it against the decision making criteria, if the participants cannot sign FIMECC IPR principles or there is nota nay consortium agreement.

In terms funding mobilised, FIMECC is among the largest, if not the largest, SHOK. The annual funding in 2011 was €51m and by the end of 2011 with the estimated volume of research was 450 person years. The total R&D project portfolio (in September 2012) was €268m and circa 2700 person years[36]. According to FIMECC's own monitoring data, by the end of 2011 over 100 research results had been published. More than 110 companies (half of them SMEs) participated in the research programmes in 2011.

36 Source: FIMECC presentation 24.9.2012

Figure 20. FIMECC organisation (Source: FIMECC)



2.5.1 FIMECC'S SRA and key activities

FIMECC key activities take place through research programmes following the Strategic Research Agenda (SRA). The first FIMECC SRA was formed between September 2007 and January 2008 by the key stakeholders with the lead from the Federation of Finnish Industries. The process involved selected people from the firms as well as separate academic working groups for each strategic theme. Tekes representatives also participated in the process. Together the various working groups prepared an SRA that consisted of five Strategic Research areas.

The SRA was updated in 2011. The updated SRA maintained the five strategic areas but made some small adjustments. The FIMECC strategic research areas are the following:

1. Service business. How to build understanding on service business logics, customer demand forecasting, inter-organizational new service development, benefit sharing, and open service innovation systems?
2. User experience. How to create established structures for understanding diversifying user profiles and design leadership platforms?
3. Global networks. How to create and manage agile, flexible and resilient demand and supply networks in continuously changing business environment?
4. Intelligent solutions. How to increase the value added of customer solutions by the means of product and process-integrated intelligence?
5. Breakthrough materials. How to improve the performance of customer solutions by the means of new material development and use?

When talking about the future directions of the SRA, there are some discussions of more interdisciplinary research. However, there are not any decisions made on the future guidelines.

FIMECC has at the moment eight research programmes and the ninth is under preparation. The programmes are the following:

1. Innovations and Network – I&N (Global Networks theme)
2. Light and efficient solutions – LIGHT (Breakthrough Materials theme)
3. Energy and life-cycle efficient metal processes – ELEMET (Intelligent Solutions theme)
4. Energy and life-cycle efficient machines – EFFIMA (Intelligent Solutions theme)
5. Demanding applications – DEMAPP (Breakthrough Materials theme)
6. Global processes for high variety production – GP4Variants (Global Networks theme)
7. User Experience and usability in complex systems – UXUS (User Experience theme)
8. Future Industrial Services – FutIS (Service Business theme)

Innovations and Network programme is directed to create novel solutions to decentralized innovation activities in project-based business. The programme aims to build competence to create customized products with the efficiency of serial production, and to manage decentralized R&D&I activities in dispersed networks. The primary pilot business in the programme is maritime industry. The volume of the programme is ca. 48 M€ between 2009 and 2013.

Light and efficient solutions (LIGHT) programme aims to providing solutions for saving raw materials and energy and decreasing CO_2 emissions over the lifetime of cars and trucks, heavy duty vehicles and other moving equipment and machinery. The programme has too branches. The strategic platform research (SPR) concentrates on increased understanding in materials performance and product design and manufacturing processes. The industrial applied research part (IAR) concentrates on applying the results of SPR into product development processes. The volume of the programme is ca. 21 M€ between 2009 and 2013

Energy and life-cycle efficient metal processes (ELEMET) programme aims at creating new, intelligent ways of producing metals to reduce energy consumption improve utilization of raw materials and reduce wastes and emissions. It focuses on processes that are relevant to the Finnish metals industry, in both steel and base metal production. The aim is to build a critical mass of knowledge, with model platforms and databases that can be used in further, more application-oriented development work. Key research areas are metallurgy and thermodynamics that are applied to production processes through modeling and simulation. The volume of the programme is ca. 34 M€ between 2009 and 2014

Energy and life-cycle efficient machines (EFFIMA) programme aims to develop new technology and solutions that enable new machines, devices and systems with dramatically lower life cycle costs as well as lower energy consumption. The

programme has three (3) work packages, aiming at the following future visions with specified R&D actions: Low energy consumption and environmental emissions, technologies for life cycle cost management, and efficiency by means of human compatible multi-machine systems. The volume of the programme is ca. 41.5 M€ between 2009 and 2014.

Demanding applications (DEMAPP) programme aims to develop solutions for applications which have demanding environmental or operational conditions such as wear conditions, corrosive conditions, service in extreme conditions, friction and energy and combinations and mixture of the above-mentioned conditions. The programme has five focus areas, wear resistant materials and solutions; corrosion resistant materials and solutions; extreme service conditions; friction and energy and production technology for demanding applications. The volume of the programme is ca. 35 M€ between 2009 and 2014.

Global processes for high variety production (GP4Variants) programme aims to develop means to boost competitiveness of Finnish global networked companies through the implementation of global product lifecycle management. The objectives are improved global network management and procedures for business processes. Research topics are a) how to adapt existing theories of business, networking organizations, product processes and virtual engineering into new environments, b) to test and to iterate them in industrial case studies, and c) to synthesize gathered experience and summarize them as best practices of global processes networking organizations. The volume of the programme is ca. 1 M€ between 2010 and 2012.

User Experience & Usability in complex Systems (UXUS) programme aims to support future knowledge creation and new innovative practices in developing the user and customer experience excellence. The overall target of the programme is to increase the capability and competitiveness of Finnish metals and engineering industry by developing and implementing new design and collaboration methods that produce personalized user/customer experiences. The volume of the programme is ca. 15 M€ between 2011 and 2014.

Future Industrial Services (FutIS) programme promotes the adoption and expansion of service business in technology-based industrial firms. The research programme investigates the future of industrial services in metal and engineering industry in three major topics: service business mindset, integrated service development, and efficient service operations. FutIS aims to develop new competence and better profitability for participating industrial firms' service business, and with its significant scope promotes the transformation of the entire industry. The FutIS network of companies and research organisations works together in an effort to turn service business into a significant success factor in Finnish engineering industry and their broader business network. The volume of the programme is ca. 39 M€ between 2011 and 2015.

In 2012 a new programme, Manufacturing technology – Advanced & intelligent manufacturing, is planned to be launched and is currently under evaluation in Tekes. The programme duration is expected to be from 2012 to 2017.

In addition to research programmes, FIMECC provides some other services and organizes supporting activities. The most notable of these may be the FIMECC Factory concept. FIMECC Factory is a new tool for research programs that brings people together to create results effectively. It is a working space which is designated for FIMECC-programme people to work together. One FIMECC factory has been opened in Tampere and there have been plans to open more similar facilities in the future. FIMECC has also been facilitating the creation of strategic research agreements between Finnish and foreign research institutes. At the moment there are two strategic research cooperation agreements, one with Politecnico di Milano and another one with RWTH Aachen. VTT and FIMECC and Tampere University of Technology and FIMECC respectively are the Finnish partners in these collaborations.

2.5.2 Relevance

Based on the data from the survey and the interviews it appears that the FIMECC stakeholders see the original policy goals still relevant. Some industry representatives see them even more relevant now after the economic crisis, than in 2006.

The promoting of high quality expertise is seen as a key component of international competitiveness factor in the metal and machinery industries. This is an important aspect especially since a major part of the key companies operate in the global markets or at least as a part of the global value chain. It was widely argued that in the field of machinery and metals there have already previously existed many public research funding instruments available. The key issue of FIMECC is that it combines the search for excellence to tight collaboration between researchers and the industry. Some of the fields of science that are close to industry in the metals and machinery field have not traditionally been very strong when looking at the traditional science indicators. It is perceived that SHOK activity has especially raised the level of research in these fields.

Enhancing industrial renewal is also seen as relevant target, although the extent that the SHOK-instrument can contribute to this development is debated. Some see SHOKs (and FIMECC specifically) as a key component in facilitating the change in firm thinking as other see that the industrial renewal is major process where SHOKs can only have a limited contribution.

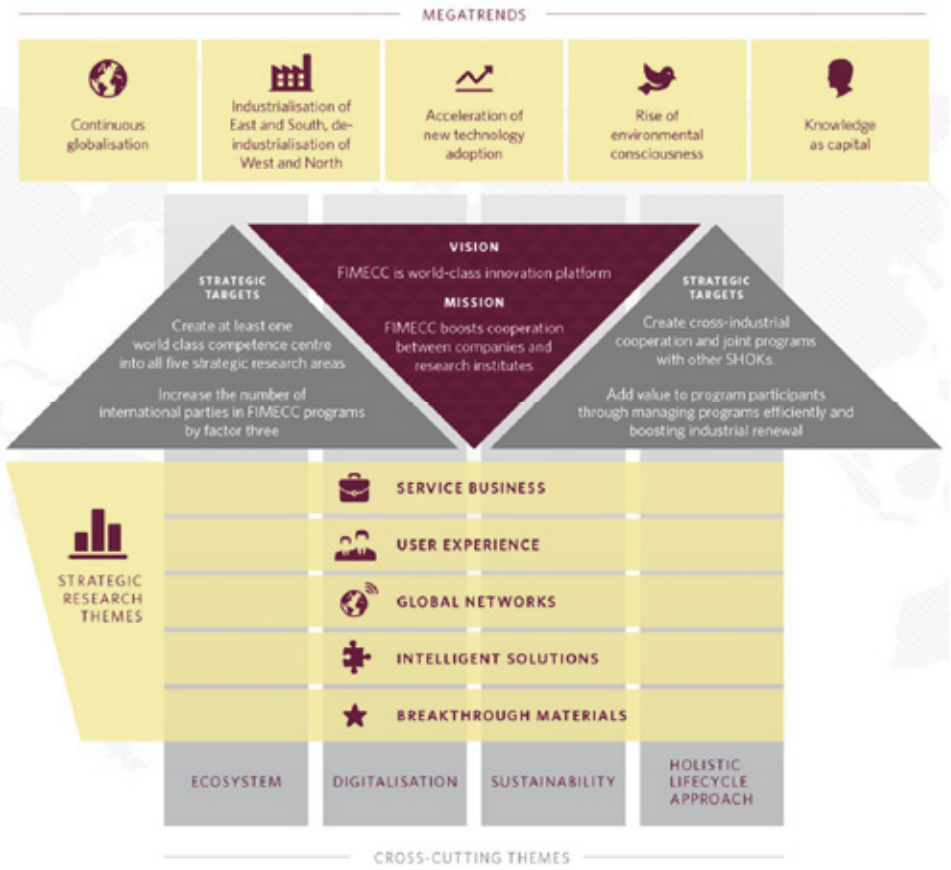
The policy goal to target resources to selected clusters does not have certain clear cut responses for relevance. Metal and machinery industry have been one of the identified key clusters for a long time and therefore have also organised as clusters or networks already previously. The key aspect that was emphasised was that objective of targeting selected clusters has been and is still a very relevant for the research community since there has been a lack of long-term funding and big enough projects so that it would be possible to promote the accumulation of critical mass in the research groups. This has been possible with the SHOK-instrument.

The FIMECC strategic research agenda has also seen as being both relevant and focused enough. Although the original FIMECC SRA has been generally considered of being too long and detailed, the basic strategic choices have been considered as very relevant to the industry problems. The original SRA was updated in 2011. In the new strategy some areas were refined but the key strategic choices remained. At the same time there has been some discussion that especially the first programmes based on SRA might have been responding to the existing needs than looking at the issues of renewal. Topics such as user experience and global networks are seen as highly relevant for industrial renewal (although some actors did not see them as important some others). At the same time these themes are seen as relatively difficult for the industry.

The FIMECC SRA has been given credit for supporting coherent long-term research. The strategy does not deviate too much but is open to new opportunities at the same time. It is quite widely recognised by the key stakeholders that SHOK activity is positioned somewhere between Tekes R&D funding and the Academy of Finland research funding. However, there appears to be a challenge between the SHOK objectives and the university performance target. Since the university incentives increasingly focus on publications and tenure track system, the value added of using resources for university-industry collaboration may be decreasing especially for young researchers.

At the beginning SHOK-activities were closer to short-term research but this was somewhat justified as the economic crisis in 2008–2009 made it more difficult to justify firms to invest. Later on the programmes have developed to be having a longer-term focus. Some firms openly admit that emphasis in projects has been in more short term research but in that case also the results have been significant. The data gives the impression that some stakeholders see that FIMECC funded research has too many short-term projects and too low requirements for scientific quality while others see the current project portfolio working well.

Figure 21. FIMECC-strategy (2011)



The relevance of SRA seems to be rather high at least according to the key private sector stakeholders. The redefined SRA was also a good evolution in the way that it was able to keep the general trends with minor adjustments and in this way facilitates long-term development. The main trend that required changes in the SRA was the economic crisis and the respective changes in the business environment. One indicator of relevance has been a strong firm investment. As one interviewee said "companies do not invest in if the topics are not relevant to them".

There has also been some criticism regarding the programmes. Some stakeholders see that the programmes are not focussed enough, which makes it more difficult to concentrate resources and the expectations on the excellence has not been high. The challenge is that the SHOK-activity is still quite broad based and may not be focused enough. On the other hand SHOK-research is trying to balance the need to be long-term and effective at the same time. At the same time broad programmes make it possible to create a more interdisciplinary research but may affect negatively to the focus.

2.5.3 Effectiveness

From the industry perspective FIMECC has been mostly seen as highly effective instrument compared with other Finnish and/or international policy instruments targeting R&D&I. The strengths identified in the FIMECC activities have been mainly the following:

- In the FIMECC projects industry typically operates as an active partner, dedicating also own human resources and not just wait for the results.
- The FIMECC projects are typically bigger and longer term than previously carried out research projects, which has enabled both more ambitious research goals as well as larger research objectives consisting of several research units/ groups.
- The FIMECC projects are typically based on research interests of the companies, which is not always the case in other forms of public funding.

Qualitative shift: from co-financing to co-creation

In terms of promoting collaborative research, FIMECC has not being a completely new way of doing things. Tekes projects have also been widely used previously also for research activities. However it has been typically seen by the industry partners that Tekes projects have more often been research group cantered where industry has been more at the receiving end. Several stakeholders emphasised that the set-up for collaboration is completely different since the initiative to various research topics comes much more often from the industry. The university and research side have expressed a slight worry about the industry influence but mainly consider that also researchers are able to have an influence on research themes by actively participating in the preparation process and discussions.

Another significant aspect has been the increased interaction between companies and especially companies with slightly different sub-sectors. Since metal and machinery industries have had a long tradition of collaboration with research groups as well as interaction inside the value chain, collaboration has not been anything new per se. However, in FIMECC the collaboration has extended to other sub-sectors inside FIMECC and has also been in some cases more concrete than just sitting in the project steering group.

Moreover, Tekes activities have been more short term in nature so that even the longest Research Programmes only have a limited duration, whereas in SHOKs the key research themes can be (potentially) continued as long as they are seen important for the stakeholders.

Although EU-projects are generally seen as one key tool for R&D&I-funding, SHOKs are for the main part seen as more effective than these projects. EU funding is generally seen as bureaucratic and rigid compared to SHOK funding.

Both industry and research institutions perceive that FIMECC programmes and projects have brought concrete results, although some programmes are only

in the early stages. The programmes aiming at more novel areas of activity, such as user experience, may have met more difficulties at the beginning, however. All respondents emphasize that the fact that the research programmes are still ongoing and although it is good to also produce quick results, one should not be too inpatient in expecting results when the target is in the medium-term research. However, it appears that the main challenge of FIMECC in terms of interactions is not in the collaboration between industrial R&D and research institutions, but more in the fact that the industry R&D has to justify the medium-term perspective to the firm management.

In terms of achieved results in FIMECC so far, the general opinion is that there are several good results from the projects but also results, where the targets should have been set higher. All in all it is seen that at this stage it is still too early to make assessment on results.

According to some interviews the main "catch" in the SHOK activity is that in SHOKs it is not enough for companies to just co-finance research made in the universities and research institutes, instead they are expected to actively participate in research projects and devote their R&D personnel in collaborative research activities. This also seems to be increasingly the trend although not a rule at the moment.

Especially in the larger companies there is also a concern whether the quality of research is high enough. On the other hand others see that the role of FIMECC is not primarily to target top level scientific research but instead the development of top competencies. In this sense "good enough" and commercially relevant research that produces top level innovation processes in companies is enough. Those actors who argue for increasing the scientific quality of the research organised through FIMECC see the two goals are not conflicting since top level scientific research often leads to top level applications as well.

The concentration of resources has been an important aspect. Many industry representatives also see that the universities and research institutes have suffered form budget cuts and SHOK programme funding has been an important and to some extent "strategic" instrument in securing resources for key research labs and groups. Industry has recognised that public research needs to be supported but at the same time they expect high quality (and relevance) in return.

In terms of internationalisation the opinions vary about the effectiveness of FIMECC. Some stakeholders perceive that FIMECC activities do not have much to do with internationalisation while other see that e.g. the collaborative arrangements with a few selected foreign partners (Aachen and Milano) have been very useful. On the other hand, based on the key performance indicators, there have been quite a lot of international collaborations as well as researcher mobility (around 6.5% of all person years). There has also been discussion among some stakeholders whether FIMECC should be more active in facilitating the use of international research

funding. However, it is also recognised that FIMECC administration does not have the resources for a very extensive international activity.

Positive results in international collaboration and researcher mobility: around 6.5% of all person years

The general conclusion is that FIMECC has been relatively successful in contributing to internationalisation of research but as a whole the volume of this activity has been relatively low and thus the impact has not been that significant. One option that has been raised has been the role of EU funding in relation to SHOK programme funding (or Tekes funding) and whether FIMECC could facilitate the researchers and companies in applying for EU funding either directly or via experienced institutes like VTT. The general conclusion from that the FIMECC has been relatively successful in contributing to internationalisation of research but as a whole the relative of importance of this activity has been relatively low and thus the impact has not been very significant. One option that has been raised has been the role of EU finding in relation to SHOK funding and whether FIMEC could intensify the facilitation of applying for EU funding either directly or via experienced institutes like VTT, who has been assisting FIMECC in this activity.[37]

Discussion on whether the selected clusters was a good idea since a lot was directed (especially for FIMECC) to sub sectors that already existed. However, since these sub-sectors seem to have increased their R&D intensity and activity, this would make it efficient especially in renewal of industries. During the launch phase of the first FIMECC-programmes the economic crisis had just begun and there seem to have been many worries of how the private funding share would be accomplished. But surprisingly the private sector funding was not a problem. Although there is not any specific evidence available, the discussions among private sector stakeholders suggest that the new research themes (as tools for catalysing renewal) as well as "co-creation" as an approach to make research during the time of diminishing financial resources may have been the key drivers. The ability to collect resources and critical mass seem to have been the drivers for FIMECC among the SHOK companies.

The general view on the role of FIMECC in contributing to the renewal business was that FIMECC surely has brought value added to the renewal processes but that the industry will be in a process of renewal in any case and especially during recent years there have been many external factors contributing to industrial renewal as well. On the other hand much of the research activity even in the first programmes is not finished yet so it is too early to assess the contribution of SHOK-research to renewal processes.

37 There exists a gap in data for international research. International research funding and research projects related to FIMECC strategy are not clearly visible. In order to improve the situation FIMECC may include the international funding more broadly linked with the national public funding.

2.5.4 Assessment of the efficiency and appropriateness

There's a wide agreement that the feature of SHOK-research to be genuinely collaborative and "co-owned" makes it more efficient than other forms of publicly co-funded research. However, some stakeholders are less satisfied than others about the publicity and the shared user rights of results. Obviously different companies have a different positioning of SHOK research in this regard. This may be a challenge in the sense that these companies are only willing to bring so called second tier ideas and problems to the table.

Some observers from the research organisations have also seen evidence of companies investing a bigger share of R&D funding through the SHOK-instrument, which has decreased private sector funding to other types of projects. This indicates that SHOK-activities have a high priority in some firms.

There is a wide agreement that research carried out through FIMECC is more efficient than EU-programmes. The EU-programmes are good for international collaboration and are seen important at least by some stakeholders but even those actors state that from a purely organisational perspective SHOK -research means much less bureaucracy and time lag.

Compared to Tekes programmes the value added in terms of efficiency is better coordination in terms of resource allocation and research utilisation. Instead of several programmes and individual projects the FIMECC is able to oversee and coordinate activities and communicate between various actors.

Most of the key FIMECC stakeholders see that the SHOK concept is an appropriate and effective way of organising R&D&I collaboration. The formal organisation with operating bodies such as the Board of Directors and R&D Council makes sure that things progress and there are ongoing discussions of key activities and key objectives.

The FIMECC governance is mainly seen as efficient and appropriate although there have been aspects that have needed improvement. Most of the industry representatives see that in FIMECC the organisation of a limited liability company works quite well. Although there is need for fine-tuning of some activities, the division of labour between different bodies works reasonably well. FIMECC organisation also appears to be slightly more decentralised than in other SHOKs, with the board of directors taking care of strategic issues only and much of the operational activity to take place in the R&D Council and at the programme level. This is visible in the comments by many interviewees that it is more important to be active in the planning and steering groups than i.e. in the board of directors, since the actual planning work is carried out at the programme level.

The strategy process has also evolved. The first SRA was made more with the existing "core actors", most of which had experience of similar exercises with Tekes programmes. Later on the strategy process has become more inclusive with a clearer planning and selection process. All in all it seems that during time the planning process has become more transparent and organised. However, the process might

also benefit from a more broad participation of academia to ensure a more efficient assessment of the quality of research especially during the application stage.

There are also views that when FIMECC processes work as intended (as they appear to do in a majority of cases), the planning of research projects is very professional, partners are sought actively and various related projects are also networked. What could broaden the scope would be assistance and cooperation in e.g. EU funding.

One of the key challenges is that FIMECC has become relatively big when looking at the number of shareholders. As a result e.g. R&D Council has become quite large and some have seen it as non-functional in that form. One main challenge for efficiency is the planning process for new themes and programmes. With a large group of shareholders there seems to be some challenges to carry out the process efficiently. The organisation with SRA-based steering groups seems to work quite well as they have some more substance specific knowledge there. As a result there is an experiment of forming a separate smaller R&D council for each strategic theme.

On the other hand, when looking at the volume of activities and the qualitative aspects of bureaucracy, it can be concluded that FIMECC administration works efficiently. With a relative low level of administration and small number of personnel, FIMECC runs eight different research programmes with annual volume of around €50m.

FIMECC also has companies from several industry fields as shareholders and participants in research projects. This has led to the situation where there are different interests and focus areas that need to be discussed. So far a balance between competing interests has been found but the potentially tightening competition between various interest groups over limited funding may prove to be a challenge[38].

From the international perspective some stakeholders raised the discussion that FIMECC administration might be too Finnish and whether it might be useful to have some foreign experts either in the Board of Directors or perhaps in an advisory board or similar body. In terms of public funding the appropriateness of FIMECC suffers from the fact that Tekes cannot directly fund foreign partners. This is not exactly a serious problem, but creates extra work for the stakeholders when trying to secure public funding for the international partners from other sources.

Positive results in increasing competitiveness of industry, but still too national focus

From a research group perspective the challenge of FIMECC is that the process for launching new projects can be seen as relatively burdensome. The preparation process needs a lot of participation in discussion and planning, which may favour active research groups instead of the best research groups. Although the application process is good in exposing the ideas to industry feedback, it may also favour known

38 The volume of R&D carried out through FIMECC programmes is limited by the amount of public funding provided by Tekes, which is not expected to increase

topics and familiar research groups. As opposed to scientific peer review the industry may have a clear view of the relevance of the research but less ability to judge the quality of the research. It would be important therefore to develop the project selection process to better ensure the scientific quality of the research.

The SHOK concept has been appropriate at least in the sense that it has had an effect on how companies may carry out and utilise research. There is evidence, that FIMECC strategies have contributed in the research strategy process in several companies and in some cases also triggered a process towards more coherent research strategies in companies. This applies to the bigger companies however and the result on smaller companies is smaller.

It has also been stated by some actors that in the planning stage new programmes are (at lest partly) planned in the areas, where single actors would probably not be able to start their own activities and there for joint effort is needed. This indicates that in FIMECC the programmes are considered to be positioned in relation to other R&D activities and support instruments.

Clear IP rules are needed in order to maintain trust and the division of labour. On the other hand even the clear IP rules do not rule out problems entirely as there are often challenges with the publicity of the background material i.e. what is public and what is not. Although the stakeholders seem to agree that the IP policy and IP rules are clear and work well, trust between the key actors is still needed. This is particularly the case where stakeholders share confidential background material in the research projects.

2.5.5 Utility and sustainability

The challenge of reporting the utility and impact to companies is twofold. Firstly, the companies may be reluctant to report the impact in detail and secondly it is often difficult to pinpoint the contribution of the SHOK research to a particular area of development. However, the survey results clearly show that the companies have high expectations of FIMECC activity to have a strong economic impact.

Many industry representatives see that FIMECC is one important piece in making Finland a good research environment for R&D activities. However, this applies basically to companies already in Finland and only consists of one part of the entity where other factors, such as the availability of highly educated labour are as important. Most of the respondents did not see SHOKs and FIMECC specifically a big attractor for companies outside Finland. SHOKs are seen as too new for that.

What has been sustainable so far has been the increasing industry-research collaboration. In some ways SHOK-activity has strengthened the already existing relationships with key groups but additionally there has been more interdisciplinary research and collaboration between research labs.

FIMECC activity is also at least to some extent seen able to make collaborative RDI more focused, more relevant and especially more functional. In FIMECC the

companies have been more actively investing their own human resources in the projects and have been also in other ways involved in the projects instead of being just investors and users of results.

For some companies FIMECC is a key value added for research activities. Internal development and applied research close to the development stage is inside the firm and often globally distributed especially for bigger firms. However, FIMECC appears to be a very central instrument for many firms, when in becomes to mid-term research. Many university actors (although not all) also see that SHOK activities have provided good results and, more importantly, have also included basic research.

Many seem to agree that FIMECC has already contributed to the firm competitiveness and also that SHOK concept does bring more potential value than other instruments. At the same time SHOK is seen as a national instrument with limited visibility and/or impact on the attractiveness of Finland as an innovation environment. Some assess that FIMECC has contributing in maintaining or even increasing firm R&D in Finland, but this has mainly applied to already existing research units.

SHOK activity has also facilitated access to new knowledge sources especially in the form of new industry-industry interaction with a larger network of partners. There is not evidence of tapping any knowledge sources previously unavailable although many partners do have access to a larger network of partners than previously. In the more strategic level the joint organizational bodies (R&D Council, programme steering groups and the board of directors) have enabled stakeholders get a broader view on issues, however.

Key result: Industry R&D investments in the metals and mechanical engineering sectors have increased from 1.2% to 1.5% of all expenditure between 2006 and 2010 despite the economic crisis in 2008-2009

Although there is not any explicit data available on the change in the volume of research, there is some evidence that SHOK activity has at least contributed positively in the R&D investments. Firstly, the statistics show that the industry R&D investments in the metals and mechanical engineering sectors have increased from 1.2% to 1.5% of all expenditure between 2006 and 2010 despite the economic crisis in 2008-2009. Moreover, the interview data suggests that many companies have been able to maintain or even increase their R&D investments. Industry has devoted their own R&D personnel to the research projects more than they have done previously.

The greatest bottlenecks for FIMECC activity seem to be the amount of available public funding as well as R&D oriented human resources in the companies. FIMECC operates now at the full volume of what is possible with current national public funding and there are already signs that more research activities would be carried

out through FIMECC if only more public R&D funding would be available[39]. This is somewhat contrasting to some other SHOKs, where the research volume is smaller. The human resources in the companies have also been one of the key bottlenecks since there appears to be a constant shortage of competent industry R&D personnel.

Public funding is also related to the sustainability of SHOK results. What is important is the stability in public funding, provided that the quality of research is good. Big fluctuation in the amount of public research funding is seen more problematic than the absolute amount of funding.

One challenge for collaboration and the utility of SHOK-activity is that the top management in firms is not always well informed on the SHOK activities, which may cause problems in terms of research utilisation as well as resource allocation.

In terms of internationalisation there are conflicting views. Others see that internationalisation comes mainly through the firms and the personal contacts of key researchers. These should be utilised and supported. There is some criticism also (or rather concern) that the indicators (e.g. number of foreign researchers) start to guide the activity more than the content.

Interaction between SHOKs has developed but slowly. Although some companies are in different SHOKs, they typically seem to be participating in projects through these SHOKs separately instead of acting as bridges. This may also reflect the fact that in companies there are different people responsible for participation in different SHOKs. In any case there is room for improvement in collaboration between SHOKs at the programme and project level.

2.5.6 Conclusions and implications for the future

In conclusion FIMECC has been a significant and well received R&D instrument. Especially the private sector sees that FIMECC has brought important value added to their activities and they also expect FIMECC to provide significant scientific as well as economic impact. This positive response may be partly explained by the catalysing role that FIMECC has had in transforming metals and mechanical engineering industry into a more R&D oriented direction. Also the research actors generally see FIMECC as being a successful instrument in the way it gathers funding for bigger and more long-term research with tighter collaboration with companies. Through FIMECC it also appears to be possible to carry out more basic research than earlier although not to the extent that was expected at the beginning. There are some reservations regarding the openness of the project selection and the ability of FIMECC organisation to secure the quality of research, but for the most part the researchers have been rather satisfied with FIMECC.

In summary the key strengths, impacts, weaknesses and challenges are briefly summarised in the following table.

39 Tekes has only a limited amount of funding available for SHOKs and it appears that FIMECC activities have already reached the maximum volume of public funding in that respect.

Key strengths and impacts	Weaknesses and challenges
• A model that brings companies with diverse knowledge closer in actual research work • Company-company cooperation effective – Bigger projects with shared resources – A broader network of partners • Better university-industry collaboration, more long-term funding • Better university-industry collaboration – Better understanding of each others needs – More long term perspective – Brought science closer to innovation • Good for young researchers to get industry connection • A tool to get closer to open innovation • More relevant projects (strategies help with this) • Ability to develop more critical mass and research hubs to specific fields with more long-term funding • New collaboration directions – a broader network of related fields • New research themes for companies • Direct research results (especially in materials) • Supported the development of a more focused research strategies in companies (evidence) • There have been some positive international collaboration openings. Need to be focused though. • Ability to efficiently manage a large research programme portfolio. • The stakeholders view that SHOKs have been able to get concrete results • Bigger projects have also facilitated larger research consortia that includes research groups from several research institutions	• Too inward-looking. International representation and role in internationalization regarded as insufficient or not appropriate for SHOK or FIMECC activity – Too dependent on Tekes funding. – More international funding – Stronger role for the Academy of Finland • Insufficient risk funding, the research portfolio should include items involving a higher risk • There has still been a lot of tendency towards existing strong areas and incremental innovation – the new research areas able to transform and renew the industry are yet to show their true impact on industry behaviour • There is still room for improvement in the quality of research (good quality brings international funding etc.) • The division of labour between SHOKs and Tekes is not clear • FIMECC activity is not well known outside the core people in the companies and research institutions

Although FIMECC has got a positive reception there appears to be still many challenges ahead. The positive results do not yet show if FIMECC will be able to truly fulfill the strategic SHOK objectives of internationally high quality research and industrial renewal. The results have been positive so far but it is yet unclear if FIMECC will reach the objective of raising the quality of research and whether the novel research areas, such as service business and user experience, are successfully utilized by the industry. All in all it can be concluded that the first step in the SHOK process has been successfully implemented, the SHOK approach seems to be both effective and efficient way of organizing collaborative research in the machinery and mechanical engineering industry. However, it is still too early to assess if the SHOK instrument is able to have the scientific and economic impact in the scale that was originally expected.

2.6 Overview of Built Environment RYM SHOK

RYM – Built Environment Innovations – was founded in 2009 as the Strategic Centre for Science, Technology and Innovation (SHOK) of built environment in Finland.

RYM is the youngest of the six SHOKs and has been active only for a couple of years. Because RYM has been operating only for a relatively short time, the evaluation cannot yet state in-depth conclusions about the long term effects and benefits of RYM for the industry and research.

RYM differs also from other SHOKs in a way that built environment was not on the original list of potential key SHOK focus areas that were listed in 2006. The industry itself saw a need for renewal and started around 2007 a preparation process to get a SHOK that would focus on built environment area.

Built environment as a SHOK focus area is broad and complex. Clearly the importance of all built infrastructure in societies is huge. It is estimated, for example, that in Finland built environment represents over 70% of the national real property.[40] Reflecting this, built environment industry is not clearly defined, but consists of a large, heterogeneous group of companies representing different types of industries. However, there are some clear drivers such as urbanization, climate change and sustainable development requirements that will affect all the companies related to built environment a lot in the future. These drivers were also motivations for the industry to start the process to build up RYM to invest more on joint research, development and innovation (R&D&I) activities.

Historically, the role of R&D&I in the built environment companies has been quite modest compared to other SHOK focus areas. Many of the companies, even the larger ones, do not have internal R&D&I structures and research ambition level is not high. In the interviews, few other specific features of the built environment industry came up that affect R&D&I activities of the companies and need also be taken into account when assessing the role of RYM.

- The built environment industry in Finland, like in many other countries, has been mainly operating in the local national markets. There is, however, global potential for many of the companies and a larger number of companies is now catching up with this opportunity. International competition in Finnish markets has also become stronger as different types of companies enter the Finnish markets. Although still being largely national and local businesses, the international competitiveness has clearly become more important for the built environment companies over the last ten years.
- The public sector has a significant role for the sector as a client and as a regulator. The requirements of this client segment affect the R&D&I activities of the companies. The risk taking attitude and innovativeness of the public sector could create incentives for R&D&I in companies.
- Business is project based and strongly dependent on economic cycles. The project basis means that the companies create short term coalitions and create very tight price competition among subcontractors. It is very challenging to build long term research and development partnerships among companies.

40 More details of built environment sector in Finland can be found at RYM web-pages www.rym.fi.

Price competition combined with a economic cycle dependency means that there is very little resources to invest in R&D with a long term strategic focus. As one interviewee put it: "A typical feature for the industry seems to be that the larger company is, the less it invests in R&D."

More than average variation in the shareholder base: 39 private companies, 4 cities, 3 universities, 2 research institutes, 2 universities of applied sciences, 2 national agencies and 1 foundation

These challenges combined with the shock that built environment was not on the list of SHOK focus areas motivated the industry and research to start a process to create RYM. The preparation officially started in summer 2007. The process itself was quite complex and wide. Few key individuals had a significant role to get the companies together to start the discussions. Interviewees had quite different memories of the early steps, but a fact is that quite many active persons were involved and were very motivated to create a basis for RYM. To officially start the preparation, a working group was created that had representatives from Finnish Association of Building Owners and Construction Clients (RAKLI ry), Confederation of Finnish Construction Industries RT (Rakennusteollisuus RT ry), Finnish Association of Mechanical Building Services Industries (FAMBSI) (LVI-Talotekniikkateollisuus ry), RIL - Finnish Association of Civil Engineers (Suomen Rakennusinsinöörien Liitto RIL ry), VTT, and Tekes. During the preparation phase, the need and potential for RYM was assessed and the group of RYM founding companies was created with a tentative share subscription. Also the first Strategic Research Agenda (SRA) for RYM was created.

The wide and complex preparation process took 1,5 years. A wide support for RYM was created and in January 2009, the RYM was founded. Directed issue of shares was organized in March – April 2009 ending with a total of 49 RYM shareholders. In the beginning of summer 2009 three more companies joined RYM.

2.6.1 RYM Ltd organization

In the same way as all SHOKs, RYM is a private owned non-profit limited liability company. At the moment, RYM has 53 shareholders[41]. These represent the founders of RYM and have invested in the basic capital to RYM (2,275 M€). The group of shareholders consists of 39 private companies, 4 cities, 3 universities, 2 research institutes, 2 universities of applied sciences, 2 national agencies and 1 foundation. There are A, B and C series of shares which differ from each other with respect to the voting power, the initial capital invested in to buy the shares, and payments that may need to be paid to cover the operating costs of the company.

41 The list of them can be seen on RYM's website: www.rym.fi

RYM has a large number of shareholders compared to other SHOKs. The difference is even bigger when also the volume of activities is taken into account. An example is a comparison to FIMECC which has 32 shareholders. In 2011, the total volume of SHOK activities measured by man years per a shareholder was five times larger in FIMECC compared to RYM[42]. One should, of course, take into account that RYM programmes have been in the ramp up phase and this example is only an illustration. However, based on the large number of shareholders, one would expect the volume of RYM to be very significant for the built environment area. RYM like all the other SHOKs has a policy that the participation in the research programmes in not limited to shareholders, all interested and committed partners can join the research programmes. Altogether there has already been in total 84 companies participating in RYM's research consortia.

Following the Finnish company legislation the general shareholder's meeting is the highest decision-making body of the limited liability company which also elects the board members for two year periods. The board of RYM consists of 11 members each with a personal deputy member. The candidates for the board are suggested by a nomination committee which consists of board members. The nomination committee has rights to suggest board members as they see appropriate. The first boards of RYM consisted of the representatives of the shareholders, but the latest board has also members who are not shareholder representatives. There also exists an advisory committee consisting of the shareholder representatives. The advisory committee meets twice a year and provides advice for RYM board.

The main task for the board is to define the strategy for RYM. The RYM board has had a yearly strategic planning cycle so that once a year the business strategy of RYM is assessed and modified if needed and also the validity of SRA is assessed. The board also decides to start the preparation process of new research programmes.

The RYM board can set up working groups/committees to support its work. RYM does not have a separate scientific committee that would work next to the board, but since November 2011 it has had a science and research committee that reports to the board. The work of the committee is in the very beginning.

RYM operational organization has been built to be very lean. RYM employs at the moment two full time persons. CEO (Dr. Ari Ahonen) and Research Director (Dr. Anssi Salonen) coordinate the RYM activities. Furthermore RYM has together with other SHOKs as a common resource a Legal Counsel. RYM outsources all the relevant other services such as external communication and financial services. Also Programme Managers work on a project basis and are paid by the RYM's research programme consortia.

Following the organisation of other SHOKs, RYM key R&D&I activities take place through research programmes following RYM's Strategic Research Agenda (SRA). At the moment RYM has two programmes in operation and one has just started. These

42 In 2011, FIMECC activities in total covered around 450 man years and RYM activities around 200 man years.

are described in more detai elsewhere in this report. In addition to this, RYM has defined its basic operational processes to be the following[43]:

- **Foresight process.** RYM participates in the foresight network of Finnish Ministry of Employment and the Economy, Tekes, Sitra, Finpro and Finnish Academy and all SHOK´s. Finpro ry is the main foresight process partner. Finpro has already organized foresight sessions for RYM advisory committee and Indoor Environment program.
- **Valuation.** RYM's CEO and CTO offer the shareholders evaluations of their visions and research ideas. A tool has been developed for this service and the first cases to test the tool have been completed in 2012. RYM has also created a partner network which offers this service to the non-shareholders.
- **Programme Management.** RYM creates a partner network to initiate research programmes and RYM is also an active partner in, e.g., Tekes programmes. In RYM, the practical programme management services are directly bought by research consortia from private companies and other service providers (details of programme management are described later).
- **Communication.** RYM communicates its work and results to the network by different means. The communication process is one of the key activities of RYM. RYM has also outsourced some of its communication work to other key-partners.
- **Networking.** Networking between RYM´s shareholders, between the consortia members and especially networking internationally is RYM's key process in which RYM managers actively put emphasis on.

2.6.2 RYM Ltd's SRA and programmes

RYM's existing strategy is outlined in two key documents:

- RYM business strategy (date 2.3.2012)
- RYM Strategic Research Agenda (SRA) (date 16.1.2009).

RYM's own business strategy has evolved during the last three years and it has been updated and revised each year. Around November each year RYM's board has a strategy meeting to validate the business strategy and set up the targets for the next years. In January the board has a two day strategy meeting to assess validity of the SRA. This year RYM also introduced a process to have an additional board's strategy meeting in June and also a web-survey is planned to be executed among all shareholders each autumn to get their views on the strategic issues to provide background information for strategy revision.

In the beginning in 2009, the practical main targets for the first years were to set up the RYM's operations and get the first research programmes up and running. The latest strategy after the first years emphasizes strongly the role of RYM in

43 RYM Business Strategy 2012, RYM report to the international evaluation panel May 2012

facilitating the creation of new innovation ecosystem between built environment industry and academia in selected key spearhead areas. It also outlines several activities in addition to research programmes that RYM need to implement in order to reach this goal. As outlined in the strategy:

Core areas of SRA:
- energy efficiency
- processes and operational models
- competitive urban infrastructure
- user-friendly spaces

"RYM strategy is to create step by step new ecosystem. To achieve this, RYM has to create foresight system, evaluation model for company visions, financing variations, research program model, Living Lab model (multidisciplinary research methods), research fellow model (opportunities for companies to have researchers as employees e.g. through doctoral thesis) and global networking model."

One should note that many of these anticipated strategic actions, such as foresight and evaluations for companies, are under development or in the piloting phase which means that it is too early to assess their success. Also the awareness of these strategic actions among the RYM stakeholders is still relatively low.

RYM's SRA was created during the preparation phase of RYM and it has not been revised since then. Each year the board of RYM has had the discussion of the need to revise SRA, but this far this process has not started. The SRA of RYM is relatively wide reflecting the wide preparation process providing "something for all". The main four theme areas of SRA are the following:

- energy efficiency
- processes and operational models
- competitive urban infrastructure
- user-friendly spaces

The SRA is implemented through research programmes. The strategic target is to have a yearly research volume between 40 and 50 million euros with 350–400 man years of which 40% is done in research programmes (target to get around 20 million euro yearly volume in programmes) and other 60% is research and development work done in supporting R&D projects.

Compared to other SHOKs, RYM is clearly still in the ramp-up phase and the SHOK funding is less than in other SHOKs. One should note that the latest RYM research programme just started. In 2013–2014, there will be at least three on-going research programmes that will get the research volume to the anticipated level. Short descriptions of the three on-going RYM research programmes are provided below based on the material provided by RYM[44].

44 RYM report to the international evaluation panel May 2012

Built Environment Process Re-engineering (PRE) (2010–2013)

The first research programme of RYM aims to create totally new procedures and business models for the real estate, construction and infra sectors. They will be more user-centered and supported by product model-based data management over the entire life cycle of the real estate, infrastructures and communities in question. The adoption of new business processes allows a significant increase in productivity and quality.

The PRE programme has 43 participants, 37 companies and 6 research institutes, and a budget of 21 million euros.

Indoor Environment (2011–2014)

The aim of the Indoor Environment research programme is to find solutions that promote productivity, pleasantness and health of space users in an ecologically sustainable manner. The focus areas are user-centric spaces and their energy-efficient management, revenue models for good indoor environments, and design and implementation of inspiring learning environments. The companies partaking in the program explore with an open mind new markets in indoor environments of the future which people enter to get invigorated and increase their wellbeing.

The programme consortium consists of 28 companies and 13 research institutes and has a budget of more than 20 million euros. A majority of participating companies are not RYM shareholders.

Energizing Urban Ecosystems (EUE) (2012–2015)

The EUE programme has just started. It aims to find operational models and solutions to meet the challenges posed by urbanization. The aim is to create user-centric and competitive urban solution concepts applicable to existing as well as new areas. Solutions for innovative activity, energy use and mobility will be integrated with design of the built environment, land use and production of services for ecosystems. Different living lab concepts create a core for the programme and also two cities are involved as key partners.

The EUE programme has three companies and the city of Espoo as lead partners and in addition to this three other companies, City of Helsinki and Helsinki Region Environmental Services Authority participate in the programmes. Aalto University and Finnish Environment Institute are the main research partners.

2.6.3 Relevance: RYM Ltd stakeholder views on SHOK policy goals

Assessing the validity of the general SHOK policy goals set in 2006 is interesting in the RYM case as this SHOK has been forming its strategy and strategic research areas later than other SHOKs. Therefore it has most recently gone through the process of reflecting the general SHOK policy goals from an industry perspective.

Overall, the interviewees assessed the general SHOK policy goals to be relevant and valid both for the built environment industry as well as for the competitiveness of Finland also more broadly. In the following chapters there are comments from the interviews for each of the SHOK policy goals as they are formulated in the questions set for the evaluation.

Promoting internationally high quality research and expertise

This goal is extremely important and relevant for the built environment industry, according to the interviewees.

All the interviewees felt this goal to be the most important for RYM and also a goal for which SHOK as a policy instrument is well suited for. SHOK concept can help to move towards this goal.

Some of the interviewees were critical whether the focus in RYM's operations and in programmes is sufficiently reflecting the policy goal in promoting *internationally* high quality research. Definition for global excellence in the research of built environment industry was felt being done only halfway and would still need further attention in the future. Nevertheless, this strategic goal was seen to be of very high relevance for the industry.

Many interviewees also talked about the research culture in the built environment industry. In this field, research has been focusing on applied science, and the industry has been satisfied with national level results and effects. Research culture, way of doing science in built environment area, still needs a lot of work, rethinking and renewal in order to achieve internationally high quality academic standards.

Enhancing industrial renewal

This strategic goal was also assessed on the interviews to be relevant and valid for built environment industry.

High quality research and industry renewal go hand in hand. High quality research and changes in research culture are prerequisites for industry renewal, although other measures are needed as well. Industry renewal should also include improvements in industry-research collaboration. The responsibility for renewal of research culture does not lie on the shoulders of academia and research institutes only, but is also a responsibility of the companies in built environment to be able to adapt the research results. If the gap between academic scientific research and company development activities is too wide, then the parties do not get "at the same level" in the discussion that is needed for using research results as a fuel for industry renewal.

Acting as a catalyst requires presence on the interfaces: collaboration between disciplines, research areas and SHOKs needed

Some critique of SHOK as an instrument for industry renewal was stated at the interviews. Due to the built environment

industry's features (wide, heterogeneous field, insufficient research culture etc.), its renewal is demanding. RYM was seen in many ways as a good instrument for promoting R&D&I activities, but by itself inadequate for fulfilling the goal of industry renewal. Some interviewees stated that renewal of companies is a somewhat naïve goal for SHOKs. The renewal of companies and industry comes also from other drivers (such as global competition in the markets) and not only from research and the public sector's funding. Thus believing that public sector would create industry wide renewal is somewhat unrealistic and easily will remain somewhat ambiguous.

Concept of industry renewal aroused also questions about the focus area that RYM is built on. Is "Built Environment" a suitable "main title" for a SHOK? Is it too wide and is it possible to define a clear strategic focus? Could some narrower group of organizations have formed a more suitable and better defined "cluster" that would have found more precise and common goals? Overall the interviewees agreed, however, that a smaller group of companies would not have been able to create RYM and the wide preparation basis was a necessity at the time.

Some interviewees commented that the most interesting industry renewal happens in the interfaces of different industries. From this point of view, building SHOKs around tight, pre-defined focus areas would not give the best results in order to catalyze renewal. Concept of SHOK may encourage in stronger collaboration within the industry, whereas the collaboration between companies representing different types of industries might be a more beneficial way for industry renewal. A positive progress with this respect within RYM has been an involvement of companies that are not typical built environment companies in the latest EUE programme.

The interviewees also pointed out that in order to create industry renewal in Finland, also the collaboration between the SHOKs would be very important. All SHOKs together should contribute towards creating new opportunities. The interviewees said that this collaboration is especially important for RYM. Built Environment is a vast field that has inherently work areas that are common with all the other SHOKs. Therefore collaboration opportunities between SHOKs could be very fruitful for industry renewal.

Targeting the resources to strategically selected focus areas

Of all three goals, this goal was the most criticized although basically acceptable. Targeting resources is naturally unavoidable and was seen necessary. However, it is difficult if not even impossible to pre-select the focus areas, and even more difficult to name the group that could be entitled to conduct this selection. In the interviews there was a lot of discussion about the focus areas of 2006 being selected by the public sector. The interviewees criticized a structure where this choice was made as a policy choice. Also, the interviewees criticized the whole concept of "a cluster/focus area" based on a certain industry and considered this to be somewhat old-fashioned. Some interviewees also asked for a clear theoretical basis for this objective.

Despite of the ready-made list of focus areas in the beginning, RYM was formed based on industry's own initiative. The interviewees gave positive feedback to SHOK decision making mechanism for being flexible and giving chance also for the strategic center for Built Environment although it was not mentioned among the original list of five SHOK areas. The interviewees hoped that this type of flexibility would remain also in the future, but also acknowledged the difficulties related to the decision making in the future. The issue of who has the power to make strategic choices and which criteria should be used is an important issue to be discussed.

The interviewees considered it to be very positive that with SHOKs the targeting of the resources and funding within the SHOKs is based on industry decisions. The SHOK concept has introduced entirely new aspects to the public funding process. In the SHOK concept, companies form the R&D programmes themselves and then apply for funding. Therefore, the strategic steering comes from the companies, not from Tekes or other public funding bodies. Receiving funding through SHOKs has thus increased the strategic steering power of the companies, which was considered as one of the best features in the SHOK concept.

2.6.4 Relevance of RYM Ltd strategy and SRA

Since RYM has been founded just few years ago, the Strategic Research Agenda (SRA) of RYM has also been developed recently. The interviewees assessed SRA to be up-to-date, relevant and in line with the policy goals for SHOKs. The SRA was also regarded by the interviewees as having the right level of challenge. So far there has been no need to react to changes in the operating environment and the SRA has not been gone through major revisions.

Figures 1 and 2 show the company and research SHOK survey respondents' views on the SRAs' ambition level. Particularly the RYM researcher respondents see the RYM's SRA to be very much on the cutting edge and future oriented (see Figure 2). Also the RYM's international evaluation panel assessed the RYM's SRA topics and framework relevant and interesting and also concluded that it offers a good basis also for future programmes.

Figure 22. Company respondents' agreement with statement "The general research aim and focus of the Strategic Research Agenda (SRA) is "cutting edge" and future oriented" in the SHOK survey. The scale used was 1 – very low, 2 – low, 3 – moderate, 4 – high.

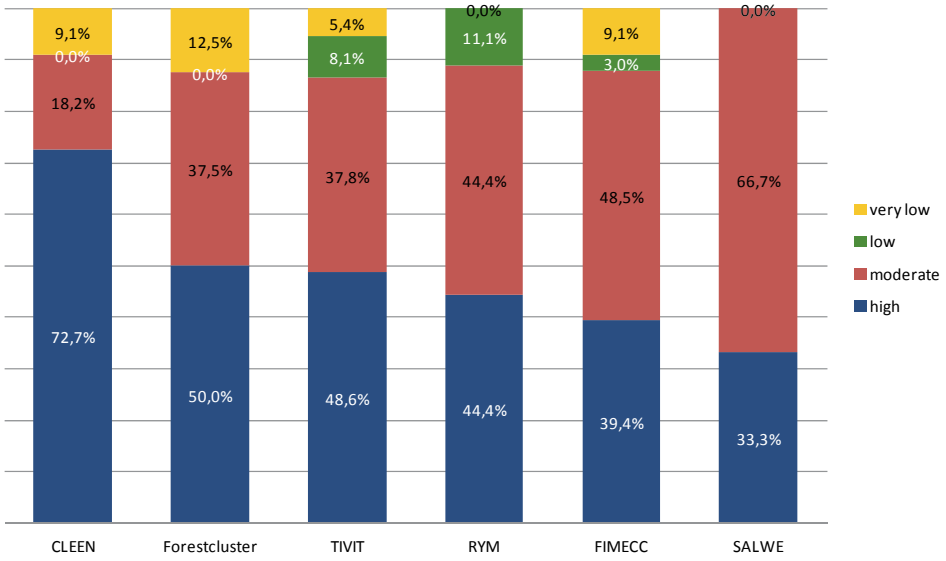
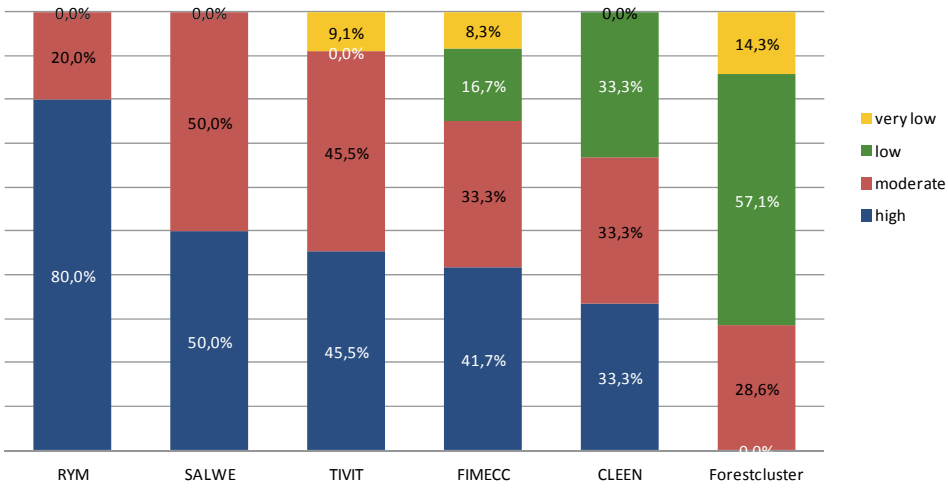


Figure 23. Research respondents' agreement with statement "The general research aim and focus of the Strategic Research Agenda (SRA) is "cutting edge" and future oriented" in the SHOK survey. The scale used was 1 – very low, 2 – low, 3 – moderate, 4 – high.



The interviewees stated that since built environment was not originally among the "clusters" chosen for SHOKs, the industry had to argue with more precision why

it needed a strategic center and how the RYM's SRA would fulfill the goals set for SHOKs. Some interviewees commented that some civil servants at the Ministry of Employment and the Economy and at Tekes did not consider the research work in the field of built environment to be at the sufficient international high quality level. Thus communicating its importance was more laborious compared to the work that other SHOKs had to do. Therefore, according to some of the interviewees, the SRA of RYM has been discussed more thoroughly than the SRAs of the other SHOKs. Also, after the beginning, there has been very little debate regarding to the role and functions of the RYM and SRA.

Overall it can be said based on the interviews that RYM operations and programmes reflect the strategy and SRA well. Chosen research programmes have been able to capture the essential elements of SRA. Especially the expectations towards the new EUE programme are high. The international evaluation panel, however, criticized the programme level capabilities to create a coherent overview of the objectives and work at the programme level. This is further discussed in the next chapters.

The biggest concern among interviewees seems to be the large group of stakeholders and the fragmentation of the built environment field and therefore also of RYM and its SRA. The SRA is found to be vast and including many different aspects and aims. It is not as focused as it, according to the interviewees, should be. On the other hand the interviewees have stated in many occasions that demanding a more focused SRA would have been unrealistic in the beginning of RYM's existence. In the preparations of RYM, many players from the built environment industry were involved and it was necessary to keep the SRA somewhat wide so that it was possible to have the commitment of the whole industry. This set up affects many of the following observations and is also one of the biggest challenges for RYM's future operations, i.e., how to create focus and reduce the number of partners involved but at the same time increase the volume and ambition level.

The future strategic planning and steering of RYM programmes was a topic that raised a lot of discussion during the interviews. The main points from the discussions were the following.

- The research culture of the companies in built environment industry is generally considered to be weak. Strategic steering of research within companies and structures for research management are underdeveloped. Typically the companies do not have strong research units or even research directors at the executive board level. Thus most companies do not have the sufficient resources for making strategic research planning.
- RYM programmes reflect the strategic decisions of companies. At the moment the universities and research organisations are also making their own strategic choices. The interviewees were worried that in many cases the research areas that are of interest to RYM companies are not high on research organisations' strategic agendas. How can the SRA of RYM and the strategic interests of research organizations (such as VTT and Aalto University) be integrated

and aligned in the future? In order to create national basis for high quality research competencies in some areas it would be important that also the research organisations' goals are line with company goals. In RYM's case, the commitment and involvement of research organizations could be higher and on the shoulders of a larger group of people. Also the international evaluation panel for RYM highlighted the importance of the co-creation and the attitude for research organizations and companies to work together.

- Built environment represents a special case in that sense that public sector has a significant strategic role both as a client and in setting general framework conditions for business environment (e.g., through spatial planning). RYM already has some cities and national agencies as shareholders and the latest programme activities also so some very positive signs of commitment. Interviewees, however, raised a valid question that how public sector is able to and should participate in the strategic research planning for the future?

2.6.5 Effectiveness: SHOK as a part of Finnish innovation ecosystem

Since RYM has been in operation only for a relative short time, the effects of RYM cannot be yet evaluated. At this stage, the analysis focuses on the issues interviewees have raised regarding the SHOK as a concept compared to other policy instruments.

Overall, the interviewed representatives of RYM were pleased with the SHOK concept. In their opinion, SHOKs have rightfully stated their place in the Finnish innovation ecosystem next to other policy instruments and fulfill some of the gaps. The following quote from one interviewee reflects well the opinions of many interviewees.

"SHOK can be compared to democracy: It is not perfect but it is the best available option for working towards our goals." –Interviewee from a company.

"If we wish to have the industry in the driver's seat and are looking for the most significant research in order to improve the Finnish economy, the public sector's strategic work is not going to be enough. Increasing Tekes funding or building up tax incentives are not adequate measures by themselves, and neither does the funding by Academy of Finland serve for our strategic goals. Instead, the SHOK concept, i.e. combining scientific ambition and industrial research within a relatively well led organizational structure in order to achieve the best possible cooperation, is an appropriate and eligible model. It is safe to say that coming up with a better alternative to reach the set goals is not easy."
– Interviewee from a company

The international evaluation panel of RYM was also very impressed of the SHOK as a concept and concluded it to be "an impressive, well conceived and modern attempt to build up a new type of research collaboration between built environment industry as a whole and academia.[45]"

Interviewees found that the SHOKs are not competing with other policy instruments but rather complement the other instruments. Where some overlapping does happen (e.g., with some Tekes project funding), it was not considered to be severe. The interviewees also mentioned that SHOKs seem to keep Tekes active with its own strategic thinking enforcing, for example, Tekes to direct Tekes programme funding to areas which are truly new and not yet at the research agenda of companies.

With the SHOK concept, the companies are responsible of the strategic planning and the companies need to create "a big picture" for their research. This change in thinking to move away from individual projects to strategic planning of larger research programmes was found to be one of the most positive outcomes of the SHOK concept. Naturally, there lies a challenge: How well can the companies in built environment use this new responsibility and are they able to make the most of it?

All the interviewees shared a view that SHOK as an instrument is primarily meant for bigger companies that are also able to invest sufficiently on their own strategic research. SHOK instrument is not appropriate for typical small and medium-sized enterprises (SME). This discussion also lead to conclusions that the relative amount of R&D&I funding which in Finland is channeled through SHOKs is at an appropriate level since other instruments and funding mechanisms are needed to serve the needs of SMEs.

2.6.6 Practical R&D&I work in RYM Ltd programmes

RYM programme structures and programme management

"Not appropriate for typical small and medium-sized enterprises (SME)"

RYM has built a programme management organization that is structured on 3 levels[46]

1. The Programme Management Committee (PMC) is responsible on overall management of the whole research programme, and is chaired by Industrial Partner of the research consortium. Each programme partner (both industrial and academic) are represented in PMC.
2. Working Committee is responsible of preparing issues for PMC as well as co-creation and aligning of the work packages. Working Committee is chaired by RYM's Research Director who is also the leader of the whole programme organisation. All work package leaders are represented in the Working Committee. RYM's Programme Manager is assigned as Secretary of Working

45 RYM international evaluation panel report, draft 12.9.2012.
46 Interview with research director Anssi Salonen

Committee and Programme Manager is also managing the practical consortium issues.

3. The third level of management is the Work Package level. Each work package has an industry leader, who is responsible for content and financing of Work Package.

The responsibilities and duties of different parties are stated in Consortium Agreement. RYM's Legal Counsel creates the Consortium Agreement. The agreement is the evolution of best practices shared by all SHOKs.

Throughout the three programmes RYM has tested slightly different programme coordination practices over the last years. The first programme (PRE) started with a structure where one of the industry leader partners also assigned a person for taking care of programme coordination tasks. In the interviews it was stated that before starting the first programme, the amount of work was badly underestimated (reflecting perhaps lack of experience in research work). The programme management proved to be too laborious without a programme manager dedicated only to the programme in question. Therefore a separate Programme Manager was hired for the coordination tasks after the first year.

In Indoor Environment Programme, the programme management was outsourced from the beginning. Programme Manager's duties included also assuring that the results were implemented properly and made good use of, as well as the coordination of activities during the programme.

With the third program (EUE), yet a new model for programme management is to be introduced. This time, the programme management consists of both a representative from the industry as well as from the research.

In general, the interviewees shared a view that programme management at RYM has been mainly successful from a company point of view. It was well understood that in the beginning different practices are tested and practices also need to be modified. The international evaluation panel, however, strongly criticized the programme management. They mainly criticized the lack of coherent overview of the programme and the lack of strong research leadership that would be visible within each programme. This would require a dedicated senior researcher to take a role of as a programme "spokesperson" for each programme separately. The new EUE programme attempts to introduce this type of a structure.

Execution of R&D&I activities in RYM programmes

The representatives of the companies were generally very satisfied with the practical operational work done in RYM research programmes, especially compared to the practices related to individual Tekes funded R&D projects. One should note that the R&D funding of the RYM companies is predominantly Tekes funding. The interviewees had very little knowledge of other funding mechanisms such as EU programmes, and they mainly compared SHOK with the Tekes funded individual R&D projects.

Following aspects were named as positive issues related to SHOKs' research practices in the interviews.

- Some interviewees found SHOK research projects to be more straightforward and less bureaucratic than other R&D projects. However some interviewees still considered most of the reporting requirements pointless, especially the demand to report results constantly, and even before results are expected to be seen.

Advantages of RYM research projects:

- More straightforward and less bureaucratic than other R&D projects
- Enables long-term planning and commitment of the companies → enhances the success rate of the programmes as built environment is typically a field strongly dependent on business cycles and therefore cutbacks and freezing of short-term R&D programmes are usual if time horizon is too short.
- The cooperation with the researchers is more straightforward and more active.
- Companies make an effort to set the goals together with the research institutions, whereas pre-SHOKs R&D typically involved researchers getting small amount of funding from Tekes and worked mainly alone.

- SHOKs enable long-term planning and commitment of the companies. The SHOK concept includes the idea of the companies committing to the R&D programmes for a relatively long time period of 3 to 5 years. This enhances the success rate of the programmes as built environment is typically a field strongly dependent on business cycles and therefore cutbacks and freezing of short-term R&D programmes are usual if time horizon is too short.
- The cooperation with the researchers is now more straightforward and also more active. Companies themselves make an effort to set the goals together with the research institutions, whereas before SHOKs typically the researchers got a small funding from Tekes and worked mainly alone to set the specific research targets.

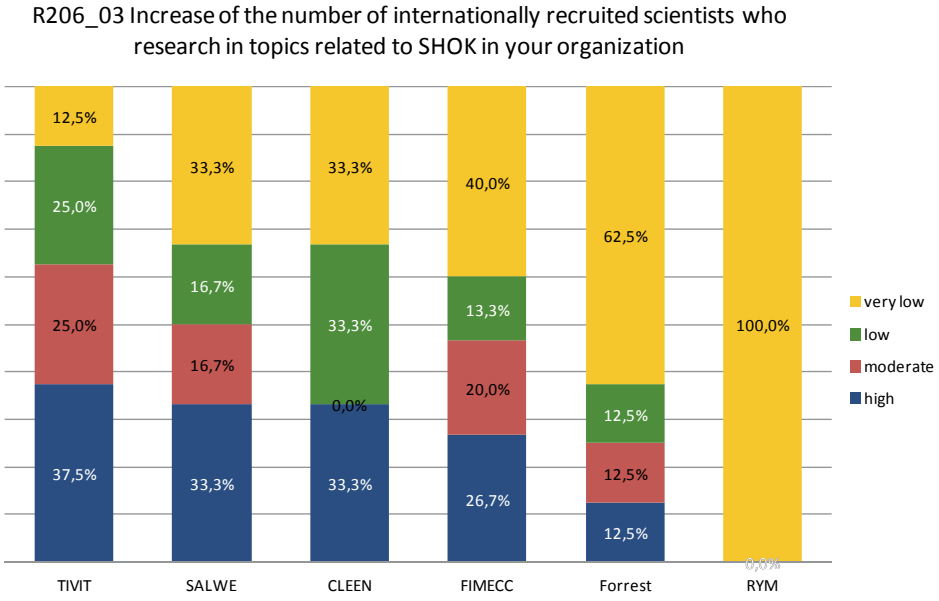
Again, the fact that all RYM's programmes have a lot of participants makes the operations within the programmes complex. Even if conducting research is more fluent and more efficient than before, the structure of the programmes is more complex than what had been a structure for individual projects from a company point of view. This is partly due to the process in which the first three RYM programmes were built, where participants were representatives of many different sectors of the built environment industry and the number of companies was large. It was discussed in the interviews, that in the future this needs to be changed. It was commented that for the next RYM programmes the number of participants should be approximately

10. This number of participants is seen to be able to put together enough volume but still be relatively small group so that decision making processes will work fine. One should note that in the latest EUE programme the number of participants is already much smaller than in the first programmes without diminishing the programme anticipated research volume.

Among the interviewees the researchers were in minority. However, the researchers interviewed generally found practical cooperation within RYM programmes as a positive way of working and feedback was mostly positive. Most frequent critical comments were related to the lack of research culture in the companies representing built environment industry. Researchers said that companies do not necessarily understand the researchers' workloads, neither the requirements for time and resources of high quality research. At the same time, the companies criticized in some cases that the researchers are not investing enough time on the research and felt that the RYM programme work gets too little attention or gets done by a too fragmented research groups. Also, some company representatives felt that there is lack of cooperation between research groups even within the same programme (e.g. researchers are not familiar with each others' work and are not willing to exchange knowledge). Overall, the building of research – company and research – research collaboration culture in the built environment area needs a lot of attention also in the future.

One critical issue that was mentioned both by company and research organisation representatives was the international research collaboration. Often the best state-of-the-art researchers can be found abroad, but at the same time involving international researchers directly to SHOK programmes has been difficult due to the funding rules applied by Tekes. This is a critical issue that needs to be solved if the SHOK programmes aim to do spearhead research that is of top international quality. The severity of this issue from the RYM's point of view is shown by the survey responses where all the researcher respondents considered the international recruitment in RYM to be at the very low level (Figure 4).

Figure 24. Survey results on the research organisations' view on international recruitment.



Programme preparation

"Trying to grasp the big picture of RYM Ltd research is like doing a huge jigsaw puzzle with the pieces up-side-down" - Interviewee -

According to the interviewees, the preparations of the RYM programmes have been quite complex processes. All the interviewees realized that in the beginning it was a necessity to have a large number of parties involved and the way to operate within SHOKs was new for all. RYM needed to find a right way to operate through broad discussions. The complex process has had its benefits on its own. One of the interviewed researchers even said that even if the programme would not have gotten funding, already the preparation process was a valuable and rewarding learning process to get to know new potential company partners.

Despite of the above, the interviewees shared a view that in the future the efficiency and transparency of the programme preparation needs to be improved. The process of presenting ideas for programmes as well as decision making process prevailing the start of preparations for new programmes was somewhat unclear for the members of RYM that were not actively involved in the board work. Also the international RYM evaluation panel criticized the lack of clear criteria for programme selection. RYM has already noted these challenges and is developing the programme preparation phase. The programmes should also be more focused and the number of participants should be lower with higher commitment.

Programme results

Despite of the complex preparation process, the interviewees considered the results of research programmes to be mainly successful to the extent that can be assessed at the moment. Common worry for the interviewees was that in the long-term the work might get too dispersed as the philosophy of the RYM at the beginning was all inclusive and not so focused. The number of participants is big and some are more committed than others. At the moment, the co-operation and discussions within the programmes take place at the lower level and not for example between the on-going programmes.

When the first PRE programme approach the end next year, due attention should be paid to create a good overview of the accomplishments and assess the lessons learned for the future. The expectations are high, but the expectations also differ among different parties involved. The international RYM evaluation panel also urged the PRE programme to pay a lot of attention over the last year to summarize clearly the accomplishments this far.

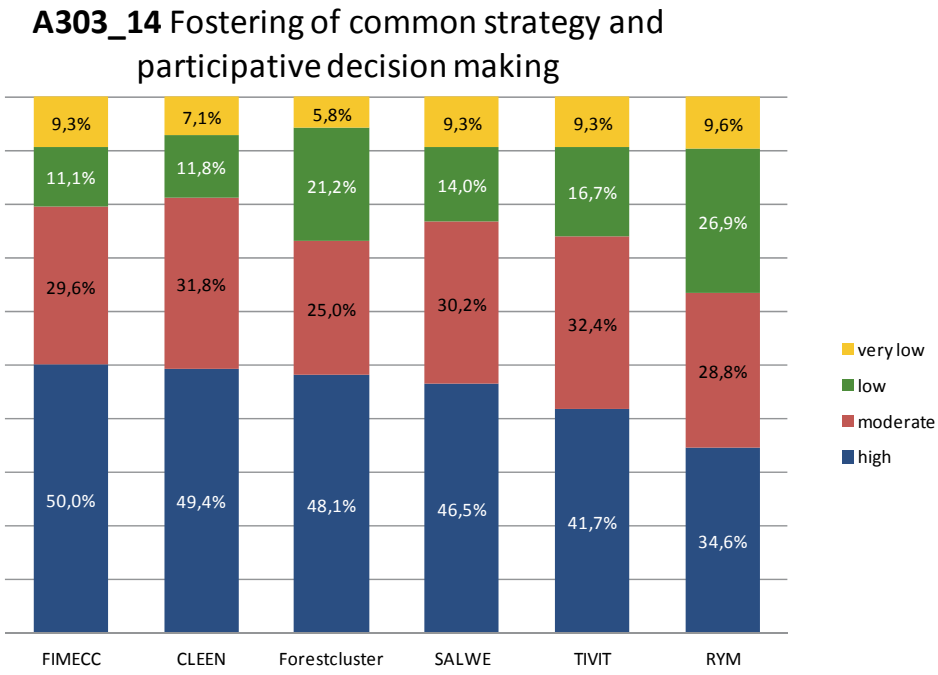
2.6.7 RYM Ltd governance model

Overall the interviewees were satisfied with the governance model of the RYM. The governance model and organizational form as a privately owned limited liability company were found to give clear structures for the operations. Moreover, the organizational structure where companies and research organisations have an ownership of a SHOK makes them more committed.

An interesting note from some interviews was that the willingness of companies to make a commitment through ownership was only possible because the built environment got their "own" SHOK. The interviewees thought that it would have been unlikely that these companies would have joined the SHOKs of other industries. In thinking of SHOK future, this is a challenge compared to the earlier note that the renewal of industries would require more interaction and collaboration amongst different industries. Also, it is vital for RYM to get companies beyond traditional built environment industries to join RYM programmes.

Interviewees that are members or had been members of the RYM board felt that the governance model is working well. Some interviewees outside the board felt that the strategic work of the board is not sufficiently visible for all RYM shareholders and partners. Especially the mapping of possible programme ideas and the early preparations of the programmes are phases that the board should more actively communicate with all actors in RYM. Figure 4 representing the survey respondents' view on the common strategy and participative decision making supports the observation from the interviews. Compared to other SHOKs, there were more respondents who were not satisfied with participative decision making. The need for a more active board will be emphasized in the future if the programmes become more focused and at the same time require larger investments.

Figure 25. Survey respondents' satisfaction with the statement "fostering of common strategy and participative decision making"



"SHOK was a cold shower that makes you scream but afterwards it feels great"
- Interviewee -

The RYM personnel, i.e. CEO Ari Ahonen and Research Director Anssi Salonen, received positive feedback for the execution of the RYM operations. Also, the interviewees were satisfied with the choice to keep RYM as lean as possible and do as much as possible of the practical work within programmes or with other partners. However, despite of the competent work, two persons was often considered as inadequate for RYM's core activities. The interviewees also listed some areas where RYM could do even more. These wishes included the following issues:

- The collaboration between RYM programmes could be enhanced. This would need some coordination led by RYM.
- There could be more common seminars for all RYM programme participants where results would be discussed more widely (interviewees referred to Tekes programme seminars as an example of this type of events).
- International collaboration is a challenge and this needs continuous attention. RYM is already doing good work in this area, but even more is needed.

One should also note that following the RYM's business strategy, RYM has introduced new foresight and valuation services that are very important for creating long term visions and to build up the capacity to create high quality research ecosystems. These activities are not yet, however, sufficiently visible to the RYM shareholders and programme participants and did not come up in the interviewees.

2.6.8 Utility and sustainability

RYM is still in the very beginning of its operation and therefore the long-term utility and sustainability of its operation and possible results cannot yet be evaluated. However, all interviewees were asked for the added value of RYM, and the summary is presented in this chapter.

The most important effect or RYM so far has been that the built environment for the first time gathered to work for a common goal and the industry has been able to be on the "drivers' seat" to define the strategic research content. There have been visions already before, but the RYM and SHOK concept has provided an opportunity for concrete action. Strategic research agenda has been successful in gathering all intentions of the actors and has transformed them into to common goals and actions.

The SHOK-framework has been a totally new way of working and it required some time to get used to. Most of the companies in built environment industry were not really aware of the SHOK instrument before the foundation of RYM. "SHOK was a shock" said one of the interviewees, and continues "SHOK was a cold shower that makes you scream but afterwards it feels great." SHOK-concept has provided guidance for renewal for both of the research organisations and companies but is this "cold shower effect" sustainable? Still the expectations of fast results and short-term evaluation of profitability are strongly part of the culture in the built environment industry. The reporting requirements of SHOK do not help in this as the focus is too much on the short term results. The true opinions of the long-term added value expectations will be seen in few years after the companies have decided on the future commitments to continue the participation in RYM research programmes.

The interviewees felt that RYM programmes enable true company – research cooperation that goes beyond meeting discussions and seminar talks. It also forces companies to make long-term commitment and to introduce concrete actions. Requirement for significant resources and efforts by companies is seen as positive and is seen to enforce the companies' strategic role.

The interviewees said that RYM also had a clear added value to force the companies to work together. The companies themselves would not have been able to put the consortia together. Some interviewees said that they got to know new collaborators due to the RYM and without RYM many of the collaborations would not have been born. Most often this referred to new research partners for companies. On the other hand some interviewees said that new contacts were not made due to RYM, "everybody knows each other in this area". However, even if the main players

in the built environment have been in contact and even have had cooperation before, networking has become more efficient and structured. Especially the programme management has been successful in that sense that common rules and ways of working have been established.

In assessing the role of RYM for fostering the industry renewal, the interviewees shared a view that the strategic renewal of the companies has not been affected by RYM. In the first phase companies involved in RYM operations are those who have already had the ability and willingness for renewal. Some companies involved in RYM have substantially become more interested in research that meets international quality criteria, but there is still a long way to go to take the strategic research thinking to a new level and to see some changes that would lead to industry renewal.

One of the strategic goals of RYM has been to increase the R&D investments of the real estate and construction sector. The concrete strategic objective has been that in Finland the volume will increase from the present 230 million euro level to a level of 500 million euros by 2020. So far there have been signs of moving towards this goal and RYM definitely has a role in this. Requirements to make commitment to long-term research and development programmes have enforced companies to invest more in R&D programmes than what they had done previously. The attitude towards investments in R&D&I has changed.

"Earlier we had heated debates with the top management whether we can invest sums of thousands of euros on individual projects and the results were expected immediately, but now we even discuss investments of hundreds of thousands euros with a longer time perspective." – Interviewee.

What is then the ambition level for the future and how high do the research and programmes aim? The answers varied. Wide set of actors and programmes based on a broad SRA lead also to a wide number of different opinions on the level of ambition. Still many interviewees shared a view that"unfortunately RYM is nowhere near international state-of-the-art research and results". Multidisciplinary approaches have been emphasized and stated as possible sources of high level results. However, the international evaluation panel emphasized that the multidisciplinarity as such tends to get too much attention. The panel concluded that a lot needs to be done to increase the quality of the research, or more precisely, to do more work to learn to present the results with a high quality. RYM has now an important task to form a roadmap which visualizes different instruments, development of industry branches and research in order to show the future research coalitions that can be expected to aim for international level leadership in their respective research areas. A positive sign with concrete numbers is the role of RYM in facilitating the allocation of project funding in areas covered by built environment SHOK and its activities from the Academy of Finland. The number of applications sent for funding to Academy with the supporting statements from RYM is small compared to the SHOKs that have been established some time before RYM but the success rate of the projects that RYM has supported was full 100 % in the year 2011 (three projects).

It is too early to assess the long term commercialization benefits resulting from RYM, but many of the interviewees discussed the future potential. Companies participating in RYM programmes tend to expect concrete results very soon, but do not have sufficient capabilities to do further development work based on the research results. Many of the companies participating in the programmes of RYM have on-going parallel development projects based on Tekes funding. Combining these separate efforts to the RYM programmes is important already in the beginning of the RYM programmes. Even if the RYM programmes aim for pre-competitive research, the commercialization is expected to happen later on and also the demand for concrete benefits is strong towards the end of the programmes. At the moment, the interviewees were not confident that all of the companies involved in RYM and its programmes would have the qualifications to produce new products and possible other new ideas and benefits for built environment industry. Moreover, the ways to utilize and commercialize the expected results are not yet properly discussed among RYM programme participants. There is also the tendency to expect the results too soon without taking into account the time it takes to build up the research structures for international top level research.

> "Important and potentially very effective catalyst for built environment reseach ecosystem"

2.6.9 Conclusions and implications for the future

RYM has been important and potentially very effective catalyst for built environment research ecosystem

RYM has been very important for the built environment area and it has a great potential to catalyze the development of world class research ecosystems in few selected areas. It should, however, be kept in mind that RYM has been operating only few years and there is still a lot of work to be done. The realization of the potential is not yet at the sustainable level.

If RYM would stop its operations now and new programmes would not be initiated, the interviewees shared a view that the situation would very quickly return to the pre-RYM status. The companies would not continue to increase the investments on R&D and ambition level would focus on short term development activities.

Overall conclusion was that one of the main benefits of the SHOK concept has been that the strategic research planning power is now at the hand of companies. In order to use this power effectively, the companies participating in RYM's programmes and activities need to build up their strategic research capabilities. Moreover, from a RYM perspective, it is critical that also the commitment and strategic leadership of research organizations is in line with companies' views and also public sector organizations take a strategic view on research. SHOK alone is not enough to build up these competencies.

Main future challenge for RYM is to focus on fewer areas with fewer partners but with higher commitment and larger volume

RYM was built up based on a very broad participation and the first programmes have had a lot of partners involved. This was a necessity in order to get the work started. However, at the moment the overview of the work done this far is fragmented. To really build up few world class research ecosystems, there is a need to focus the work with fewer partners that on the other hand are more committed and also invest more. This is a challenge to implement and requires actions at many levels.

There needs to be more border crossing at different levels, but this also requires appropriate research culture and structures

Built environment area as a whole shows up as a slightly confusing set of actors. On the one hand it is very broad field involving a lot of different industries and having a significant role in the society. At the same time the "circles are small" and also the research community is small. In order to renew the ways of doing research and foster industry renewal a lot of different types of border crossing is needed. The building and real estate sector companies need to seek for research collaboration opportunities with companies that represent other industries and research groups need to work across the science disciplines. In practice, also within existing programmes the collaboration among researchers and between the programmes could be enhanced. Also the collaboration between the SHOKs could be used much more than what takes place now.

The active role of public sector in built environment area is an important feature that is both an opportunity and a challenge

The role of public sector is more significant for RYM than in many other SHOK areas. This should be seen as an opportunity and the involvement of public sector actors may open up a lot of interesting opportunities. The active role of the public sector actors in strategic research requires more attention. There are both practical issues to be solved and also strategic questions to address. Also in the public sector, the competencies to make strategic research decisions need to be strengthened.

There should be realism with the expectations

It takes at least 10 years to build a research team with high world class results. The further development and final commercial utilization of the insight that research generates takes also its own time and effort. Three years is too short time to yet assess any concrete results from RYM and one would hope patience with the expectations. The researchers and companies should be able to set their visions for future at least with a 10 year perspective. Also the policy makers should have the same or even longer time horizon in their mind when the results are monitored and the success assessed.

Strengths and impacts	Weaknesses
• As a youngest of SHOKs RYM has had only few years time to operate, but has managed to activate the network and get programmes up and running. • Has strengthened long-term research-industry collaboration and strategic long-term view of many industry partners. • The R&D investments of the real estate and construction sector have increased and RYM has had a role in this.	• The commitment and strategic leadership role of research organizations should be strengthened. • Too broad network and lack of focus, the overview remains fragmented. • International outreach of research.
Opportunities	**Threats**
• Has potential to catalyze the development of world class research ecosystems in few selected areas. • Focus on fewer areas with fewer partners but with higher commitment and larger volume. • Public sector organizations could increase their commitment and participation as well as take a strategic view on research. • RYM operates in areas appropriate for initiating more collaboration between the SHOKs.	• Lack of committed industry partners with the commitment to increase the research volume. • Strategic capabilities to define future research programmes with sharp and ambitious focus

2.7 Overview of SalWe

2.7.1 SalWe Ltd history and characteristics

SalWe was established by 28 shareholders in May 2009 as the Strategic Center for Science, Technology and Innovation (SHOK) in Health and Well-being. The number of the shareholders of non-profit limited liability company SalWe., responsible for operational work and allocation of resources, has increased to 19 companies and 14 research organizations that represent the Finnish health and well-being cluster.

The theme of health and well-being covers several fields of science and sectors of industry. Until now there has been the collaboration between various fields in the health and well-being sector has been rather limited. SalWe, which is multidisciplinary platform, has brought together more than 10 research fields and sectors. As mentioned by interviewees, the establishment of SalWe has been considered as an achievement. The preparation the SalWe took nearly three years. Ever since its establishment, operation of SalWe has progressed as planned and the companies have committed to collaboration. According to the interview of SalWe Board members, an advantage is that the companies of different sectors are not overlapping and they are not competing with each other. On the other hand, SalWe has not accepted all the researchers who have shown interest in the programmes. The selection of researchers has been based on quality of research and willingness for co-operation with companies. Peer review has not been used.

SalWe has two research programmes. Both programmes i.e. the Intelligent Monitoring for Health and Well-being (IMO) and the Mind and Body have started in 2010. The IMO started its operations in the end of 2010, whereas the second

programme Mind and body started its operations in the beginning of 2011. Since the activities of the SalWe have been in operation only two years, it should be noted that it is an early stage to evaluate the outcome of SalWe.

2.7.2 SalWe Ltd organization

SalWe is a non-profit limited liability company. The shareholder companies are as follows: Biotie Therapies Oyj, CSC – Tieteen tietotekniikan keskus Oy, Elekta Oy, Finnzymes Oy, GE Healthcare Finland Oy, Invalidiliiton Asumispalvelut Oy, Kustannus Oy Duodecim, Lääketietokeskus Oy, Mawell Oy, Medisize Oy, Oy Medix Biochemica Ab, Mobidaig Oy, Nexstim Oy, Orion Oyj, Philips Oy, SPR Veripalvelu, Thermo Fisher Scientific Oy, Tieto Healthcare & Welfare Oy and Valio Oy. In addition, all universities and research institutes in the area of health and well-being are also shareholders of SalWe: Aalto University, Tampere University of Technology, Åbo Akademi University, University of Helsinki, University of Jyväskylä, University of Eastern Finland, University of Oulu, University of Tampere, University of Turku, Finnish Institute of Occupational Health, MTT Agrifood Research Finland, National Institute for Health and Welfare, UKK Institute and VTT Technical Research Centre of Finland.

The organization is comprised of SalWe Board, Managing Director, Programme Directors, Programme General Assemblies and Programme Steering Groups. The 10 members of the SalWe Board represent the shareholders. The role of the SalWe Board has been active from the beginning.

The Managing Director of the SalWe serves as a Secretary of the Board. At present SalWe employs one full-time person, the Managing Director. In addition, SalWe has two part-time programme directors. The Legal Counsel is serving for all six SHOKs legal affairs. Other services such as communication and financial services have been outsourced. Based on the interviews and surveys, the feedback about the coordination and operation is very positive.

2.7.3 SalWe Ltd's SRA

The strategic research agenda of SalWe was compiled in the spring of 2009 (Version 1.0 27.3.2009). It was based on cross-disciplinary collaboration between selected nutrition, diagnostics, imaging, pharmaceutical, information technology, and service companies. SalWe's mission is to improve the health and well-being of individuals and to foster related Finnish business.

According to the SRA, the goal of SalWe is to pursue research leading to the development of products, services and practices that prevent and treat diseases having major impact on public health and the economy, and comprehensively maintain and improve the functional capabilities of individuals. To achieve the goal, SalWe has selected diseases and conditions, which have been internationally

recognized as major challenges for the health care, for focus. The focus areas are as follows: obesity, metabolic syndrome, neurodegenerative and psychiatric diseases, a healthy brain under stress, microbial infections, inflammation, and malignant diseases (especially solid tumors).

The focus areas chosen for SalWe are based on recognized Finnish strengths such as molecular and translational medicine, pioneer position in preventive measures of type 2 diabetes, brain research with prototype products for a variety of imaging approaches, innovations in the technology platforms for diagnostic applications, cancer research and nutrition. In addition, the strength in ICT and telecommunications and a uniform health care system support selected areas.

Three programmes were prepared on the basis of SRA. SalWe started to prepare programmes as follows: 1) Health and Functional Capacity of the Brain, 2) Intelligent Monitoring of Individuals' Health and Well-being, 3) Obesity and Related Health Challenges – Stopping the Epidemic. However, two programmes have been started, and the themes of the third programme were included in two programmes (see 2.2 below). The updating of SRA is ongoing and will be finished by the end of 2012. The next research programmes will start in 2013 and 2014 on the basis of updated SRA.

2.7.4 SalWe Ltd's programmes

SalWe has two research programmes i.e. Intelligent Monitoring for Health and Well-being (IMO) and Mind and Body (Elixir). The contents of the current research programmes were planned in co-operation between companies and research institutions on the basis of the companies' research needs.

The shared goal of the SalWe's programmes (Table 1) is to create high level scientific know-how and to apply this know-how in the development of new solutions and innovative, intelligent, cost-effective tools. During the second phase of funding, both programmes aim to increase horizontal collaboration within the programme and improve utilization of the synergies of the work packages. The budget for activities and coordination function of the SalWe's research programmes is ca €61 million (469 person years).

Table 2. Summary of SalWe's research programmes.

	Intelligent Monitoring for Health and Well-being (IMO)	Mind and Body (Elixir)
Period	1.6.2010-31.12.2013	1.7.2010-31.12.2013
Goal	to develop tools that allow individuals or healthcare professionals to promote well-being and health activities	to improve management of obesity and brain disorders
Number of participants	14 companies, 7 universities or research institutes	13 companies, 11 universities or research institutes
Total volume (€)	€ 25 million (companies ca €12.5 million, universities and research institutes ca €12.5 million). The share of Tekes funding is 35-50% / company and 70% / university or research institute.	€ 36 million (companies ca €19 million, universities and research institutes ca €17 million). The share of Tekes funding is 35-50% / company and 70% / university or research institute.
Total volume (number of person years)	209	260
Key figures of the stakeholder companies (total)	Company stakeholders employ ca 3,500 people in Finland, combined turnover is around €550 million, combined investments in research, development and innovation is ca €45 million	Company stakeholders employ ca 8,800 people in Finland, combined turnover is around €2,700 million, of which exporting accounts for €1,100 million, combined investments in research, development and innovation is ca €150 million

The work methods, organization, and management of SalWe's research programmes are similar. During the first years of operation, effort has been put on building processes. The programmes are managed by SalWe's Board, a Programme General Assembly (PGA), a Programme Steering Group (PSG), a Programme Director, and an Expert Group (EG) comprised of Work Package Managers. The programmes are implemented by interdisciplinary and cross-sectoral consortiums. The tasks of the stakeholders are presented in Table 2 (see below 4.2).

A research portal has been established for both the Intelligent Monitoring for Health and Well-being (IMO) programme and the Mind and Body programme. The access to the research portal has been restricted to the stakeholders of the programme. SalWe Board and the stakeholders of each programme monitor the outcome of the programme yearly.

The programmes are funded according to the model so that at least half of the programme's expenses results from the companies' research activity. SalWe's expenses resulting from research programme management are covered by administrative fees, which are eligible for Tekes' funding for the stakeholders participating in programme implementation. The administrative fees also cover the work done in the programmes by the Managing Director of SalWe as well as other administrative expenses related to the programmes i.e. meetings, seminars and communication.

2.7.5 Relevance: stakeholder views on SHOK policy goals

The general SHOK policy goals set by the Research and Innovation Council (RIC) in 2006 were as follows: promoting internationally high quality research and expertise, enhancing industrial renewal and targeting the resources to strategically selected clusters. These policy goals were considered as relevant and valid by interviewees. On the other hand, some interviewees were critical. The original policy goals were said be too broad. Focus was lacking. It was stated that the SHOKs such as SalWe would have been established faster if the policy goals by RIC had been more focused. It took time to define the focus of SalWe. The negotiations between different sectors and research fields took time. However, the long-term preparation period of SalWe was seen to be necessary. SalWe's consortium agreement governing the conditions for the programmes was compiled in good spirit.

In addition, the goal concerning internationalization was considered as a challenging topic. It was asked what is meant by the internalitionalisation of SHOKs. Some of the interviewees argued that export and the perspective of national economy were missing. According to the interviewees, the aim to increase employment should be noted in the SHOK policy goals.

2.7.6 Relevance of SalWe Ltd strategy and SRA

Future wish list ranges from internationalisation to entrepreneurship

It should be noted that SalWe's research programmes have been in operation only for approximately two years. SalWe's strategy and SRA have been seen to be relevant and in line with the policy goals. One of the main strengths of SalWe is that the preparation of SRA was interactive. The companies participated actively in the process. SalWe's focus areas were considered more and more relevant although the operation environment is changing rapidly. SalWe has ordered a study on global trends for the purpose of updating of SRA.

According to the survey, most of the respondents agreed that the general research aim and focus of the Strategic Research Agenda (SRA) of SalWe is "cutting edge" and future oriented". Company respondents agreement with the statement was 67% high and 33% moderate, whereas research organization respondents agreement with the statement was 50% high and 50% moderate. On the other hand, the e-survey results for satisfaction with fostering of common strategy and participative decision making varied between all respondents (47% high, 30% moderate, 14% low, 9% very low).

Interestingly, the e-survey showed that research organization respondents agreement with the statement "the SRA of SalWe is attractive to all relevant international partners active within the topic of SHOK „was 67% high and 33% moderate. On the other hand, satisfaction with initiation of international contacts

varied between SalWe respondents (35% high, 24% moderate, 17% low and 24% very low). Research organisations' view on international recruitment outputs was more positive than the company respondents view. The research organizations' agreement with statement „Increase of the number of internationally recruited scientists who research in topics related to SHOK in your organization" was 33% high, 17% moderate, 17% low, 33% very low. Respectively, the company respondents' view was 91% very low and 9% low. Although SalWe's company stakeholders primarily operate in Finland, some of them have strong international business. The internationalization is further discussed during the current updating of SalWe's SRA.

According the interviewees, the updating of SRA will not include any major changes. The actions of the updated SRA will be presented at more concrete level than today. The SalWe's focus will be on brain diseases and lifestyle diseases as present. In addition, the updated SRA will state that focus of internationalization should be toward Finland. There is a need to attract foreign funding, researchers and companies and to strengthen operations of international companies which already have their offices or centers in Finland. In the future, SalWe will make an effort to increase the volume of international cooperation and funding. Some interviewees stated that SalWe should also promote entrepreneurship in the future.

SalWe's strategy and SRA were based on recognized Finnish strengths. According to the interviewees it is an advantage that only two research programmes were selected. In Finland, the number of companies and the amount of critical mass in the area of health and well-being are limited. Therefore, the number of research programmes is seen valid. SalWe covers all the main players in core development areas.

Based on the interviews, there are significant opportunities at the interfaces between different sectors and research fields of SalWe. The horizontal collaboration within the programme will be increased during the second funding period of both programmes. It is aimed to improve the utilization of the interfaces and synergies of the work packages. Some of the interviewees said that it has been discussed that a cross-cutting theme would be useful between the current research programmes (e.g. the perspective of system biology). SalWe plans to foster collaboration between the programmes. For example, there are co-operation opportunities between SalWe and RYM in environmental health as well as between SalWe and TIVIT in personalized medicine.

2.7.7 Effectiveness: SHOK as a part of Finnish innovation ecosystem

The SHOKs were considered to be too isolated from other parts of the Finnish innovation ecosystem. The lack of the host of SHOK was considered as a problem. Although coordination was asked from the Ministry of Employment and the Economy, it was stressed that the SHOK issues not only belong to the Ministry of Employment

and the Economy. Some of the interviewees were disappointed with the commitment of the government. It was argued that only two sentences concerning SHOKs are included in the current Government Programme. The general SHOK strategy set by the RIC was seen relevant. On the other hand, the RIC is working at strategic level, whereas it cannot commit government and other governmental agencies.

Most of the interviewees commented on SalWe and its operations only. The interviewees had limited knowledge about the background of the SHOKs at policy level. The SHOK concept as a part of Finnish innovation ecosystem is discussed elsewhere in the evaluation report (Chapter 1).

2.7.8 Practical R&D&I work in SalWe Ltd programs

SalWe has built up a similar programme structure and management system in both programmes. The practical work in SalWe programmes is summarized in Table 2. Interviewees were very pleased with the programme administration and management. The support from SalWe's Managing Director was seen to be very good. The programme preparations were said to be successful learning processes for the participants.

Table 3. The tasks of the stakeholders of the SalWe programmes.

Stakeholder	Tasks
SalWe Board	Approves the participation of non-shareholders in the programme on the basis of the PGA's recommendation, decides on submission of funding applications for the programme, nominates the Programme Director, nominates the PSG together with programme participants, assists in settlement of any disputes between the parties, adopts development projects supporting or generated by the research programmes into SalWe, decides on termination issues at the Consortium Agreement level.
Programme General Assembly	Approves the meeting practices and decision-making procedures unanimously agreed on in the first PSG meeting (including Chairman), approves significant programmes changes and issues, decides on termination issues at the individual programme agreement level, reports (when necessary) to SalWe's Board
Programme Steering Group	Steers and supervises implementation of the programme, approves the meeting practices and decision-making procedures unanimously agreed on in the first PSG meeting (including the Chairman), monitors the programme's progress and supports realization of the objectives with its expertise and ensures that acquired expertise can be conveyed to such parties that can utilize such expertise, steers allocation of work between the industrial parties and research parties, collects proposals for development projects of the research programme and presents such proposals to SalWe's Board, prepares mechanisms for monitoring basic research in the field of the programme including an annual scientific seminar, builds international co-operation in the field of the programme, reports to the PGA

Programme Director	Implements and supervises operative management of the programme, ensures that the programme is duly managed, provides information to the parties, investors, and the members of the programme steering group on research funding decisions and their terms as well as on the progrees of the programme, compiles a content report describing the programme's progrees on an action basis. The report covers both the companies' and the research organizations' shares of the actions, collects the respective parties' settlements of expenses and prepares a summary of such settlements, delivers the content report and the settlements of expenses according to the reporting schedule set forth in Tekes' funding decision, notifies Tekes in writing of any changes that have an impact on implementation of the programme or any other circumstances that have an impact on the use of funding, evaluates, together with separately appointed experts, the applications to the Academy of Finland for which a recommendation will be requested from the Coordinator, and plans an annual scientific seminar together with the PSG
Managing Director of the Coordinator	Acts as the secretary of the PSG and the PGA, supports the programme director in implementation of the research programme (including follow-up reports and settlements of expenses), organizes seminars and workshops by assignment of SalWe's Board and the PSG, contributes to collaboration between programmes, supports communication between the research programmes and basic research, supports internationalization of the research programmes, reports to SalWe's Board
Work Package Manager	Monitors research done in the work packages, compiles a content report describing the progress of the work package, the report covers work done by both companies and the research organizations, reports to the Programme Director

2.7.9 Assessment of the R&D&I activities in SalWe Ltd programmes

Success stories range from image segmentation for therapy targeting, prostate cancer biomarkers measured with multianalyte platform and chronic airway diseases to biomarkers of intestinal inflammations and affordable monitoring by printing technology

It is too early stage to assess the R&D&I activities in SalWe programmes, which have been operating for approximately two years. Overall the interviewees were satisfied with the first steps of the SalWe R&D&I activities. The co-operation, networking and commitment have been excellent. One company has dropped from a SalWe research programme due to economical situation. Based on the e-survey, research organizations' expextations on improving of existing scientific competencies/ knowledge base are at high level. Most (75%) of the respondents answered „high", whereas 25% answered „moderate". On the other hand, company respondents' expectations on developing research capabilities were lower. One-third of the respondents answered „high", „moderate" and „low".

So far, the outcomes of SalWe have been published as success stories. The programmes' success stories will be actively reported and disseminated by SalWe.

The success stories are also available in paper format both in Finnish and English. The success stories of the IMO programme are as follows: 1) Image segmentation for therapy targeting, 2) Prostate cancer biomarkers measured with multianalyte platform, 3) Chronic airway disease - from genetics and proteomics to novel diagnostic approaches, 4) Biomarkers of intestinal inflammations, and 5) Affordable monitoring by printing technology. Respectively, the success stories of the mind and Body programme are as follows: 1) Novel methods for intensive care, 2) Web-based support for lifestyle changes, 3) Can we foster linguistic neuroplasticity, 4) Milk works in many ways, and 5) Changes in brain function during recovery of stroke patients.

The interim results at the 1 year milestone of the IMO's work packages (WP) have been described as follows[47]:

- WP: Intelligent Biomarker Combinations
  - New candidate biomarkers for COPD have been discovered by sputum proteomics
  - Celiac disease symptom groups associated with altered microbiota composition and blood group secretor status
  - Lipid profiling reveal age and functionality related differences in lipid composition of mesenchymal stem cells
  - Proteomic biomarkers from serum and tissue samples and panel of 13 gene expression markers
- WP: Intelligent Platform Integrations
  - Prototype of Universal Integrated Electrochemical Sensor Platform was developed
  - Extensive Survey of Sample Preparation Technologies and Company Needs was prepared forms basis for many sample pretreatment projects
  - Many possibilities for collaboration and cross-WP projects were created, eg. High Density Plate + Prostate Cancer panel of WP201 (proof-of-concept) and Sample preparation + printed POCT of WP203 (next step)
- WP: Intelligent Printable Monitoring
  - Proof-of-Concept for Printable microfluidic chip demonstrated with sensitivity of 2 mg/l CRP in plasma
  - Proof-of-Concept for the whole blood CRP with sensitivity of 3 mg/l by using TR-fluorescence measurements in filtration based printable assay
  - Techniques, materials, and designs for manufacturing of 3D capillary for a finger prick sampling and enzyme stabilizers in printing evaluated
- WP: Citizen – Professional Collaboration
  - Analysis of a real patient medical record has started and first health impact results have been calculated

47 Source: Programme Director's presentation 18 September 2012.

- The data collected in Espoo and preliminary results on process and clinical outcomes presented, collection started in Hämeenlinna

- WP: Multimodal Image Processing & Archiving
  - Algorithms have been developed for using segmented fibroids of uterus for automated treatment planning, segmenting prostate started
  - Usability study to define the user interaction related to image segmentation and MRI-MEG co-registration for MEG data analysis was made.

According to the SalWe, the five most significant results of the Mind and Body programme[48] are as follows: 1) Recovery mechanisms of the sensorimotor cortex after stroke; 2) Novel speech and language therapy approach to post-stroke aphasia combining intensive language action therapy and transcranial magnetic brain stimulation, 3) The intensive care unit EEG Headset, 4) A Method for Detecting Epileptic Seizures in the intensive care unit (ICU), and 5) Internet-based low-resource diet and physical activity counseling method to support lifestyle changes (PI Urho Kujala, University of Jyväskylä). The results of the work packages have been described as follows[49]:

- WP: Associations between stress and overweight at population level
  - Cohort and follow-up data (DPS, FinnTwin, North Finland Birth cohort, Nuadu, Professional drivers data, Life at Stake, Nurses study) have provided knowledge on the association of work related strain with life styles, food preferences and eating behaviors used by companies and in planning subsequent studies
- WP: Short-term impacts of lifestyle changes
  - Study protocol to characterise changes caused by work fatigue in measured and experienced cognitive functions and brain processes
  - Internet-based low-resource diet and physical activity counseling method to support lifestyle changes
  - Data on sleep and activity collected with personal devices and information on consumer needs related to such data to be used for further development
- WP: Mechanisms of obesity, stress and the pleasure experience
  - Effects and mechanisms of dietary factors and physical activity on body composition and performance
  - Development and piloting of methods to measure pleasure and emotions induced by foods
- WP: Applicability and efficiency of different approaches in lifestyle interventions
  - 'Lifestyle management and changes in everyday life' multicenter intervention begins 9/2012
  - Family intervention promoting healthy lifestyles on the family level begins 1/2013

48 Programme Director's presentation 18 September 2012.
49 Programme Director's presentation 18 September 2012.

IPR issues not actively discussed – yet? Possibilities to be pro-active in this area

The research results will be presented to the programme stakeholders at annual SalWe seminars. The scientific results of the SalWe programmes will be published as usual in the form of programme reports, theses, scientific publications, presentations at international scientific seminars. By September 2012, the Mind and Body programme has resulted in 30 articles accepted or published in peer-reviewed scientific journals, 14 theses at L.Sc., M.Sc. or B.Sc. level (17 Ph.D. theses and ca 30 Master's or Bachelor's theses ongoing). Respectively, the IMO programme has resulted in a number of articles published in scientific peer-reviewed journals and ca 20 conference papers. In addition, ca 10 PhD theses are ongoing.

The results of the e-survey showed that the company respondents of SalWe are more satisfied with the technological competitiveness than outputs such as new businesses. According to the e-survey, agreement with the statement "increase of the overall technological competitiveness in topics related to SalWe was 53% „high", 32% moderate, 5% low, and 10% very low. On the contrast, the agreement with statement "increase of the number of new markets entered" was 55% very low, 36% low and 9% moderate. Furthermore, the company respondents' view on outputs such as new businesses and spin-offs was at low level. The agreement with the statement „Increase of the number of new businesses created/spin-off by employees of your firm in topics related to SHOK" was 67% very low, 17% low, 8% moderate and 8% high. SalWe is in its early stage. Therefore, the views on outputs should be asked again after the period of the research programmes IMO and Mind and Body.

According to the interviewees, the industrial property rights (IPR) have not been actively discussed. By September 2012, SalWe has five invention disclosures of both programmes. Some interviewees stressed that IPR created within a SHOK programme should be protected before publications. The company stakeholders of SalWe will utilize the results to develop products, services, and operating methods. On the other hand, the activities of companies are not transparent because of competition. The companies have made an FTO (freedom to operate) assessment in their own area of operation at the beginning of the programmes. According to SalWe[50], it is possible that the patent situation will change during the programme period and prevent utilization of results.

Some interviewees stressed that there is a need to develop the assessment of R&D&I activities of SHOKs. The interviewees expressed wishes that the R&D&I activities should be monitored in relation to objectives such as international business and export (in euros), commitment, networking and new interphases e.g. number of SMEs around SalWe. For example, it was recommended that a survey should be sent

50 SalWe 3.4.2012 The material gathered and prepared in relation to the SHOK evaluation.

to participants of SalWe asking what kind of changes has taken place in networking and co-operation. It was stressed that the lifecycle of R&D&I activities of SalWe is long. Therefore, the goals such as extended lifespan and organization of health care system were seen to be out of scope of Salwe's period. It is impossible to answer to what extent the policy goals set in 2006 have been achieved in SalWe. It should be noted that the lifecycle is different between different SHOKs. For example, the research and development project in the field of health and well-being in general takes longer time than in the field of IT.

2.7.10 Efficiency and appropriateness

The first phase of SalWe has shown that SHOK concept is an appropriate and effective way of organizing R&D&I collaboration. The main strength of the SHOK concept is the active participation of industry in preparation of the research plans. The priority of SalWe is international business. The SHOK such as SalWe was seen as a unity.

In comparison, a Tekes programme was seen as an umbrella. According to the interviewees, the Tekes programmes are lacking the perspective of business, whereas the research programmes of the Academy of Finland are primarily based on scientific quality. It was said by interviewees that the perspective of business has decreased in OSKE (Osaamiskeskusohjelma in Finnish, Programme for Centres of Expertise). The companies of OSKE were said to be too passive.

Overall the interviewees were very satisfied with the SHOK concept and its governance. The co-operation between SHOKs as well as between SalWe Board and Managing Director is working well. The management, leadership and administration of SalWe were seen to be effective. The advantage is that the administration of a SHOK company is thin. The Managing Director of SalWe received positive feedback from interviewees, who represented SalWe Board and Programme Managers. The Managing Director of SalWe has previous experience of coordination and strong capital of networks.

The SHOK concept was seen appropriate for the renewal of businesses. For example, service business and digital services were proposed by several interviewees. As mentioned above, TIVIT and SalWe should develop co-operation e.g. in e-health and personalized medicine.

2.7.11 Utility and sustainability

Utility and long-term sustainability of SalWe cannot be evaluated after two years of operation. In terms of the impact chain i.e. input-output-result-impact, the outputs such as the number of publications,

"Critically important to develop the collaboration with public health care system"

conference papers, number of invention disclosures reflect the expected impacts. As presented by SalWe, operation has progressed as planned. It was seen as an important indicator that the companies' commitment to collaboration has been concretized as efforts invested in the programmes. There has been only one drop-out company. Based on the interviews, the participation of large-scale enterprises such as Valio was seen important.

So far, the main impact has been that SalWe has promoted the co-operation between companies and research institutes as well as between different sectors and research fields. SalWe has been a successful network. For example, SalWe is a promising platform for the mobility of researchers between universities and companies.

SalWe has had an impact in participating companies. In some cases, SalWe has affected the strategy of participating company. According to the SalWe's survey, 26% of the respondents reported that SalWe has changed the research policies of their own organization, and 39% answered that SalWe has changed their organization positively. An added value is that SalWe has provided new networks for the companies. Previously, the co-operation between researchers and companies has been on bilateral basis, whereas the SHOK is a unity, which has a common goal.

In terms of utility and sustainability, the lacking collaboration between SalWe and service providers such as municipalities and hospitals, is a weakness. Both programmes of the SalWe aim to produce solutions with which the public system could be developed and the border between public and private could be dissipated[51]. As mentioned by several interviewees, it is critically important to develop the collaboration with public health care system, which is seen one of most important partners. In the future, hospitals, municipalities, and other functionaries such as occupational health care providers should have an important role in providing need-oriented test beds for SalWe.

As an industry driven approach, the purpose of the SalWe concept is to create business from research in a long period of time. The SHOK projects are positioned in a precompetitive phase. According to the SalWe[52], the main impact from the standpoint of companies is to create new business, significant international exporting, and growth in productivity. The best outcome meters are the companies' development projects spawned by the SalWe research programmes and the new or improved products, services, and operating methods created as a final outcome of the projects. On the other hand, it is difficult for SalWe to monitor the number of the companies' development projects, because the companies do not need report about their own development projects for SalWe. As the results of the e-survey showed (see above), the outcome in terms of new business is still open.

51 SalWe 3.4.2012 The material gathered and prepared in relation to the SHOK evaluation.
52 SalWe 3.4.2012 The material gathered and prepared in relation to the SHOK evaluation.

2.7.12 Conclusions and implications for the future

SalWe is deemed to have been very successful in its operations. So far, the main impact has been that SalWe has promoted the co-operation between companies and research institutes as well as between different sectors and research fields. SalWe has been a successful network. The coordination of the SalWe is outstanding and the spirit is good. The commitment in SalWe has been very good.

It is impossible to answer to what extent the policy goals set in 2006 have been achieved in SalWe. It is too early stage to evaluate outputs such as new businesses after two years of operation. There is a need to develop the monitoring system so that objectives such as international business of the participating companies and number of SMEs around SalWe could be monitored.

SalWe's focus areas i.e. brain diseases and lifestyle diseases play an important role in the ageing society. The SalWe's focus will continue on brain diseases and lifestyle diseases as present. It is an advantage that only two research programmes have been selected. In Finland, the number of companies and the amount of critical mass in the area of health and well-being are limited. SalWe covers all the main players in core development areas.

The weakness of SalWe is the low level of international cooperation. There is a need to attract foreign funding, researchers and companies and to strengthen operations of international companies which already have their offices or centers in Finland. In the future, SalWe will make an effort to increase the volume of international cooperation and funding.

There are significant opportunities at the interfaces between different sectors and research fields of SalWe. For example, there are co-operation opportunities between SalWe and RYM in environmental health as well as between SalWe and TIVIT in personalized medicine and E-health. In the future, hospitals, municipalities, and other functionaries such as occupational health care providers should have an important role in providing need-oriented test beds for SalWe.

SalWe

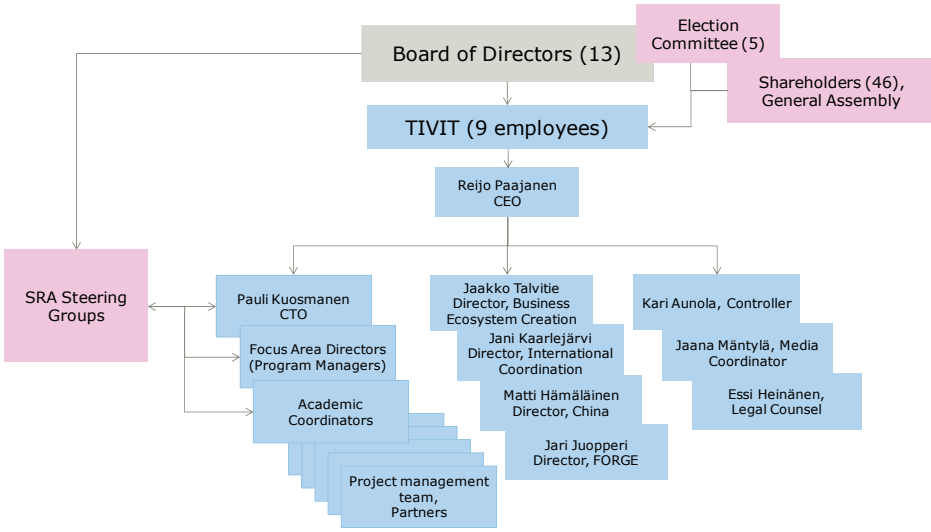
Key strengths and impacts	Weaknesses and challenges
• Focus of SalWe is on very important fields. The importance of health and well-being for the society, the high quality of research (e.g. in biomedicine, epidemiology, food and nutrition, and cancer) and infrastructures (e.g. IT, population based data and comprehensive integrated health system) coupled with high but largely unexploited potential in Finnish companies makes health and well-being a particularly promising area for public-private collaboration in research and development. • Interdisciplinary and cross-sectoral collaboration between industry and research has been successful. SHOK concept has put the companies in a more active role. • Management of SalWe has been excellent. • A substantial part of the current research programme carried out in SalWe is of high scientific quality output and represent the global cutting edge. • Because of the short duration of the SalWe projects it is too early stage to assess the impact of the new concept on new businesses and other commercial spin-offs.	• Current research programmes are highly heterogeneous in terms of the research themes, research volumes and quality of research. • Lack of key performance indicators for monitoring • The whole area of SalWe is not a strong hold of Finnish industry. SHOK is a bottom-up Finnish industry driven approach – also a weakness if relevant industry is limited. • Lack of links to service providers is a major disadvantage as e.g. municipal health services both form a testbed and are an important user of the product innovations. SalWe should develop collaboration between municipal health and social services, occupational health companies and insurance companies to identify needs, to support testing of innovations and to find new shareholders. • To foster outputs and impacts, SalWe should develop collaboration with TIVIT in the field of e-health, integrate industry from outside and start up companies (to have international companies with potential to collaborate) and contact other similar type of organizations in Europe e.g. in the Netherlands

2.8 Overview of TIVIT SHOK

Tieto- ja viestintäteollisuuden tutkimus TIVIT Oy (here referred to as "TIVIT") was founded in February 2008. TIVIT's legal form is Limited Liability Company. TIVIT has altogether 46 shareholders, including private enterprises, Higher Education Institutions (HEIs) and other research organisations, business and science parks and associations (see Annex 1 for a complete list). Technically TIVIT has two tiers of shareholders, those who have 1000 shares, giving the first tier less than 8% of votes per shareholder, in the general assembly and those who have 100 shares.

TIVIT is run by a core staff of nine persons, including the CEO, CTO, Director of Business Ecosystem Creation, Director of International Coordination, Director of China Programmes, Director of FORGE, Media Coordinator, Controller and a Legal Counsel who serves all the SHOKs. The six research programmes have a steering company or a programme owner called 'driver company', specifically, Nokia Plc, L.M. Ericsson Llc, Logica Plc, Sanoma Llc, F-Secure Plc (see below for details on the programs). The program directors are on the host organisations' payroll, and their working time spent on TIVIT activities is compensated from the programme budget. While TIVIT doesn't have a scientific board, each program has an academic coordinator who coordinates the research activities within the programs.

Figure 26. TIVIT governance structure 2012



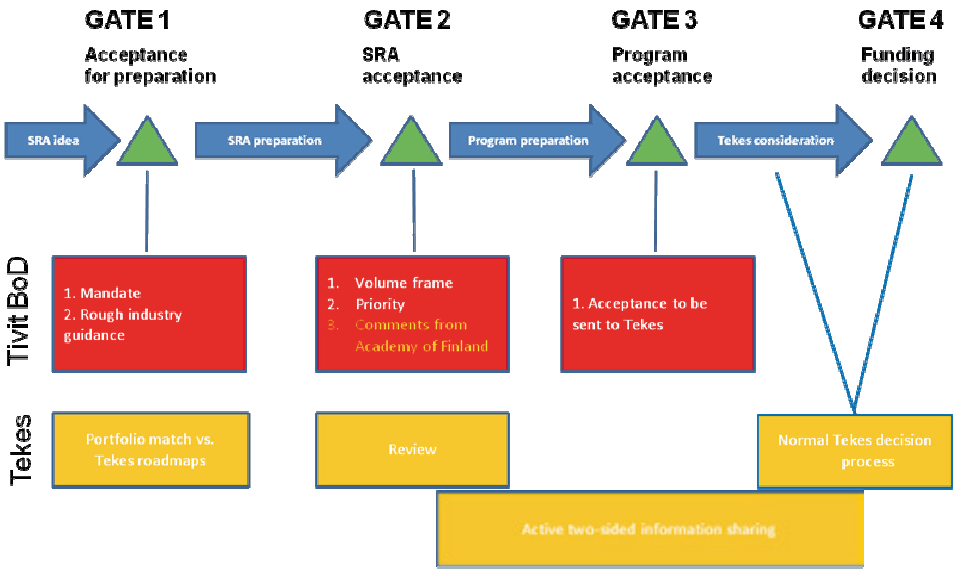
While the TIVIT strategy spans several years, up to ten, the research strategy is assessed, updated and approved yearly, enabling TIVIT to follow the technological progress in the ICT industry and to answer demands as they arise without creating unnecessary friction. The major vehicle for implementing the strategy is the Strategic Research Agenda (SRA) and the programs. Differing from some other SHOKs, TIVIT has a one core strategy, and each program have their own SRA built by the research partners to implement TIVIT strategy. The other model in SHOKs is to develop a SHOK-level SRA which is then taken to the research programmes. This puts the beneficiaries into charge of their own success, and especially the network engine plays an important role in formation of the SRA and its later success.

According to the TIVIT – SRA and Program Manual, "[t]ypically the SRA-idea is presented to public in TIVIT's annual Foresight presentation. Based on the interest of potential partners TIVIT BoD will make the go/no go decision. On the positive case, the SRA is written and then accepted by TIVIT BoD [Board of Directors]. Acceptance may precede 1–2 presentations to the BoD. After the acceptance the SRA is made public and the actual program plan starts. Naturally program and SRA planning may overlap. The BoD accepts the plan (partners, budget, research plan), which is then sent to Tekes.

Both [TIVIT and Tekes] are having active and decisive role in the processes. In the beginning the SRA-preparation is mandated by TIVIT BoD after portfolio discussions with Tekes. Tekes is reviewing the SRA, which is accepted by TIVIT BoD. After acceptance, TIVIT BoD gives guidance about the volume of the program and the priorities of research. The program is prepared in an open manner, especially towards Tekes. The acceptance of the program to the Tekes is done by TIVIT BoD,

as described above, Tekes is using their normal processes in the evaluation and acceptance of the program."

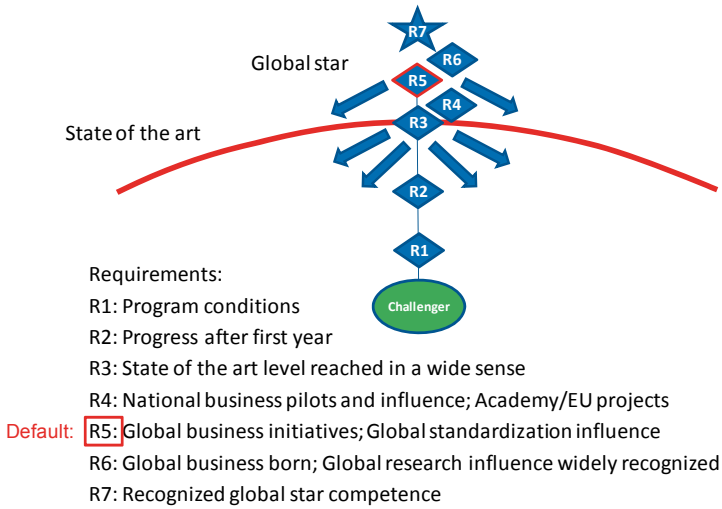
Figure 27. Illustration of the process for creating the Strategic Research Agenda (SRA) in TIVIT (BoD, Board of Directors, Source: Kuosmanen et al. 2012[53])



The TIVIT programs (see Figure 27) are planned against a set of TIVIT milestones, or requirements/criteria. There are seven milestones, R1-R7, as shown in Figure 3. The seventh is "Recognized global star competence", where the benchmarks are recognised global leaders in a field. The level of milestone 5 (R5) is the minimum aim for each program. At the time of the panel meetings Future Internet had reached R5, and Next Media as well as Cloud Software have passed their R3 milestone evaluation, conducted by an independent panel. Device and Interoperability was also considered to have reached the state of the art. The other three programmes, Digital Services, Internet of Things and Data to Intelligence are in their first year and are at the second level. Future Internet was considered to have reached the R5 level when it finished.

53 Kuosmanen, P., Aunola, K., Heinänen, E., Mäntylä, J., Paajanen, R., Talvitie, J. 2012. TIVIT – SRA and Program Manual , Version 1.80, 3.1.2012

Figure 28. TIVIT competence benchmarking framework and levels (Source: Kuosmanen et al., 2012; Kuosmanen, 201254)



TIVIT research is organized in a fashion loosely derived from agile development and Scrum practices, which are employed in many IT firms; in the case of the Cloud Software program, the problem setting in the SRA would be the program backlog, and the program is organized on three-month development sprints, resulting in certain incremental progress towards the program goals, followed by a sprint review and potential reorientation of the product backlog[55].

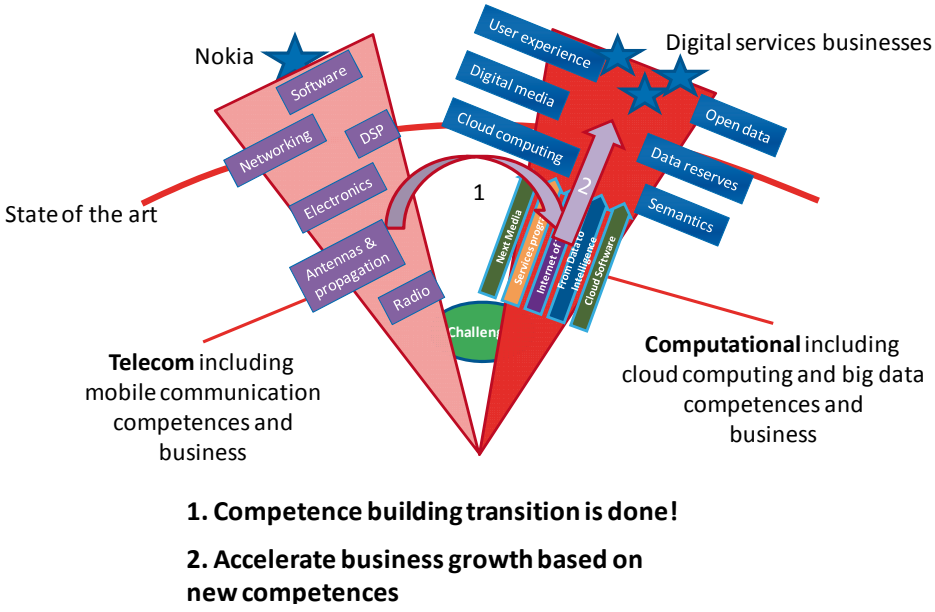
2.8.1 Overview of TIVIT activites

TIVIT's mission is to create new business in the information and communications technology (ICT) industry. Specifically TIVIT focuses on new service creation, aiming to create functional business ecosystems in the Finnish market, which can be scaled up toward international markets. TIVIT has made a conscious strategic decision to diversify research, development and innovation to digital services, and out of the hardware-driven RDI. Engineering oriented RDI has been traditionally strong in Finland, due to the fact that Nokia alone has an order of magnitude larges RDI budget than any other Finnish company, and it has been the largest single employer in the ICT industry for over a decade. TIVITs aim has been to complement the existing knowledge by building competence for digital service business through its research programs. As illustrated below, TIVIT aims first to build competence and then a global business ecosystem based on mobile services within the Finnish ICT industry.

54 Kuosmanen, P. 2012, TIVIT Strategic Research Agenda - SRA Governance, presentation at the panel meetings, 20 September, 2012.

55 for Scrum terminology and concepts, see e.g. The Scrum Alliance, Scrum: The Basics, Available at: http://www.scrumalliance.org/pages/what_is_scrum

Figure 29. Illustration of TIVIT strategic direction and focus areas (Source: Paajanen, 201256)



TIVIT offers four services for its shareholders and programme participants. The basis of TIVIT operations and its main operative cash flow source are the research programs (see below). On top of the research TIVIT offers services for facilitation of business ecosystem creation to secure the take-up of research results to actual business innovations. In practice the business ecosystems are built around the research results with business partners, who sign a business ecosystem frame agreement for a risk sharing RDI cooperation. Each ecosystem have their own steering group, chaired by TIVIT CEO, an ecosystem manager elected by the consortium, as well as representatives from the participating enterprises. By the ecosystem frame agreement, selected RDI and business results may be shared on voluntary basis. Each ecosystem may apply for grants from a funding organisation of their choice, in practice commonly Tekes, for joint risk sharing RDI projects to develop business innovations. TIVIT sees the ecosystems as a part of a continuum, where the SRA and corresponding research programmes produces prototypes and technologies, which act an" ecosystem core". The core is further developed toward business innovation and business models are developed around it for several stakeholders. These business models are then taken up by the partners at their discretion to the marketplace (Hermes, 2012[57]).

56 Paajanen, R. 2012. Overall presentation of TIVIT (ICT SHOK), Presentation at the evaluation Panel meetings, 19.9.2012

57 Hermes, J.W.S., 2012. Business Ecosystem Management: TIVIT's Ecosystem Analysis and Advancement (TIITUS), Project Report, University of Oulu, Business School.

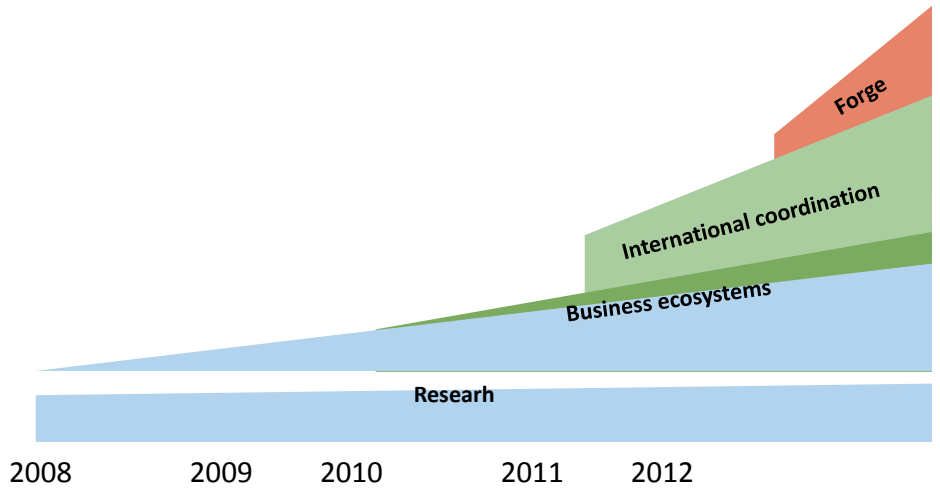
Additionally TIVIT participates in coordination of international research activities, where the main efforts are participation in the EU-funded Future Internet Public-Private Partnerships (FI PPP)[58], specifically the Facilitation and Support Action CONCORD, and China-Finland Strategic ICT Alliance[59]. TIVITs coordination activities are operated in close cooperation with the EIT ICT Labs Helsinki Node[60]. The role of international coordination is to enhance international networking and also enable service development for the international markets.

On top of these services, TIVIT is in the process of launching the TIVIT FORGE, which is an open digital service development platform/toolkit with an open development environment and sandbox cloud to develop and test digital services. The plans for FORGE include alliance with business incubation services, e.g. the successful Protomo network[61], to further support digital service business creation. In a manner the service create a continuum from research, to business model and ecosystem building all the way to operative new service development.

The services are summarised in the figure 30 below.

SERVICE INNOVATION: "FORGE"
⇨ open digital service development platform/toolkit with an open development environment and sandbox cloud to develop and test digital services

Figure 30. TIVIT services (Source: Paajanen, 2012)



58 See: http://www.fi-ppp.eu/
59 See: http://www.ictalliance.org/node/30
60 See: http://eit.ictlabs.eu/ict-labs/nodes-co-location-centres/helsinki/
61 See: http://protomo.fi/protomo-brings-ideas-and-people-together

As a part of and in support to its core services TIVIT organizes event ranging from high level summits, e.g. the European Summit on the Future Internet 31.5.2012 (in cooperation with The Interdisciplinary Centre for Security, Reliability and Trust of the University of Luxembourg), theme seminars and webinars, and preparation workshops for Tekes and Academy of Finland funding calls.

Additionally TIVIT offers what they call advanced innovation management tools to support the business impact of the SRA activities. The current tools are in practice the procedures and processes described in the SRA and program manual (Kuosmanen et al. 2012).

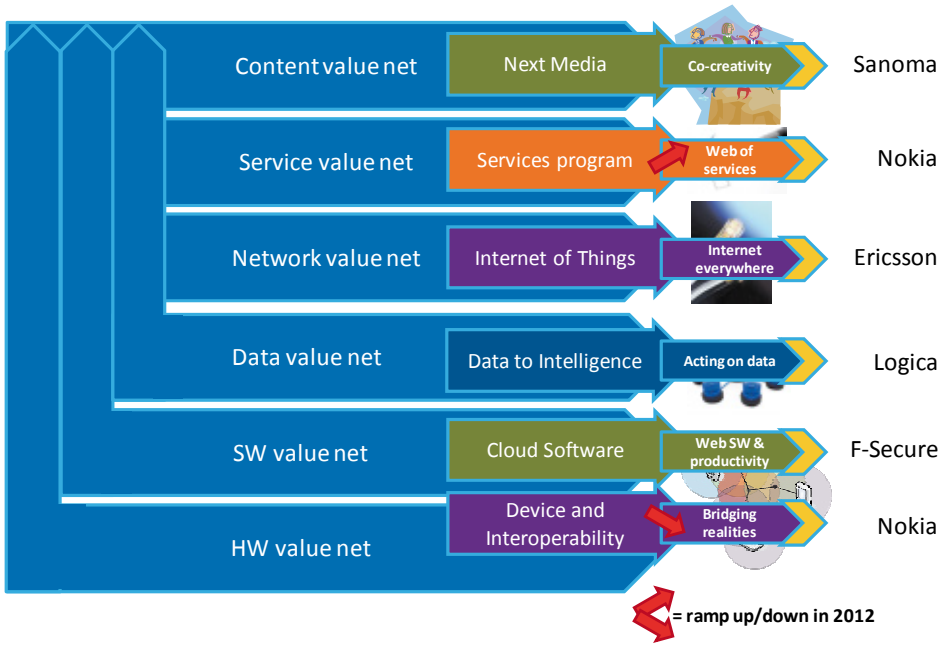
2.8.2 Overview to SRAs

The basis of TIVIT activities are the six research programmes (Figure 5), which focus both on the computational basis of value creation in digital services and the value networks or ecosystems that build on these capabilities. All of the programs contribute to the two overarching key themes of TIVIT, digital services and data reserves.

Starting on bottom of the figure, the programs are focused on hardware-software interface and architecture in Devices and Interoperability Ecosystem (DIEM); on cloud computing and Cloud Software (CSW); on developing application and services to make "Big Data"[62] more actionable in Data to Intelligence (D2I); on development of networking capabilities in and between different appliances in Internet of Things (IoT); on developing new services specifically aimed for SMEs based on use of mobile internet and new terminal solutions in Digital Services (DS); and new business model for media, based on co-creation, access and content profiling in Next Media (NM). The following table summarizes the key objectives set for the SRAs.

62 Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburh, C., Hung Byers, A. 2011. Big data, The next frontier for innovation, competition and productivity, McKinsey Global Institute, McKinsey & Company. Available at: http://www.mckinsey.com/Insights/MGI/Research/Technology_and_Innovation/Big_data_The_next_frontier_for_innovation

Figure 31. TIVIT research program protfolio 2012 (Source: Paajanen & Kuosmanen, 2012)



In addition to the on-going programs, TIVIT has already closed down three programs, aimed at creating solutions for Intelligent Transport Systems by developing ICT solutions for vehicles, logistics and traffic control in Cooperative Traffic ICT (CT, ended in February 2011, led by IBM Finland); developing flexible and scalable digital service infrastructures and platforms, creating a Web of Services for the global markets in Flexible services (FS, ended autumn 2010, led by Elisa Communications); and improving the quality of service and robustness of Internet routing infrastructure and resilience in abnormal conditions in Future Internet (FI, ended spring 2012, led by Nokia Siemens Networks).

When comparing the programs between each other, there is a high degree of complementarity, as realizing the full potential of cloud computing and services requires a stable and robust internet routing infrastructure, and developing new applications and services benefits greatly from interoperability and common architecture platforms, which in turn make cloud computing and delivery of digital services easier, more flexible and reliable, and also offer novel opportunity through a wider array of terminals. Looking at the ramped-down programs, it seems that some of the original objectives have been carried out to the present programs, e.g. from Flexible Services to Digital Services, and from Future Internet to Internet of Things.

The vision operationalised into specific goals is outlined in detail in the appendix.

2.8.3 Central results

Starting from the key performance indicators KPI as reported to the Ministry of Employment and the Economy (Table 2), TIVIT is among the largest SHOKs by funding and committed person years. One observation is that resource commitment from enterprises is larger than academia and research organisations roughly by a factor of two. The volume of person commitment and turnover between TIVIT and FIMECC are roughly comparable. TIVIT programmes have resulted in five IPRs, 15 development projects in participating enterprises and approximately 80 publications per year. In comparison to FIMECC, TIVIT lags behind in IPR as measured by invention disclosures, patent applications and patents as well as academic publications. Where TIVIT is clearly the strongest, is participation EU programmes. TIVIT is active e.g. in ARTEMIS Joint Technology Initiative and European Institute for Innovation and Technology.

The built-in expectation behind the TIVIT SRAs is that the consortiums are working toward creating globally recognized capabilities and business ecosystems, as portrayed in the milestones set for the programs. As of mid-2012, all TIVIT programs that have been running over a year are, according to self evaluation, on R3 "State-of-the-art level reached in a wide sense" or on R4 "National business concepts and influence; Academy/EU projects". The default target for the programs is R5, where the program has global influence in research and standardization as well as global business initiatives. The now defunct Future Internet reached R5 during its final year of operation.

Looking at the reported results and achievements (Table 3), most of them are quite business oriented, while of course they build on technological research and development. The following table details TIVIT results in the qualitative sense and the competence level according to TIVIT self-assessment.

Looking past the key performance indicators (KPI), the interviewees note that TIVIT programmes have a great indirect benefit to the industry as they have created new networks and given opportunities especially for SMEs to get new contacts and develop their services by offering a new arena for exchange between industry actors. One of the key added values of TIVIT across the board to the participants is creation of business ecosystems. The non-participant view is that TIVIT is not well known in the field. However, the services needed or called for included mostly services that have been on TIVIT agenda.

Besides creating business ecosystems, TIVIT seeks to disseminate its results, or information about the results actively through multiple channels besides academic publications and press releases, including an annual results seminar for the stakeholders, and separate results seminars within the programs, theme webinars organised every other week, as well as an activity blog, and a result of the week series of posts in the TIVIT blog. TIVIT also seeks to participate and launch Open

Source Software communities where possible and appropriate to maximize the impact of the RDI activities.

Table 5. Key performance indicators (KPI) for the SHOKs

	TIVIT 2010	TIVIT 2011
Social and economic significance		
Launched 5-year program volume, M€		
Total volume of activities (person years)	472,0	415,3
Proportion to total r&d&i activities in sectors involved (%)		
Number of national connections/partnerships	0,0	0,0
Launched 12-month volume, M€	53,4	42,7
Human and financial resources		
Funding from businesses, M€ commitment	32,2	25,8
Investment (person years) by companies	279,9	252,1
Funding from universities, M€ commitment	15,3	12,3
Investment (person years) by universities	130,8	123,8
Funding from research organizations, M€	7,3	4,6
Investment (person years) by research organizations	59,3	48,8
Infrastructure made available for SHOK, M€	0,0	0,0
Funding secured through public competitive tendering, M€	0,0	0,0
Key outputs		
Number of invention announcements and patents secured	5,0	5,0
(Number of) Licences sold	0,0	0,0
Results leading to development projects within companies	15,0	15,0
Number of spin-off companies generated	1,0	1,0
Number of pilots generated	29,0	17,0
Number of scientific disciplines participating	29,0	21,0
Number of sectors participating	29,0	23,0
Number of referred published articles	86,0	78,0
International links		
Participation in EU projects, including role	19,0	19,0
Proportion of EU funding in total budget		
Number of international partners	1,0	1,0
Proportion of international partner organisations in total budget, %	0,3	0,3
Person years contributed by international researchers	4,0	4,0
Researcher mobility (person years, country of origin and destination)	7,0	7,0
Future objectives for participation in EU research programmes (M€ total budget (target year))	16,8	16,8
Future objectives for participation in EU research programmes (person years)	144,4	144,4

Table 6. Key results from TIVIT RDI activities (Source: Paajanen & Kuosmanen, 2012. TIVIT – 20 major Achievements from SRAs)

Programme	Milestone	Academic	Business
Device and Interoperability Ecosystem (DIEM)	R3: "State of the art level reached in a wide sense"	- Prototype Augmented Reality technology for smart phones	*Direct business impact*: - Non-intrusive application load monitoring (NIALM) tool for remote measurement of risk situation in senior homes - Smart exercise environment implementation based on RFID and personal training profiles *Ecosystems/business consortia*: - There - ThereGate / ThereCore based ecosystem - Healthy Flying - Airport fitness centers
Cloud Software (CSW)	R3: "State of the art level reached in a wide sense"	- Twonky packet video search engine - Vividworks web-based visualization and 3D modeling tool for interior design	*Direct business impact*: - Lean development process adopted in Ericsson R&D center, other partners to follow - Ixonos has developed a cloud based e-gov't solution for municipalities *Ecosystems/business consortia*: -Finn-Cloud - Open Finn-Cloud stack
Data to Intelligence (D2I)	R2: "Progress after the first year"	n/a, ramp-up phase	n/a, ramp-up phase
Internet of Things (IoT)	R2: "Progress after the first year"	n/a, ramp-up phase	n/a, ramp-up phase
Digital Services (DS)	R1 "Program Conditions"	n/a, ramp-up phase	n/a, ramp-up phase
Next Media (NM)	R3: "State of the art level reached in a wide sense"	- Know-how on using new content delivery platforms - New insight in measuring media experience and basic knowledge on new kind of advertising in tablets	*Direct business impact*: – Technological enablers: HTML5-publishing, metadata for automated workflows and layout on different terminals – Know-how for new generation of editorial systems and tools for doing business on multiple platforms *Ecosystems/business consortia*: - Entitle – Semi-automatic subtitles for TV broadcasting - Mobile publishing - Device-independent content delivery platform - Epaper – Content & media distribution with novel solar powered tablet - Finn-Tag - NFC based cost effective, scalable service package and business model

Collaborative Traffic (CT)	n/a (R4: “National business pilots and influence; Academy/EU projects”)	- Several multi-service platforms for pay-as-you-go traffic and location based services	*Direct business impact*: - Parking guidance and information application systems developed and piloted, including a web-based parking reservation system - Real-time traffic information system/portal *Ecosystems/business consortia*: - INPRED - Intelligent travel time prediction for demand responsive transport
Flexible Service (FS)	n/a (R4: “National business pilots and influence; Academy/EU projects”)	- Cross-media publishing, including metadata models, sematic profling, mobile content feed systems and location-based news ervices (carried over to Next Media)	*Direct business impact*: - Mobile Financial Services platform development, resulting a mobile banking solution and mobile ticketing solution - Supply Chain Management, including demonstrator system and a mail sorting service
Future Internet (FI)	R5 “Global business initiatives; Global standardization influence”	- Novel implementation of Access Network Discovery and Selection Function (ANDSF) for offloading traffic from 3G to WiFi network, improvement in UX and service quality - Solution for transmitting IPv6 pcket data over Bluetooth connection, enabling implementation of wireless sensors etc. without exhausting the IP address space (carried over to IoT program) - Malware identification engine with learning capabilities for Wintel executable/program files	*Direct business impact*: - Floating content Android app in development - 43 specific contributions to standardization within Internet Engineering Task Force (IETF), Internet Research Task Force (IRTF) and The 3rd Generation Partnership Project (3GPP) for mobile communications standards between 2008-2011 *Ecosystems/business consortia*: - D2S (Data to Security) - security products based on data analysis methods

2.8.4 Relevance

The research agendas, SRAs, have been built by the TIVIT stakeholders in collaboration. The TIVIT strategy and the SRAs are updated typically once every program period, as illustrated by the running version number. Smaller changes and adaptations happen within the programs during the lifetime of the program.

With regards to the SRAs, according to TIVIT, the ICT industry is headed strongly towards digital services, and accordingly TIVIT programs are all in one way or the other oriented towards digital services. In principle, as the participants themselves can create the SRA, it should be relevant to them. Additionally TIVIT and the BoD also typically advise the SRA creation according to their vision of what is important in the future. The lead companies of the SRAs have a very positive experience from the SRA process, and value the support and guidance they received from the BoD and CTO. Also the academic partners feel that they have been able to contribute to the SRA phase.

The flipside of the coin of industry-led agenda creation is that it can introduce groupthink, when people from the industry discuss among each other where they should be headed. This potential for tunnel vision may be amplified by the fact the SRAs are being set and approved by (mid-)senior executives who are preoccupied by the operative goals of their respective enterprises more than the strategic direction, and the same players, if not the same exact people, work on the TIVIT BoD, write the SRAs, sit in the program steering groups, and work in the programmes.

In the SRA-process the BoD and CTO have very strong roles and according to the interviews they tend to seek a broad consensus in the industry, especially between incumbent market leaders who naturally have places in the BoD. This tendency to try and gain wide industry acceptance makes the SRAs very broad, describing a whole area of work, its development directions and challenges. The challenge is then in the programming phase, to find a suitably sharp and attainable focus to avoid dissipation of resources. It also seems that the project/programme scope within the SRA is often determined more by the choice of consortium and the steering group, rather than by deliberate strategic choice based on the future prospects and potential to transform the industry.

The risk in this consensus-oriented culture is that the SRAs and programmes tend to converge towards a happy medium, and the revolutionary and horizontal topics that do not have intuitive appeal to industry incumbents and well defined target market tend to be pushed into the sidelines and may not easily make it into the programme agenda. Taking two examples where the risk may have be realized to some extent: It seems that for example the new programme Digital Services where the, at least implicit objective, given by the FAD was to support the lead enterprises' present business model in the face of changes in the industry, rather than trying

to reinvent or redirect it. This specifically is an example of sustaining, rather than renewing thinking, which may be a product of various factors, including certain amount of tunnel vision and locking into present strengths. Another one is Internet of Things, which is still in the orientation phase, where the programme has a very wide scope, and it to some extent seems to aim to accomplish more or less everything in the field.

The impact of the RDI to the participants' strategy varies between the programmes. In some cases participants indicate that the work and RDI they do in TIVIT is more or less business as usual, and in others TIVIT research has had a significant impact to the strategic direction of the participants, and to the whole industry. TIVIT has also has had an impact on the partners business through some commercial ventures. During the last two years TIVIT has reported one spin-off venture and around twenty business pilots each year.

The evaluation panel particularly noted that while the TIVIT portfolio is fine as such, and works on relevant topics for the IT industry, the programs are similar to those run by many other centres of excellence and other research initiatives, and they lack a horizontal nature. This is evident in the lack of potentially transformative horizontal agendas, such as smart cities, or gaming and multimedia, or digital service agenda that spans across industries.

In sum, TIVIT has a structured process for preparing, accepting and assessing SRAs. The stakeholders view the TIVIT management as very professional and fluid overall as well as regarding the SRA governance. In general the agendas are relevant to the industry, and they target areas that are novel and expected to grow in the future. For example, TIVIT has made a bold judgement to leave IT and telecom engineering aside, and focus specifically on creating technology and platforms for digital services. The ambitious objective is to renew the business model in Finnish ICT industry. However, to reinforce renewal of the industry TIVIT and/or research funding organisations could encourage research on horizontal topics and introduce significant incentives for the incumbents to cannibalize their own business in the interest of introducing really new innovations.

2.8.5 Effectiveness

The original mandate for SHOKs was to perform strategic RDI combining high-quality academic research with commercial interest over a longer time span. The TIVIT view to SHOKs is development and innovation oriented. The BoD of TIVIT saw the position of TIVIT as a more market oriented instrument compared to e.g. Tekes programmes or Academy of Finland funding. As such, the impact of TIVIT is to be expected more in the market than research side. The BoD of TIVIT saw the ecosystems creation and networking as the main valuable aspect of TIVIT operation, while others stakeholders have different views. Thus it seems that while TIVIT actors have generally a mutually accepted understanding about the position of TIVIT in the

Finnish RDI policy landscape, it somewhat differs from the original policy goals set by RIC. It has also become apparent that the mission of SHOKs in general seems to be unclear and there are different positions on what the SHOKs should be aiming at and with what means between the different stakeholders, including Tekes, the SHOKs themselves, and the programme participants.

Regarding effectiveness of TIVIT administration, TIVIT runs six research programs with a full-time staff of 8+1 persons (eight full time, and one legal counsel who works with all the SHOKs), and six program managers. TIVIT administrative fee is 2% of participating entities' research budgets and it has managed to administrate the programs and set a host of services, ending up in roughly zero profit – zero loss situation during its life span. However as Tekes ramp-up funding for the SHOKS is ending, in TIVIT's case it is foreseen to end 2012 there is a pressure to raise the administrative fee from the present 2% to roughly 4% (ungratified proposal). Compared to other SHOKs TIVIT has relatively heavy organization; TIVIT employs 8 full time people per six operational programs versus 4 full time people per eight programs in FIMECC. The explanation lies in the service portfolio offered by TIVIT, including international participation, coordination, and business ecosystem creation services. Thus, the amount of personnel is directly linked to the spectrum of services offered by TIVIT, and the international coordination activities do not burden the programme participants. Generally the satisfaction to TIVIT services is high, with rating 'very high' by approximately half of respondents in the stakeholder survey.

Return on Investment (ROI) too early to assess: still in the phase of building the competence base for digital service ecosystem, and that the economic impact will be realized down the line.

Now the TIVIT shareholders and participants of the programmes seem quite unanimously position TIVIT as an innovation platform, rather than a basic or fundamental research effort. If we look at TIVIT as an innovation program, then the Tekes standard in the ICT industry is in rough terms that innovation funding returns 10-20 times turnover once the product or service has matured, and development times are for SMEs commonly 1+1 years and for large enterprises 3+2 years of combined RDI time from idea to market. With that standard TIVIT should generate in the order of hundreds of millions to in excess of one billion EUR turnover in a couple of years to be on the same track. Looking at the results presented in SHOK symposium 2012 and reflection of the interviewees we cannot estimate to meet that ROI at this point. However, TIVIT claims it is in the phase of building the competence base for digital service ecosystem, and that the economic impact will be realized down the line.

Compared to e.g. Tekes technology programme "GIGA – Converging Networks" (2005–2010)[63], GIGA had a similar volume (Tekes funding to the program was 99 MEUR out of total 279MEUR volume, that is 20MEUR per year, roughly equivalent to TIVIT funding from Tekes) and many of the same actors as TIVIT, yet it produced more outputs than TIVIT for the same funding; during its six years GIGA programme resulted in excess of one thousand patents, and some of the largest enterprise projects alone generated up to one hundred patents, while TIVIT research has resulted in five invention disclosures and patents in 2011 and 2012.[64] The main bottleneck that is proposed for an explanation is that the SHOK funding terms that dictate sharing IPR within the programme will keep the participants from creating exploitable IPRs within the research programmes, and thus the KPI do not reflect the reality of capability building.

Thus, if evaluated as a research and technological development effort, TIVIT programmes have contributed less commercially exploitable IPRs as corresponding programs. The commercial results are also relatively rare, not many tangible products and services are directly attached to TIVIT. However, some of the lack of the results is explained with the fact that TIVIT prefers open source solutions where appropriate and shares the IPR, by virtue of funding Terms and Conditions set by Tekes, which sets the incentive to commit to R&D that is relatively far from commercialization, and not necessarily in the core business area. Also several programme participants are running sibling programs either by themselves or with Tekes that do not contribute to TIVIT programmes, but to their own product and service development.

The TIVIT SRAs and matching programmes are a mixed bag. In the interviews and evaluation panel meetings the consensus was that two of the first programs were disappointing: Collaborative Traffic went to disarray because the original lead company had to pull out because of strategy change, and Fexible Services because the consortium was too wide and ownership was lacking, leading to problems in performance. On the other hand, other programs, FI, CSW and NM for example, have been quite successful in creating new capabilities within the industrial partners and have also resulted in changes in the incumbents' business models.

In sum TIVIT has been effective in organizing research in the sense that the stakeholders have clear vision where TIVIT should be headed and the programs implement that vision. TIVIT also offers services to its constituents, which are generally highly satisfying to the participants as portrayed in the survey results. At its best, TIVIT can effective help renewal of the ICT industry and create new capabilities.

If we look at the facts however: on one hand if TIVIT work is to be judged as innovation programmes as per TIVITs own goals, it has contributed far less commercial results than the preceding Tekes technology programme GIGA. On the

63 See: http://www.Tekes.fi/programmes/Giga
64 Tekes, 2011. GIGA – Converging Networks programme 2005-2010, Final Report, Tekes Programme Reports 4/2011, Tekes, Helsinki. Available: http://www.Tekes.fi/ohjelmat/Giga/Aineistot

other hand, if TIVIT is to be viewed as a strategic research effort as per RIC goals, the focus is on rather short term and commitment to transformative research seems to be lacking. Thus it seems that TIVIT is left somewhere in the middle, trying to do a little bit of everything, but not producing as much outputs as the benchmarks. What remains to be seen is that will the building of business ecosystem based on digital services realize its potential in future.

2.8.6 Assessment of the efficiency and appropriateness

TIVIT's overall management is structured and professional, as mentioned above. The processes for SRA creation and management are structured and inclusive for stakeholders. TIVIT is also actively seeking to improve its operations, e.g. by means of outside evaluations of its activities, e.g. from the user experience point of view (Lehikoinen, 2010[65]) or from an analysis of the services (Hermes, 2012).

In general the interviewees were satisfied with TIVIT services, but one question remains to be asked: what is the added value of the SHOK over say Tekes RDI programs? The interviewees generally agree that it is the support and value-added services. As of now TIVIT offers legal services for e.g. contracting and other issues, support for applying and using funding and also publicises the results. Also during the evaluation panel interviews the view expressed by academic and enterprise partners was that TIVIT has introduced more genuine collaboration and exchange of ideas between researchers and enterprises than in conventional funding instruments. Particular points were indeed exchange of ideas and creation of a shared vision for the industry.

However, especially from non-participant perspective, TIVITs visibility and the services they offer are relatively unknown in the Finnish ICT industry. TIVITs situation is that present programs fill up the Tekes quota for funding, so in effect the programs are full already and there is technically little need to advertise TIVIT within or outside the industry. On the other hand broadcasting TIVIT and the services would potentially attract new players to the network and raise the probability that the most competent and ambitious companies are involved.

Governance best practice: exit strategy exists for TIVIT programmes

TIVIT has set an internal review process for the programmes, and one programme (Flexible Services) was shut down after a mid-term review that indicated that it will not reach its objectives. This speaks for the strength of TIVIT administrative procedures and healthy reflectiveness. However, there has been no clear answer to the question how does TIVIT measure success in its own operations and the programmes. TIVIT personnel explicitly

65 Lehikoinen, J. 2010. User Experience and Innovation Management in TIVIT programs – Current State Analysis, LeadIn Oy, presentation September 8th 2010.

expressed that the KPI set by the MEE are not meaningful for SHOK activities, and do not steer the activities. Now the programmes are evaluated against the international state of the art, but apparently there are no explicit measurable criteria that would be used, other than an independent review panel that sets the standard on reaching the state of the art. The other monitoring data sources are monthly reports to BoD from programmes and a pulse survey to stakeholders.

On the level of the TIVIT research programmes, there are potential governance issues. First, the sizes of the program consortium tend to be very large, up to three dozens of partners, and the connection between the partners are not always apparently very strong in the programming phase when the SRA is translated into a programme. The TIVIT BoD views the SRA as a 'white paper' that describes an area of work, the state of the art and the challenges. In their view it should be up to the programming phase to make choices of focus. However, looking at the programmes, e.g. IoT that is just starting, it tries to fill up the whole area of work. Similar situation has been apparently in NM, where the initial focus was very broad as illustrated the FAD's presentation in the panel meeting, but the programme has evolved over time to a much more focused effort with selected key topics and approaches. Second, the SRA creation and programming are largely consensus-based, so they topics and approach either tend to converge toward a happy medium or least common denominator, or split apart internally. DIEM was mentioned as an example of a programme that has two mutually exclusive and competing technical RDI strands. While this broad based consensus-seeking approach has clear benefits for networking, it may contribute to the fact that many stakeholders also think that there is internal rivalry on the programmes and dissipation of resources and relatively large communication and coordination overhead due to large number of involved actors.

The discussed points both set a challenge for the program administration and also program governance on the SHOK level. It seems that the stakeholders, especially on the academic side feel that the resources are dissipated to too large a host of actors. In the survey altogether 37,5% of respondents agreed at least moderately that SHOK programme does not provide enough coordination for sub activities. Related point on partnering is that 53% of TIVIT stakeholders agreed that research activities had been significantly affected by individual partners' internal problems, and 54% disagreed with the statement that partners stuck to the decided deadlines. All in all, TIVIT is in below the median in all items measuring programmes' internal dynamics compared to other SHOKs.

Additionally, instead of focusing on high-quality international-level capability building, especially smaller partners tend to focus on development and innovation activities in the programmes, with apparently relatively little contribution to the program. Also even quite large enterprises may participate in the programs with quite small volumes, in some cases in the neighbourhood of ten person days per year, which gives raise to the suspicion that these companies participate only to

see whether something interesting turns up in the results, ready to start their own development, without much interest in contributing to the research. More than one informant reported that they suspected that hang-around enterprises that have little to do with the core of the program are taken in to grow the private collateral funding volume, or that there were clear indications that some participants had committed to the program mainly to follow whether something useful that they could commercialize would be developed. In 2010 Lehikoinen (op cit.) also criticized that the partners tended to seek short term benefits from their own angle, which hampered taking full use of the benefits of cooperation in the longer term. As such this is a feature, not a bug, unless the hang-around corporations misuse the rights to use the IPR built into the programme by picking the best parts from the programmes and using them to their own advantage.

Which brings us to the Terms and Conditions for handling IPR created in the programmes. Several interviewees indicated that the mandatory IPR sharing that is an integral part of the whole SHOK concept is quite challenging for industry participants across the board. The present Tekes funding ToC mandate a blanket release for participants to use all IPRs and other results created in SHOK programmes. From an industry standpoint, it creates perverse incentives for participation. For one, starting out on a strategic research project, there is often little visibility to the scientific foreground that will be developed, or its applications and their marketability. For many enterprises it is very hard to commit to that kind of agreement, especially for SMEs that are often dependent on very few good ideas and one or two patents in their initial phase of development. This set-up creates an incentive to participate to see where the industry is headed and to meet potential partners and clients, but to keep ones best ideas and efforts to oneself.

While the participants are generally very satisfied with the efficiency of SHOK funding, the dark side is that time expenditure, activities and their outputs tend to be documented quite concisely, compared to e.g. EU FP7 or Tekes projects. While this effectively reduces administrative burden and overhead, it is also the main reason for the comments about difficulty of assessing the programs from a funding organisations' point of view. It also seems that communication within the larger programs tends to be focused work packages, and there are indications that there is some throw it over the wall mentality between work packages. This behaviour may also be a response to the IPR rules; the fact of the matter is that from the participants' standpoint, work that has not been properly documented has not been done at all. Without documentation, the work is only invested in individuals and tends not to cumulate over the consortium. This potentially hurts the impact of the program and prohibits pooling of knowledge resources within the program.

These findings also beg the question, are some of the programs too large, should they have been organized differently or split to multiple programmes? Another question is that should the selection procedure for partners be more selective? Looking at the individual programs in the light of the data, it seems that the structure

of the consortium and program management is the key aspect that determines the impact of a SHOK program. According to the participants and managers, the programs tend to have better impact when the consortium is led by a strong lead organization, and when the partners have clear and jointly owned objectives. This also motivates the participants to follow through the RDI work rather than just completing their part and documenting it according to bare minimum specifications.

In sum, the TIVIT perception of impacts was in general that the programmes have introduced new best practices to participants, lean agile project management being a case in point; have contributed to standards, particularly in the case of Future Internet; have helped product development by developing scientific foreground for new product development as well as applying and combining existing technologies; and have created stronger business ecosystems and given particularly SMEs access to new networks and knowledge. TIVIT is professionally organized, and all stakeholders are satisfied with the management efficiency and professionalism. However, the programme management in individual programmes seems to lack focus, which was noted in the panel report, and has in one case (indirectly) led to termination of a programme.

From the funding organisations' point of view, lack of transparency to the work and the tangible results of the programs posed a question that what is actually happening in the programs. As of now the results are not transparently reported to the funding organisation, which makes it impossible to estimate the return of the public funding. This in fact is a program level governance issue across all the SHOKs, as the funding principles as well as Terms and Conditions are set on the program level. Concerning the impact, there are three intertwined issues that pose a challenge to the contribution of TIVIT research: positioning and mission of SHOKs and TIVIT in the innovation and industrial policy field, Terms and Conditions regarding IPR and consortium structure.

2.8.7 Utility and sustainability

Based on the data, it seems that the greatest added value of TIVIT is associated with networking among the industry's key actors and creation on new business ecosystems. In quantitative terms the outputs of the program do not match traditional Tekes technology programs, if we benchmark e.g. the GIGA program. However one plausible explanation is the relatively unconventional IPR rules that bind TIVIT partners in sharing the programme results with all the partners in the programme. A Tekes representative noted that some of the SHOK programme participants run complementary proprietary research programmes under other Tekes instruments, where they file patent applications. This behaviour explains at least some of the apparent lack of outputs in from TIVIT, together with the fact that the programmes are relatively new.

In terms of focus, TIVIT agenda, as discussed is differentiated from the traditionally strong hardware driven development, and aims to develop new business multidisciplinary ecosystems around ICT-enabled services. The focus is also jointly defined not only by TIVIT, but the research consortia, which work to create a SRA for themselves. From the participants' view, this is aspect of TIVIT also the most important focus area and source of added value. The BoD members specifically rated creation of novel business ecosystems as the most important value adding dimension in TIVIT activity.

In general the commitment of the participants is high when measured with number of participants per program, and volume of industry funding. In fact the Tekes budget ceiling for SHOK funding has been the bottle neck for growth of the programs. However, it is expected that the added value of TIVIT, together with other SHOKs will become under closer scrutiny; TIVIT runs on service fees collected from the programme participants' respective research budgets and an initial ramp-up funding for SHOK operation, which Tekes will end in the near future. As of 2012 the TIVIT service fee is 2% of programme volume, while after the ramp-up funding has ceased, it is estimated settle to the level of 4%. It is foreseeable that this rise in overhead will try the commitment of the partners.

TIVIT stakeholders estimate on the utility of the research in terms of output measures consistently lowest or second to lowest in most items compared to other SHOKS, bar recruiting of highly skilled workers. This is an interesting finding, as in terms of TIVIT the KPI are among the highest. In terms of evaluating the SRA, stakeholders are satisfied, although the sample is split exactly 50–50 on the issues that is the agenda a failure for being too conservative and serving established companies. TIVIT stakeholders were also the least interested in developing their research capabilities, or utilising findings from basic research, and 36% estimated that impact to technological competitiveness was low or very low, the second worst estimate between the SHOKs. Nevertheless, the participants claim that TIVIT has created new networks, and new collaboration in general. It is suggested that the impacts are not limited to what is reported or visible around TIVIT itself.

TIVIT achievements:
New best practices to participants, including lean agile project management
Contribution to standards, particularly in the case of Future Internet
Product development by developing scientific foreground for new product development as well as Applying and combining existing technologies
Creation of stronger business ecosystems and giving particularly SMEs access to new networks and knowledge.
Challenges:
Lack of focus in some programmes

From an academic standpoint, there are two major disincentives for participating in SHOK research: the funding model and the content in the agendas. These two combined do not make SHOK funding and participation attractive for many researchers. Regarding funding, as an example, one associated university unit has a baseline budget funding of roughly 20% of total turnover and the 80% comes from research project funding. Now SHOK participation requires 30% of collateral funding which can be in-kind i.e. working hours, from academia (65% from large enterprises and 50% from SMEs) that cannot be other project funding, which would be a major strain in the units budget and in practical terms prohibits using Tekes funding for SHOK research. The other route then would be to apply for parallel project funding e.g. from the Academy of Finland, or ERC, but here the fitting the interests in the SRA and academic research form another disincentive for participation. As a matter of fact, the Academy funds a number of these parallel projects.

Going to the research content, while the SHOK objective is to conduct transformational research and create innovations that renew industries, according to the interviews, the agendas and particularly programmes are largely set by people preoccupied with the present problems and next years' product launches. From an academicians perspective they tend towards technical if not trivial and as the program goes closer to markets, industries become more secretive and less reluctant to collaborate amongst each other and researchers Also the stakeholder responses together with the interview data suggest that the level of ambition on average has been quite low, and the focus has been largely on incremental, business-as-usual, innovation activities. It could be hypothesised that also the Tekes decision to cease ICT technology programs has put a lot of pressure to TIVIT to continue with carry-over topics from e.g. Tekes GIGA program. These findings are reinforced by the academic stakeholders' notions about the short time horizon in the programmes and focus on business sustaining, rather than transforming and renewing topics. However, it has to be noted that these disincentives have not kept researchers from participating in SHOKs as illustrated by the KPI.

Another point of critique from the academic side is that TIVIT SRAs are not subjected to academic review in TIVIT nor Tekes. The implicit argument is that review of the SRA from an academic perspective would conceivably ensure contribution not only to business, but also to the body of academic knowledge, and also ensure that the research design would represent the state-of-the-art. Additionally there also seems to be internal friction in the programme budget negotiations, as the funding distribution between researchers within the programs is not based on academic merit, but apparently also with previous relations with the core partners. This is an additional disincentive for 'top' academics to participate.

Looking at the KPI, TIVIT's academic output is among the best in SHOKs. The academic quality in general is average, the journals are typically rather young cross disciplinary conferences and journals, while some publications are in established journals such as IEEE Software as well as IEEE and ACM conferences.

Looking at the h-indices[66] for the participating researchers are on average approximately 15, with some over twenty and the highest being 37. Typically 'top' researchers are in the high twenties. While there are clearly some top researchers involved, the lack of interest towards scientific excellence is evident also both in the attitudes of TIVIT personnel who claimed that, paraphrasing an interview comment, they are not especially concerned about recruiting the best researchers, but working with the people who subscribe to TIVIT vision. The same message can be heard from the academic side, as one of the leading technical universities put forward the view that SHOKs are not lucrative research environment because of lack of ownership and sharp focus in the programmes, and lack of international networking, and the short term focus, which is reinforced by the yearly programme budget negotiations to some extent the agile research model with constant reporting.

Despite disincentives for top academics, TIVIT amongst "best in class" in terms of KPIs: see table 5

The question from an academic standpoint is that if one has to in any case apply for one's own funding and plan a project, why should one go through the trouble of trying to partner with SHOKs, which tend towards applied rather than basic research? It has to be kept in mind that individual academics are hired and paid based on how many journal papers they can write and how much project funding they can source. Especially if pursuing a serious academic career, constant high-quality publications are essential. From this perspective, working with SHOK consortia may well be seen as another uncompensated complication on the way to better publications. The TIVIT answer to this question is that the academics get input from the industry on where the world is headed and that professors have interesting results they want to disseminate and/or commercialize. The academic participants' perspective is that they get access to real data and networks that would not be otherwise possible.

The SHOKs, despite their efficiency still seem to do some duplicate work within SHOKs and between them despite the fact that e.g. the TIVIT SRAs explicitly recognize the interfaces with other SHOKs. Looking at e.g. FIBIC and TIVIT Next Media who both have set out to work on hybrid media (combining print and electronic/mobile media), or TIVIT themes such as Internet of Things, and Digital Services, which have a high degree of overlap with FIMECC Future Industrial Services programme, and particularly in IoTs case also with RYM's smart city initiatives of Cleen's smart grids. Also within TIVIT there is a degree of overlap in themes between e.g. the previously mentioned IoT, Cloud Software, and Services.

66 "The index is based on the distribution of citations received by a given researcher's publications. Also known as Hirsch-index after the original author. Hirsch writes: 'A scientist has index h if h of his/her Np papers have at least h citations each, and the other (Np – h) papers have no more than h citations each.' In other words, a scholar with an index of h has published h papers each of which has been cited in other papers at least h times." Source: H-index. (2012, September 19). In Wikipedia, The Free Encyclopedia. Retrieved September 21st 2012, Available from http://en.wikipedia.org/w/index.php?title=H-index&oldid=513489268

However, this feature cannot be attributed so much to individual SHOKS as their incentives drive them to work primarily within the SHOK, thus it can be suggested that the fault if one wants to call it that, is in the program structure. Now the SHOKS have had the liberty to define their research agendas amongst the shareholders and other participants, and have ended up partly looking at the same themes from different angles.

The question is that is there actual duplication of effort, and are there complementarities developed to their full potential. The alternative scenario would be devising industry independent horizontal SHOKs or programs between SHOKs, on e.g. Media User Experience and Channels, Future Digital Services and Platforms, of the more technical Smart Cities. However the another question is that even though some of the programs within and between SHOKs could be fused together, would they remain manageable, or would the fragmentation of duplication happen more opaquely in the work package level within the programs?

In sum, the main contribution of TIVIT in the IT industry seems to be creation of new IT ecosystems through partnering and networking activities. In terms of concrete business value the results are not immediately visible in the data; it seems that TIVIT has contributed to business creation in the form of multiple start-ups, and there are several good cases where established enterprises have created new business with new partners in TIVIT programs. It is not transparent, however, how much actual business value in terms of new products, services and revenue has resulted. The counter argument for this finding is that TIVIT has embarked to build the competence base and business ecosystem for a new digital service paradigm, and that setting up a RDI programme of 50MEUR a year is an impact as such. In either case, the impacts remain to be seen.

What is worrying, though, is the criticism for short time focus and lack of interest towards capability building among the programme participants, exhibited in the survey results. Strategic long-term research and capability building are after all two key aims of the whole SHOK concept. Coupled together with the relatively low concrete outputs and low expectations, it seems that the initial programs on average have not been very successful in energizing the industry to commit to strategic level RDI for totally new businesses. On the other hand, TIVIT has boldly chosen a new general direction, differing from the traditional Finnish approach to ICT. Thus it seems TIVIT impacts are a mixed bag, there are certain highlights and successes in renewing industry structures and business models, as exhibited in the Next Media programme, and on the other hand there has been international impact in Future Internet, but on average it seems that the results are somewhat lukewarm at the moment.

2.8.8 Conclusions and implications for the future

At their best, TIVIT programmes are very useful in bringing the industry actors together to develop a shared strategy for the present industry problems, and to solve problems that are pertinent to the whole industry, and they succeed in that. At their worst, they are large-volume networking programmes and 'just another innovation funding instruments to do one's own work' where the participants focus on their own problems and work on to create new products with little contribution to the industry in general.

The question for TIVIT and SHOKs in general for that matter is that what is the added value of running the SHOK organization as a mediator between the funding organisations and beneficiaries? As such all the stakeholders were satisfied with TIVIT and its services, and highlighted the competence and gusto of TIVIT personnel in dealing with their issues. In TIVITs case the value is in the services that span from program administration to value-added services including business ecosystem building and TIVIT FORGE business incubation platform. What was felt to be missing from TIVIT, though, was general PR activity that would keep the parties outside stakeholders informed about the activities and results.

The contrafactual situation where TIVIT would not exist is basically the previous situation where Tekes funding would be channelled through the programmes. In comparison to Tekes programmes, the participants see TIVIT very beneficial. The main contributors to this satisfaction are broader and more active networks, more commitment to the programmes from both industry and academia, better transparency and exchange of ideas between participants, and mutually beneficial access to data and interesting new problems. On the negative side, it seems that while the participants value the volume of activities and large networks they create, the great volume is spread quite thin over large areas of work, and many actors receive quite a limiting budget. Additionally the academic actors as a whole seem to agree that the research is not cutting edge, and that all the best people are not involved. Thus in comparison, TIVIT seems to have definitely some benefits and added value over Tekes programs, especially in the networking department.

Where TIVIT clearly succeeds is in professional management of the programme, which is unilaterally highly regarded, and creating new networks and collaboration within the ICT industry. Though, is that TIVIT excels in running business relevant innovation programs, but it has veered from the course set originally by RIC and later Tekes in combining far reaching research to business relevance. Looking at the data, the main points for development would be sharpening focus of research, looking for more risky and transformative programmes, some of them horizontal, and embracing academic excellence more closely.

The challenges in the actual programmes seem to stem from consortium structure and objective setting. SHOK programs seem to work best, when the program for an SRA is set by a strong network engine with a relatively small and tight consortium,

around jointly defined and owned strategic goals. Building horisontal consortia with (potential) competitors amplifies the disincentives to contribute one's best. This suggests that the preferable mode is building a consortium along the value network of one strong player who has the resources to invest resources in managing the consortium and direct ownership of the program, as well as global presence for dissemination of the results.

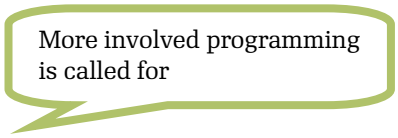
Some of the challenges have as much to do with the general policy framework and funding rules than necessarily shortcomings in governance. Namely the IPR terms arose as a major sticking point for collaboration over several interviews, despite the fact that core of TIVIT actors do not in fact see them as a problem. In programmes with a large number of partners, some (potential) competitors with each other, the blanket IPR sharing policy was seen as a source of friction, and a disincentive for collaboration. The suggested alternatives include setting up a holding company or a trust to manage the IPR portfolio and sell licenses to the co-created inventions.

TIVIT personnel and academic partners would like more commitment from the Academy of Finland in SHOKs and TIVIT, not just in terms of funding volume, but perhaps even more a formal and active commitment to development of the SHOK concept and RDI activities within. Academy involvement also has the potential to lengthen the time horizon of research programmes.

One overarching finding that arises from the interviews is that actors involved in the SHOK seem to have quite different views on what TIVIT or SHOKs in general should be. TIVIT at its present tends to be viewed as an innovation and business ecosystem creation instrument/environment, while the RIC goals were set originally towards long-term high-risk research and development, and capability building. While there TIVIT programmes do put out a considerable number of academic publications, the centre of gravity is quite close to the market horizon. The tendency towards short time horizon is amplified by the fact that that budget is granted for the SHOKS a year at a time by Tekes, and thereafter allocated the by TIVIT BoD. This also is perhaps to viewed as a feature, not a bug, as the SHOKs themselves are free to form their SRAs and research consortia themselves.

Altogether these findings give raise to the following recommendations for SHOK governance and funding both on TIVIT level and programme level:

More involved programming: Generally it seems that within TIVIT, tighter consortia have succeeded better in fulfilling the program objectives. Thus it is advisable to develop more involved programming and funding processes. The first point for development would be selecting smaller and tighter consortia, with more selective screening of participants, ensuring mutual interest and goal congruence. Second, developing more ambitious and far reaching research goals, which are at the same



time academically and economically interesting, would be of paramount importance for the impact of the programme.

Here TIVIT could support SRA creation by disseminating information on where the industry is headed, and what are the future challenges, based on the unique information that accumulates in Finland-China ICT Alliance programme, ARTEMIS-IA and Future Internet PPP. In the programming phase, TIVIT could drive towards sharper focus and goals for the programmes and for more selective partner selection.

Introducing competition: One practical suggestion that arises from the data is introducing competition especially in the programming phase, in the form of competitive bidding for programmes under each SRA. As discussed, there is a tendency for programmes to try and take on all the problems within a field and consensus-oriented and broad-based recruitment for programmes amplifies the tendency for the programmes to become a 'wishing well' of mixed interests. The focus could get sharpened if there would be open competition between joint business-academic consortia consortia to undertake the research. This would also in fact probably serve the motto "industry shows where we are headed, and academia shows how"

One workable model would be to develop the SRA with the stakeholders with the present process, and then publish a call for proposals to choose the best programme(-s) under the SRA. The difference to the present model would be that the consortia would get together and come up with a programme proposal which would be then scored by TIVIT against a set of criteria, such as impact to industry, novelty and ambitiousness of goals and competence of the consortium. The aim would be to ensure cohesiveness and goal congruence within the program, higher level of ambition and presence of competence necessary to attain the goals. Evaluation criteria could include academic excellence and competence of the partners, ambitious and realistic work plan, as well as deliverables. This would have a twofold advantage, it would improve transparency of budgeting and project selection and foreseeably introduce stronger commitment and cohesion and better focus inside the programmes.

Several smaller and more focused programmes could also be committed to under each SRA. This is mostly relevant to TIVIT directly, as TIVIT programs have each their own SRA that implements TIVIT strategy.

This suggestion includes establishing a SHOK-specific independent review board with industry and academic presence to review and rank the programmes before funding based on e.g. impact, capacity for delivery and ambition. Review could include review of applications and group interview of partners. Due to conflicting interests, this review could be best executed by Tekes and the Academy of Finland during funding decisions, as discussed below. Additionally, Tekes and Academy would be in a good place to recognise overlaps between programs within and across SHOKs and propose integration of programmes where appropriate.

Flexibility in program management: The participants suggested that it would be beneficial to allow programs of variable length, with variable commitment to the program from different participants. This would potentially reduce slack and overhead in program funding, as partners could contribute to certain phases where they have added value, without having to keep the project open for the whole duration. Also variable program length, depending on the goals, should be considered. Allocating some of the budget for shorter and smaller programmes with tight consortia would allow developing more risky programmes to test new ideas before committing resources to a full 4-year programme.

Reconsideration of IP ownership model: There are multiple suggestions that mandatoy IPR sharing is a limiting issue for collaboration in TIVIT. The challenge is amplified by the fact that TIVIT RDI operates rather close to commercialisation and close to the core competence areas of the participants, which frequently are competitors with each other. The sticking point is that when one starts a completely new research project, one can hardly know the outcome beforehand, and the magnitude of its importance. Thus the present model of IPR ownership forms a negative incentive to contribute one's best. A suggestion that arose from the data directly would be to commit the IPR to a shared trust or holding company that would manage the IPR portfolio and sell licences and conceivably also pay dividends or invest back to research.

Reconsideration of funding model for higher education institutions (HEIs): The demand for collateral funding in principle ensures that the enterprises are committed to the programmes, but also may act as an obstacle for HEIs, which have constrained budget, and cannot commit in-kind funding out of budget to large programmes. An alternative funding model could be a framework contract for HEIs for commissioned research work that would enable stable participation and commitment to long standing research.

Criteria geared towards strategic research: In principle the SHOKs are private corporations, and are free to do as they please, and there is little need to change this practice. However, if it desired that SHOKs concentrate on larger more fundamental issues, the two tools in policy makers' toolbox are SHOK monitoring and funding processes and criteria. Thus, if the desire is to steer the RDI programmes toward longer time horizon, funding evaluation criteria should envelop the strategic impact of the programmes with a high priority. The preferable model for budget allocations would be longer duration and fixed budget based on the accepted work programme, instead of granting budget for a year at a time. Furthermore, introducing an independent peer review for the programme applications perhaps as a joint effort of the Academy of Finland and Tekes would introduce healthy competition to the selection process and raise the level of ambition.

Clear governance and ownership for the SHOK instrument: The SHOKs have had the freedom to shape the programmes and SRA according to their needs. This has to some extent apparently resulted in TIVITs case in goal shift from the original

RIC goals towards innovation rather than long-standing strategic research and capability building. As such it is a feature of the programme structure, rather than a bug. It has been enabled by lack of clear cut ownership and accountability for the whole SHOK instrument.

To be clear, SHOK companies are private incorporations, and as such are and should be free to do as they please, but the Government and its duly appointed representatives as instrument owners can give or remove this special SHOK status for any enterprise that works toward the high-level SHOK goals, and there should be a transparent process for this action. If there is a desire to steer the SHOKs more toward e.g. original RIC goals, there is a need to institute an owner for the instrument, who continually monitors and evaluates the SHOKs. There should be a transparent process, S.M.A.R.T.E.R. criteria[67] set together with the SHOKs, ministries and stakeholders, as well as pre-selected thresholds for terminating the SHOK status for entities that do not perform according to the goals set for the instrument. Additionally there should be an application procedure and equally transparent evaluation criteria for applying for the SHOK status, if only to introduce a clear and present danger of losing privileges and budget for the established SHOKs.

Strengths	**Weaknesses**
• Professional management and processes • Light organisation • Strong industry involvement and satisfaction • Bring networking in the industry • Shareholders are satisfied	• Relatively short time horizon, and focus on current issues • Inward-looking orientation, no mechanisms to draw in the best partners • Strategic choices are based on broad consensus, programmes lack sharpness and ambition • Especially earlier programmes were large and lacked cohesiveness among the research partners
Threats	**Opportunities**
• The orientation to present stakeholders current needs in research may undermine the objective to renew the industry • Broadly defined programmes and large consortia may limit the programmes' impact	• Cross-SHOK/horisontal collaboration with possible lead-users for new market creation • Sharper focus and perhaps smaller vertical consortia in programmes could raise the level of ambition

67 Preferably SMART criteria: Spefically operationatised, objectively Measurable, Ambitious and Actionable, Results-oriented and Rewarding, Time-bound, Evaluable and Recordable. See e.g. SMART criteria. (2012, September 25). In Wikipedia, The Free Encyclopedia. Retrieved September 25th 2012, Available from http://en.wikipedia.org/w/index.php?title=SMART_criteria&oldid=514438491

3 Assessment of SHOKs made by the international expert panels

3.1 Cleen panel

3.1.1 Cleen panel's executive summary

The review panel was impressed by the research capacity and resources concentrated in the Cleen SHOK and by its ambition to establish world-class research quality in its constituent programmes. In order to reach this goal, the panel recommends an internal progress and quality assessment and monitoring process to be urgently implemented, in support of a process of re-allocation of SHOK funding and roles during the programmes' execution. The panel was not sure that clear entry and exit conditions for Cleen consortium partners have been defined and recommends the consortium to be strengthened with non-technical universities to nourish innovative interdisciplinary work and with the societal problem owners to ensure the societal relevance of the Cleen SHOK work. The panel appreciates the dynamics of the SRA process and recommends to strengthen the Cleen programmes' focus building on unique Finnish strengths and needs in the forthcoming revision of the strategic research agenda. The panel furthermore advises to review IPR procedures especially with respect to the potential for new businesses to emerge from the Cleen SHOK. Many of the shortcomings diagnosed by the panel can be attributed to the short time that elapsed since the start of the SHOK. If these are addressed effectively, the SHOK model for collaborative research between industry and academia is seen as a promising model with the potential to encourage better research and more innovation in the Cleen area, provided the openness of the consortium is safeguarded and funding processes are implemented with some flexibility for re-allocation of funds.

The task of the Cleen panel

The panel's task was defined as follows:

> *To evaluate the strategic centres' research agenda, the quality of their programmes and main projects, and the competence and expertise of the actors involved, from the point of view of the key goals of the strategy.*
> *The panels should also evaluate the relevance of the present strategic centre programme strategy.*
> *The evaluation shall also cover the outcomes and impacts of activity and assess how successfully the centres are working and advancing towards their strategic goals and what kinds of results they have achieved so far.*

The panels were expected to assess the current SHOK research, with the global competence level as a standard. In providing the baseline assessment, the panel's questions to be addressed included

- *Does the centre's activity represent the global cutting edge or is it plausibly advancing in that direction so that the cutting edge can be reached in the future?*
- *Do the centre's competencies and capabilities reach the international top level of innovation?*

The panel was also asked to draft recommendations on how to further develop Cleen SHOK's activity.

The panel was chaired by Professor Margot Weijnen from Delft University of Technology, the Netherlands. Other panel members included Professor Fraser Armstrong (University of Oxford), Professor Jyrki Kettunen (Da Wo Ltd), Professor Bengt Johansson (University of Lund) and Professor Peter Pearson (Cardiff University). Biographical notes of the panel members are included as an attachment to this report.

Core findings of the Cleen panel per theme

The Cleen partnership and collaboration

From a national perspective the SHOK was seen as network-creating, fostering a variety of perspectives in research and providing benefits for graduate training. Many of the stakeholders emphasised the novelty of the collaborative effort, both in its depth and breadth. The industrial representatives themselves stressed the value added of a cross-industry perspective in the Cleen research programmes. The inter-connectedness of energy and environment implies a multitude of players and therefore SHOK is a useful instrument for this particular area with considerable societal significance not only for Finland but also internationally.

In view of the goals and ambitions, the panel expressed a serious concern for the very limited inter-disciplinary work in place. There seemed to be only a minor role for the social sciences and the humanities in the current programmes. The panel also noted the absence of the societal stakeholders (government on a local and national level, as well as third sector) as problem-owners. As a related concern, the panel noted throughout the assessment exercise that the societal targets pursued by the Cleen work programmes are not made explicit (in terms of emission reductions, energy security, affordability, international competitiveness etc.) In this area there is clearly more potential for international and specifically Finnish impact and value added.

The fact that public sector shareholders / stakeholders beyond the research organisations seemed not to be directly involved as problem owners, was seen as a serious concern for knowledge diffusion and the societal impact of the Cleen SHOK research work. The panel recommends formulating an explicit strategy to reach and involve the non-industrial societal stakeholders in Cleen, as well as to implement

and monitor the process of embedding the Cleen research outcomes in (under) graduate programmes.

The collaboration in the SHOK seeks to build on Finnish competitive edges. It was reportedly qualitatively different from research collaborations that existed previously within Tekes projects for instance, where less intensive industry-academia cooperation was achieved and disciplinary silos remained fully intact. In order to encourage and sustain the collaborative effort, the panel recommends the formulation and monitoring of performance indicators for the frequency and quality of the cross-industry collaboration and the industry-academia collaboration. For the latter, such performance indicators may include, for example, the number of knowledge exchange events, the in-cash versus the in-kind commitment of industry and the number of industry-academia co-authored publications.

The specific role of the non-academic research institutes (e.g. VTT) should also be acknowledged and made explicit. Some of the academic research groups did not seem unambiguously positive about their experiences in collaborating with the non-academic research institutes. The process of building trust between the partners in collaborative research may need more attention from the Cleen management and the Work Package leadership. Without an adequate level of trust between the partners, the SHOK will not be able to harvest the full potential of combining the research resources available. The panel recommends the Cleen management to give explicit attention to the ethics of joint research, including the sensitive issue of intellectual property of innovative ideas. In due time, as the SHOK unfolds, Cleen may consider to encourage co-location of academic and non-academic research groups on the same campus, as a structural mechanism to support intensive research collaboration.

The SHOK approach

The message on the uniqueness of the SHOK approach in the Finnish context was clearly identifiable: the breadth of consortia, the improved industry-academia dialogue and the search for balance between industrial relevance and scientific excellence came across as core characteristics of the Cleen SHOK. Many of the observed weaknesses of the approach could be partly explained by its novelty and the relatively brief time in which these major cultural paradigm shifts have been attempted. The panel was fully aware of the fact that SHOKs are a new instrument and they should not be assessed against more mature programme achievements. Considerable learning and process improvements have already been taking place since the programme's take-off (e.g. SRA process, governance). While the original ambition and agenda was seen as too comprehensive, the panel acknowledges the fact that the SRA updating process is now in place and progress has been made in this regard. The panel recommends the processes of learning to be made more explicit, both for the benefit of internal monitoring and shared learning and for the purpose of sharing lessons learned with other SHOKs. The panel in fact saw its role as contributing to the learning process.

As was indicated in the introductory presentations, SHOKs were originally set up as a response to global competition. In the panel's view, the SHOKs are an investment in the national knowledge and innovation infrastructure which generates the capacity to respond more effectively to the international competition and to emerging needs. While a question was posed on possible international benchmarks, it was felt by the panel that other non-Finnish national models of public-private knowledge partnerships would be difficult to translate into the Finnish institutional context.

Open innovation is a new and challenging element of the SHOK approach. The panel has some concern that the process by which the Work Packages have been brought into being at the start of the Cleen SHOK, might not have been (sufficiently) open to all interested and relevant industrial parties and academic research groups. As incumbent industries and research groups seem to dominate the Cleen SHOK, innovation opportunities may be missed. The panel has difficulty to see how new business might emerge from the Cleen SHOK. The opportunities and challenges include the IPR questions, which should be further clarified to all parties. Despite the clarifications made by Tekes, the Cleen community was clearly uncomfortable with the IPR practice. The quasi-absence of patenting and licensing activity seemed to be evidence of this. The rules on shared IPR are, furthermore, prohibitive for international partnerships in Cleen SHOK research.

The dominance of Tekes in funding terms and the fact that Tekes does not seem to provide additional funding for SHOK-relevant themes through other instruments than SHOK was seen as restricting the possible research activities, especially where outsiders to the current Cleen SHOK partnership are concerned. In the discussions, also the challenge of accessing Academy of Finland funding was raised, in pursuit of SHOK expansion into the area of fundamental research. As it stands, the panel recommends Academy of Finland funding to remain reserved for innovative research projects generated bottom-up by the academic research community. In order to stimulate more focus on and critical mass in the areas pursued by the SHOKs, Tekes and the Academy of Finland might negotiate a system in which bottom-up research projects which qualify for Academy funding, and which are judged to benefit Cleen SHOK objectives, may be entitled to some kind of bonus.

There is interest in SHOKs internationally. The idea of enlarging into an international affiliate may be a way of addressing the rather introvert nature of SHOK activity today, as testified by most of the SHOK representatives in discussions with the panel. It was seen as positive that the SHOK collaboration has allowed for the programme participants to feel empowered to "speak for Finland" in an international (e.g. EU) context. There is an international interest in the outcomes of the Finnish SHOK model and this has increased the potential for international visibility.

The role of Cleen was not entirely clear. With the resources available there seems to be very little that Cleen itself can do. Given the size and demands of the Cleen SHOK, more staffing might be needed to ensure adequate support of the Cleen SHOK community. In the opinion of the panel, the central Cleen organisation

should be responsible for the monitoring and reporting of progress in the various work packages. The Cleen management is not responsible for the scientific quality assessment, but they could and should be organising and facilitating the process. The Cleen management has a clear role in facilitating the SRA process, it has taken the initiative to establish a working group for new funding models and, more recently, to start a new integrative theme (flexible future energy systems). In addition, they organise and accommodate the internal portal functions for the Cleen SHOK community as well as the external portal for dissemination of results to the wider public. With the current level of overhead (2%), the Cleen bureau seems to be far too small to ensure adequate support of these important central functions. Other issues, such as the internationalisation strategy and the IPR strategy, should also be dealt with at the overall Cleen programme level. In this respect, a slight increase in overhead would instill more confidence in adequate programme support for the future. However, the panel felt that the roles and responsibilities of the Cleen personnel should be made more explicit, especially as the funding expands, and that some support functions (which are not SHOK-specific) could perhaps more economically be organized at a supra-SHOK level, with a support office for all SHOKs.

Strategic research agenda of Cleen

The panel appreciated the fact that the SRA has come to be seen as a dynamic agenda, which is updated periodically. In the opinion of the panel, the current SRA is too broad and would benefit from a sharper focus. The updating process could be structured around contrasting global knowledge needs with the particular strengths of Finnish industry and academia. In order to contribute to building the capacity that would gradually shape a "world class research cluster" it is important to identify some unique Finnish strengths on a realistic scale. According to the panel, this implies that it is appropriate to select some specific knowledge areas, even small niche areas, where Finland can outperform the international competition. For instance future combustion engine power plants offer a competitive advantage for Finland, as do some areas of smart grids, in particular with ICT combinations. In support of the identification of the unique Finnish strengths, the panel recommends the mechanism of scrutiny by international peers to be extended to the SRA process.

All the key actors of Cleen today are involved in the SRA process. However, the panel recommends the Cleen management to critically evaluate the field of players currently involved, in order to identify potentially missing expert groups that might strengthen the scientific depth of Cleen beyond the original partners.

The depth and focus of the SRA should be improved and the breadth caused by the extensive nature of corporate interest reduced. Furthermore, the panel recommends more transparency in the process of translating the SRA into work packages and research activities. At present the linkage between the SRA and the programmes intended to put it into operation is not clear. The panel expressed its concern of

the risk that the Cleen programme will only benefit the current industrial partners rather than providing fertile ground for innovative new businesses to emerge.

Cleen research programmes

The panel was concerned whether the research topics covered by the research programmes are those with most value-added potential for Finland. Bio energy for instance was seen as an area where there is clear potential to be developed. (The collaboration between FIBIC and Cleen was acknowledged in this context.) There was a perception that the areas being chosen might be those which are easiest to agree upon rather than those with more innovation potential.

The wide scope of the programmes was another cause of concern. One should distinguish clearly between the knowledge transfer activities and other (e.g. knowledge generation and demonstration) programme activities, and structure the programmes accordingly. In their current form the programmes are too inclusive and the WP structure does not form a useful hierarchy for monitoring and follow-up. There may be activities which are not high quality science, but yet are an essential part of the activity and as such their role could be isolated from individual programmes into a support structure, while avoiding overloading the bureaucratic and management practices.

The global potential and current international significance of the Cleen programme activities was seen as difficult to judge, partly connected to the previous points. In addition to serving the needs of current industry, a globally significant knowledge base with potential for new industry is required. It was difficult for the panel to see how new business would emerge from the SHOK model, as there seems to be very little incentive for this.

The panel was not confident it had the necessary information available to assess the individual programmes. For future evaluations that include a scientific quality assessment, the panel recommends a comprehensive self-assessment on both SHOK level and programme level, supported with ample evidence.

In the programme of the review panel insufficient time was available for substantive discussions with the programme leaders. Rather than focusing on the actual work being carried out within each of the work packages, including their outputs and impacts, the presentations to the panel wasted valuable opportunities by mostly dealing with obvious general issues such as programme structure and procedures. Considering the scientific quality assessment that was part of the panel's task, the panel strongly recommends that the Cleen SHOK invests in scientific quality assurance (and monitoring) and in the research management skills of its programme leaders, especially as some appeared to be quite junior and inexperienced. The profile and external visibility of the SHOK would greatly benefit from investment in the communication and presentation skills of all researchers and programme leaders involved and from a more standardised tool kit for communicating the SHOK concept, its programmes and programme results. In future external quality

assessments, the panel furthermore recommends to more prominently involve doctoral students, perhaps with a poster session.

The programme manager presentations suggested a relatively low degree of flexibility in implementation. The panel felt that if the annual budget planning does not allow for flexibility in the execution, this will limit the innovation within the research.

University and research perspectives

It was seen as positive that all technical universities are involved in the programmes, though the relative absence of other (multi-disciplinary) universities was seen as a possible weakness.

The panel was concerned that for the universities SHOK may not allow the best university researchers to receive SHOK funding, as in the process of developing the SHOK especially those research groups with strong ties to industry were involved, which may not have been a sufficient criterion for research excellence. The advantage of SHOK is the opportunity it offers to build large consortia. There is great value in university-industry partnerships. In areas where Cleen is active, the SHOK provides an important resource for attracting good students. SHOK projects within the technical universities also allow for students to familiarise themselves with industry (and vice versa).

It was concluded on the basis of the financial information, annual reporting and the presentations that the collaborative constellation of ABB, Aalto and VTT seemed to be currently by far the strongest, as they are involved in all programmes. This allows for flexibility for these shareholders that other parties do not enjoy. The dominant role of VTT in particular was discussed. Co-location of research institutes and technical universities was suggested as a possibility to ensure better use of the available research infrastructure.

Despite the fact that many of the programme topics require multi-disciplinary expertise (in addition to the technical conundrums, social, economic and regulatory issues), the fact that there is a very low degree of multi-disciplinarity in the current programmes was seen as a reason for concern, in particular as the timeframe for developing true multi-disciplinarity is quite long (10 years+). “Smart grids” for example was identified as a topic where the societal impacts and relevance would be very central. The programmes’ contributions to societal targets should be more clearly outlined. The multi-disciplinary setting should also be part of the SRA update and international expertise should be used to this extent.

The panel emphasised the need for the funding organisation (Tekes in particular) to ensure that the capacity, competence and culture is in place that allows for multi-disciplinary expertise to be assessed and ensured.

A final concern of the panel is that the level of risk in most of the SHOK research programmes may be rather low in view of the SHOK’s ambitions, and the panel sees few incentives for increasing the level of risk of the activities. Despite the broad and

increasingly deep industry-academia collaboration, the panel is concerned, on the one hand, that industry prefers to execute its business critical research outside the SHOK and, on the other hand, that academia depends on research funding from the Academy of Finland (rather than the SHOK) for the truly innovative projects with the potential to disrupt incumbent industries.

The panel's reflection on the task

When reflecting on the task of the panel, there was a feeling that assessing the implementation of the Cleen SHOK programme and the quality of its outcomes was difficult, if not impossible on the basis of the information and materials provided. The panel appreciated the richness of the materials provided, but were surprised by the lack of structure and the absence of a comprehensive self-assessment report. To guide self-assessment exercises and external reviews of progress and quality in the future, a meaningful set of Key Performance Indicators (KPI) should be formulated that reflect the objectives of the programme as a whole and its constituent work packages. Considering the goals of the SHOK instrument and the Cleen SHOK Strategic Research Agenda (SRA), the set of KPIs should include indicators for scientific quality, industrial relevance, internationalization, commercialization of programme results and indicators for wider societal relevance. Ideally, the set of KPIs should have been formulated at the start of the programme. However, acknowledging the novelty of the SHOK instrument, the review panel recognized that the Cleen SHOK is on a steep learning curve. The panel therefore considered its role as contributing to the learning process.

The review panel did not touch on the link between the Cleen SRA and the eight programmes that were (and are being) started as a result. While the Cleen SHOK is meant to address the global energy and environment challenge, the panel thinks that the SHOK work packages should reflect the specific needs and competencies of Finnish industry, academia and society, if they are to produce world class results. It is not evident for the panel that such selection criteria did play an important role in the design of the present work programmes.

On the assessment and the data required

The material made available was seen as an inadequate basis for the assessment of the programme implementation. In addition to the scientific summary of the programmes and their key Working Packages and core teams, a summary of the outputs, results and impacts reflecting the industrial relevance and societal impact should also be included. Basic information to be included should involve a systematic compilation of publications with an affiliation, as well as number of joint publications and their key messages. Co-authorship of various universities and industry representatives as co-authors would also be useful. To allow for a quality assessment of the research outputs, internationally accepted indicators of scientific quality should be used, in addition to Web of Science and Google Scholar.

The research programme coordinators would best prepare for such an assessment endeavour by compiling a brief account of the key activities and their results, such as their top five publications, possible patents and innovations etc. Given the timetable and breadth of the research agenda, selectivity should be key here and the structure of the report could reflect a discussion of the most meaningful indicators and the "most central" publications. The indicators compiled would benefit from a classification into shared SHOK-indicators, as well as SHOK-specific, programme-specific and even activity-specific ones (best reflecting the variety of activities, ranging from knowledge transfer to research and innovation).

For external review panels, more clarity should be provided on which outcomes and achievements can be attributed specifically to the SHOK. As it turns out, the SHOK funds seem to be added to other funding sources in the funding of, for example, PhD projects in Finnish academia. As a consequence, the number of PhD students engaged in the SHOK is hardly a relevant indicator, and the number of PhD theses reported can only in part be attributed to the SHOK. Similarly, the international research relationships reported can only in part be attributed to the SHOK, if at all. The panel recommends a more dedicated use of Cleen SHOK funds, so that evidence can be provided for the difference that the SHOK instrument makes vis-a-vis other instruments in the Finnish energy and environment field.

In addition to an external assessment, provided by exercises such as the one reported here or those undertaken by the Scientific Advisory Boards (SAB) in September 2012, the panel highlighted the usefulness of carrying out an internal review. Periodical internal progress and quality assessments would allow for making corrective moves during the programme implementation. It was emphasised by the panel that the Cleen management needs to have the possibility of re-allocating / transferring funds. Processes connected to the productivity and quality assessment could provide the grounds for such re-allocation. There was a concern expressed by the panel that there may be insufficient flexibility of Tekes funding to allow this kind of re-allocation to take place in mid-course.

The next evaluation panel should be provided with a self-assessment and clear structured material, including how the SHOKs themselves perceive their activity, and their international status. A competition analysis would equally be a useful tool of further developing programme quality. Each research group / programme could comment on how their work compares internationally, who are their peers and how they compare amongst international peers, how and why is their work better than that of their peers, and most specifically, what is the competitive advantage in their work that is unique to Finland. This type of assessment would benefit from being done on a very detailed level, within WPs perhaps rather than per programme.

Conclusions and implications for the future

The SHOK seems a promising model for the Cleen area, since the interdependencies between energy and environment require a multitude of players to be involved

in a concerted knowledge and innovation effort. The industry-academia dialogue facilitated by the SHOK is clearly appreciated by the partners involved, as is the improved international visibility of the Cleen consortium.

The shortcomings of the Cleen SHOK as diagnosed by the panel can largely be attributed to the short time that elapsed since the start of the SHOK, and to some extent to the (perhaps excessively) lean coordination effort at the level of the Cleen. There are clearly no grounds at the moment for "closing shop" at Cleen. though the panel sees grounds for adjusting the SRA, the constituent programmes and the management at the overall Cleen SHOK and the individual programme levels:

- In the development of the SRA and its periodical revision, there needs to be a conscious and explicit balancing between the interests of industry and academia by the Cleen management.
- In the design of the WP's more focus is wanted, with explicit attention for unique Finnish strengths, competencies and needs. A sharper focus and further concentration of the resources available is likely to improve the quality of the research.
- A Cleen SHOK internal progress and quality assessment process is urgently needed. The Cleen management and the WP leaders must develop a meaningful set of performance metrics to assess the quality, productivity and relevance of programme outputs against the Cleen SHOK's ambitions, on the basis of which an internal quality assessment and monitoring process can be implemented. A periodical external assessment by the Cleen Scientific Advisory Board can contribute to this process. However, the panel recommends for the Cleen to go even one step further and define processes for re-allocation of roles and funding, on the basis of annual internal reviews of progress and quality. The panel did not see that such processes were in place, including formal processes for entry and exit of (new) partner organizations.
- The Cleen management must ensure that the consortium is open for new partners (industry as well as non-technical universities) to join. More potential for genuinely innovative combinations and inter-disciplinary work should be nourished within and between the SHOKs. The panel welcomed the new programme within bio-energy (in collaboration with FIBIC).
- The Cleen management should develop clear incentives for IPR and new businesses to emerge from the Cleen programmes.
- Research training forms an essential part of the Cleen agenda today and the post doctoral programme within the Cleen community was seen as a good initiative further building on this focus.
- The high absorption of resources and the fact that the ceiling of available Tekes funding has been reached was considered as another opportunity for realigning the agenda: a process should be introduced where funding could be reallocated within Cleen, not only within but also between the constituent programmes. The structure of the programme should not be too rigid in this

regard, though at the same time long-term commitment needs to be ensured, especially in research training.

- The programmes could be better structured with respect to the various types of activities: innovative research with the potential to become world-class, supporting research, development, demonstration and knowledge dissemination, including education and training. Each of these activities requires a tailored set of performance indicators to measure progress and quality, and their specific needs (e.g. different time constants) should be accounted for in the SHOK funding policy.
- On the basis of the results shown so far, there is no justification for increasing the public SHOK budget. The share of industrial funding could be increased, but not at the expense of scientific quality. The hope expressed by some stakeholders during the panel discussions of increasing the Academy of Finland funding, whilst appreciated and understood by the panel, is not a view shared by the panel on the basis of its assessment. Multiple funding modes and sources are likely to benefit the diversity and therewith the viability of the Finnish research and innovation community.

3.2 FIBIC panel findings

As a part of the SHOK evaluation, Academy of Finland invited international evaluation panels to provide a separate assessment of each of the six SHOKs. All the panels followed the same methodology in their work. The methodology is described in more detail in the main report of the SHOK evaluation.

The panel members for FIBIC –SHOK evaluation are listed in the Annex section of the report. The panel received the background material in summer 2012 and met in Helsinki 19–21 September 2012 in a workshop. During the workshop the panel interviewed several FIBIC-SHOK representatives. The list of people interviewed during the workshop is also provided in the Annexes.

The panel decided that the evaluation approach should be as independent as possible and that panel members should give their own opinion and insights. The panel took into account the provided material, e.g. the survey results, but decided that there was no need to rely on or to streamline the conclusions with the survey, or other evaluation material. Panel took into account the given guiding questions to structure the discussion and this panel report with an emphasis of the highlights chosen and presented by FIBIC members.

Overview of the FIBIC SHOK approach

The forest sector and its future is of utmost importance to Finland as the exports of the sector account for some 20% of the total Finnish exports. Given the ongoing and fast change in the society related to forest industry (e.g. decrease of newsprint, new demands on packaging materials and an increasing competition from eucalyptus

based pulp and paper mills located on the southern hemisphere), the panel members believes that there is a clear need for a major change/development of the forest sector and an organization like a SHOK is an appropriate action as it provides, among others: a platform for close cooperation between industry and researchers. In the development of a new forest-based industry and new forest products, the panel members consider that there is also a strong need for cross-disciplinary approach and actions in order to find new applications based on the components in the wood. Traditionally, the forest sector has been very agile in forming clusters to address short term, current technology challenges. In contrast, the industry has had difficulties in forming strategic high-risk/high return research clusters; the burden of traditional applications and high investments is understandably very present in the FIBIC owners.

Taking the above issues into account the SHOK initiative may be one of the most important instruments needed in the long term reconstruction of the Forest sector in order to take full advantage of the Finnish forest natural resources. The panel members want to emphasize that the FIBIC SHOK is very ambitious: worldwide it is probably the largest single research entity with the clear aim to renew the Forest sector. However, in Canada and in Sweden there are also a number of clusters/ initiatives that are going in the same direction and consider parallel objectives; these clusters/initiatives are, however, not under the same "umbrella" as the case is in Finland. Consequently, if the FIBIC SHOK is operated in such a way that the participants benefit from each other it may be a big advantage compared to the efforts made in Canada and in Sweden.

Overall the vision of FIBIC was found to be realistic, long range, far-sighted and quite interesting, although the link to the forest products platform – that was the basis of FIBIC design – needs to be further refined. The vision focuses on products, not just bioenergy, which is very important in the content of maximizing the value of Finnish forest resources, companies and people.

Also the strategy of the SHOK was considered rather unique. Some of the strategic aims are sound, but there were some worries on whether these aims really take one to the vision. The FIBIC strategy might possibly benefit from implementing more rigid targets and goals. The initial strategy to develop present industry and to start to develop completely new product and processes is reasonable, and seems to have been working by providing interesting results. However, the panel thinks that the benefits for the industry should be outlined and furthermore exploited. In addition the link between the strategy and the anticipated results should be clearly spelled out, or at least better specified.

The panel noted that there was no/very little room for so called "blue sky breakthrough research". Such a lack could somehow become a big drawback since it is in this type of research that significant step changes are more likely to be initiated. Consequently, the panel members would like to propose that a part of the programme founding ought to be reserved to "blue sky research".

The panel found that environmental aspects as well as the climate change aspects are explicitly lacking from the materials. It may be argued that these aspects are already built in the bioeconomy approach, and need not necessarily be repeated here. On the other hand, since it is a great benefit, it ought to be pointed out. Another aspect that may be considered is whether agriculture should be a part or not of a bioeconomy cluster based on renewable biomass resources. Finally, present FIBIC SHOK has no apparent connections to the petrochemical industry; developing such a link might become of strategic importance to develop in the near future as several of the proposed product platforms are targeted to leverage and/or displace petroleum based-products.

The panel noticed that the start up of the first FIBIC programmes was very quickly implemented and the main directions were found from the very start. There was, however, a re-organization after the two first years which sharpened the programme and the panel wishes to compliment the SHOK CEO and programme team on successful implementation of these transitional changes.

At this point the panel has some comments/concerns:

- There is no mechanism for peer review or assessment on developing new projects.
- It is not clear how to move from pre-competitive to competitive research objectives within the FIBIC SHOK.
- The IPR issues seem not to have been resolved completely.
- Even if part of the FIBIC's programmes were re-focused and sharpened after two years the programmes still, at least partly, looks like a "fishing expedition" palette of projects.
- As a function of the overall FIBIC strategy the panel members were specifically interested and looking for striking examples of cooperation between different projects and/or research groups, and what added values as a result of cooperation could be outlined. Very few subtask leveraging efforts were found, although one good example should be cited in the area of ionic liquids (Prof. Kilpeläinen and Prof. Sixta) where added value from cooperation should be expected in the future.
- Communication issues are not accentuated to a satisfactory extent in the materials. How does the SHOK and its programme structure work? It looks like that the pieces are there, but how the communication truly works remains fuzzy. The communication aspects are of critical importance in order to take full benefits of the potential of the present FIBIC SHOK.

Strategic research agenda of FIBIC

The SRA of FIBIC is a very ambitious but broad program based on in-depth scenario analysis and as such appears to be quite unique. It is well suited to the Finnish forest products industry. It is described as being developed from three "milestones" documents:

- R&D challenges of pulp and paper industry in media and packaging value chains, 2003
- Forest-Based Sector Technology Platform, A Strategic Research Agenda, January 2006
- World leading ForestCluster till year 2030, the Finnish Strategic Research Agenda, October 2006

From the Finnish SRA three out of seven areas were selected:

- Resource- and energy-efficient technologies (EffTech)
- Future Biorefinery (FuBio)
- Future customer applications (FoCuS)

The EffTech programme tackles the short, and to some extent, the middle term issues in the present industrial structure (it represents the FIBIC pre- competitive aspect); the FuBio tackles middle and long term issues in the future industrial structure (it might be considered as the pre-commercial aspect). The FoCus programme is dealing with different scenarios of the future. It can be concluded that there is a reasonable balance between short and long term issues and that SRA of FIBIC is well positioned in Finland: as elsewhere in the world, the Finnish industry needs new paths and new business models.

The panel's view of the vision provided by FIBIC is that the vision is appropriate and well-tailored to the development and the economy of the Finnish forest products industry. It can also be concluded that the target appears to be reasonable and based on feasible predictions originating from market analyses. One important part and a potential benefit is that FIBIC leverages the core competencies of human capital.

Research programmes of FIBIC

The program review process was generally well preformed and scheduled. All team members and representatives from, research centres, industry and academia were responsive and helpful to the review committee questions. Future reviews would benefit from a more standardized presentation format in which the presentators help address key review committee issues. (i.e., # of publications, patents, funding, project participants/subtask).

- Both programmes were positively reviewed but FuBio sub-programme was the best one from a scientific point of view.
- Efftech is closer to the market, mostly incremental research and optimization with an exception of tree genomics.
- FuBio is a paradigm change that could lead the Finnish forest products to developing new high-value products based on Finnish forest resources.

Eff programmes

For the overall evaluation of the "Eff projects", the panels members considered that, in the FIBIC program, the Eff programmes were developed from a "bottom-up" approach with ideas that orginated mainly from academia and research institutes.

The fact that the final selection of topics was validated from the industry with, from the start of the process, selection criteria being "challenging" and "disruptive" did not appear clearly to the panel members. Such an analysis can be well understood and sustained when comparing the "Eff programmes" to the FuBio programme. The separation into two programs with better focus, EffFibre and EffTech is then a positive modification and strengthening of the program focus. In effect, and probably due to the above analysis, the EffFibre sometimes appeared like a gathering of loosely related, and sometimes thinly funded, efforts. Notwithstanding above, the panel members considered that the research highlights presented were impressive and of value to the Finnish forest cluster.

The novelty of the results was questionable to some extent, although researchers thought differently. The comment is based on the knowledge of panel members that similar research is done elsewhere (Canada, USA, Japan). It is also understood that research in the area is often quite competitive and that proper, relevant information might be difficult to compile which further emphasis the need for international collaboration and/or a scientific advisory panel.

Some observations on the project presentations are given above.

- The presented utilization of pulping additives for yield improvement is not different from literature (virtual chemical pulping model). Some panel members nevertheless considered that the combining of the various pulping approach, if economically feasible, would be of interest.
- The functional genomics of wood formation is composed of four distinct projects. Due to the time required for such research, panel members wonder if the research effort might be spread too thinly. The answer and recommendation could be either to provide more resources or more focus to the project.
- The research on functional genomics of trees is globally significant and underpins most of the strategic developments in this area. It is a key finding that tree growth can be enhanced. However, the strategy to move the research from laboratory to industry is not yet clear and requires further consideration, particularly in view of recent developments in next generation sequencing of softwoods.
- The project dealing with the impact of forest management is the only part of the programme dealing with how to get raw material. It was unclear how this project fits to the overall strategy of the programme as insufficient information was provided to know if the research would allow accessibility to more wood/biomass supply. It is nevertheless felt that forest management should be part of the answer to producing more wood/biomass.
- Although insufficient data were presented for the hemicellulose, recovery project (CROXY), the panel members acknowledge the benefits of such a fundamental programme and the need to establish more data to a successful implementation.

- The (fibrillated) nanocellulose project is well focused and targeted at high priority questions and the utilization of forests of Finland. Investigators should investigate financial models and overall value proposition of the research. While understanding the confidentiality and competitiveness issues, panel members propose that investigators should also get information on what is being developed elsewhere and attempt to develop potential cooperation.
- The foam forming with fibrillated nanocellulose that enables production of structures, products that cannot otherwise be produced with standard paper/board making technology was considered exceptionally well developed by the panel.
- The panel members are not fully convinced that modelling projects for mill operation may support the generation of new processes although it might be quite helpful in developing knowledge for the operating of the new processes. Such analysis is based on the hypothesis that, although new process might be considered, the unit process operations would/should somehow be similar. The researchers are thus encouraged to investigate possibilities to make more detailed modelling, and/or to provide hands on tools for operators over the web.
- In the EffNet program, the vision of the future pulp mill aim is to minimize loss of hemicellulose by combining different cooking methods. Although the importance of this subject is high and relevant, panel members considered that there are not many new elements in the used approach. Basically, it appears like "obtaining higher yield by controlling the hemicelluloses". For instance, a grand scale project entitled "Value Prior to Pulping" linked to Agenda 2020 in the U.S.A. has similar objectives. However, the novelty here lies in the systems integration in a modern pulp mill; i.e. in arranging practical mill concepts based on such an integrating approach.
- Still in the future pulp mill project, the achievement of a 4-7 % higher yield while satisfying the demand of packaging grades is a recognized achievement that would significantly enhance the viability of Finnish pulp mills.

FuBio programme

Trying to separate polymers with minimum damage and minimal processing and putting them together in new ways is a fundamentally important goal. The separation of the polymers is, however, a very difficult task which needs good ideas as well as patience. An immediate breakthrough may not be expected, but when it comes the impact will be large.

In general the FuBio programme is very impressing and covers a very broad field. The scientific level is in general high/very high and even exceptionally high in some cases. There are six directions of the programme but, unfortunately, no highlights on composites was shown, this would have been nice in order to have a more complete overview.

Some observations on the project presentations are listed below:

- One area that was found to be very promising is the work with the ionic liquids. Here one is trying to solve a critical issue, the recovery issues, by developing new ionic liquids (Kilpeläinen's work). But there is also research on how these ionic liquids can be used in dissolving wood polymers and how the dissolved molecules can be used for the production of fibers (Sixta's work).
- Kemira and GA were examples of smaller application projects/niche studies that fit into the concept and demonstrate the future possibilities
- Speciality sugars for health: An exemplar and model of a spinoff in SHOK. It is a company success. Tekes is providing venture capital at the moment through its NIY programme. The spin-off of this company should be viewed as a learning experience that could then simplify and accelerate the development of new forest-based businesses from this SHOK.

Carrying out techno-economic evaluations and risk assessments is very important in this type of programme and a principle procedure scheme was presented. It was, however, unclear in which degree of detail the evaluation was done. Furthermore, it was unclear if this tool was used to terminate projects/ideas.

FoCuS/RAMI programme

Before providing any analysis of the program, whose results appeared impressive, the panel members pondered the difficulty of establishing joint research in what is the core competence of the industry and the companies: i.e. market innovation, market development, and business models. It might be due to the fact that such market oriented research is indeed too close to the market. In other words, developing ideas for market innovations is quite fine but the next steps do not necessarily fit in a SHOK approach as presented to the panel members.

Despite the concerns above, the panel members were impressed by the results which provided input to create major leap and significant changes in the business model of today's companies, sometimes with very radical concepts. For example, the BOP (base of pyramid) project developed the potential of a business model to reach a 4 billion population living with less than 5€ per day. The analysis was found to be sound and helpful for the companies which are planning to make a business decision to enter such market; should it be for social of true business rationale. Indeed, the question remains to understand if the approach proposes a true add-on to present business model versus the good citizen/corporation image of a company conscious of its social (and global) responsibilities. This was considered as very interesting work.

Scientific impact, innovativeness and quality

In general, the headlines of the three selected programmes (EffTech, FuBio and FoCus) are very appropriate for Finland.

It was concluded that the research in FIBIC consists of a mixture of fundamental and applied/development work. The quality of the work done was in general on the

scale from good to exceptionally good. The competence of the individual researchers is in general high/excellent.

The evaluation panel perceives a noticeable difference between the EffTech and FuBio programmes in their approaches, from bottom-up to top-down which translate into a more applied research in EffTech and a more fundamental research in FuBio.

Since the programmes are a mixture between fundamental and applied/development work, the scientific input and innovativeness varies. The largest scientific impact can be found in the FuBio programmes. In the Eff programmes the scientific level was reasonably high, but not as high as in the FuBio programmes. However, in the short perspective of time the results from the Eff programmes will be useful for the Finnish industry.

The highlights shown were generally good. Examples of very nice high quality project highlights and results were shown and the level of research in the shown highlights was good and often impressive.

There were some drawbacks, too:

- It would have helped the panel had they had the metrics on the programmes.
- The budgets of the WP's were not given, the relation between achieved work and budget could, therefore, not be evaluated.
- No risky projects were shown.
- Greater leveraging and integration of individual projects should be considered, when possible.
- Biotech tree breeding is missing to any great extent and this may be a possible future bottleneck? Since plant science plays a crucial role in developing these new industries, the SHOK should consider future strategies in this area.
- Business models are extremely sensitive from the industry point of view
- The panel members were fascinated by the RAMI programme
- But being very close to the market, is it correctly positioned in the SHOK?

Management of the programmes

The panel fully recognizes that a programme of the size and ambitions of FIBIC poses real challenges with regard to management. Not only is the programme representing a significant part of the total Finnish science volume in the fields covered by FIBIC, it is also non-conventional in being a joint effort between industry and governmental funding agencies. Further, it involves a great many research groups, from different disciplines and different universities: which in itself was perceived as a plus by most of the panel members.

Against this background it is not surprising that the management of the programme is a difficult task, which is also the impression that the panel got during its visit. As a background to our recommendations, we will first highlight some observations that we regard as crucial.

Our overall observation is that the research programmes consist of a number of subprojects/subprogrammes that do not appear to be sufficiently integrated.

Thus, while the individual projects are often scientifically good, very good, or even excellent, they give the impression of being run and managed as if they had simply been granted money in a regular application and granting process – without being part of a greater whole. The panel thus conclude that FIBIC would benefit from being run in such a way that synergies are obtained with the result that the whole becomes greater than the sum of its parts.

For example, the panel members did not see much evidence that the projects come together in regular joint seminars, for mutual exchange of ideas, for building personal contacts, and for calibrating that the different research lines are in harmony both with each other (i.e. no unwarranted overlaps) and with overall goals. Such regular congregations/meetings are important for all staff, but probably particularly more so for students and young scientists in the beginning of their carriers.

Probably as a corollary of this lack of frequent contacts, several of the PIs seemed to be unaware of, or at least regarding as insignificant, the fact that their project is part of the overall FIBIC endeavour. Researchers do not appear to work in a team but on individual, weakly related projects. Thus, it was obvious to us that mechanisms should be put in place to complement the annual meeting, with the aim of enhancing the networking potential. Focus should be on students (poster meetings, elevator speeches to present their work, students close to graduation presenting themselves), and on communication to the FIBIC SHOK owners. To this end, a function/position might be considered to integrate, to facilitate interactions, to develop student´s potential and future employment in industry (to reap the rewards of such an ambitious program, so-called student issues), to improve communication within the program, with industry, with media, to organize events, etc.

Nor was it clear to the panel members whether there is a systematic and open evaluation of the scientific quality of the individual projects, including their success in meeting milestones and other predefined targets and success criteria. Only one PI seemed to know the metrics (the other ones thought the panel already had it) that were relevant for our assessment of the project. In short, the panel members missed evidence that peer review mechanisms are used as a guiding principle in selecting projects, in allocating resources to projects, and in deciding whether a particular project should be receiving extra support and back-up in order to be able to stay in the game. Such criteria are, of course, particularly important in the event that a particular project has to be phased out of the overall programme.

We contend that most of these observed weaknesses can be attributed to various factors, the most important being an insufficient management structure. We fully realize that academics usually do not expect that an evaluation team suggests that the management should be increased and strengthened. Yet, we are convinced that in a case such as FIBIC this is precisely what is needed to improve the efficiency of the research programmes.

Our observations and recommendations are summarized below:

- A reasonable management and organizational structure was put in place, but it appears unconvincing in practice. All organizations face the same two major problems, i.e. to ensure sufficient flow of information, and to enhance interactions between the different groups, which is especially difficult to achieve when the organization is spread geographically. To tackle these shortcomings more resources might be needed to strengthen the overall program management. There seems to be too few full time managers for a program of such a broad scope as FIBIC, maybe particularly with respect to the focus areas of FuBio and EffTech
- There is a general lack of systematic peer reviewing as a means of resource allocation and quality assurance. While this might in itself be a sign of too lean management structures, it is also a sign that established academic/scientific values have been partly placed in the back seat during the development of FIBIC. The panel members propose that the situation should be amended. Detailed data concerning rate of publication in refereed journals/conferences, patents, and exams should be available for all parts of the project, and these metric data should have a defined and communicated role in project management. There is also a need to put in place a way to finance "blue sky" research as a part of the program: this part could be a significant unexpected game changer. The "blue sky" research should, however, be based on the vision of FIBIC and the management of FIBIC should decide what kind of "blue sky" project that is founded or not.
- Finally, we recommend that in all parts of the programme development, an integrating activity based on a systems approach should be considered. The aim of such an approach should be to enable an adequate choice of projects that will be techno-economic and environmentally feasible, among those (scientifically sound) alternative projects that could be selected.

INDUSTRY AND UNIVERSITY IMPLICATIONS

At the strategic level, it is clear from our interaction with senior university representatives, that they hold the SHOKs in high regard and consider that SHOKs provide a net benefit to both university and industrial partners. The importance of the SHOKs to universities is reflected in the fact that Finnish universities have wasted no time in aligning their activity to a number of areas encompassed by the SHOKs. The two-way relationship can act to benefit the university since the SHOK provides a mechanism to place the university on the world-stage, through contacts gained from multi-national companies and the engagement in world-leading well-funded research. The universities were clear that aligning university research strategy alongside the SHOKs was appropriate, since it reflected an interest in society moving forward through problem solving and innovation, likely to be a central thrust in any high quality research-focused university. At the same time,

Masters and doctoral students gain from better experience and insight of industrial problems and how they may be solved and have access to a network of potential employees. The relatively large amounts of funding that SHOKs provide, can help to enhance core infrastructure and facilities and ensure that universities remain at the cutting edge with respect to the latest technologies and instruments for high quality research output that may benefit the university more widely than the SHOK.

The SHOKs may act to strengthen new multi-disciplinary research activity. Since many of the world's most pressing problems, associated with natural resource utilization, energy, food and technology development, will require such multi-disciplinary approaches, the SHOK may provide a vehicle enabling appropriate university collaborations across disciplines to develop.

From the industrial perspective, a better insight is gained of university research potential and portfolios where relationships in research may be extended outside the core mission of the SHOK. Through new interactions, novel ideas for basic research are likely to be generated, promoting new applications-based research of benefit to both industry and academia. Working together, the academic-industrial partnership in a SHOK can gain a critical mass of people that would be absent with each of the partners working alone and this should help to accelerate novel discoveries and research delivery.

One note of caution sensed by the panel is that universities may not yet be making the best use of the industrial contacts provided by the SHOKs with respect to graduate employment and job creation for the next generation of highly skilled industrialists that the FIBIC SHOK may produce. Within the bio-economy area, the next generation of highly skilled technologists will be critical in ensuring that the forest-based products industry succeeds. However, traditional career paths may be redundant for these graduates. The universities are well-placed to make better efforts to develop new networking relationships, through joint events, showcase activities for their students and the generation and maintenance of a SHOK database that keeps students and companies in touch and informed.

It is hoped that the relationship between Tekes, the universities and SHOKs does not become too comfortable, with an elite group of universities only, enabled to join the SHOK programmes. Tekes should ensure that the widest consultations and skills sets are considered for the SHOKs, even outside the 'recognized' constituencies. Better use of international experts and advisory groups should help to ensure that such a goal is achieved.

Challenges remain to ensure that the SHOK approach is fully immersed in university strategy. One tension was how to ensure that at PI and Professorial level, that SHOK research remained attractive and relevant such that the very best academics would wish to participate. A key solution seems to be the ability to fund "blue-sky" research that, at the same time, truly shortened the innovation chain and led to useful output to industry. There was some concern from university representatives that there was some 'mission-slip' within the SHOKs with a drift towards more applied research

and this should be addressed through discussion between Tekes and the Academy of Finland. It is possible that new future funding mechanisms could be included in SHOK activity with better focus on 'blue-skies' speculative research, although the exact nature of this arrangement should be determined by the Academy and Tekes.

Although presented as a key goal within the programme by many PIs and the FIBIC management, it was apparent throughout the evaluation that no clear strategy or tactics for internationalization was apparent. The purpose, role and approach to internationalization should be addressed, as recommended elsewhere in this report. Similarly concern was expressed that a risk of the SHOK approach was that efforts became too short-sighted, with no clear vision for the long-term future, given the timeframe with which SHOKs were funded. It would be worthwhile to consider mechanisms to ensure the long-term agenda is captured so that SHOKs enable rather than curb innovation. For example it was not clear without 'blue-sky' funding how radical ideas could be captured and developed. More effective actions between industry and universities would seem appropriate to providing the environment in which such type of thinking may evolve, both within and outside the SHOKs, perhaps through joint workshops.

Conclusions

Overall, it is seen that FIBIC has a unique potential to leverage the core competencies of human capital. FIBIC exploits the potential of the Finnish forest natural resources; its vision is appropriate and well-tailored to the anticipated future needs, competitiveness, and economy of the Finnish forest products industry. It is also apparent to the panel that FIBIC receives full support from the industry, academia, VTT, and the individual researchers. It is also recognized that the commitment of the industry is growing, most probably because FIBIC is now getting closer to applied research. However, getting closer to applied research might also be considered as a risk for the overall SHOK objectives. The desired balance should clearly be spelled out.

The programmes were developed in a short but timely time period. Through the programmes, FIBIC tackles both short-middle term concerns and long term concerns, thus providing both pre-competitive and pre-commercial potential: i.e. both applied and fundamental research. However, some parts of the programme (e.g. part of EffTech)is moving towards a more applied research which could be perceived as a mission drift from the original SHOK concept. Despite this, the results presented were deemed to range from good to excellent. It should be remembered, however, that the overall management must be strengthened in order to improve the internal communication and integration of projects.

RECOMMENDATIONS FOR THE FUTURE

- Programme management structure must be strengthened: FIBIC is a large and important programme operator, but there are too few persons dealing with general management issues. In order to meet many of the identified challenges

it is proposed that the programme management be strengthen, perhaps with addition of some key functions (e.g. a function dealing with communication and student issues, and a function dealing with integration of projects).

- As far as programme management is concerned, it is suggested that the metrics of programme follow-up are gatherered continuosly in a comprehensive and synthetic manner including peer reviewed publications, patents, conference presentations, number of post-doctoral, PhD and Masters students involved, dissemination events organized and attended, etc (i.e. KPIs are needed).
- A way to finance "blue sky" research as a part of the programme ought to be implemented since this type of research could be a significant unexpected game changer.
- An international advisory group could be considered to help the FIBIC management make sure that the projects/programme adequately fit the Finnish forest products industry strategic agenda.
- It is recommended that considerably more efforts be placed on ensuring better interactions and collaboration within and between programmes, with a particular emphasis on young researchers
- It is also proposed that the agenda setting of FIBIC be considered in the scope of FrameWork Program 8 – Horizon 2020 by either making the Finnish agenda fit with the EU agenda or, considering that Scandinavian countries are key EU forest products nations, having the Finnish/Scandinavian agenda influence on the EU agenda.
- The management group ought to evaluate the true benefit and/or concern of international cooperation. Furthermore, it needs to clarify the strategy and implementation of the procedure to implement international cooperation and communicate it to the SHOK researchers/managers.
- FIBIC should receive continued funding and provided that the evaluation recommendations of this report are followed-up this SHOK should become a leading innovation centre for Finland providing new technologies and human resources that will leverage Finland's intrinsic forest resources and societies demand for new high-performance green materials and energy.

3.3 FIMECC evaluation panel findings

The SHOK instrument, with strong industry-university co-operation, is impressive and ambitious, and FIMECC is in general considered important for the Finnish metal products and mechanical engineering industry. FIMECC management is very good, with an efficient lean organization. The panel could not assess the results of research supported by FIMECC. Assessment was too early, particularly for projects building on on-going research. Furthermore, for some projects the horizon of 5 years is considered to be too short. Another difficulty in assessing results versus objectives was the lack of definitions in the SHOK instrument. The objectives "word-class" and

"to create globally leading competences" were considered ambiguous and in need of clarification. "Internationally visible research" would be a more realistic objective.

The panel did not see any real evidence on the development and building of international research co-operation.

"Sustainability" and other "eco" issues introduced as cross-cutting themes in the SRA were welcomed by the panel.

The strong FIMECC emphasis on initiatives from industry could hamper the inclusion of high risk topics and might focus university research on short term projects. However, one positive direct result was that of networking (primarily on a national level).

A tendency for risk avoidance behaviour was noticed - both in terms of internal trust and conscious risk taking in programmes and projects.

The objective for new business benefits was only partly met. A policy concerning IPR and the exploitation of research results also seems to be lacking.

The character, volume and the timeframe of some programmes are very diverse. This might lead to scattering of resources, lack of critical mass for small projects and a diversity of objectives for the larger ones.

Many programmes include multi-disciplinary expertise, but there seems to be too little interaction/synergy between the more technical projects and projects within other disciplines (e.g. behavioural science).

- The process of shaping the SRA should be more inclusive, transparent and consulted by peers.
- Interaction between SHOKs on the SRA-level should be encouraged.
- In the SRA, more directives should be given to the size of the programmes and projects.
- FIMECC should attract a wider set of Finnish research groups.
- Benchmarking of research and definition of "world class" would be needed, as well as clarity with the use of these terms. Benchmarking of FIMECC might be carried out versus one representative competitor country. Benchmarking and road-mapping of competences from a Finnish perspective would be desirable.
- More intensive international research co-operation should be encouraged.
- Some programmes/projects with higher risk should be introduced.
- The Academy of Finland should take a more active role, e.g. in establishing and funding of FIMECC programmes/projects

3.3.1 The task of the FIMECC panel

The panel's task was defined as follows:

- To evaluate the relevance of the FIMECC programme strategy.
- To evaluate the Strategic Research Agenda (SRA) of FIMECC, the quality of its programmes and main projects, and the competence and expertise of the actors involved, from the point of view of the key strategic goals of FIMECC.

To cover also the outcomes and impacts of FIMECC activities and assess how successfully FIMECC as a SHOK performs compared with other SHOKs and how it is advancing towards its strategic goals and what kinds of results it has achieved so far. The panel was expected to assess the current SHOK research against global competences, with the global competence level as a standard. In providing the baseline assessment, the panel´s questions to be addressed included:

- Does FIMECC's activity represent the global cutting edge or is it plausibly advancing in that direction so that the cutting edge can be reached in the future?
- Have the competencies and capabilities of FIMECC reached the international top level of innovation?

The panel was also asked to draft recommendations on how to further develop the activity of FIMECC.

The panel was chaired by Professor Jan-Gunnar Persson. Other panel members included Professor F.J.M van Houten, Professor Herbert Birkhofer, Professor Panos Tsakiropoulos and Professor Ahti Salo. Biographical notes of the panel members are included as an attachment to this report.

The panel's reflection of the task

Firstly, the panel expressed its intention as a committee to supply their views and assessments on how to improve the programme, and that the remarks made should be interpreted in that sense – not as direct criticism.

When reflecting on the task of the panel, there was a feeling that assessing the main outcomes and results on the basis of the information and materials provided was difficult due to the excessive volume of a variety of diverse data, the multiplicity (in terms of breadth and depth and overlap) of programmes and their different lifetimes. Meaningful set of indicators may need to be formulated to support the currently used FIMECC performance indicators. This would include using the internationally accepted indicators of scientific quality, such as number of papers in ISI journals. The organisations funding FIMECC and other SHOKs (Tekes, Academy of Finland, industry) and the organisations defining the strategic themes and priority research programmes of FIMECC (and other SHOKs) should clearly define (that they agree on) what they mean with general terms such as "world class", "internationally competitive", "research impact", "and societal impact". Without such definitions, the panel found it rather difficult to assess the FIMECC activities and research programmes within the framework of the panel's tasks as outlined in the previous section, because there was rather little comprehensive data available and ambiguity in terminology. Moreover, many activities and research programmes are still ongoing and, as a result, it is too early to assess the results, in particular in terms of the economic and societal impact of FIMECC.

Against this backdrop, the panel has carried out the evaluation more from a developmental perspective, with an emphasis on what the strong and weak

aspects of the SHOK instrument are at present and what could be improved in the future.

Core findings of the FIMECC panel per theme

Background

The panel´s assessment of the role and appropriateness from an international perspective of the SHOK-instrument and of FIMECC in particular, was as follows:

- The SHOK instrument is a Finnish approach to industry-university cooperation in which industry, universities and research institutes cooperate on pre-competitive research, with the aim of developing innovations, competencies and capabilities that will strengthen the competitive position of Finland globally in the medium to long term. In the SHOK instrument, industry takes a leading role in the formulation of long/medium-term research, together with universities and research institutions (currently without international benchmarking and without the input of independent advisor(s)). The panel members had not seen other programs exactly like the SHOK instrument but were aware of similar instruments developed inside and outside the EU to "activate" industry-academia research cooperation. The panel agreed that the SHOK instrument, though impressive and ambitious, does have (potentially severe) implications for engineering education and training in Finland and for the autonomy of Finnish Universities.
- According to SHOK objectives in general FIMECC is also fostering the change of mindsets both in industry, universities and research institutes, from the point of view of co-operating at pre-competitive research level. The panel agreed that it is essential that more care and effort should go towards monitoring and managing the co-operation and interaction between different themes and programmes within FIMECC and towards outlining, establishing, monitoring, managing and evaluating the evolution of co-operation and interaction with other SHOKs (in particular Cleen, RYM).
- The SHOK instrument represents a new mode of funding, with a sizeable budget and ambitions for a long time span. The long-term funding ought to facilitate both long-term and innovative research, and strengthen university research via funding that covers the entire PhD project period.

The panel agreed that the SHOK instrument is impressive and ambitious, and that it needs to be implemented with caution, because much work still needs to be done to achieve the aim and general objectives established at the start of the SHOKs.

- Regarding the FIMECC objectives and the question whether these were too ambitious and/or realistic, the panel agreed that:
  - There was not much evidence on the creation of new international research networks, and therefore more efforts may be needed to establish such networks.

  - As for the objectives of new top science and fundamental research, the evidence consisted mostly of good application driven research but not necessarily of new or breakthrough research, or more fundamental research.
  - The objective for new business benefits was only partly met. However, one positive direct result was that of networking (primarily on a national level).
  - The ambition for creation of a world-class research centre was vaguely defined – what does "word-class" mean? This objective needs to be clarified.
  - The objective "To create globally leading competences" was also ambiguous and in need of clarification.
- The panel´s opinion was that the objective 'Internationally visible research' would be a better and more realistic objective than 'world class research' and 'globally leading research'.
  - The panel did not see any real evidence on the development and building of a world class research cluster. Some individual groups do have international visibility and reputation, but the connection (if any) of international reputation to the SHOK instrument was not apparent (a research group's international reputation may be strengthened, but not created, by a SHOK such as FIMECC).
  - The panel noted that often "international reputation and international recognition" was considered to be exchange of PhD students, and that international co-operation (in some cases) often consisted of visit(s) by Finnish researchers who would use key research facilities overseas even though such facilities were available in Finland.

Regarding the FIMECC objectives, when viewed as part of the overall objectives of the SHOK instrument, the panel was concerned with how the objectives for "world class", "internationally competitive", "globally leading research" could be achieved given the current approach(es) for the selection of bids and the current mechanism(s) used for the prioritization and funding of successful bids for SHOK instrument research programmes.

The panel also assessed the potential for globally significant breakthroughs and economic and societal impacts, as follows:

- Activities in the high risk phase were evident in only a minority of cases (parts of LIGHT in case of research, UXUS in case of a conceptual clarification).
- A world class research centre has to have world class research facilities and links of collaboration with international leaders in the field, as well as visits of key researchers. This was not well demonstrated.
- The economic and societal impacts of FIMECC could not be assessed, not only because of lack of definitions in the SHOK instrument, but also

because it is in most cases still too early to produce and assess such general benefits to society.

The main strengths and weaknesses of the SHOK instrument for different types of stakeholders and target groups were assessed as follows:

- Strength: Major Finnish corporations are likely to benefit from the strengthened co-operation with universities and research institutions, regarding long/ medium term research.
- Strength: Industries and research institutions should benefit from the substantial and long-term funding available via the SHOK instrument.
- Strength: SMEs can participate in and benefit from research projects even if many of them are not stakeholders in FIMECC.
- Weakness: SMEs are less influential in the definition of strategic themes, because they are not SHOK founding members (SMEs are not represented in SHOK boards). Thus, SMEs have less influence (i) in the definition of the SHOK strategy, (ii) in the prioritization of research programmes and (iii) in the preparation of bids seeking funding of research projects via a SHOK.
- Weakness: The imbalance between the influence of companies and universities (and in the latter a potential imbalance created via the selection of academic(s) and academic units to "participate" in a SHOK) on the FIMECC Strategic Research Agenda (SRA), with strong emphasis on initiatives from (or themes prioritised by) industry(ies), could hamper the inclusion of high risk topics and has, in the long term, the danger that the university research will be biased towards short term projects that secure funding because of their link with the needs of industry.
- Weakness: FIMECC should continue to put considerable emphasis on the dissemination of results to wider R&D audience(s) in Finland. This may encourage more companies and research institutions to become interested in participating in FIMECC programmes and/or projects.

The SHOK instrument approach

The need and rationale behind this SHOK, namely FIMECC, was regarded as quite clear. FIMECC was seen as crucial for the international visibility of Finnish engineering research, for the sustainability of the Finnish manufacturing industry, for securing non-Finnish research funding (e.g., EU framework program research funding), and, ultimately, for improving the prosperity of the country.

The key observations with regard to the SHOK instrument and FIMECC in particular are the following:

- Setting of the research agenda should be internationally benchmarked: currently there is too much inward focus.
- Establishing an international FIMECC advisory board could be one way of improving the international influence.

- The FIMECC organization was considered to be very lean, efficient and well working.
- FIMECC should ensure interaction between different SHOKs and research programmes and the management of these interactions, where appropriate.
- The FIMECC vision in terms of impact of innovation should be clarified and better articulated. Especially IPR issues might be complicated (despite, as it was claimed by the FIMECC board, that IPR had so far not been problematic). Specific issues to be better articulated are: Who (which companies and universities?) should be involved in an innovative R&D project? How should such a project be exploited and who will hold and exploit the IPR?
- FIMECC should pay more attention to proactively engaging a wider set of Finnish research groups that could contribute to its research programmes.
- The panel got the impression that the FIMECC management (board and CEO) is very competent and well aware of all major issues, in particular those linked with manufacturing.
- The transparent and thorough internal evaluation of the programme proposals should ensure research of the highest quality that meets the targets and agenda of the different funding bodies (e.g. Tekes, Academy of Finland, EU).
- FIMECC should contribute to the structured and conscious development of human resources (in academia and industry) by fostering the development of competences needed in the future by the Finnish society and its role in the global economy. Material resources and equipment needed within academia must be systematically developed, too.

Strategic research agenda of FIMECC

The key observations with regards to the SRA of FIMECC were the following:

- The SRA was set up by shareholder companies in a dialogue with universities and VTT so that it was very relevant to current business objectives shaped by the existing industry structure in Finland. Yet a more inclusive approach would be needed to account for the need for competences that would be crucial to other application areas in the future.
- FIMECC via its SRA should be realistic about the "breakthroughs" that could be achieved within a 5 year period. For some topics the horizon of 5 years is way too short.
- The character, the volume and the timeframe of the programmes are very diverse. This could lead to scattering of resources, lack of critical mass for small projects and a diversity of objectives for the larger ones. In the SRA, more directives should be given to programmes and projects of different size.
- The cross-cutting themes were stressed in the revised SRA version. The emphasis on "sustainability" and other "eco" issues that were introduced as cross-cutting themes in the revised SRA was welcomed by the panel. Still the benefit of dealing with cross-cutting themes could be improved by establishing

working groups or workshops right across the FIMECC programmes to increase efficiency and to decrease fragmentation of related research activities.

- There were some doubts about the robustness of some of the research programmes that were presented to the panel.
- The panel´s impression was that not all available competences and expertise were utilised in shaping the SRA process of FIMECC. This process should be more systematic, inclusive and transparent, and should have international dimension in an advisory role.
- The panel noted that there are gaps in the strategic competence base, both in terms of the research facilities and research expertise - SHOKs should assess the competence base through their SRAs so that solutions to competence gaps can be found within the wider R&D agenda in Finland.

FIMECC research programmes

The panel agreed that it did not have all the necessary information available to assess the individual programmes. There was not enough time for the programme presentations. The presentations were rather varied despite the presenters' efforts to concentrate to the rationale and the results. A specific problem was that there are eight FIMECC research programmes underway, but the time available to discuss each programme was limited to half an hour only.

In the future, in an evaluation where scientific assessment is expected, a more systematic self-assessment at both SHOK level and programme level, with hard evidence must be required. The data collection and programme/project reporting should be developed accordingly.

The panel was concerned whether the research topics covered by the research programmes are those with most potential.

- For some topics (projects, work packages and tasks) the horizon of 5 years is too short.
- The character, the volume and the timeframe of some programmes are very diverse. This might lead to scattering of resources, lack of critical mass for small projects and a diversity of objectives for the larger ones. In the SRA, more directives should be given to the size of the programmes and projects.
- There were some doubts about the robustness of some of the research programmes presented to the panel.

University and research perspectives

The key observations made by the panel included, amongst others, the following:

- The panel was concerned that, for the universities, the SHOK instrument may not allow the best university researchers to receive SHOK funding.
- Despite the fact that many of the programmes include multi-disciplinary expertise, there seems to be still too little interaction/synergy between the

more technical projects and projects within other disciplines (e.g. behavioural science).

- Benefits from participation in FIMECC programmes include the exposure of university academics and management to industry relevant research topics, opportunities for knowledge creation, securing additional and longer lasting funding for universities, new employment opportunities and retention of jobs, enabling hard and soft skill development, promoting co-operation within and across universities, as well as stimulating researcher mobility.
- A source of concern is that the SHOK instrument may tend to shift research priorities towards short-term current "fashionable" topics for which research funding is relatively easy to acquire but which may focus on established routes and stimulate risk avoidance.
- Deliberate attention should be paid to the balance of activities and accompanying funding between pure and applied science and engineering and R&D, in order to foster the development and exploitation of world class competences at Finnish universities.
- The Academy of Finland needs to recognize its responsibility for the strengthening of engineering research relevant to Finnish industry and its needs identified in SHOKs in general and in FIMECC in particular.
- FIMECC could foster entrepreneurship and global networking both for institutions as well as for individuals on all levels.
- FIMECC could contribute to improving the reputation and attractiveness of engineering disciplines and engineering research.

Conclusions and implications for the future

The panel was given the opportunity to "experience" how FIMECC applied efficiently the SHOK instrument approach to the future needs of the metals and mechanical engineering industry in Finland via a wide range of actions, activities, ideas and policies which have resulted in the identification of research themes and the prioritization and execution of research projects that have been informed by the vision, mission and strategic targets of FIMECC.

These were outlined and/or presented (in some detail) by Tekes, members of the FIMECC Board, selected representatives of Finnish industry, as well as by members of Finnish academia and VTT.

The panel was impressed by the breadth of evolutionary work that is undertaken by many of the research teams.

On the whole, the FIMECC work was seen as general and important, though there are grounds for adjusting the SRA and the programmes. There needs to be a conscious balancing between the interests of industry and academia and especially more incentives for exploitation. International research co-operation should also be strengthened. Some key findings and messages include the following:

- "Truly international" - what does this mean and what is expected?

- Benchmarking of research and definition of "world class" would be needed, as well as clarity with the use of these terms.
- Benchmarking of FIMECC might be carried out versus one representative competitor country.
- More intensive international research co-operation should be encouraged.
- The process of shaping the SRA should be more inclusive, transparent and consulted by peers.
- The panel noticed a tendency for risk avoidance behaviour - both in terms of internal trust and conscious risk taking in programmes and projects. Some programmes/projects with higher risk should be introduced.
- Balance of activities and research funding could be improved.
- FIMECC should attract a wider set of Finnish research groups.
- Interaction between SHOKs on the SRA-level should be encouraged.
- Benchmarking and road-mapping of competences from a Finnish perspective would be desirable.
- There seems to be a lack of policy concerning IPR and the exploitation of research results.
- The Academy of Finland should recognize its responsibility for the strengthening of engineering research relevant to Finnish industry and should take a more active role, e.g. in establishing and funding of FIMECC programmes/project.

3.4 RYM evaluation panel findings

- As a part of the SHOK evaluation, Academy of Finland invited international evaluation panels to provide a separate assessment of each six SHOKs. All the panels followed the same methodology in their work. The methodology is described in more detail in the main report of the SHOK evaluation.
- The panel members for RYM evaluation are listed in Annex 1. The panel received the background material in summer 2012 and met in Helsinki 10 – 12 September 2012 in a workshop. During the workshop the panel interviewed a range of RYM representatives. The list of people interviewed during the workshop is provided in Annex 2.
- The panel decided that the evaluation approach should be as independent as possible and that panel members should give their own opinions and insights. The panel took into account the material provided, e.g. the e-survey results, but decided that there is no need to rely on or align the conclusions with the survey, or other evaluation material.
- RYM is a special case among SHOKs in that sense that it is the youngest. Given the early stage of RYM, it should be noted that the evidence concerning long term impacts is very limited.
- The panel took into account the given guiding questions to structure the discussion and this panel report.

Overview of the RYM Ltd approach

- Overall the panel is of the opinion that RYM (and SHOK) as a concept is an impressive, well conceived and modern attempt to build up a new type of research collaboration between built environment industry as a whole and academia. SHOK as a concept is interesting and innovative on an international level as a research and innovation policy instrument. The panel was impressed by the level of ambition to make a difference.
- For building up strategic research together, built environment industries provide a very challenging platform due to their very fragmented structure and lack of integration. The "horizontal" industries (material suppliers, technology/device suppliers) are easier to integrate and engage with strategic basic research but the "vertical" industries (design and construction industries, real estate) are very hard to get committed. The latter, real estate, design and construction industries, are of main importance in defining the quality of built environment.
- Built environment research in Finland has good international reputation, but seems to lack strategic connectivity with the Finnish built environment industry. RYM tries to build a strategy around the work already done and, more importantly, build a basis for the future by encouraging the built environment industry to participate in high quality research. These main aims are very relevant.
- Clearly an aim of RYM has been to encourage industry to be in the driver's seat to define strategic research directions, but it seems that industry-academia co-creation has not been that high on the RYM's agenda. Academia and industry should work more closely together not only in the delivery of research, but also in the prioritization of research projects and the setting of research objectives. Co-creation is necessary throughout the research life-cycle if the RYM is to make a real difference.
- The biggest threat for RYM is the time frame. Three years has been too short time to create new structures for industry where many companies are not used to engaging with underpinning basic research. In the future more commitment is needed while at the same time the funding will most likely diminish. One can only hope that industry will not lose interest.

Strategic research agenda of RYM

- The Panel was unanimous in its view that the SRA topics and framework are relevant and interesting. SRA provides a good basis for the currently research programmes. The panel considers that the SRA in its present articulation would also offer a good basis for future programmes. There is no urgent need to make a major revision on SRA, but more focus on the implementation and assessment of programmes. These challenges are further elaborated in the following chapters.

- A remark from the panel was that climate change emphasis in the overall SRA framework is perhaps too narrow. The overall umbrella could arguably be people and environment. Furthermore energy efficiency could be a broader sustainability view covering also, e.g., resource efficiency.
- The main concern of the panel was how the SRA and programmes are related to each other. It is clear how the first two programmes (PRE and IE) have been built based on the SRA, but this is less clear in the case of the third EUE programme. Also, it is important for the future to understand how the new programme ideas are assessed and how the selection of new programmes is made based on the SRA. The process through which research programmes are established was not clear to the panel.
- The panel appreciates the RYM attempt to involve industry strongly into the process of defining interesting research questions. However, there is some concern that there is apparent lack of sufficient high level communication and coordination between industry and academia in defining the SRA. RYM has an important strategic role in enhancing this communication and coordination.
- The panel agrees with the importance of articulating the need for underpinning basic research as well development and innovation activities. However, there is a danger that the split between research and development appears to be too strict. There is a need for basic research to be informed by the development activities and vice versa. The relationship between the two should not be assumed to be linear and unidirectional.
- SHOK concept gives priority to science and technology. The panel would therefore expect this to be reflected in RYM research programmes. There are in RYM programmes a lot of people representing different research fields. The increase in multidisciplinarity is good, but throughout the research programme different knowledge needs to be mobilized towards the common aim of industry improvement. The challenge with multi-disciplinary research is how to ensure that all results are usable.
- The panel gained the impression that there is a lack of explicit selection criteria for the initiation of programmes. This lack of precision in selection was seen to lead to follow-up problems with respect to strategic and operational programme management.
- The panel believes that more attention needs to be put on seeking an appropriate balance between high and low risk research in the overall portfolio consisting of all RYM programmes as well as within each programme. There is a need to ensure that there is also acceptance for the fact that all the research work does not necessarily succeed – research is inherently a risk business. The panel was especially keen to see a greater emphasis on explorative research.

Research programmes of RYM

Overall the panel was concerned about the quality of the material provided for the evaluation. This applied equally to all of the programmes. For each programme there was lack of cohesiveness and systematic structure within the documents presented.

The panel strongly believes that a major problem for all RYM programmes is that they lack a clear key academic person (principal investigator) being able to provide research leadership for each programme as a whole and not only on a WP level. The apparent lack of leadership currently means, for example, that there is no advocate for each research progamme who is in a position to inform all the relevant stakeholders about the current status and progress of the research (in a coherent, professional, enthusiastic manner).

Separate panel conclusions are provided below for each of the three RYM programmes. Overall conclusions and implications for future are presented in the last chapters.

Built environment process re-engineering (PRE)

The panel agrees that Finland has good academic capabilities particularly in this area, but these capabilities are not shining through in the programme material provided to the panel.

- The panel missed a description of a coherent picture of the relationships between programme objectives and WPs. It is considered that this observation is in part related to the lack of principal investigator.
- There was no accessible overview of the outputs from the programme. It may be that the separate WPs are doing good work, but these outputs were not visible at all. Both the material and the presentation were not able to describe the deliverables. During the second year of the programme there should be at least a 10 page summary report of the achievements this far.
- Generally a lack of programme monitoring processes and laissez faire management attitude.
- ***A strong recommendation for PRE is immediately to take hold of the problems and do something over the last year and not to let the programme to end without RYM taking a clear leadership.***

Indoor environment (IE)

- Indoor environment is an important topic and very challenging area full of complexities. Finland has a tradition of doing good research in this area.
- However, the IE programme seems to lack novelty. Programme seemingly repeats work that has already been done elsewhere. Why not to look for something new? An example could be to look at the mixture of pollutants affecting indoor quality or the development of new sensors. The programme has not been able to demonstrate such new content.

- Anticipated outcomes are unclear, how they are planned to be used?
- The programme management of the IE programme appeared to be more consistent than in the PRE programme. However, once again, the absense of a dedicated Principal Iinvestigator is a serious concern.

Energizing urban ecosystems (EUE)

- The panel agrees that the urbanization is a serious issue worldwide and requires research attention. It was recognized that Finland has a rich tradition of urban planning and city development.
- It was noted that the programme has just started. The two presentations, however, gave conflicting pictures of the programme content and aims.
- There seems to be lack of precision in the research questions. The research ideas are interesting, but the programme needs a clearer scope.

RYM vision to create Strategic Centers of Excellence

RYM has a long term vision to create a number of sector-specific Strategic Centers of Excellence. SHOKs are seen as means to create centers of science, technology and innovation.

- The panel noted that the vision for the future cannot cover only few years ahead and stop with the establishment of a center of excellence. There needs to be a clear long term road map with associated contingency plans. What happens if funding drops? How do centers of excellences together look like? How will they network and co-operate together? How are the new ideas incorporated and supported while also supporting the strong existing groups? When a center of excellence is formed, they should get extra funding, get famous and attract more money and become self-sufficient. How will this happen? How is the bridging between programmes taking place?
- The built environment industry deserves to be supported by centers producing high quality scientific research and development programmes. Having such centers should attract and support highly qualified research personnel.
- The panel strongly believes that maintaining high quality research requires thorough and ambitious peer review system to assess the quality of the content of the work. Peer review should be applied to the documentation in support of proposed research programmes, and also to the mid-term evaluation of research results.
- The panel believes that the successful development of centers is currently constrained by inappropriate governance structures. There does not appear to be any effective procedure to monitor the progress of the research programmes at the board level. Neither does there appear to be any effective independent mechanism to remedy adverse trends (programmes not delivering what they promise). It is important to emphasize that these comments do not relate only to programme and cost, but also to research deliverables.

Conclusions

- SHOK concept is a very ambitious an innovative attempt to enhance the competitiveness of Finnish industry. It is necessary to acknowledge that the SHOKs are surrounded by a lot complexity. There are considerable challenges involved in attempting to pull a large number of themes together to create a coherent picture. It is a bold attempt and not easy to accomplish.
- RYM's SRA topics and framework are very relevant.
- The panel was of the view that the biggest problem is that RYM has rushed too quickly to implementation
  - Lack of throughout peer review of the content, both at programme initiation and mid-term review.
  - Problems with the management at different levels (board, RYM work, programme management)

Recommendations for future

Board related recommendations.

- Mandate of member of 2 years is too short and should be extended to four years.
- RYM board should comprise of 50% independent membership to guarantee that there is no conflict of interest.
- Board should have the responsibility to monitor and assess the progress in programmes. For this high quality information is needed.
- Each research programme should have a dedicated Principal Investigator who has the responsibility to collate the necessary and report progress to the board. It is emphasized that these report should not be limited to time and cost, but should crucially embrace the extent to which the envisaged research deliverables are being achieved. It is imperative that the Principal Investigator reports on his/her research programme as a whole.
- Board should seek support from a strategic advisory / research strategy group which advises the board on research strategy and dissemination. This strategic advisory group could be used as the primary arena for engaging the interest and input relevant stakeholders, thereby relieving the board to focus on an quasi-independent governance role.
- The panel recommends that there should be clear separation in roles between the board and the "advisory group" outlined above.

SRA and programme governance

- The panel highly recommends that the research programme ideas are peer reviewed before initiation of programmes and also at mid-term.
- Each programme must have a Principal Investigator who must provide research leadership to the progamme and report directly to the board. Principal Investigator is also expected to be strong external advocate of the research programme and should be required to present regularly to the strategic advisory group.

3.5 SalWe evaluation panel findings

Exececutive summary

The Finnish Government's resolution on the structural development of the public research system on 2006 required the preparation of a national strategy on the establishment of an internationally competitive Strategic Centres for Science, Technology and Innovation under the guidance of the Science and Technology Policy Council. The six Strategic Centres for Science, Technology and Innovation (SHOKs) that were set up as a consequence are one of the main instruments of Finnish innovation policy today.

Tekes and the Academy of Finland have commissioned an evaluation of the SHOKs mechanisms. The evaluation will address both the level of research, development and innovation policy and individual SHOKs. This report describes the central observations and recommendations of the Evaluation Panel for the Health and Wellbeing SHOK (SalWe).

The Panel noted that, due to the time point, the current evaluation has major limitations. The funding of SalWe started in 2010. It is not possible to evaluate the scientific value and output of the individual projects after two years of action. Therefore, the Panel has focused in its work on the strategy, work plan and processes as well as the success and potential of the new tool for initiating and sustaining collaboration between industry, academia and research institutes. A careful evaluation of the research programmes should be carried later using conventional methodology of research evaluation.

Based on the available information received through the background material, questionary surveys, and discussions with shareholders, stakeholders and researchers the Panel came to the conclusion that SHOK concept in general has reached many, although not all of its goals. The concept itself is not a new one as similar tools are in use in several European countries and elsewhere. Nevertheless, the tool is an innovation in Finland and has been developed and applied in a way that is well suited for the Finnish circumstances.

The Panel noted with some concern that no formal long term strategy has been set for the overall SHOK concept. Furthermore, it became evident that the ownership of the SHOK tool in the Finnish research and innovation system is not clear. The Panel recommends that the strategy of the SHOKs is reformulated based on the experiences from 2008-2012 and the recommendations of the present evaluation process. The formal ownership of the SHOK structure should be defined as a part of the revised strategy.

Overall, the Panel was impressed by the work that has been carried by the management team to develop the strategy of SalWe. The mission and principal objectives of the strategy are formulated in broad terms. In the view of the Panel this is appropriate and provides a flexible framework within which SalWe can properly discharge its tasks both in terms of people's health and the interests of

the companies. The Panel noted with satisfaction that the Board and the Managing Director have initiated a process for updating the SalWe strategy for 2014-2017.

A non-profit limited company was originally chosen as administrative model for the SHOKs. Based on the experiences accumulated during the first two years of SalWe the model is well-suited and appropriate in this context. The administration and management of SalWe have been arranged in a highly efficient and lean way. The Panel particularly applauds the success of the Managing Director in building an organization with a clearly defined strategy, efficient processes and high user satisfaction.

The Panel noted that SalWe has not defined key process and outcome indicators to support the monitoring the success of the strategy and annual work plans. The Panel recommends that work should immediately be launched to document all work processes and define relevant process and outcome indicators.

The strategic research agenda was compiled in the spring of 2009 based on consultations of Finnish companies and academia. The research programmes were planned and decided by the companies participating in the consultations in a bottom-up process. The academia and research institutes were consulted mainly as competence resources, although in some instances the initiator for the collaboration was academia or the research institute.

The current research programmes are highly heterogeneous in terms of the research themes, research volumes and quality of science. The heterogeneity of the programmes is a major problem as one of the goals of the SHOK concept is to promote dialogue and cross-fertilization between companies within work programmes. The potential for successful development could be increased by sharpening the focus according to specific strengths of SalWe and the specific Finnish industrial and societal needs. The Panel recommends that the Board and management should compile a competence and needs road map to build up new partnerships that would complement the existing ones both in terms of science and relevance.

The actions of SalWe are focused almost entirely on the development of products and diagnostic methods while services and new practices are conspicuously absent. Furthermore, the Panel was concerned that some of the projects do not fulfill the definition of precompetitive research and were in fact close to competitive product development. It is emphasized that the SHOK tool should under all circumstances be limited to precompetitive research, as other tools already exist in Finland for supporting competitive product development.

The current policy of Tekes does not allow funding of research and development of international companies unless they have a branch in Finland. Although the current policy may be justified in product development, it is clearly counterproductive in precompetitive research and long-term industrial activity within Finland. The Panel recommends that the policy of Tekes in funding of international companies is revised to allow funding of foreign companies through the SHOKs even when the company has not a branch in Finland.

For several reasons, the Panel was not in the position to carry out a full evaluation of the research projects in SalWe. Nevertheless, the Panel reached a broad judgment that a substantial part of the current research programme carried out in SalWe is of high scientific quality output and represent the global cutting edge or is plausibly advancing in that direction. These activities were in contrast to some projects which did not clearly reach a level worth of public support.

The business potential of the research programmes and work packages can be evaluated only by the industry. Overall, two years is too short time period to allow objective evaluation of the business potential of the SHOK tool. Nevertheless, the Panel noted that the representatives of the industry interviewed during the evaluation expressed their satisfaction both as to the process of encouraging interactions and the research agenda itself as well as to the results achieved so far. The positive impressions were corroborated by the results of the questionnaire surveys.

During the interviews it became evident that the SHOK concept has impacts on the research and innovation system that fall outside the immediate interests of Finnish companies. The attitudes of the researchers (and the attitudes of the universities and state research institutes) towards companies have formerly been negative and sometimes very negative. The SHOK concept and SalWe has potential to change and may already have changed the attitudes in a way that will facilitate and accelerate the development of public-private partnerships in the future.

Active collaboration with all actors in the Finnish research and innovation system and with the actors of the Finnish health and wellbeing system is a key factor for the future success of SalWe. The Panel encourages the Board and management of SalWe to reach out and build up collaborations with the other SHOKs (e.g. health, wellness and telecom oriented innovations together with TIVIT), universities and research institutes, Ministry of Health, municipalities and Federation of Municipalities, occupational health services, insurance companies, and private health care.

Background

The Finnish Government's resolution on the structural development of the public research system on 2006 required, among other things, the preparation of a national strategy on the establishment and confirmation of an internationally competitive Strategic Centres for Science, Technology and Innovation under the guidance of the Science and Technology Policy Council. The Strategic Centres for Science, Technology and Innovation (SHOKs) that were set up as a consequence are one of the main instruments of Finnish innovation policy today.

Among the key objectives of the new policy instrument were the promotion of ever closer cooperation between business life and the world of research. The stated intention was to generate top-level centers of excellence with competitive basis on a global scale with a critical mass required by it for strategically selected fields. The projects conducted within SHOKs were expected to be of high international quality, competitive and significant for the future of Finnish industrial activity and society.

The aim was to bring together and support existing and new R&D resources in a new way and in a significantly larger scale than previously.

Tekes and the Academy of Finland have commissioned an evaluation of the SHOKs mechanisms. Six expert panels have been set to support the evaluation. The evaluation will address both the level of research, development and innovation policy (SHOK as a policy instrument) and individual SHOKs (the research, development and innovation activities implemented as part of this policy).

This report describes the central observations and recommendations of the Evaluation Panel for the Health and Wellbeing SHOK (SalWe) prepared under the chairmanship of Professor Jussi Huttunen, former Director General of the National Public Health Institute of Finland. The other members of the panel were Professor Kay Tee Khaw (University of Cambridge), Professor Robert Istepanian (Director Medical Information and Network Technologies Research Centre, Kingston University, London) Professor Michael Sendtner (Institute for Clinical Neurobiology, University of Wuerzburg) and Professor Wim Saris (Scientific Director of the Nutrition and Health Program of the PPP "Top Institute Food and Nutrition," Wageningen and Maastricht University). Dr. Katri Haila (Ramboll Management Consulting) served the Panel as an evaluation expert and secretary.

Objectives of the evaluation

According to the Terms of Reference the evaluation panels' task is to evaluate the research agenda, the quality of their programmes and main projects, and the competence and expertise of the actors involved, from the point of view of the key goals of the SHOK strategy. The panels should also evaluate the relevance of the present SHOK strategy and assess the added value of this particular instrument.

The evaluation shall cover the outcomes and impacts of activity and assess how successfully the centres are working and advancing towards their strategic goals and what kinds of results they have achieved so far. The panels should also discuss and evaluate the implementation of the programmes. The panels are expected to set the global competence level as a standard. Does the centre's activity represent the global cutting edge or is it plausibly advancing in that direction so that the cutting edge can be reached in the future? Do the centre's competencies and capabilities reach the international top level of innovation? Does the centre form relevant networks as a globally competitive competence cluster?

Relevant questions to be answered are as follows: What is the quality and innovativeness of the centre's research agenda, programmes and projects from the point of view of global breakthroughs and competitiveness? Does the centre have competencies and capabilities to reach world-class level in research, development and innovation? Are there relevant Finnish actors involved and does the centre have relevant global networks for development? Is the programme strategy (goals and premises) still valid? What kind of added value does the programme bring to the innovation system? Value added to different stakeholders?

Conclusions and recommendations

The Panel is conscious that an evaluation of the SHOK concept and activities is needed in order to reach decisions on the future of this new strategic R&D innovation tool (e.g. continuation, funding, strategy and implementation). It is noted, however, that due to the time point the current evaluation has limitations that are not minor. The funding of SalWe, the target of the present evaluation, started in 2010. Apart from the groups that had collaborated before joining SalWe, it is not realistic to expect major breakthroughs or cutting edge research results after two years of action. Nor is it possible to evaluate the scientific value and output of the individual projects.

Because of these limitations the Panel has focused in its work on the strategy, work plan and processes as well as the success and potential of the new tool for initiating and sustaining collaboration between industry, academia and research institutes. The Panel emphasizes that a careful evaluation of the research programmes is definitely needed but should be carried later using conventional methodology of research evaluation.

SHOKs as a policy instrument

The Finnish Government's resolution on the structural development of the public research system in 2006 required the establishment of internationally competitive Strategic Centres for Science, Technology and Innovation (SHOKs) to become one of the main instruments of Finnish innovation policy. Among the key objectives of the policy instrument were the promotion of ever closer cooperation between business life and the world of research, and the generation of top-level expertise and the critical mass required by it for strategically selected fields. The centres focus on producing globally new information and utilising it more efficiently.

The activities of the SHOKs are based on strong cooperation between actors. In the centres, high-quality science, technological development and innovation activities are intended to be in dynamic interaction with one another. The centres are application-driven and support multidisciplinary cooperation so that they create a functional platform for cooperation between researchers, companies and other actors from different fields. The aim has been to build the centres around one or more strong cores that enable new openings and applications. Another aim is to target existing and new R&D resources in a new way, at a significantly larger scale than previously.

It is the view of the Panel that the strategic focus areas selected for the SHOKs are based on careful analysis (including foresighting) of the research competencies and business opportunities of Finland. Some overlapping of the focus areas between the individual SHOKs is unavoidable (e.g. information technology between SalWe and

SHOK for information and communication industry and services) but the potential problems should be addressed through further collaboration between the SHOKs.

In order to achieve these ambitious goals and develop the activities, new funds should be directed to the stated activities, at least in their early stages. Public R&D funding has a crucial significance at the stage of launching of the SHOKs in order to establish quickly a credible and internationally competitive position for them. The Panel was pleased to note that between 2008 and 2011 Tekes has funded the SHOK research programmes by a total of 343 million €. An average of 40% of research conducted by the SHOKs has been co-funded by companies.

Based on the information received through the background material, questionary surveys, and discussions with shareholders, stakeholders and researchers the Panel came to the conclusion that SHOK concept has reached many, although not all of its goals. The concept itself is not a new one as similar tools are in use in several European countries and elsewhere. Nevertheless, the tool is an innovation in Finland and has been developed and applied in a way that suits well the Finnish circumstances.

The Panel noted with some concern that, apart from the working paper document prepared by the steering group appointed by the Science and Technology Policy Council in 2006, no formal long term strategy has been set for the overall SHOK concept. Furthermore, it became evident during the interviews that the ownership of the SHOK tool in the Finnish research and innovation system is not clear. Obviously, Tekes and Academy of Finland have an important role in the funding of the SHOKs, but the strategy and long term goals of the SHOKs should be directed by the Research and Innovation Council.

The coordination between the SHOKs is executed by the work of the informal steering group established by the SHOKs. However, the system appears to work well and is well suited for collaboration of independent limited companies. Nevertheless, in the absence of formal ownership and strategy, the informal nature of the collaborative structures may lead to outcomes and disparities that are not in line with the goals set for the system. Some of the potential problems (e.g. lack of common key processes and key indicators) are discussed in the next sections. These problems may hamper the monitoring of the success of the SHOKs and strategic development of the SHOK concept in the future.

The current policy of Tekes does not allow funding of research and development of international companies unless they have a branch in Finland. Because of this policy it is not possible for the academic centres of excellence to build precompetitive research projects with international business partners using the SHOK as the tool. In particular, the current policy is not favourable for new areas of potential industrial activity with excellent academic group available. Paradoxically, in the SHOK environment the policy may harm the interests of domestic companies, as the interaction and dialogue within SHOKs would promote knowledge transfer from academia and international industry to domestic companies. Although the current

policy may be justified in product development, it is clearly counterproductive in precompetitive research and long-term industrial activity within Finland.

Conclusions and recommendations

The SHOK concept is a new innovation as a part of the Finnish research and innovation system. The funding of the SHOKs should be continued after the end of the current funding period.

The strategy of the SHOK concept should be reformulated based on the experiences from 2008-2012 and the recommendations of the present evaluation process. The formal ownership of the SHOK structure should be defined as a part of the revised strategy.

The policy of Tekes in funding of international companies should be revised to allow funding of foreign companies through the SHOKs even when the company has not a branch in Finland.

Evaluation of the SalWe Ltd

Strategy and mission

The Strategic Centre for Health and Well-being (SalWe) is one of the six SHOKs launched in 2008–2010. SalWe (a limited non-profit company) was established in May 2009 to manage the operations of a SHOK in the field of health and well-being. The mission of the SalWe is to promote health and well-being of people and to foster Finnish business related to these important areas. The goal is to pursue internationally competitive research which leads to the development of products, services and practices for prevention and treatment diseases with major public health and economic impact, and improvement of the functional capability of individuals.

One of the important goals of the Strategic Research Agenda (SRA) of SalWe has been to build up research programmes based on recognized Finnish strengths such as world class molecular and translational medicine, pioneer position in preventive medicine and epidemiology, high quality brain, cancer and nutrition research, innovations in the technology platforms for diagnostic applications and the strength in the ICT and telecommunications. Finland has a highly advanced infrastructure and uniform health care organization enabling new solutions to be studied for efficiency in selected testbeds. Furthermore, numerous projects have been launched and are ongoing in Finland aiming at improving innovativeness and health and social care structures.

Implementation of the strategy forms a continuum that covers basic academic research, applied research programs, consortium projects, and company projects

already realized or to be realized in the future. Introduction of products and services and their impact assessment is seen a part of this continuum. The research programs have numerous interfaces with each other, and the collaboration between programs is active.

Overall, the Panel was impressed by the work that has been carried by the management team to develop the strategy of the SalWe SHOK despite the fact that this is a very wide field of activities and expertise. The mission and principal objectives of the strategy are formulated in broad terms. In the view of the Panel this is appropriate and provides a flexible framework within which SalWe can properly discharge its tasks both in terms of people's health and the interests of the companies. The strengths of the Finland in health research are addressed in detail and constitute an important starting point for planning of the research programmes and work packages. The Panel noted with satisfaction that the Board and the Managing Director have initiated a process for updating the SalWe strategy for 2014-2017.

Nevertheless, the Panel is concerned that the fine-tuning and implementation of the strategy has not been entirely successful. The selection of the disease entities has been based solely on the expressed interests of companies thus excluding several themes with high-quality academic research in Finland. The current programmes are focusing almost totally on product development, while services and best practices are largely omitted. These issues are discussed in detail in section (5.3.).

The strategy of SalWe is an umbrella for the research programs, but also for consortium and company projects that support the research program or are spin-offs from it. The strategy includes some projects and programs funded by other organizations (e.g. Academy of Finland, Sitra, EU). The impression of the Panel was, however, that the role of the Academy and EU projects in the strategy and implementation of the strategy is unclear and at least not fully integrated.

Conclusions and recommendations

The importance of health and well-being for the society, the high quality of health research and infrastructures supporting health research in Finland and the high but largely unexploited potential in Finnish companies makes health and well-being a particularly promising area for public-private collaboration in research and development.

The strategy and mission of the SalWe are consistent with the goals of the SHOKs as formulated in the original strategic plan of the Science and Technology Policy Council. The Board and the Managing Director are currently updating the strategy. Special attention should be paid to aspects that would support the full implementation of the strategy and the recommendations listed in this report.

Management issues

A non-profit limited company was originally chosen as administrative model for the SHOKs. Based on the experiences accumulated during the first two years of SalWe the model is well-suited and appropriate in this context. The model is sufficiently flexible to enable the use of a single structure for both the implementation of small-scale coordination and large-scale operations. Furthermore, the roles of the actors (shareholder, strategic partnership, etc.) as well as associated responsibilities and limitations are clearly defined. A limited company also enables flexible administration of strategic partnership and other cooperative relationship on behalf of the shareholders by means of different agreements.

The Board has an active role in the operations of SalWe. Two of ten members of the Board represent the research community and eight members are appointed by the companies. The staff of SalWe consists of the Managing Director. In addition, SalWe has bought services; two Programme Directors (both 50% of time), Legal Councel (10%) and Chief Financial Officer (25%). The Panel particularly applauds the commitment and success of the Managing Director in building an organization with a clearly defined strategy, efficient processes and high user satisfaction.

The SHOK's joint functions, such as preparation of a strategic research agenda and work plan, and submitting research program applications based on these plans to Tekes, are carried out by the SalWe's Board and Managing Director. Appointed program preparers planned work packages and programs and formed consortiums with the support of the Managing Director. Once the programs were started, program steering groups and program directors were appointed. The Managing Director coordinates collaboration between the programs, a function of utmost importance for the success of the SHOK strategy.

The Panel noted that SalWe (as well as several other SHOKs) has not defined key process and outcome indicators to support the monitoring the success of the strategy and annual work plans. The Panel recommends that work should immediately be launched to document all work processes and define relevant process and outcome indicators. A part of this work should be carried out in collaboration with other SHOKs to save resources and to unify/standardize the processes that support the work of the funding agencies.

While the current processes of SalWe efficiently promote issues important for companies, the academic interests and particularly societal aspects are not always considered in a way that would benefit the overall work of SalWe. Several experts interviewed during the evaluation noted that municipal health and welfare services, occupational health companies and insurance companies have not shown interest in participating in the SalWe activities. This might be one reason explaining the absence of service research in the research agenda. Lack of links to municipalities is a major disadvantage as municipal health services form a testbed and are an important first user of the product innovations, which is essential for commercial success internationally.

The Panel strongly recommends that SalWe should consult regularly representatives of municipal health services, social and occupational health sectors, medical and insurance companies keeping two aims in mind: i) the possibility of these stakeholders to join the research programmes, ii) identifying needs which might lead to new innovative solutions and iii) collaboration in testing the new innovations in everyday practice. Collaboration with these actors could be arranged by inviting experts to the Board meetings on a regular basis, by appointing an Advisory Board for SalWe or by regular interviews and consultations organized by the Managing Director.

Conclusions and recommendations

The administration and management of SalWe have been arranged in a highly efficient way. The Panel particularly applauds the success of the Managing Director in building an organization with a clearly defined strategy, efficient processes and high user satisfaction.

SalWe should, in close collaboration of the SHOKs, document the key administrative processes and develop key process and outcome indicators for monitoring the success of the strategy, research programmes and work packages. This work has a high priority as this information is needed both by SalWe and the funding agencies.

SalWe should regularly consult representatives of municipal health and social services, occupational health companies and insurance companies in order to identify needs, to support testing of the innovations and to find new shareholders. Mechanisms for such collaboration are many and range from setting up an Advisory Board to specific thematic consultations.

Scientific quality and relevance of the research agenda

According to the concept formulated by the Science and Technology Policy Council in 2006 the activities of the SHOKs are based on strong cooperation between the relevant stakeholders. In the centres, high-quality science, technological development and innovation activities are in dynamic constant interaction with one another. The centres must be application-driven (relevance) and support multidisciplinary cooperation so that they create a functional platform for cooperation between researchers, companies and other actors from different fields. The centres are built around one or more strong cores and create opportunities for combining expertise from different fields in a way that will enable, based on foresight, new openings and applications when accounting for the different needs of business life and society in 5 to 15 years.

The SalWe's SRA was compiled in the spring of 2009 based on consultations of Finnish companies and academia. The goal was to establish cross-disciplinary collaboration between nutrition, diagnostics, imaging, pharmaceutical, information technology, and service companies. The research programmes were planned and decided by the companies participating in the consultations in a bottom-up process. The academia and research institutes were consulted mainly as competence resources, although in some instances the initiator for the collaboration was academia or the research institute. The diseases and conditions selected for SHOK focus were:

- microbial infections and inflammation
- metabolic syndrome
- neurodegenerative and psychiatric diseases as well as a healthy brain under stress
- malignant diseases, especially solid tumors

Three programmes were prepared based on the SRA. However, because of lack of resources only two programmes were ultimately launched, both operative since 2010. The total volume of SalWe for 2010-2013 is ca. 61 million € (Tekes 55%, companies 30% and universities and research institutes 15%). The volume of Intelligent Monitoring of Health and Wellbeing (IMO) is ca. 25 million € (19 partners of which 12 are companies, and 7 universities and research institute) and that of the Mind and Body programme ca. 36 million € (23 partners companies of which 12 are companies and 11 universities and research institutes). IMO includes five and Mind and Body Programme three work packages.

The two research programmes are highly heterogeneous in terms of the research themes, research volumes and quality of science. The reasons for the heterogeneity are many. The health industry in Finland is not particularly well developed (with exceptions), and the needs and research competence do not necessarily meet. The big pharmaceutical and food companies that could exploit the high quality genomic, clinical and epidemiological research in Finland are absent since the Tekes policy does not allow support of international companies from outside Finland as discussed earlier. Finally, some important areas with major health related interests and major potential in Finland are conspicuously absent. As a result, the number of the interested companies is relatively small and their interests are highly variable.

The heterogeneity of the programmes is a major problem as one of the goals of the SHOK concept is to promote dialogue and cross-fertilization between companies within work programmes. The potential for successful development could be increased by sharpening the focus according to specific strengths of SalWe. The Panel recommends that the Board and management should compile a competence and needs road map to build up new partnerships that would complement the existing ones both in terms of science and relevance. To this end, SalWe should consult academia, municipal health and social services, medical and telecom and insurance companies, occupational and well being health companies and others. The purpose

of these consultations would be identifying new actors potentially interested in the SHOK collaboration and filling in the thematic gaps in the research programmes.

The current programmes are focused on the development of products and diagnostic methods while services and new practices are conspicuously absent. Furthermore, the Panel was concerned that some of the projects did not fulfill the definition of precompetitive research and were in fact close to competitive product development. It is emphasized that the SHOK tool should under all circumstances be limited to precompetitive research, as other tools already exist in Finland for supporting competitive product development.

For several reasons, the Panel was not in the position to carry out a full evaluation of the research projects in SalWe. Thus, the Panel was able to review only a few research projects selected by the management, and the reviews were based on short presentations and one-page written documents .As discussed above, the research agenda of the SalWe is heterogeneous and includes themes ranging from basic biomedical themes to social sciences. A panel with five members does not have competence to evaluate in detail the scientific value of the complete programme.

Furthermore, the first SHOKs were established in 2007 and the first funding decisions were made in 2008. The funding of the SalWe SHOK, the target of the present evaluation, started in 2010. Apart from the groups that had collaborated before joining SalWe, it is not realistic to expect major breakthroughs or cutting edge research after two years of action nor is it possible to evaluate the scientific value of the individual projects. A longer period is obviously required to ensure the consistency of the progress with the stated and strategic objectives.

Nevertheless, the Panel reached a broad judgment that a substantial part of the current research programme carried out in SalWe is of high scientific quality output and represent the global cutting edge or is plausibly advancing in that direction as indicated by the number of Ph.D. theses and publications in leading journals. These activities were, on the other hand, in contrast to some projects which did not clearly reach a level worth of public support. Furthermore, it became evident none of the Centers of Excellence funded by the Academy of Finland are currently participating in the SalWe research programmes.

In this context, the Panel noted that mechanisms for the scientific evaluation of research projects in Tekes are rather bureaucratic and may not adequately support selection of the best projects for the precompetitive research. The Panel does not consider that the present arrangements are satisfactory for these purposes.

The business potential of the research programmes and work packages can be evaluated only by the industry. The number of patent applications filed by the companies or the cost savings with new production processes based on the SalWe projects might shed some light on success rate, but is not a reliable measure after two years of action. Overall, two years is too short time period to allow objective evaluation of the business potential of the SHOK tool. Nevertheless, the Panel noted that the representatives of the industry interviewed during the evaluation expressed

their satisfaction both as to the process of encouraging interactions and the research agenda itself as well as to the results achieved so far. The positive impressions were corroborated by the results of the questionary surveys reviewed below.

Conclusions and recommendations

The strategic research agenda was compiled in 2009 based on consultations of Finnish companies and academia. The final decisions were made by the participating companies in a bottom-up process. The academia was consulted mainly as competence resource, although in some instances the initiator for the collaboration was academia or the research institute. The Panel recommends that the role of the society, academia and the users (e.g. municipal health and social services) in the planning of the research programmes should be strengthened.

The current research programmes are highly heterogeneous in terms of the research themes, research volumes and quality of science, while some important areas with major health related interests (e.g. information technology) are conspicuously absent. The heterogeneity of the programmes is a major problem as one of the central goals of the SHOK concept is dialogue and cross-fertilization between companies within work programmes. The Panel recommends that the Board and management should compile a competence road map to build up new partnership that would complement the existing ones both in terms of science and relevance. This could be achieved, among other means i.e. by encouraging academic partners to found startup companies that could play an essential role for translational research in SHOKs, or to integrate international industrial partners.

The policy of Tekes in funding of international companies should be revised to allow funding of foreign companies through the SHOKs even when the company has not a branch in Finland.

For several reasons, the Panel was not in the position to carry out a full and detailed evaluation of the research projects in SalWe. Thus, the Panel was able to review only a part of the research projects, and the reviews were based on the short presentations and one-page summaries. The funding of the SalWe started in 2010, and it is not realistic to expect major breakthroughs or cutting edge research after two years of action nor is it possible to evaluate the scientific value of the individual projects. Nevertheless, the Panel reached a broad judgment that a substantial part of the research carried out in SalWe is of high scientific quality and represents the global cutting edge or is plausibly advancing in that direction.

The business potential of the research programmes and work packages can be evaluated only by the relevant industry. The Panel noted with satisfaction that the representatives of the industry interviewed during the evaluation expressed their satisfaction both in terms of the research agenda itself as well as the results achieved so far.

Meeting the needs of the users

The major users of the research outputs of SalWe are the participating companies and academic research groups and indirectly the Finnish society (public health, health and social services, economy) .The SHOK concept and particularly the activities of SalWe are not yet widely known and, therefore, the Panel was able to evaluate the user satisfaction only among the companies and researchers participating in the SalWe research programmes.

The SalWe management has carried out a questionnaire survey among the participating organizations in the spring of 2011, i.e. one year after the launch of the SalWe programmes. The feedback was very positive: almost 90% of the respondents gave a positive feedback, 87% felt that the operating methods met their expectations and 90% felt that the programme management had been successful.

A second survey carried out in connection with the present evaluation was also positive, although not as positive as the survey described above. Most of the respondents (both company representatives and academic researchers) felt that the strategic research agenda of SalWe is "of cutting edge, "future oriented" and "relevant to international partners". Furthermore, the majority felt that SalWe has had a major impact on improving the existing competencies/knowledge base. More than 50% of the respondents were satisfied with initiation of international contacts and more than 80% stated that SalWe has increased the overall technological competitiveness. Almost 70% of the companies stated that SalWe is an important tool for developing the research capability of the company.

In view of early phase of the SalWe actions it may not be unexpected that the companies criticized the low number of new businesses and other commercial spinoffs and noted that the number new patents is very low. Other critical comments dealt with difficulties in recruitment of national and international scientists. On the other hand, SalWe respondents were highly satisfied with the publication record, knowledge creation and sharing as well with improved collaboration between the companies as well as between industry and academia. Common strategy, rate and length of funding and the joint events arranged for SalWe groups received positive feedback from several participants.

The interviews of the SalWe Board Members and the representatives of the universities, the Academy of Finland and Tekes were in good agreement with the results of questionnaire surveys.

Conclusions and recommendations

After two years of action the companies and researchers are satisfied or highly satisfied, with the SHOK concept and the strategy, management and processes of SalWe. From the user point of view the strengths of SalWe include active collaboration between academia and companies, dialogue between the companies within SalWe, potential for improving existing competencies/ knowledge base and improvement international competitiveness. On the other hand, because of the short duration of the SalWe projects it is not yet possible to assess the impact of the new concept on new businesses and other commercial spin-offs.

Other outcomes

During the interviews it became evident that the SHOK concept has impacts on the research and innovation system that fall outside the immediate interests of the participating research groups and companies. The attitudes of the researchers (and in fact also the attitudes of the universities and state research institutes) towards companies have formerly been negative and sometimes very negative. The SHOK concept and SalWe has potential to change and may already have changed the attitudes in a way that will facilitate and accelerate the development of public-private partnerships in the future.

Participation of the SalWe teams in doctoral and postdoctoral training will help young researchers to skills and competencies that are needed in industrial research and development work. Such skills will, in turn, change the attitudes of the companies and encourage them to employ staff with background in academic research.

Conclusions and recommendations

SalWe (and the SHOKs) has an important role in research education and promoting interactions with industry. SalWe should collaborate closely with relevant graduate schools and doctoral programmes in Finland and encourage and promote postgraduate training in SalWe research programmes. Further engagement with the EU and international collaborations is also recommended.

Collaboration

Active collaboration with all actors in the Finnish research and innovation system and with the actors of the Finnish health and wellbeing system (both public and private) is a key factor for the future success of SalWe. The Panel encourages the Board and management of SalWe to reach out and build up collaborations with the other SHOKs (e.g. health, wellness and telecom oriented innovations together with

TIVIT SHOK), universities and research institutes, Ministry of Health, municipalities and Federation of Municipalities, occupational health services, insurance companies, and private health care.

Conclusions and recommendations

The Board of SalWe should direct more resources (management time, money) to building up collaborations with key actors in industry and the public sector. Investing in collaboration will benefit the companies both in the short and long term.

3.6 TIVIT evaluation panel findings

Terms of reference for the panel

The panel's task was defined as follows:

To evaluate the strategic centres' research agenda, the quality of their programmes and main projects, and the competence and expertise of the actors involved, from the point of view of the key goals of the strategy.

The panels should also evaluate the relevance of the present strategic centre programme strategy.

The evaluation shall also cover the outcomes and impacts of activity and assess how successfully the centres are working and advancing towards their strategic goals and what kinds of results they have achieved so far.

The panels were expected to assess the current SHOK research, with the global competence level as a standard. In providing the baseline assessment, the panel's questions to be addressed included

- Does the centre's activity represent the global cutting edge or is it plausibly advancing in that direction so that the cutting edge can be reached in the future?
- Do the centre's competencies and capabilities reach the international top level of innovation?

The panel was also asked to draft recommendations on how to further develop TIVIT SHOK's activity.

The panel was chaired by Dr. Graham Vickery. Other panel members include Dr. João Schwarz Da Silva (University of Luxembourg), Professor Schahram Dustdar (TU Wien), Professor Serge Fdida (University Pierre et Marie Curie), and Lic.Sc. Pekka Ylä-Anttila (ETLA). The panel was assisted by Dr. Kalle A. Piirainen (Ramboll Management Consulting). The biographical notes of the panel members are available in Appendix 1.

Objectives of the SHOK-programme

The SHOK programme is founded based on the paper on Strategic Centres of Science Technology and Innovation published in 2006 by the Finnish Government's Research and Innovation Council (RIC). The SHOKs were introduced as new instrument to address STI issues identified important at that time. The mission is:

> *"**High-quality research units and R&D and innovation clusters and programmes must be created** for Finland that are internationally visible and interesting. This enables us to **strengthen the sectors of research and technology important for Finland** and **create new national areas of expertise** as well as improve the way we respond to the needs for new knowledge, competence and innovation activity in society and business life. The aim of the centres is to promote the growth and renewal of the economy and employment."* [68]

To fulfill the mission, the following objectives were set: [69]

1. Leading companies, universities, research institutes and funding organisations operating in Finland will commit to the activities and objectives of SHOKs and target their resources in the long term to strategically selected, high-quality, international-level clusters.
2. The clusters will engage in dynamic and interactive research, development and innovation activities, the results of which will then be exploited broadly and effectively. Research activity carried out by the centres will anticipate the needs of society and business life with a time span of 5 to 10 years.
3. High-quality expertise and a reputation in science, technology and innovation activities will attract innovative companies, global market leaders and international-level top experts to Finland.

Panel's notes on the background materials

Panellists were presented with a mission to evaluate the SHOK operations, governance and results. Emphasis was placed on results and impacts. The panel members noted that general background on structure of Finnish Economy and performance in relation to comparable benchmark countries would have been very welcome. Other questions were directed at SHOK governance, the process defining the research agenda, externalities and the structure and dynamics within TIVIT. The technical assistant supplied additional economic background and other questions were directed to the subsequent interviews.

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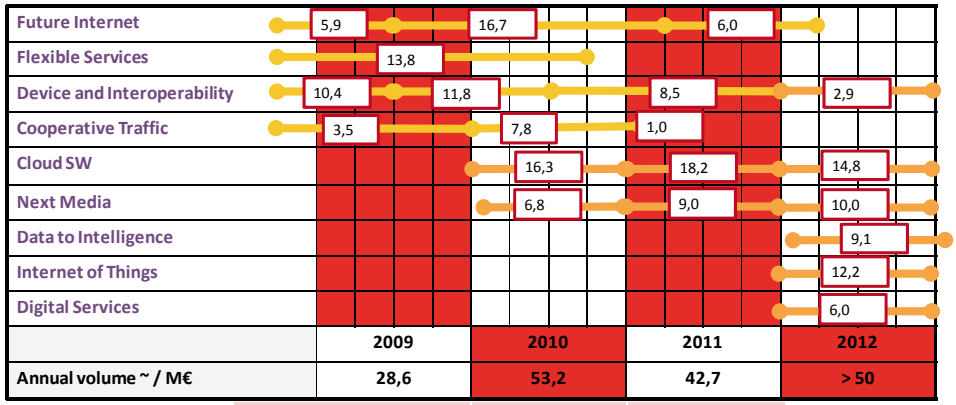
68 RIC, 2006, Competitive strategic centres for science, technology and innovation, p. 3, translated from Finnish by Tekes, May 2012.
69 RIC, op. cit., p. 7.

Overview of TIVIT

TIVIT (Tieto- ja Viestintäteollisuuden Tutkimus TIVIT Oy, transl. Information and Communication Technology Industry Research Ltd.) was founded in February 2008. TIVIT currently has 46 partners/shareholders, including private enterprises, universities and associations. The volume of research dedicated to the various research programmes that have been running, is approximately 50MEUR per year (see Figure 1). Currently out of the nine research programmes listed below, three have come to an end (Future Internet, Flexible Services and Cooperative Traffic) and three have started in 2012.

Figure 32. TIVIT research volume (Source: Presentation by Pauli Kuosmanen, panel meetings).



Company #	152	93	
University #	13	8	
Other party #	6	4	
Private funding share	35,6 %	36,1 %	
Tekes funding share	52,4 %	52,1 %	
Other public funding	12 %	11,8 %	

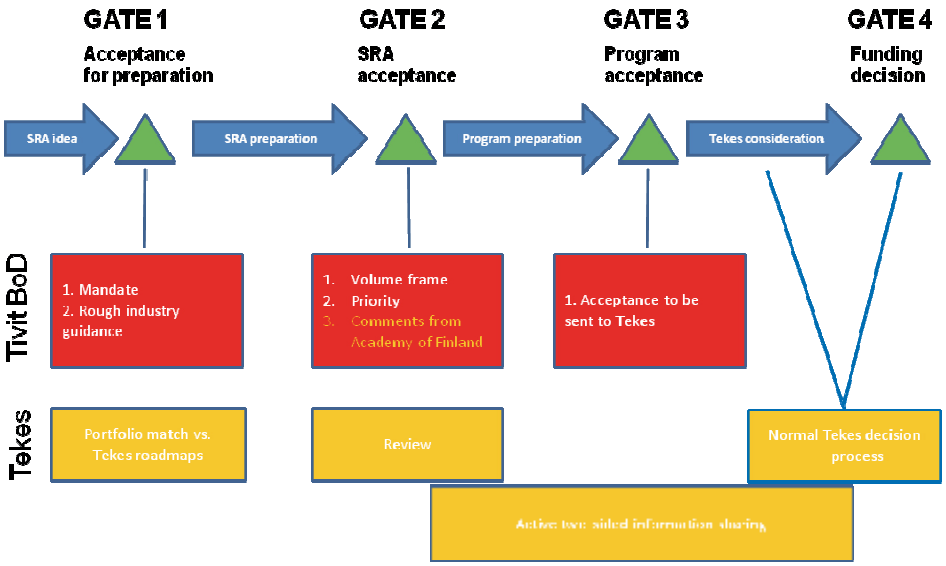
TIVIT is run by a full-time core staff of nine persons, comprising the CEO, CTO, Director of Business Ecosystem Creation, Director of International Coordination, Director of China programs, Director of FORGE, media coordinator, Controller, and a legal counsellor who serves all of the six SHOKs. The currently running six TIVIT research programmes are led by partners, specifically, Nokia Oyj, Oy L.M. Ericsson Ab, Logica Oyj, Sanoma Oy, F-Secure Oyj (see below for details of programs). A Board of Directors built out representatives of large companies (8), SMEs (2) and academia (2), oversees the entire programme.

While the TIVIT research strategy can have a time horizon of up to ten years, in practice the research strategy for each of the running themes is based on near market considerations, leading to time horizons of one to three years. The specific

contents of the SRA (Strategic Research Agenda) of each theme is assessed, updated and approved yearly, enabling TIVIT to follow technological progress and business developments in the ICT industry and to answer demands as they arise without continually having to create a multitude of new themes and SRAs. The vehicle for implementing the strategy is the overall Strategic Research Agenda (SRA), and the SRA for each of the programs. Differing from some other SHOKs, TIVIT has a core strategy, and each program has its own SRA built by the research partners to implement TIVIT strategy.

According to the TIVIT – SRA and Program Manual, "typically the SRA-idea is presented to public in TIVIT's annual Foresight presentation. Based on the interest of potential partners [the] TIVIT Board of Directors (BoD) will make the go/no go decision. […] After the acceptance the SRA is made public and the actual program plan starts. Naturally program and SRA planning may overlap. The BoD accepts the plan (partners, budget, research plan), which is then sent to Tekes. […] After acceptance by Tekes, [the] TIVIT BoD gives guidance about the volume of the program and the priorities of research." (See Figure 2 for the stylised process.)

Figure 33. The process for creating the Strategic Research Agenda (SRA) in TIVIT (BoD, Board of Directors, Source: Kuosmanen et al., 201270).

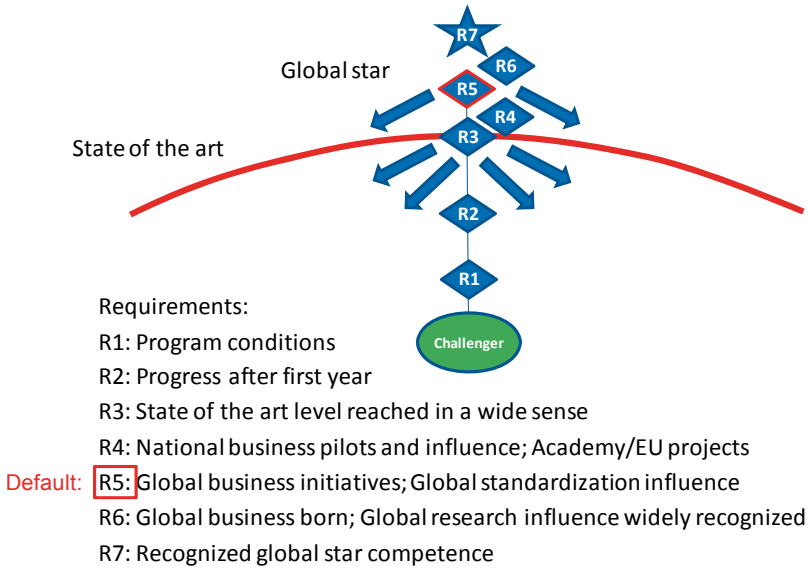


The TIVIT programs (see Figure 1) are planned against a set of TIVIT milestones, or requirements/criteria. There are seven milestones, R1-R7, as shown in Figure 3. The seventh is "Recognized global star competence", where the benchmarks are recognised global leaders in a field. The level of milestone 5 (R5) is the minimum aim

70 Kuosmanen, P., Aunola, K., Heinänen, E., Mäntylä, J., Paajanen, R., and Talvitie, J., 2012, TIVIT – SRA and Program Manual, Version 1.80, 3.1.2012

for each program. At the time of the panel meetings Future Internet had reached R5, and Next Media as well as Cloud Software have passed their R3 milestone evaluation, conducted by an independent panel. Device and Interoperability was also considered to have reached the state of the art. The other three programmes, Digital Services, Internet of Things and Data to Intelligence are in their first year and are at the second level. Future Internet was considered to have reached the R5 level when it finished.

Figure 34. TIVIT competence benchmarking framework and levels (Source: Kuosmanen, 2012[71]).



TIVIT research is organised in a fashion loosely derived from agile development and Scrum practices, which are employed in many IT firms. For example, in the Cloud Software program the detailed problem setting in the SRA would be derived from the backlog in the agreed program. The program is then run on three-month development sprints, aimed at incremental progress towards the program goals, followed by a sprint review and potential reorientation of the product backlog[72].

Findings on TIVIT specific environment

Over the last 20 years Finland has been well placed in the global ICT eco-system. The share of the ICT goods and services sector in business GDP was around 14% in 2008, the highest of all OECD countries, with this share doubling from 1995. Around 9% of business sector employment was in ICT goods and services, with very high labour

71 Kuosmanen, P. 2012, TIVIT Strategic Researcjh Agenda - SRA Governance, presentation at the panel meetings, 20 September, 2012.
72 For Scrum terminology and concepts, see e.g. The Scrum Alliance, Scrum: The Basics, available at: http://www.scrumalliance.org/pages/what_is_scrum

productivity in ICT goods. ICT specialist employment is well above the EU average at around 4.5% of total employment in 2010 and ICT-intensive occupations are also well above the EU average, around 25% of total employment. R&D has also been very strong, due to the high expenditures of Nokia, which was one of the global top three ICT R&D spenders in 2009 along with Microsoft and Samsung.[73]

There has been a consistently strong revealed comparative advantage in ICT goods trade and consistently large trade surpluses in ICT goods, notably communications equipment, with ICT goods making up around 15% of Finland's goods exports. Finland has also had a relatively strong performance and high growth rates in computer and information services trade with higher growth rates than in goods but from a lower base, but in general, ICT services have tended to trail the strong goods performance.[74] Thus Finland has had an outstanding ICT sector performance, ICT skills and R&D capabilities are widespread and the education system excellent, providing a solid base for further ICT business development in new areas with growth potential.

Nokia was the keystone of this performance. Over the last years the economy of Finland has been dominated by Nokia, which contributed a fifth of Finnish GDP growth and a fifth of total exports between 1998-2007. At the same time 27% of the patent applications filed in 2011 were due to Nokia.[75] Nokia was the global top company in communications equipment and systems in the late 2000s (Ericsson was number 3 in this segment), but the 2008-2009 financial and economic crisis affected activity very markedly.

Subsequently, the success of Nokia has been seriously put in question by competitors such as Samsung and Apple, with the result that the market share of Nokia has dwindled and its share price has fallen by over 90% since 2007.

The ICT sector is in turmoil globally. Mature industries are close to technology exhaustion and their innovation drive is weak. When old economies stagnate and new technologies are incipient, the need arises to identify new engines of growth, based on shifting from supply-push to demand-pull in investment and innovation and on moving from individual focus to collective interests. Worldwide and in Finland, society is confronted by a number of crucial challenges resulting from the ageing of the population, the health care and energy crises, urban transportation congestion and urban development crises, inefficient service infrastructures, privacy invasion and security challenges. New drivers of Finnish growth are necessary which will move the Finnish economy from a technology and product oriented economy to a services and application economy. Products and services increasingly need to be created on the basis of new networked arrangements involving cooperation of a number of actors from large companies, SMEs and academic research laboratories.

The SHOK concept and TIVIT as introduced some 5 years ago were an answer to these challenges as it became increasingly apparent that Nokia potentially would

73 OECD, 2010, OECD Information Technology Outlook 2010, Paris.
74 OECD, op. cit.
75 See http://www.economist.com/node/21560867

not continue to be the single ICT powerhouse for the Finnish economy. SHOKs were also introduced as a new instrument to accompany the shift of emphasis in Finnish S&T policies in the mid-2000s towards more strategic and globally oriented thinking that put critical mass and generation of new-to-the world know-how in the forefront. The aims of SHOKs were:

- To enhance knowledge transfer from academia to industry by establishing new platforms for collaborative research and development
- To increase internationalization of R&D&I,
- To strengthen conditions for industry-driven, but more long-term research at universities and research institutes,
- To address global competition by creating internationally competitive and globally attractive locations for R&D&I.

Now 5 years after the start of TIVIT, the need arises to review the mission and strategy of TIVIT, its approach and governance and the results achieved.

It is clear that TIVIT can have a positive contribution in creating competitive new digital services that build on existing Finnish strengths. But the fundamental questions are whether TIVIT, and SHOKs in general, have added value to the Finnish innovation system and would the system have performed better or worse without establishing SHOKs as new policy instrument. These questions remain to large extent unanswered due to relatively poor information on the quantifiable results and economic impact of TIVIT so far. TIVIT is gathering feedback data from participants, but otherwise impact analyses or data for undertaking rigorous impact analyses are lacking.

Role and implementation of TIVIT

Clarity on the goal setting of TIVIT is essential since there is a clear departure from the initial goals of having an instrument supporting research and development with a longer-term 5-year perspective, to an instrument concentrating on near market results with time horizons of 1–3 years. This creates an ambiguity and leads to compromise "consensus based" solutions and approaches among companies, SMEs and academics.

At the same time questions can be raised regarding the disruptive potential of the approach followed within TIVIT. The most crucial questions are: Can "out of the box" innovation be ensured? Is innovation in TIVIT dictated by large companies who are not willing to question their own internal approaches? Are the large companies willing to entertain high-risk solutions and approaches? Are the SMEs in a position to follow, resource wise, the pace set by large companies?

SHOKs, by their very definition, should be positioned between Science, Technology and Innovation. The survey results show on the one hand that TIVIT participants clearly do not see sufficient business impact and performance and on the other hand

also do not see sufficient dynamics and interactions inside TIVIT.[76] In particular, academics see their role diminished.

The panel recognises the important effort developed by TIVIT to reconsider its portfolio and sharpen its contribution to the definition of the ICT roadmap for Finland. The strategic research agenda has evolved over the years to better consider the challenges and vision of the various stakeholders involved to better support their interest. Some programs have been stopped (Future Internet or Cooperative Traffic) and others created more recently such as Data to Intelligence, Internet of Things and Digital Services all of which began in 2012.

A program ambition is to address objectives such as novelty, balance between industry and research, openness and international impact integrated into a coherent global vision. Overall the programs were designed to be and are clearly driven by industry. Nevertheless, the Panel questions the process from which the SRAs emerge and how they are populated in the individual programs.

Current strategic research agendas within TIVIT

The 6 active programs cover a large spectrum of topics. Each program is broadly defined and very much aligned with the main directions covered by the ICT community worldwide, i.e. there are no surprises in the list of program SRAs. Although the Panel understands that each program provides a forum for discussion, it believes that their scope is too broad and the expected impact loosely defined. In addition, it was often difficult to identify the contribution from universities and research centres and to evaluate their intrinsic impact.

Based on interviews and published information available to the Panel, the programs cover: [77]

Device and Interoperability Ecosystem (begun 2008/09)

The Device and Interoperability Ecosystem (DIEM) led by Nokia seeks to develop enablers for device (mostly wireless and mobile) interoperability. It covers three topics: Building automation, Public spaces and Mobile mixed reality. It seems to have identified important issues such as interoperability and provide value for participants. It is important, as it involves SMEs and has led to the creation or development of start-up or small companies in the field. Pilots have been defined to better suit the shorter-term objectives of these companies and provide a proof of concept environment. The Panel considers that the research topics are excessively scattered and that the contribution by the academic members to the definition of more ambitious scientific challenges should be enhanced. There are many potential interactions with other programs such as the Internet of Things calling for a re-examination of the raison-d'être of the DIEM area.

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76 The SHOK Evaluation Survey of Participants was undertaken by Joanneum Research for the evaluation consortium for the overall SHOK evaluation.

77 Note that a thorough analysis of the technical merits of these programs is beyond the scope of the Panel's terms of reference and would require an in-depth audit of individual SRAs' research by area experts.

Data to Intelligence (begun 2012)

This is an important area of research addressing the massive and ever-increasing volume of available information and the methods to process those and transform them into value and business. This program started with the goal to consider data, methods and business cases and provide some kind of mapping between them. Methods and data will be collected and shared in an open repository. Providing access to data is key to strengthen the research impact in this area. An ecosystem of partners, lead by Logica, was enabled thanks to the creation of this program, which is also grounded on in-depth competences that exist in participating universities and research centres. There are many potential interactions with other programs such as Next Media.

Cloud Software (begun 2010)

The Cloud Software SRA, driven by F-Secure, has positioned itself not in the core Cloud Computing research field but at the intersection of Software Engineering and methods applied to Cloud software. This is a good example where the current strengths of the consortium led to the definition of the program. In general activities to extend the outreach of the Cloud Software SRA are good, however, it is also observable that the technical and scientific strength is not yet fully demonstrated. This can be seen, for example, in the scientific outlets where this SRA publishes its papers, and the very large dissemination output, which could be better focused. Current tools are focused on a wide range of applications in upper layers (business models) of cloud computing rather than infrastructure, including firm organisation and software productivity, municipal e-government services, automatic testing of cloud services, video services, and design applications. There are many potential interactions that could be developed with other programs such as the Internet of Things, Digital Services and Data to Intelligence.

Digital Services (begun 2012)

This program, driven by Nokia, aims at implementing enablers to facilitate development of horizontal services, especially in areas where not well covered needs are identified. SME services, Financial services, Education services, and Wellness services have been identified. Although it is clear that numerous solutions will appear, or already exist in these areas, it is not clear how this program is positioned, what strategic framework it will develop, or how it will evolve. The business case also needs to be clarified as education or wellness services have rather high entry costs with strong competition. Services have a high potential of development in these area but it is not clear that influential actors from the content/user side are involved. Thus the outcome of this program might lead to narrow, simple applications rather than broader services for example in conjunction with the Health and well being SHOK.

Internet of Things (begun 2012)

The Internet of things (IoT) SRA, driven by Ericsson, is an extremely wide domain covered in many countries and most ICT research programs. It is definitely a topic to consider, although it addresses many different areas such as architecture, interoperability, security, privacy, energy, etc. It also has both a hardware and service dimension. The IoT program, is involving many actors in the field. It has started quite recently, and the presentation suggested that decisions about the priorities where a strategic impact can be achieved have not yet been resolved. The wide range of problems in the IoT area as well as the various potential solutions supported by some partners mean that a weak consensus has been reached. The scope of work has to be reduced to encourage risk-taking in fewer areas and increase potential impact. This should be an important focus for the short-term development of this program.

Next Media (begun 2010)

The Next Media SRA, led by Sanoma, is a large program in an important area where the business and competition have evolved radically. All business related to content production, dissemination and exploitation is affected and large companies in this area must reposition themselves. Next Media is not the sole initiative in this field and others have emerged worldwide, in the EU and in member states and links to these should be extended. They address the various Next Media content areas such as publishing, video, music, gaming, advertising, culture and their interaction. There is a strong opportunity for multi-disciplinary work in this domain as well as tight cooperation opportunities with academia with deep knowledge in the underlying fundamental disciplines covering Next Media work packages in paid content, personal media and local community media. The objective to implement a radical renewal of the media business value chain in Finland was however not convincingly demonstrated and information sharing and networking could be improved. Nevertheless, some good results have been obtained in applications such as in tablet content services.

Summary

In general SRAs and programs provide a vision that reflects the developments that the TIVIT stakeholders would like to achieve in the next 1-3 years. They are all industry driven with a well-identified leadership. They provide opportunities to create a community and address more cross-disciplinary challenges. They also build a forum for the partners as well as a venue to exchange best practices. Most SRAs are broadly defined and appear as White Papers for the different areas rather than strategic and coherently focused research areas. The Panel considers that synergies in-between the running SRAs need to be urgently explored to achieve a less fragmented R&D landscape, and contribute in a cohesive manner to the reduction of overlaps between areas.

The Panel also believes that TIVIT would be well advised to consider the development of SRAs for areas corresponding to more clearly defined vertical value chains where the contributions of all of the current horizontally defined ICT could be of real value. For these newly defined SRAs to have real value, it would be necessary to draw into TIVIT a number of non-ICT actors (e.g. energy, health, transportation, the financial sector etc.)

Setting the strategic research agenda

The starting point within TIVIT is the setting of the Strategic Research Agenda (SRA) and the approach followed in setting the overall and individual SRAs dictates the likely outcomes. From examination of the SRAs and the panel interviews it is clear that SRAs are White Papers that form a basis for understanding the theme or area under consideration. The scope of the SRAs is typically extremely wide, catering for everything (all options, all approaches, all technologies) and is far more "budget demanding" than what is possible to achieve with Tekes funding, and projects should address topics with a much narrower mission.

There is a continuing tension between funding long-term pre-competitive generic research and close-to-market applied developments. The position of TIVIT along the research chain from science and technology to innovation is not clearly defined, it has not always succeeded in reconciling the different time perspectives in academic and company research, and there appear to be difficulties in attracting the best academic researchers. There is a crucial need to clarify whether the programme is designed to take money and make ideas (research) or take ideas and make money (innovation). The Panel believes that the overall programme should be shifted more towards the longer-term, five-year time horizon, using the collaborative research model that was the starting point when setting up the SHOKs. This would help to counter perceptions that TIVIT has not contributed very much to the overall goal of increasing long-term research.

The areas covered are similar to most of those addressed by similar initiatives worldwide, and fresh areas or more innovative research seem difficult to introduce and carry out in the programs. The question arises as to whether the best set of partners has been gathered to address and build a given SRA. While projects must have a clear value for industrial partners, the academic contribution, measured in terms of its scientific component is not very visible or somehow hidden.

Although the process used to set the SRA is open to all, it suffers from the "consensus" syndrome with companies (especially large companies) having a key say on the final product. They seek to have SRAs that complement or are in full agreement with their own views and do not necessarily reflect a level of ambition leading to the renewing of their own "business models". To facilitate the competition of ideas within TIVIT, competing projects led by different companies should be encouraged, to allow a stronger degree of innovation and potentially more fruitful market outcomes.

International visibility and major outcomes should be better emphasised. Each program should better highlight its attractiveness, main contributions and success stories, positioning itself with respect to the competition and international standards.

The Panel considers that at the stage where the SRA has been defined by potential participants and before the funding decision has been taken by Tekes, an evaluation panel drawn from experts who are not members of the current TIVIT should carry out an evaluation of the SRA. Evaluation criteria would cover issues such as: key personnel involved and their R&D track record, tangible results to be achieved, management aspects, openness of the test bed pilot, dissemination, networking of resources, market background, similar projects elsewhere, standards, European issues, etc. The evaluation panel should be empowered to take decisions on the ranking of the proposals retained, which would be submitted for funding by Tekes/ TIVIT.

Dealing with uncertainty, innovation and risk

SRAs are created in a top down manner. This leads to an early "freeze" of ideas and proposals as well as players in the programmes leaving essentially no room for disruptive ideas and radical innovation. The current SRAs and TIVIT at large have created a structure where the big players (board member companies) have clearly articulated their "claims" from technology and business viewpoints. One fundamental question is how can novel and innovative business model considerations be included? For example, the current SRAs assume that there is a more or less fixed notion of "service layers" on top of "ICT infrastructures", whereas business value increasingly comes from building technology platforms and ecosystems targeted toward "verticals". Such verticals might also include aspects such as lifestyle, age etc. that are not traditional vertical industries.

Essentially, there are no mechanisms in place to ensure that the best ideas become part of TIVIT and their respective SRAs and programmes. What is missing is a clear methodology for defining the structure and dynamics inside TIVIT, including decision making processes, motivation, rewards and incentives for academic staff members of TIVIT and their relationship to a wider ecosystems including universities, R&D labs, start-ups, venture capital.

Currently within TIVIT all weaknesses appear to be strengthened equally in a consensus-oriented programme culture. In other words, technological areas where a lack of know-how is identified will be part of a program where resources are invested in order to strengthen it. It would be advisable to strengthen the strengths that are already in an area defined by an SRA, thereby creating leadership in an area much earlier.

During the interviews the Panel was told that putting project leadership in the hands of one large company can stop a project due to a change of company strategy, with negative results across the programme. Means should be considered to ensure

that companies commit to the full duration of the project or that alternatively more than one company shares responsibility for technical leadership.

Mechanisms need to be investigated for fostering cannibalization of existing businesses of TIVITs' main stakeholders. For example, new service areas such as education and wellness have been identified in TIVIT activities, however, there may be no uptake inside the major share-holding companies to create sustainable new business models based on these services, and SMEs may not be positioned to take advantage of advances.

While the perception is that the potential for breakthroughs exists, it is not clear that the structure and approach followed by TIVIT when setting of the strategic research agendas or at the project stage are conducive to the emergence of significant breakthroughs with a high market disruption potential. To the contrary, it is felt that the stakeholders within TIVIT are not readily willing to leave the comfort zone of traditional thinking. Progress is largely incremental with very low chances for it to be radical.

While it is widely recognized that ICT is an horizontal component of almost any vertical business value chain, TIVIT has not succeeded in ensuring the presence of actors from non-ICT sectors in domains such as financial markets, energy, health, transport etc. When considering that services have typically a payment component it is hard to envisage how a new business model can be created which does not incorporate financial aspects.

Reorganisation of the SRAs in horizontal and vertical areas would be beneficial. For example, data to intelligence could be used to transport novel ideas into the other SRAs. Restructuring the current layered SRA stack into horizontal and crosscutting SRAs would help to understand the commonalities the crosscutting SRAs have to the other areas.

It is also felt that TIVIT should take the initiative to establish bridges across the other SHOKs to ensure the availability of the most appropriate ICT technology. An example is that of the requirements for Smart Cities (for which there is a well defined European Innovation Partnership Project), which to a large extent depend on the availability of an array of ICT technologies (sensors, networks, cloud etc.). The Panel notes that there is currently no Smart City initiative in Finland and the question should be raised as to whether or not TIVIT should take action on this.

Once up and running, the projects should be subjected to an annual technical audit that would result in projects being continued, stopped or red flagged. Again this Audit Panel should be built around experts not part of the current TIVIT community. These should go beyond the current "state-of-the art" audits undertaken by external experts once per programme to assess whether individual SRAs have reached the R3 level in the competence benchmarking framework (see Figure 3). These annual audits should also aim to quantify benefits more systematically.

Benefits of collaboration to stakeholders

TIVIT has been able to create networks and collaboration between firms, universities and research institutes that would not have been possible without TIVIT. New collaborative arrangements have emerged between competitors, SMEs and larger firms. According to the interviews the participating companies are, in general, relatively happy with TIVIT activities. They have created new collaborative R&D, business models, and business opportunities that would not have existed without TIVIT research programs and funding.

From interviews with stakeholders (no SME representative was present), it is clear that the expectations of the main shareholders (large companies) have been met. This is not necessarily the case with the academic partners, who would appreciate a further degree of competition at the project level, and longer term funding to meet their criticisms regarding the planning of budgetary cycles which can only give a one year long certainty. A higher level of ambition setting based on research challenges was also felt as appropriate by academics. They also felt that new ideas and talent were not exploited to the extent that they could and should be.

Key players in TIVIT have largely been the same, although the participation of SMEs has varied significantly. There is a perceived threat that TIVIT is becoming too closed to both academic research and new entrants from business. The purpose of a public innovation instrument, to create positive external economies, might be at risk. The big established companies can use TIVIT more to enhance their on-going research rather than creating something new that would not have been created without public funding, i.e. additionality is low. The Panel had no opportunity to question SME representatives regarding these issues, but little attention appears to be paid to diffusing the results of SHOK pre-competitive research out to the wider community of SMEs and encouraging start-ups.

Building a viable R&D ecosystem, teams and the human resource base

TIVIT has emphasised the benefits of cross-cutting collaborative thematic research. Virtual teams are set up to tackle research areas of mutual interest with members drawn from large companies, SMEs and the research community (universities, VTT, etc.). The strengths and benefits of these cross-cutting teams were described by various participants to include the possibility of working with competing firms on long-term issues (large firms), the potential to tap into the knowledge base of large firms and the research community (SMEs), and the opportunity to work on closer-to-market issues that may not otherwise be tackled (research institutions).

Issues of IPRs have generally been dealt with, and there are no real hindrances to effective collaboration among partners who may not normally work together. For example, the participant survey indicated that only one quarter of TIVIT participants knew each other prior to TIVIT. The participant survey also clearly showed that participants valued the opportunity to work in national collaborative set-ups involving firms and research organisations, that there were high expectations of

developing long-term partnerships and, where it occurred, the reconciliation of interests of companies and the research community was highly valued. Over one-half of respondents had high or moderate expectation to establish new routines for project management due to TIVIT, and there were very high expectations for significant improvements in knowledge and qualifications.

Despite these widely perceived benefits of the SHOK-TIVIT co-operative model for ICT research and innovation, there were some perceptions that more could be done to foster effective "teams" within particular SRAs and further enrich the ICT ecosystem. In some of the SRAs the very large number of potential project areas risks diluting the formation of viable teams and weakening rather than strengthening the ecosystem. Co-location was also seen as an advantage for some projects - to be balanced against cost and the development of lean and agile organisations. Furthermore there appeared to be rather low coordination of sub-activities within TIVIT, and opportunities to develop exchanges between business and research communities and promote educational development may be missed.

Building critical mass

The focused set of TIVIT SRA projects are designed to build critical mass in sub-areas within the broader SRA domain, with the aim of building world-class viable eco-systems in these areas.

Despite these aims there are two main challenges militating against their achievement. The first is that resources in some SRAs are spread thinly across too many areas, making it difficult to build critical mass. The second is that there appears to be little cross-SRA and cross-SHOK co-ordination to build critical mass in new areas. The panel suggests cross-cutting areas of "smart cities" and "smart living" could be used to provide new research synergies. Given constrained funding compared with the objectives, and fragmentation of proposals, it is recommended that broad objectives within funding areas be better focused and have greater continuity and cross-project synergies. The current annual work programme is beginning to recognise this, and it is needed to enable forward planning, build cross-project critical mass and create synergies between projects. The Panel believes that clustering will enhance cross-fertilisation and increase the chances of tangible and sustainable outcomes that will help expand the use of results from successful projects, and help mobilise users of project outputs.

SMEs and pre-pilots

The presence of SMEs within the TIVIT process is welcomed as it offers opportunities for SMEs to access new knowledge, expertise and market developments. More however should be done to ensure that SMEs benefit from the programme. Most SMEs are resource limited and have typically no means to embark on a long range R&D programme spanning 3 or more years. Clearly there are exceptions, notably in the case of high tech SMEs who are device or hardware oriented as opposed to

software oriented. To cater for the industrial market needs, each SRA should be designed so as to encompass a test-bed or pre-market pilot dimension that could bring in SMEs and attract them to the overall process.

Internationalisation

TIVIT and other SHOKS have been mandated to enlarge the participation of non-Finnish partners in their R&D. The attractiveness to international participants of R&D carried out in Finland was one of the original objectives when setting up the SHOKs. Clearly from the results so far, the panel interviews and surveys conducted, these objectives have not been achieved, and the instrument has not been very strong in strengthening the international exchange of knowledge and internationalization of research. TIVIT has signed cooperation agreements with China and the USA and there were indications that within specific SRAs there were attempts to enhance the international dimension.

However the panel feels that these activities need a more convincing analytical and strategic base that would clearly show tangible benefits accruing to Finland. More should be done to establish a prioritised strategy for cooperation before embarking on specific cooperation programmes.

TIVIT as a legal entity should be encouraged to participate more visibly in the EU FP7 and FP8 programmes to enlarge the perspective of shareholders on EU-wide issues and potentially open new developments and markets to Finnish actors.

Economic and societal impacts

After almost 5 years of operation, it was felt that measures and procedures would have been taken to clearly assess the economic and societal impact of the work undertaken within TIVIT. Clearly this is not the case, with TIVIT not being able to show the value for the money spent. Beyond the conventional KPI measures already collected (number of patents, licenses issued, number of papers in refereed journals, number of PhDs, number of standards contributions), there is a clear need for TIVIT to develop a methodology for impact analysis and results-capturing to demonstrate the economic and societal value of TIVIT on a regular basis.

There were indications given by all stakeholders that a key benefit of TIVIT is the "forced" networking of talent, resources and expertise, and that this is highly valued. This can result in the development of networked approaches, it can lead to a better understanding of the potential of companies, and it can facilitate the acquisition of talent and circulation of new concepts and ideas. But these indirect results must be quantified in order to clearly demonstrate the added value of TIVIT.

Recommendations

Based on a review of panel interviews and available evidence the expert panel recommends:

Shifting emphasis towards research. The panel strongly recommends that the emphasis in TIVIT research be moved to the SHOK's original objectives to foster longer-term (5+ year time horizon), pre-competitive collaborative generic applied research. This will provide longer-term benefits for the Finnish economy and ICT ecosystem and enhance the potential to develop new products and activities in new areas. Publicly financed product development activities should be moved into other Tekes programmes as TIVIT shifts its focus to longer-term collaborative projects.

Setting and reviewing the work programme. Once projects are formulated in response to a Call for Proposals, a panel of experts who are not members of the current TIVIT (scientists, business people, economists) assess the merits of proposals before budgets are committed. Once funded, the Panel recommends that independent experts undertake annual audit reviews of the progress at SRA and project levels and that these be made widely available. Such audits would aim to assess the research merit of program activities and help to position activities in their national and global ecosystems.

Introducing competitive calls for implementing SRAs. Competitive calls should be introduced to find the best project consortia, and where appropriate consider how to implement competing projects addressing different aspects within the SRA (e.g. different technological options, technical approaches, implementations). The Panel suggests that experts who are not members of the current TIVIT carry out the selection of the projects in competitive calls.

Changing roles of scientific partners. It would be beneficial that academics become leaders in some project areas to foster novel ideas in the SRA. Novel mechanisms for the definition of roadmaps and bottom-up proposal by academic partners should be investigated and encouraged. One idea would be to propose a cross-cutting high-priority area and call for new ways to organise research and involve stakeholders. Academics should also be commissioned to think beyond the horizon of 6 months or one year to challenge the companies' strategies as many novel services can be invented when thinking outside the box.

Involving the Academy of Finland. The role of the Academy of Finland needs to be re-examined and the links with TIVIT clarified. Currently the Academy funds a considerable body of peer-reviewed basic research that is linked with TIVIT and that receives the TIVIT "stamp". Further tightening of the links and outputs of this funded basic research and its use in TIVIT SRA projects would be beneficial. It is also suggested that the Academy should take a more direct role in the governance of TIVIT, which currently does not seem to be the case. This could also help to resolve some of the tensions between short close-to-market development and longer-term, generic applied research.

Maximising involvement through cross-cutting pilots. It is suggested to pilot in one / a few horizontal areas, e.g. "Smart cities", across SRAs to search for new research synergies. These pilots should have a finite mandate and the obligation to bring in non-traditional non-TIVIT partners in user areas. This could also be trialled

across SHOKs in a light way, through e.g. allocating a small fund to finance extra cross-SHOK costs. TIVIT should further consider how to optimise participation of SMEs, notably by ensuring that they are invited to participate at the test bed or pilot phase and not necessarily in the earlier phases of the projects.

Developing human resources. Use TIVIT collaborative projects to develop a larger pool of highly qualified researchers (Ph.Ds.) and increase experience and use of the highly qualified (e.g. Post-doctoral exchange and experience) nationally and internationally. It should be investigated how mobility between academic and industrial partners could be encouraged, for example through a PhD fellowship program for academics to spend time inside the company and for company staff to spend time in an academic research group.

Encouraging co-location and exchange. Pay more attention to building more stable longer-term structures for research collaboration in some but not all activities. It has been shown that co-location of research teams can be highly beneficial to outcomes and in developing the ICT ecosystem. It is recommended to investigate geographical co-location of teams from various TIVIT stakeholders, for example at the test-bed or pre-pilot phase, even if only for a limited time.

Building horizontal support functions. Many different projects require horizontal support, for example in areas related to standards, patents and IPR, venture capital financing etc. It is suggested that TIVIT should provide a support function in these domains across the various projects.

Attracting international participation. The Panel recommends making a more strategic and concerted effort to both attract foreign participation and to participate more actively in international programmes. The current short time horizons and focus on product and firm-specific development does not encourage two-way international participation and this requires attention.

Undertaking economic and societal impact analysis. There is little knowledge of the actual or potential economic impacts of the SHOK to justify public expenditures. There is a major need to undertake an economic impact assessment going beyond the simple KPIs already collected to assess the added value of the SHOK in general and in comparison with traditional Tekes programme support. To that end, the availability and feasibility of the currently existing data for rigorous impact analyses should be checked and, if needed, new information gathered.

4 Perceptions of the SHOK steakeholders on the evaluation questions: stakeholders results summarised

The survey was drafted in May 2012, with a pre-test with selected representatives of each SHOK between the 1st and 4th of June. The questionnaires were subsequently adapted in the following week, with the survey being implemented between the 11th of June and 21st June, and a further extension with a ossibility to respond until the end of June. Joanneum research was responsible for the survey, which had two seprate surveys, targeting different groups on their perceptions of SHOK activity. First, the strategic survey, targeting the representatives of companies and research organizations with a position allowing to judge the strategic significance and the possible linkages between SHOK strategy and the strtagey of the organization in question. This survey targeted a smaller group than the second survey, which targeted all with experience of SHOK programme / project activity. The database was built on the Tekes and Academy of Finland datat bases and complemented with contacts from the SHOKs, reseresenting their governance bodies.

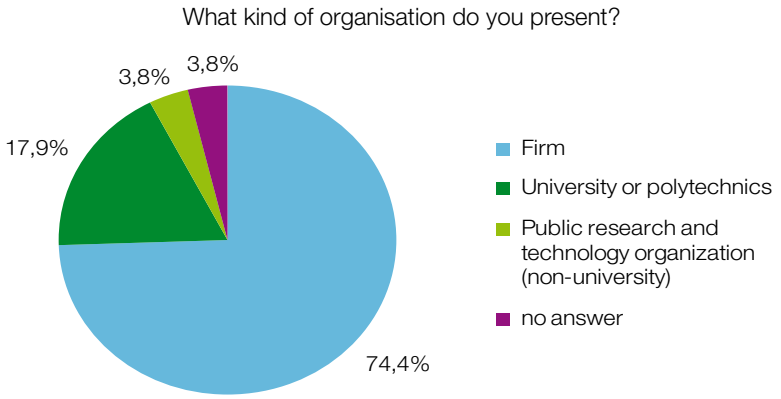
The minimum level set for the response rate was 20%. In this regard the overall response rate was sufficient, though stakeholders and target group representing some SHOKs provided insufficient level of responses.

Response rates

SHOK	Type of survey	The size of the target group	Response rate
Cleen	Activity	286	24%
	Strategy	109	13%
FIMECC	Activity	290	40%
	Strategy	123	40%
Forest	Activity	145	37%
	Strategy	37	43%
RYM	Activity	278	19%
	Strategy	98	12%
SALWE	Activity	81	48%
	Strategy	38	45%
TIVIT	Activity	500	20%
	Strategy	271	19%
Total	Activity	1580	27%
	Strategy	676	24%

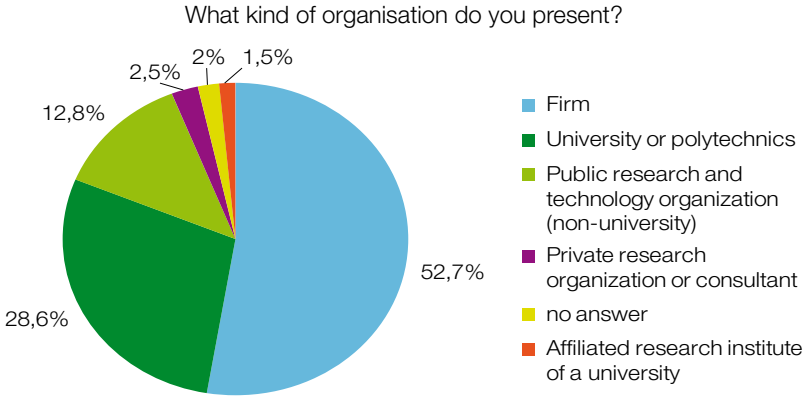
One of the positive aspects of the survey was the relatively high response rate of the companies, who are often more difficult to engagae in evaluation surveys. The fact that they were more active in responding was in itself an interesting result, echoing the fact that the industry community is more engaged in SHOKs than the academic community, which is in many cases very critical or uninterested. Almost 75% of the respondents in the strategic survey represented industries.

Figure 35. Respondent types in the strategic survey



Picture emerging from the activity survey is slightly more balanced in this regard, i.e. 52% of resepondents come from the companies, as is indicated in the figure below.

Figure 36. Respondent types in the activity survey



Summarising the survey responses, the general view is that SHOKs have succeeded in creating a joint between the participating organisations on the strategic research agenda, and providing a platform for research collaboration. The general view is that there is added value compared to Tekes programmes, in terms of improved

collaboration and access to research infrastructures. The impact of SHOKs to strategies of the participants varies greatly between the SHOKs. In Cleen, TIVIT and RYM, respectively 86%, 67% and 68% of enterprises claimed that their strategy has been altered as a result of SHOK activities.

Regarding expectations, the strongest are developing research capability and scientific competence across all SHOKs. These are followed by entering new markets, creating new products and services, new knowledge and long term partnerships. In the low end are access to venture capital, international knowledge exchange and investment to new RDI infrastructures. Contradicting the expected of new products and services, expectations for developing new technologies is low as well.

The most unanimous source of satisfaction is increase in overall technological competitiveness in SHOK-related topics and increase in knowledge about future markets. The participants are most satisfied with gained visibility and reputation (enterprises), developing technological competitiveness and knowledge creation and sharing within the programmes and collaboration with domestic enterprises. In quite stark contrast to expectations, participants are least satisfied with IP and business creation. Enterprises are not satisfied with collaboration with domestic research organisations, and neither enterprises nor research organisations are satisfied with collaboration with international partners. Thus it seems that the SHOK activities mostly have so-called behavioural additionality, i.e. collaboration the research programmes have introduced new tools, methods, ways of working and knowledge exchange between participants, while the tangible outputs have not been as strong. However, while most SHOKs have had an impact to RDI volume of the participants, it has not apparently realized that much into recruitment of highly skilled workers, especially internationally.

Comparing to other national instruments, including Tekes programmes and Academy of Finland programmes, the SHOKs are viewed as the most fruitful platform in terms of collaboration. Enterprises rate SHOK selection mechanism as the best among the programmes, while research participants see them as opaque and weak. This can be explained probably with the fact that SHOKs create their agendas and programmes through negotiations within SHOKs, while academic partners are used to open and more transparent calls for proposals. In effect the enterprises get to choose their agendas and programs for themselves, which makes it transparent for them.

Table 7. Comparison between national RDI instruments

SHOK	Tekes	SA
Intensity of collaboration highest (both company and research respondents feel this way)	The role of applied research more important than in the SHOKs according to the companies	Most basic research for the research respondents
For the industry respondents, highest degree of risk, scientific complexity and best quality selection mechanisms	According to research respondents the most transparent selection process (opposite in the case of company respondents)	For research respondents highest risk and most complexity
Most predictable and stable instrument for research respondents, also highest degree of testing activities	For industry respondents most testing takes place here	For research respondents best quality selection criteria
Biggest project volume	Least bureaucratic for company respondents	Least bureaucratic for research respondents
For research respondents weakest quality and transparency of selection criteria and		Best instrument for the research respondents to involve both young researchers and estabished top researchers
For industry the best instrument of profiling oneself among the academic community		For researchers the best way to profile oneself in the academic community
For industry respondents supports best the involvement of best established researchers		
For research respondents equal to Tekes programmes as an instrument for doing research, for company respondents the best		

The whole set of survey responses and the figures are included as appendices in the report.

5 International benchmarking report of the SHOK programme[78]

5.1 Introduction: Rationale and scope of the exercise

The main aim of this exercise is to provide the programme authorities and those responsible for the programme management and governance at Tekes and beyond, with international experiences and good practice of selected network based research programmes.

The international benchmarking analysis is closely linked to the analysis of the programme rationale and intervention logic of the SHOKS. As such it will contribute to achieving a comprehensive and relevant information base for assessing and updating the expectations as regards results (outcome and impact) of the SHOK programme.

The structural information collected serve the purpose to contribute to the assessment of the SHOK programme in terms of its relevance, effectiveness, efficiency, and sustainability. The underlying evaluative questions guiding the analysis of the benchmarking are presented in Table 1.

Table 1. Key evaluative questions guiding the benchmarking exercise

Evaluation Domain	Evaluative Questions
Relevance	What are the main technological, economic and societal challenges that the programmes seek to address?
	What are the main target groups addressed by similar research programmes? Is there a specific need to focus on balanced participation of e.g. large and small enterprises, international actors, research organisations?
Effectiveness	What are the main target groups addressed by similar research programmes? Is there a specific need to focus on balanced participation of e.g. large and small enterprises, international actors, research organisations?
	What are key performance measures for network oriented research programmes similar to SHOK?
	Which governance mechanisms can be chosen for operating the programmes?
Efficiency and Sustainability	What are good principles for an efficient and appropriate management, administration and leadership of network oriented R&D programmes?
	Which costs have to be borne by constituents (Programme management,research participants) to ensure programme performance?
	Are there chances for a self-sustainability of the research activities?

78 This section of the report has been compiled by Joanneum Research – Cemtre for Economic and Innovation Research, team of experts including Michael Dinges, Michael Ploder and Susanne Meyer.

The benchmarking exercise provides a qualitative comparative assessment of the SHOK programme with four international programmes operating with a similar scope of activities but with different structures and funding modalities. By large, the analysis rests upon text analysis of existing documents such as key policy documents, programme documents and results of evaluations of the programme.

The report synthesizes good principles, practices and lessons learned of other programmes, which should be taken into account in a possible further development of the SHOK programme.

The basis for selecting the case studies for benchmarking has included the similarity with SHOKs in terms of a) scope of funded activities (strong focus on excellence in research/innovation and science-industry collaboration), b) critical amount of funding within the national innovation system, c) duration (focussing on long-term cooperation), d) thematic focus, and e) the existence of evaluation reports and a track record of experiences with the programme, have been the most important criteria.

In collaboration with the client, it was agreed that the following four programmes have been selected for the analysis:

1. The Austrian Competence Centre Programmes Kplus and its successor COMET

The Austrian Competence Centre Programmes represent cooperation networks between the scientific and business communities, which are open to international cooperation. The programmes primarily serve to promote cooperation among partners in the scientific and business communities as the basis for jointly implementing research projects. Similar to SHOK, the Competence Centres in Kplus and COMET are own legal entities, which jointly have to set up multi annual research agendas. The Austrian competence centre programmes have a long history and therefore, we can draw upon a wealth of information regarding governance aspects of the competence centres and results from evaluations.

2. The Networks of Centres of Excellence Programme

The Canadian Networks of Centres of Excellence (NCE) program leads the world in research areas as diverse as disease prevention, diagnosis and treatment, natural resource management and industrial information technology and provides opportunities for Canadian researchers and students to work with receptor communities to accelerate the creation and application of knowledge.

Previously an academic oriented programme with a history of more than 20 years, the programme has considerably increased in scope and range, which makes it particularly interesting for a comparison with SHOKS, as 2007 Centres of Excellence for Commercialisation of research and Business-Led Networks of Centres of Excellence have been launched.

3. The German Leading Edge Cluster Competition

The Federal Ministry of Education and Research launched the "Spitzenclusterwettbewerb" in 2007. The German Programme and the SHOK-Programme have some relevant characteristics and objectives in common

(international excellence, thematically open etc.). The funding of Leading-Edge Clusters is based on a common strategy (5 years) that starts from the respective strengths of each cluster and is aimed at the definition of future development objectives. Actually ten clusters in the following segments have been selected: Biotech , Medical Technology, Logistics, Photovoltaics, Electronics, Software, Aeronautics, Microsystem Technology.

4. The Joint Technology Initiatives (JTIs)

The Joint Technology Initiatives are an entirely new mechanism for performing research at EU level. They are long-term Public- Private Partnerships and are managed within dedicated structures. JTIs support large-scale multinational research activities in areas of major interest to European industrial competitiveness and issues of high societal relevance. Similar to the SHOKs the JTIs are strongly industry-driven, and aim at international cooperation and development of leading edge technologies.

5.2 The international cases

In order to provide a coherent picture on the benchmarking cases, the case studies adhere to a common structure detailing the following aspects:

1. *Programme features and framework conditions* (Type of activities funded, target groups, funding volume and sources, duration)
2. *Characteristics of Networks* (Vertical and horizontal, geographic scope, degree of formalisation of networks such as formal/informal, center based etc., openness of networks)
3. *Governance of the Networks* (the institutional setting of the programmes, intervention logic, priority setting as regards research agenda, funding models and sustainability)
4. *Targets and Performance Measurement Systems* (key performance measures)

In the following sections we provide short descriptions of the cases.

5.2.1 The Austrian competence centre programmes

Programme features and framework conditions

The Austrian Competence Centre Programme Kplus and Kind/Knet have been launched in the late 1990s with the clear **objective to raise science industry linkages in Austria to a new level and contribute to the internationalisation of R&D**. In 2007 the programmes have been transferred into a new competence centre programme COMET. The main analytical part provided in this section focuses on the Kplus programme and COMET, as the programme was considered to be a good practice example for technology policy making at this time, and key elements of the Kplus programme have been transferred to COMET.

The programme Kplus was spurred by a small number of innovation policy administrators located in the Ministry of research and transport (BMWV) and initiated due to the long lasting backwardness of Austrian Science Industry Co-operation in a European perspective.

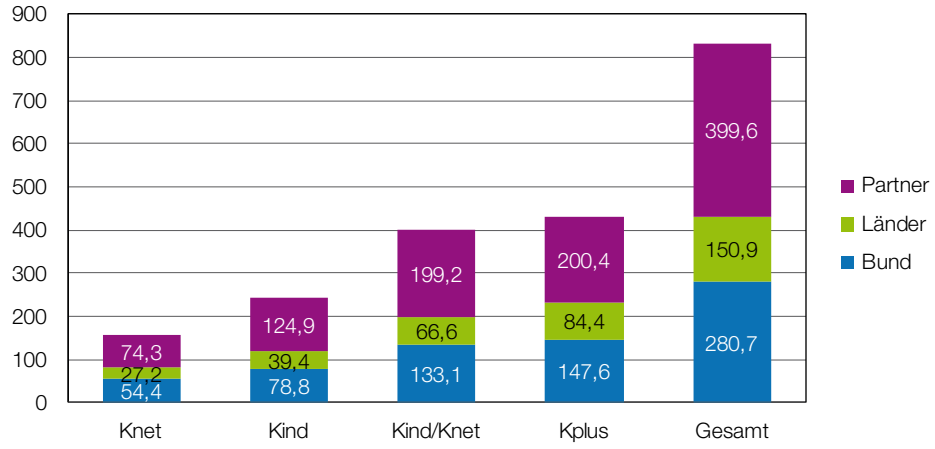
The Competence Centre programme Kplus focused on the **provision of precompetitive, collaborative R&D jointly run by enterprises and R&D institutions**. Individual projects should involve multiple partners and in each competence centre at least 5 companies had to be involved.

The **target groups** of the Kplus programme and the Kind/Knet programme were industrial enterprises and research institutions carrying out high-quality research in fields with high potential for application. For operating the programme, 17 physical Kplus centres and 28 Kind/Knet centres and networks have been set up, with locations spread almost all over Austria.

Funding of the initial Kplus programme provided an annual budget in the range of 2–4 million Euros per year, of which a maximum of 60% stem from public sources (national and regional funding). Industry was requested to provide both financial contributions and in-kind contributions. In-kind contributions should not exceed 50% of total contribution from industry.

Also scientific partners were requested to provide some contributions, up to 5% of costs should be borne by research institutes involved in the programme. A presentation of the funding volume and sources of the Competence Centre Programmes Kplus and Kind/Knet is provided in Figure 1.

Figure 37. Funding of the Competence Centre Programmes Kplus and Kind/Knet by funding source



Source: JOANNEUM RESEARCH

For operating the centres, the programme documentation had foreseen a maximum duration of 7 years. A compulsory mid-term evaluation had to be performed after 4 years. In this mid-term evaluation, an option for discontinuing activities of centres was provided, but actually no centre was closed 4 years after its operation.

The programme was launched in 1999, in which the first centres started its operations. Funding for the last centre ended in 2009. The initial will, emphasized in the first evaluation concept of the competence centre programme, that the Kplus centres turn into self-sustained entities did not become reality. However, already in 2006 plans for launching a new competence centre programme, in which existing competence centres could apply as well, were launched.

The new Competence Centre Programme COMET started its operations in 2007. It kept the main strategic orientation of its antecessor Kplus, but incorporated a more differentiated approach as centres and networks of different size has been set up, including three types of funding mechanisms[79]:

1. **K-Projects:** The objective of the "K-Project line" is to initiate high-quality research in science-industry cooperation with a medium-term perspective and a clearly defined subject having the potential for further improvement. This is to increase the flexibility of the programme and to enable those consortia and research topics to participate, whose potential is not yet sufficient for a K1 application. Within the Competence centre programme approximately 20 K-projects have been funded. The rate of public financing is 40–50%, the project duration is about 3–4 years.
2. **K1-Centres:** The objective of K1-Centres is the initiation of high-quality research defined jointly by science and industry with a medium-term to long-term perspective. K1-Centres implement top-level research with a focus on scientific and technological developments to qualify for the markets of the future. The project duration of K1-Centres is foreseen to be 7 years, public financing is in a range of 40–55%. To a large degree the K1 centres represent centres established in the antecessor programme Kplus. Minimum requirements are the existence of a joint research programme, a minimum of 5 company partners, and a mid-term evaluation in the 4th year.
3. **K2-Centres:** The objective of K2-Centres is bundling of existing national expertise in the long-term and cooperation with the world's leading researchers, scientific partners and company partners in joint strategic research programmes at highest level. This is to achieve long-term strengthening and a significant increase of Austria's attractiveness as a research location internationally. 5 K2-Centers have been established, with a rate of public financing in the range of 45–60%. The project duration of a K2-Centre is 10 years. K2-Centres have to be characterised by outstanding research programmes corresponding to high risks in development and implementation. High international visibility and

79 Information on the funding instruments has been retrieved from: http://www.ffg.at/sites/default/files/allgemeine_downloads/strukturprogramme/comet_0.pdf

international networks mark K2-Centres. Most of the K2 centres emerged out of a bundling of pre-existing Competence Centres within the programme Kplus.

Characteristics of the networks

The competence centres within Kplus and later COMET are formal networks with a legal framework (Ltd. Company), which provide easy access for new companies to join the Competence Centre (also for a limited period of time).

In terms of its geographic scope, all centres act as national knowledge hubs for companies throughout Austria, but they are nevertheless strongly embedded in the regional innovation system. On average about 40% of companies co-operating with the Centres are local, innovative SMEs. In addition, there is no federal province without being active in a Competence Centre.

The centres are also seen as a tool for internationalisation of R&D (see openness/ boundaries). In particular, all centres of the Kplus programme and the COMET programe co-operate with international companies. To a large extent, the ongoing ex-post Evaluation of the Kplus programme shows that these cooperating firms stem from the neighbouring country Germany (80%) and Switzerland (8%) building upon existing co-operations which intensified during the operation of the programme.

The networks have been requested to do not only research within the framework of the Competence Centre Programme – which provided core funding – but also to engange in a) national thematic R&D programmes, b) international collaborative R&D projects, and contract research for companies.

The internationalisation of the Competence Centres Programme gets visible, when considering their participation in the EU Framework Programmes (FP6 and FP7). The Centres act as facilitator for international cooperation activities. Within the Kplus programme, almost 90% of Competence Centres have been engaged in at least one FP6 or FP7 project. However, the Competence Centres did not raise Austrian participation in FP6 and FP7 considerably. In FP7 the Competence Centres contributed to 2,7% of all Austrian participation in the Framework Programmes (Proviso 2012).

Governance of the networks

In terms of its governance, the major relevant features of the Competence Centre programme Kplus were that its operational management was delegated to a funding agency, which elaborated transparent and clear selection procedures as well as a continuous evaluation and monitoring system (see Edler et al. 2004).

The system established for the Kplus programme, which was considered a major novelty in the Austrian Innovation system at this time was transferred and further elaborated in the COMET programme. Key features of the system as described by the programme management authority FFG[80] are:

80 http://www.ffg.at/sites/default/files/allgemeine_downloads/strukturprogramme/comet_0.pdf

- Competence Centres are selected by way of regular calls. The selection of centres (K1 and K2) is based on two-stage, criteria-based selection process. K-Projects are selected in a single step.
- The applications are evaluated and selected according to defined quality criteria in a competitive process by a jury consisting of internal and external experts. All applications for the COMET Programme have to be submitted electronically via eCall as well.
- Result of the evaluation of the short application is a recommendation of Panel 1 naming the consortia that should be invited to submit a full application. Applications from existing centres that are not invited are examined according to their eligibility towards a phasing-out. Panel 2 results in a recommendation for funding for all three programme lines.
- The jury for Panel 1 consists of nine voting members; each organisation involved in the evaluation of applications (FFG, FWF and CDG) nominates three of them. This ensures a balance between national and international experts form science and industry. The chair person is nominated by FFG.
- The jury for Panel 2 is completed by three experts of international renown and consists therefore of a total of 12 voting members. Both panels allow for more participating than voting members. The participation of representatives of the Austrian federal states is equally possible in both panels.
- The submitted full proposals are subject to an internal as well as external evaluation. The external evaluation is coordinated by FWF and CDG and carried out by international experts. The internal evaluation is carried out by FFG.
- The funding decision is prepared by a jury consisting of 12 members. Basis to this decision are peer reviews of the applications as well as hearings with the applicants.

Targets and performance measures

The overarching goal of the Competence Centre programme is to systematically improve science-industry collaboration in Austria. Specific objectives are:

- Improved exploitation of existing knowledge and production of new knowledge via long-term R&D programmes with high additionality effects in the science and industry sector
- Increase Austria‘s attractiveness as an industry and research location and ensure Austria‘s international competitiveness
- Increase Austria‘s participation in international research programmes, especially in the EU-FPs, by creating appropriate national competence
- Boost the acceptance of long-run, strategic collaborative research among the public and among the scientific community

Evaluation and monitoring systems have been in-built in the programme design of the Competence Centre Programme. Competence Centres are subject to financial and scientific reviews, which include the following building blocks[81]:

Ex-ante Evaluation: The application and the research programme are assessed through a panel of experts consisting of members from the following organisations: Austrian Promotion Agency (FFG), Austrian Science Fund (FWF) and Christian Doppler Research Association (CDG).

Review: The review of the centres and projects is carried out by FFG. K-Projects are reviewed in the middle of their duration, K1-Centres in their second and K2-Centres in their third year of their duration. The result of the review are provided as recommendations to the K-Centres and K-Projects.

Mid-term Evaluation: The mid-term evaluation of the centre, its targets, its results and the research programme for the next funding period is carried out by external evaluators. K1-Centres are evaluated in the fourth and K2-Centres in the fifth year of their duration. Funding for the second period depends on a positive outcome of the mid-term evaluation.

Ex-post Evaluation: The ex-post evaluation of the centres and projects and their respective outcomes is carried out by external evaluators the final year of the second funding period.

As a monitoring process annual reports have to be provided by the Competence Centres. This internal reporting to the management authority includes the provision of Key Performance Indicators. Key performance measures for the Competence Centre programmes tracked in the monitoring reports are:

- Adherence to programme plans and milestones
- Number of scientific publications (Priority should be given to joint publications)
  - Publications by single authors
  - Joint publications among science-industry partners
  - Joint publications with international partners
- Number of patents granted (national, international)
- Level of third party funding (national, international)
- Human Resources (Qualification of scientific offspring)
  - Number of Master/PhD Theses, Nr. of Post-Docs in Centres
  - Career steps of HR employed at centres and job mobility of employees
- Conferences, workshops and visiting fellows

5.2.2 The networks of centres of excellence programme

Programme features and framework conditions

The Canadian Networks of Centres of Excellence Programs starts from the premise that "Canada's global economic competitiveness depends on making new discoveries

81 http://www.ffg.at/sites/default/files/allgemeine_downloads/strukturprogramme/comet_0.pdf

and transforming them into products, services and processes that improve the lives of Canadians. To meet this challenge, the Networks of Centres of Excellence (NCE) offers a suite of programs that mobilize Canada's best research, development and entrepreneurial expertise and focus it on specific issues and strategic areas."[82]

Dating back to 1989, the program was launched by a joint initiative by the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council, the Canadian Institutes of Health Research, Industry Canada and Health Canada. Starting as a primarily academic oriented program with potential for translational activities, the 2007 federal science and technology strategy greatly expanded the NCE mandate by adding to the initial Centres of Excellence thee initiatives:

- Centres of Excellence for Commercialization and Research (CECR)
- Business-Led Networks of Centres of Excellence (BL-NCE)
- Industrial Research and Development Internships (IRDI)

The **main targets** of the NCE programs are to meet Canada's needs to focus a critical mass of research resources on social and economic challenges, commercialize and apply more of its homegrown research breakthroughs, increase private-sector R&D, and train highly qualified people. As economic and social needs change, programs have evolved to address new challenges.

In terms of its **focus**, three pillars can be distilled from the Networks of Centres of Excellence Programs. First, the networks perform strategic oriented R&D and "translation-commercialization" activities. Secondly, there is a strong focus on human resources: the programmes strive to bring Canadian researchers and students to work with user communities to accelerate the creation and application of knowledge. Thirdly, the programmes act in strategic fields which aim to provide benefits for Canadian citizens/society. This means that not only technological innovations but also societal challenges need to be addressed by the networks.

The **target groups** of the multi-actor programs are multi-disciplinary partners from academia, industry, government and not-for-profit organizations.

As regards the duration of the programme, initially a 5 year funding period nineties had been foreseen in the early 1990s, then the NCE Programme became permanent. The duration of CECRs and BL-NCE is foreseen to be 5 years. Prolongations of Networks are subject to evaluation results.

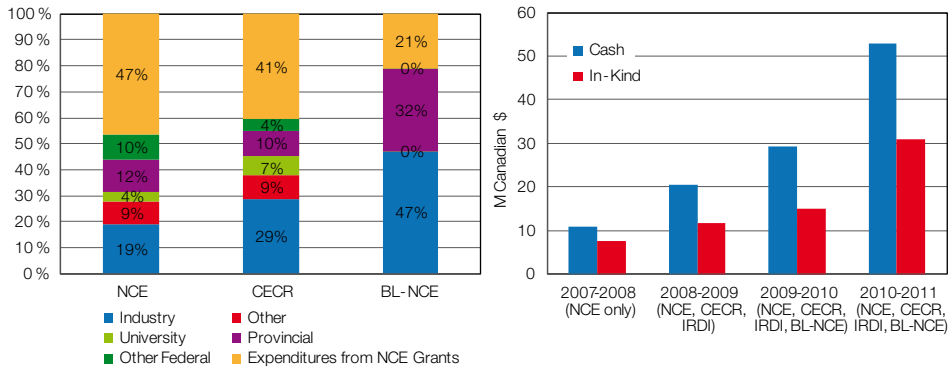
The NCE programs receive considerable public funding. For the different initiatives, the average Public Funding per year is:

- 3.7 Million Euros per year and network for the Networks of Centres of Excellence
- 2.15 Million Euros per year and network for the Business-Led Networks of Centres of Excellence
- 2.26 Million Euros per year for the Centres of Excellence for Commercialization and Research

82 http://www.nce-rce.gc.ca/About-APropos/Index_eng.asp

Figure 2 shows that funding for the different programs stems from a variety of sources. In particular, the level of industry involvement and public funding differs considerably between the different initiatives. While in the more strategic oriented NCEs industry involvement is at levels of 19%, industry contribution in the BL-NCE is close to 50%. For the whole programme the figure shows, that industry contribution in cash and in-kind terms has significantly increased due to the launch of four BL-NCEs.

Figure 38. Funding for the NCE-Programmes: Repartition by sectors and cash and in-kind contributions from industry (2007-2010)



Source: http://www.ar-ra.nce-rce.gc.ca/ByTheNumbers_eng.asp

The programmes have a considerable number of university and non-university researchers employed. The four BL-NCEs have 190 employees, of which 106 are highly qualified personnel. Within the full NCE program, 6112 people are employed, of which 4416 (72%) are highly qualified personnel. The number of foreign employees is limited. Non-University researchers are dominant within the BL-NCE programme, whereas in the overall NCE programme non-university researchers only account for about 12% of researchers. The table below provides an overview on the human resources active in the programme.

	University	Non-university	Total researchers	HQP supported by non-BL-NCE funds	HQP supported by non-BL-NCE funds	Total HQP	Total personnel
BL-NCE	30	54	84	87	19	106	190
NCE-Total Canadian	1518	178	1696	1825	2591	4416	6112
NCE-Total Foreign	15	8	34	10	10	20	43
Gramd Total	**1533**	**186**	**1719**	**1835**	**2601**	**4436**	**6155**

Characteristics of the networks

There are three main types of Networks within the Networks of Centres of Excellence programmes:

NCE

Large-scale, academically-led virtual research networks to accelerate exchange of research results; Develop and retain world-class researchers; Creation of functional multi-regional interdisciplinary research teams; Development of a pool of highly qualified personnel. The academic-led virtual research centres bring together multi-disciplinary partners from academia, industry, government and not-for-profit organizations. Networks perform R&D and "translation-commercialization" activities, and enable Canadian researchers and students to work with receptor communities to accelerate the creation and application of knowledge.

CECR

Creation of Centres with sufficient scale and focus to position Canada at the forefront of international research breakthroughs that yield economic, social or environmental benefits; Acceleration of commercialisation of leading edge technologies. According to their own definition, the Centres are defined as follows[83]: a CECR is a not-for-profit corporation created by a university, college, not-for-profit research organization, firm or other interested non-government party that matches clusters of research expertise with the business community. Each Centre shares knowledge, expertise and resources to bring new technologies to market faster. These cost-shared centres stimulate new commercialization activities that would likely have never taken place without the CECR program.

BL-NCE

According to their own definition, BL-NCEs are large-scale collaborative networks headed by not-for-profit industry consortia that increase private sector investments in Canadian research, support training of skilled researchers, and accelerate the timeline involved in translating research into commercial products and services. These cost-shared networks respond directly to real-world challenges facing Canadian industry. At present, there exist 4 business-led NCEs:

- Canadian Forest NanoProducts Network – ArboraNano ($8,991,000 for 2009-13)
- Green Aviation Research and Development Network – GARDN ($12,958,633 for 2009-13)
- Quebec Consortium for Drug Discovery – CQDM ($9,126,242 for 2009-13)
- Sustainable Technologies for Energy Production Systems – STEPS ($10,970,000 for 2009-13)

Governance of the networks

The Governance Structure of the programme is detailed at the NCE website. The Networks of Centres of Excellence is jointly administered by Canada's three granting agencies: The Canadian Institutes of Health Research (CIHR), the Natural

83 http://www.nce-rce.gc.ca/NetworksCentres-CentresReseaux/CECR-CECR_eng.asp

Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC). This is done in partnership with Industry Canada.

A Steering Committee made up of the presidents of the three granting agencies and the deputy ministers of both Industry Canada and Health Canada manages the Networks of Centres of Excellence. The Steering Committee is assisted by the NCE management committee, which is made up of a representative at the vice-president and director-general level from each of the three granting councils and Industry Canada, as well as the associate vice-president of the NCE and the director of the Policy and International Relations division at NSERC.

An overview on the governance structure of the NCE programme is provided in Figure 3.

Figure 39. The NCE Programs Governance Structure

Source: http://www.nce-rce.gc.ca

Key elements of the NCEs as described in the programme document are: [84]

Each network most have a **Scientific Director or Network Director** respectively, who is responsible for providing leadership and direction, reporting to the governance body for the Network and liaising with the NCE Secretariat.

Each NCE-Network must have a senior manager with the appropriate background and expertise to direct the business and management of the Network. This **network**

84 http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/NCE-RCE/ProgramGuide-GuideProgramme_eng.asp

manager provides the leadership and direction for all of the Network operations and ensures control and accountability on a day-to-day basis.

For the governance of the network each NCE-Network must appoint a Governing Board that has the overall responsibility for the governance and management of the Network, and shall act in accordance with the NCE program guidelines and the Funding Agreement. **The Governing Board of a Network is accountable to the NCE Steering Committee**.

The membership of the Board must reflect the interests and concerns of the various stakeholders involved in the Network. The Network must obtain the approval of the NCE Steering Committee for the initial composition of the Board and must advise the NCE Secretariat of any changes in membership of the Board during the course of funding. A NCE staff member has observer status on the Governing Board of the Network and also attends meetings of the Network's committees.

The governance structure of the BL-NCE

As regards the institutional setting and organisation of the BL-NCE, the following management system is specified in the program guide. In order to provide an appropriate organizational structure for the management of the network activities and business functions of a complex multidisciplinary, multi-institutional program, the program guide foresees that the following institutions within a network are set up:

Board of directors

Each BL-Network must appoint a Board of Directors that has responsibility for the management and direction of the Network, and shall act in accordance with the BL-NCE program guidelines and the funding agreement. The membership of the Board must reflect the interests and concerns of the various stakeholders involved in the BL-Network.

Network director

Each BL-Network must have an appointed Network Director who reports directly to the Board of Directors. The BL-Network Director is expected to commit at least 70 percent of their time to network-related activities in order to manage the BL-NCE grant effectively.

Administrative centre

The BL-Network must have an Administrative Centre. The BL-Network Administrative Centre is responsible for:

- receiving and distributing grants to Network Members;
- securing matching contributions from non-governmental sources; and
- providing suitable support to assist the Network Director and BL-Network staff in their network related roles and responsibilities.

Role of the NCE secretariat

The NCE Secretariat will identify a NCE liaison to work closely with each BL-Network over the grant period. This partnership will enable the BL-Network to better achieve alignment with the BL-NCE program. The NCE liaison may be asked to participate in the resolution of technical, financial or administrative difficulties; assist the BL-Network in the preparation of submissions to the BL-NCE program; advise on the interpretation of the BL-NCE program objectives, rules and guidelines; and support co-ordination of the network's activities with those of other networks or of other government-sponsored initiatives.

The NCE liaison is the primary NCE Secretariat contact for the BL-Network and will have observer status in the BL-Network Board of Directors and its sub-committee meetings. If the NCE liaison is not able to attend a meeting the NCE Secretariat may temporarily appoint an alternate representative.

Targets and performance measures

A very important feature of the NCE programs is that they are based upon clear performance expectations detailed at the very beginning of the programs in forms of logic-chart analyses. For the BL-NCEs the programme document delineates the following expected benefits relating to research and commercialization and key risk areas that might hinder full accomplishment of objectives.

Research-Related Benefits

- Increased private sector investment in R&D and advanced technologies;
- high quality post-graduate and post-doctoral training in innovative research;
- Strengthened public-private sector collaboration, including links between young researchers and firms, to address significant research challenges that meet business needs, and
- Increased industry R&D capacity, including among SMEs, and receptivity to the results of R&D

Commercialization-belated benefits

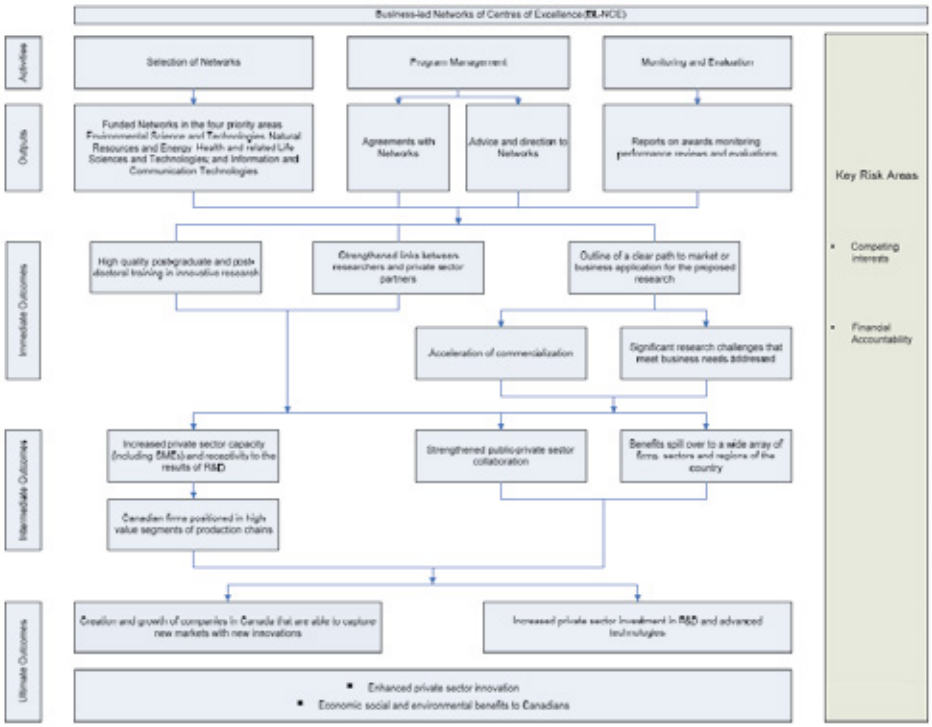
- A clear path to market or business application for the proposed research;
- Commercialization benefits that position Canadian firms in high value segments of production chains;
- Created, grown and retained companies in Canada that are able to capture new markets with new innovations;
- Accelerated commercialization of leading edge technologies, goods, services in priority areas where Canada can significantly advance its competitive advantage, and
- Strengthened domestic collaboration, ensuring that benefits spill over to a wide array of firms, sectors and regions of the country.

Key risk areas

- Competing interests/conflicts of interest: Regulations concerning IPRs
- Financial accountability: need to establish appropriate accounting and financial accountability processes, rules and governance starting with a fairly clean slate.

The logic-chart of the BL-NCE program details the expected activities, outputs, intermediate outcomes and ultimate outcomes (impacts) of the programme. Notably, within the logic chart, monitoring and evaluation are part of the activities of the programme and also the targets and expected results of the monitoring system are portrayed therein.

Figure 40. Logic-Chart of the Business-led Networks of Centres of Excellence



Source: NCE-Canada, Programme Document

Key performance measures and the monitoring and evaluation system of the BL-NCE Program are documented in a Joint Results-based Management and Accountability Framework and Risk-Based Audit Framework[85]:

85 http://www.nce-rce.gc.ca/_docs/reports/RMAF-RBAF/BL-NCE_RMAF-RBAF_RCE_TBS_eng.pdf

- The monitoring of awards is an ongoing function of the NCE Secretariat to ensure that BL-NCE funds are used effectively to attain the expected results. These monitoring activities are linked to ongoing performance measures, also the data collected feed into evaluations.
- Annual progress reports have to be provided to the Steering Committee by the grants recipients. These reports indicate major achievements of the networks over the last year, strategies used to achieve their goal(s), and any course corrections, or deviations from the original objectives. In addition, the progress reports include statistical tables, summary reports, and administration reports such as conflict of interest and an environmental review report as stipulated by the NCE Secretariat.
- The Secretariat is compiles, and analyses these performance data on a yearly basis and reports to the NCE Steering Committee on various trends and confirms if the BL-NCE objectives are met.
- An evaluation will also be used to monitor and evaluate program performance at the end of the fourth year. Evaluations will make use of ongoing monitoring data as well as data collected during the evaluation.

The performance measurement strategy detailed in the Accountability Framework also details key performance areas, indicators, data sources, data collection method, responsibility for collection, and timing/frequency of measurement.

Measures for outputs include information on:

- Funded networks in the S&T priority areas
- Agreements with networks (number and nature of agreements)
- Advice and direction to networks (opinions of key informants/network management)
- Reports on awards monitoring, performance reviews and evaluations (annually)

Measures for intermediate outcomes include:

- High quality post-graduate and post-doctoral training in innovative research
- Links between researchers and firms
- Address significant research challenges that meet business needs
- Acceleration of commercialization
- Intermediate Outcome Measurement
  - Increased private sector capacity (including among SMEs) and receptivity to the results of R&D
    - Changes in number (and type) of employees dedicated to R&D
    - Changes in R&D expenditures
- Strengthened public-private sector collaboration
  - Changes in inventory of industry partners
  - Number of university-industry links within the network
  - Opinion of stakeholders

- Benefits spill over to a wide array of firms, sectors and regions of the country
  - Number and size of firms, sectors, provinces and regions using results of the network research
  - Number and nature of policies and practices of the user sector have been influenced by research findings
  - Evidence of economic impacts

The responsibility for the management of the monitoring system is with the NCE Secretariat, which compiles data from annual reports and also conducts surveys among participating institutions.

5.2.3 The German leading edge cluster competition

Programme features and framework conditions

The main focus of the Leading Edge Cluster Competition (SCW) is to position regional Clusters with a strong scientific and economic starting position in the international top league. The programme wants to foster high-level precompetitive, collaborative R&D and innovative forms of cooperation of science and industry. The programme is embedded in a broader landscape and a long history of policy measures supporting Clusters and Networks.

The target groups of the programme are industrial Clusters with a strong scientific and economic starting position. There are no thematic stipulations.

The Leading Edge Cluster Competition has gone through three selection rounds (2008, 2010 and 2012), foreseeing a 5 year funding period. A mid-term evaluation is taking place after 2½ years with an option for discontinuing activities. In fact, all clusters of selection round 1 and 2 continued after the mid-term evaluation.

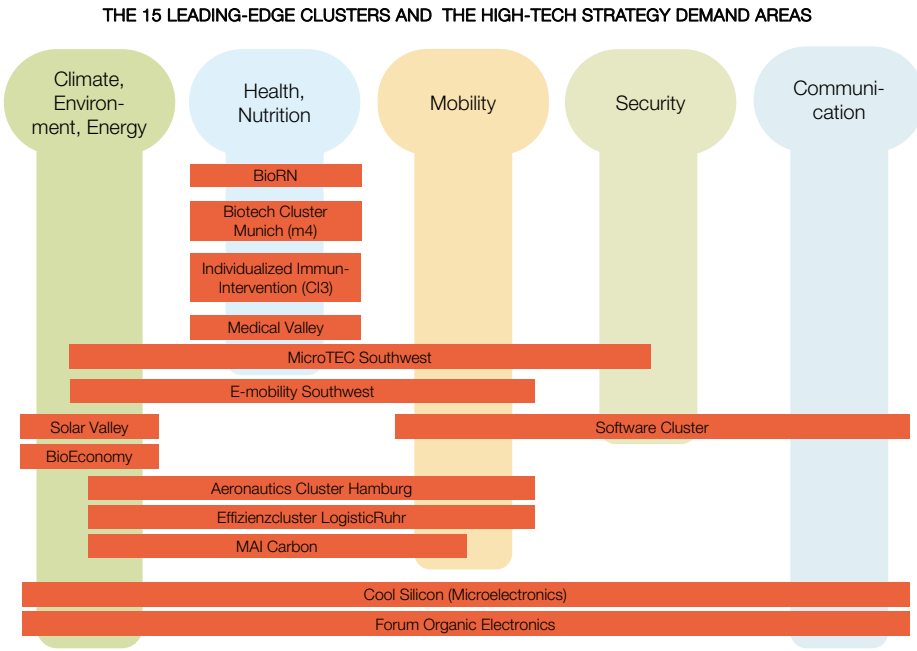
The funding decisions have been based upon a careful, independent selection procedure involving specialists from the field.

The experiences to date show that the programme has been implemented successfully; the first projects are already running, and there is a tremendous commitment on the part of the institutions and companies involved.

The first available evaluation results confirm the success of the competition's fundamental orientation and the jury's decisions: Promising fields of technology have been selected and the respective key actors are working together so that there are not only good prospects for regional effects, but also chances for targeted economic stimulus.

Overall, the The approach of not pre-determining regions or topic areas has proved successful. The 15 existing leading edge clusters are well embedded within the overall strategy of the German Innovation system, the High-Tech Strategy. This is exemplified by the figure below, which positions the 15 clusters across the demand areas of the High-Tech Strategy.

Figure 41. The thematic position of the 15 leading edge clusters



Source: Joanneum Research, Own compilation

Challenges for the SCW are to be found in particular in the area of "cluster management". Here, some clusters have not yet found optimum solutions. Also the approval periods are in some cases very long due to the need to adapt project applications in individual clusters.

Germany's experience so far gives cause to consider whether a similar approach without pre-determined regions and topic areas is also wise at the European level. The instrument of funding clusters could play an important role in the planned European Innovation Act.

In terms of funding, the following regulations and procedures have been set up. The programme provides funding over a period of a maximum of five years. Complementary funding by the regions is possible (contact with the local support programmes in the German Länder). The funding provided per competition round is up to 200 million Euro (40 million per cluster). There are 20 to 70 beneficiaries per cluster and at least 50 % participation is by industry. Indirect costs of cluster management and research infrastructure are not eligible for funding.

The R&D projects within the SCW do not necessarily include all members of an existing cluster. A significant part of total budget should be left to the time after the mid-term evaluation. The R&D projects within the cluster receive 75% - 85% of the funding for R&D projects.

Governance of the networks

In terms of its **institutional setting** there is no particular legal form of the cluster initiative and cluster management required. The cluster initiative nominates one contact person (legitimization by cluster partners) representing the cluster initiative during the selection and funding phase.

The Cluster management comprises between 3 to 10 persons and the management costs are not funded by the SCW programme. The portfolios of projects are embedded in a common research agenda / strategy of the cluster.

In the application phase of the programme an overall budget plan over the 5-year-period has to be provided. However the portfolio of projects can be redefined during the funding period. The funding authorities provided feedback to the cluster organization, and develop recommendations based upon the md-term evaluation.

Characteristics of the networks

The Spitzencluster are basically **regionally embedded within a 30km to 80km territory**, however selected partners from other regions also participate in the cluster activities. Within Germany, the industrial stronger southern regions strongly represented. An involvement of key players in the region's innovation and value-added chains is a major prerequisite: Global players and SMEs work together with excellent scientific institutions.

Regarding the **structure and openness of networks** within the SCW, it is important to consider that an SCW objective is the induction of cooperation in new projects with new partners. The SCW leads to more intense and more local connections between cluster actors.

Interviews with project leaders showed that in 87% of all cases new partners were integrated. Science industry co-operations clearly dominate. However a slight tendency towards already known partners was observed. Only 16% of the project leaders did not know any of new partners in SCW projects before. Unknown partners were often integrated via already known partners.

Frequently, long-term collaboration projects extending the SCW funding period have been established. Furthermore projects external to the own field of competence of the institutions got initiated by the R&D activities within the SCW.

Targets and performance measurement

Also the SCW constitutes a programme, in which specific funding objectives of the clusters have been detailed and a clear monitoring and evaluation strategy has been developed along with the programme development.

Key objectives of the programme are:

- Developing and ensuring an unmistakable, exceptional profile with a high innovative and competitive ability, wide reputation and strong international appeal

- Development and testing of innovative forms of cooperation between science and industry
- Intensifying measures to encourage the founding of new companies and the establishment of foreign companies
- Targeted promotion of young talent, practical qualifications and the recruitment of specialist and managerial staff, e.g. also from abroad
- Professionalization of cluster management through the further development of management processes

The main objectives of the monitoring and evaluation system of the SCW are:

- To evaluate the relevance, efficiency and effectiveness of the programme – at the policy and the cluster level.
- To monitor, assess and document the cluster development during the policy measure.
- To consider sectorial and technology distinctions and trends.

In order to satisfy these objectives, three main columns of the evaluation and monitoring system have been set up: First, a continuous monitoring by recipients of funding and reporting by cluster managements. Secondly, an independent accompanying evaluation by an independent scientific consortium. Thirdly, a mid-term evaluation by an independent expert jury at the level of individual clusters.

The **continuous monitoring** is provided by the recipients of funding, and by the cluster managements. The annual reports of Spitzencluster representatives are supported by cluster managements. The monitoring and reporting at the project level and the continuous project control is the task of the programme management authorities (agencies, which receive funding from the responsible ministry to perform this task).

The **independent accompanying evaluation** with a duration from 2008 to 2013 focuses on distinct tasks: The provision of a programme design analysis, an analysis of the network structure, an analysis of the embeddedness of clusters in the sectorial and regional systems, and an analysis of implementation, outcomes and impacts of the clusters.

The **accompanying evaluation** makes use of qualitative assessment and interviews with cluster representatives, recipients of funding, stakeholders, and external experts. Furthermore, non-successful applicants of all three calls and other cluster initiatives in Germany are considered.

On an annual basis, but with changing focus, a survey among firms/research institutions, projects, and cluster management is conducted.

Qualitative assessments and structural characteristics (economic, R&D and innovation, qualification) of the clusters as well as key performance indicators, co-operation patterns are provided by secondary data analysis. This include firm and structural business data; R&D, innovation and patent data.

The reporting of the accompanying evaluation provides annual reports which provide feedback to the clusters and the policy makers in order to facilitate learning and ensure the take-up of results.

The **interim evaluation review** by an independent expert jury is based upon a review of extended progress reports by cluster representatives. The progress reports provide information on the accomplishment of the cluster strategy and its research agenda.

Site inspections with external experts take place in order to provide an assessment of external experts (technology peers). Also hearings with cluster representatives are performed. The jury then decides on the success of the cluster in implementing its cluster strategy. If adaptions are necessary, the jury may recommend continuing funding pending different conditions to be met. If a cluster fails to comply the jury may recommend cancelling the funding.

5.2.4 The joint technology initiatives (JTIs)

Programme features and framework conditions

The Joint Technology Initiatives **focus** is to establish Pan-European Public-Private Partnerships aiming at enhanced productivity and strengthened industrial competitiveness. The JTIs are mainly built upon existing European Technology Platforms ETPs, and seek to level up their activities. JTIs are provided in the following areas:

- "Innovative Medicines Initiative (IMI)"
- "Embedded Computing Systems (ARTEMIS)"
- "Aeronautics and Air Transport (Clean Sky)"
- "Nanoelectronics Technologies 2020 (ENIAC)"
- "Hydrogen and Fuel Cells Initiative (FCH)"

Target groups of the JTIs are large Industrial enterprises represented by industrial associations running the JTIs. Joint project calls are carried out by industry in cooperation with academia and SMEs.

The foreseen duration of JTIs is 10 years. Funding for JITs e.g. ARTEMIS in the year 2011 has been 72,423 Mio € of which 65% stem form Member States' contribution and 35% from the ARTEMIS-Joint Undertaking. The Joint Undertaking concludes grant agreements with participants: The financial contribution of the JU is 16.7% of eligible costs incurred.

The ARTEMIS Member States conclude national grants with participants. The financial contribution of the ARTEMIS Member States will be a certain % of eligible costs incurred by participants depending upon type of participant and type of R&D activity.

The JTIs are represented by legal entities (Joint Undertakings) in form of public-private partnerships. The participation of Public and Private Partnership is reflected in Governance Structure comprising a **Governing Board** (Voting rights 50:50 for

industry and public authorities), an **Industry and Research committee, a Public Authority Board**, and an Executive Director.

Characteristics of the networks

In terms of its **geographic scope** JTIs are considerably different from other initiatives. They represent international R&D networks comprised of members of EU-27. For example, within ARTEMIS, the Industry Association "ARTEMISIA" represents an influential network of more than 200 members from all over Europe. The members of ARTEMIS Industry Association define the ARTEMIS Strategic Research Agenda (SRA) for Embedded Systems in Europe. The Industry Association is the voice of its members in the ARTEMIS Joint Undertaking collaboration.

The organisational structure of the networks seeks to ensure the provision of formal networks with clear targets and to ensure openness of networks with easy access for new companies.

Project funding within the JTIs is dependent upon eligibility criteria and commitment of the Member States.

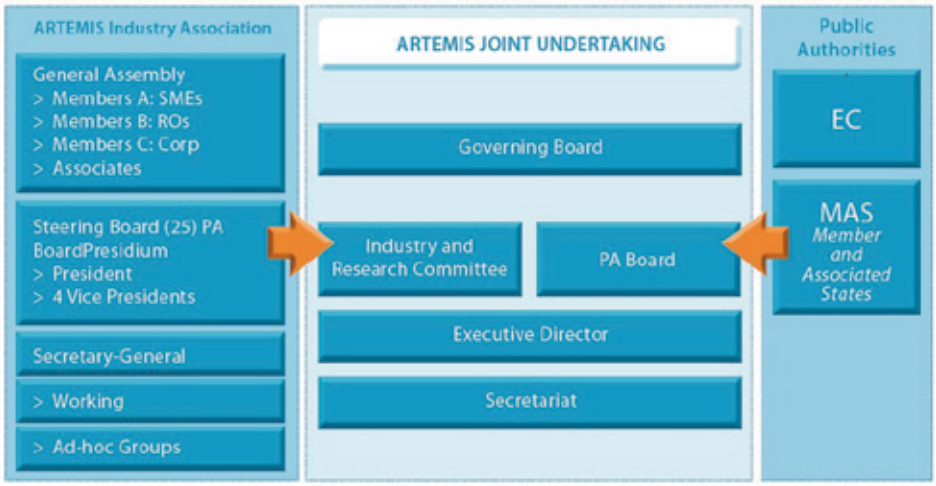
Governance structure

The JTIs are characterised by two core functions, which set JTIs apart from other European initiatives:

- JTIs have a so-called **"funding responsibility"**, which is to bring forward research and technological development in the respective field. For this purpose JTIs define and implement the Research Agendas of the JPIs via calls for proposals.
- JTIs have a **"coordination responsibility"**, which means that JTIs have the responsibility to promote a public-private partnership to mobilise and pool the funding efforts of different sources. This coordination activity also means that JTIs need to achieve synergies of research efforts across Europe.

In order to pursue these functions, the JTIs have set up specific form of governance mechanism. The main elements of the governance structure in the case of the JTI Artemis is presented Figure 6.

Figure 42. The governance structure of the ARTEMIS Joint Undertaking



The governing institutions of the JTIs are described as follows[86]:

The Governing Board: Includes the members of the JTI and the chairperson of the industry and research committee; The governing board has the overall responsibility for the operations of the JTI and oversees the implementation of its activities.

Industry and Research Committee: The Industry and Research Committee represents the interests of industry and the research community. It consists of members appointed by ARTEMISIA. Its role is to draft the Multi-Annual Strategic Plan based on the Research Agenda. In addition, it drafts an Annual Work Programme for the activities of the JU including calls for research proposals.

The Public Authorities Board: consists of the public authorities (EC and ARTEMIS/ENIAC Member States) of the JTI. The Public Authorities Board ensures that the allocation of public funding is fair and transparent. It oversees all activities and regulations related to the calls for proposals and discusses and approves the annual work programme of the JTI.

The Executive Director: is the chief executive responsible for the day-to-day management of the JTI in accordance to the decisions of the governing board; the executive director oversees the daily business and carries out necessary actions for the successful operation of the JTI; The Executive director is appointed by the governing board.

Targets and performance measurement

The JTI initiatives exhibit a number of strategic and operational objectives.

86 http://www.artemis-ju.eu/organisation_info

The key strategic objectives of the JTIs are:

- **Coherent implementation of European research efforts** in the strategic technological fields for the future
- Accelerating the **generation of new knowledge, innovation and the uptake of research into strategic technologies**, leading to enhanced productivity and strength-ened industrial competitiveness
- **Concentrating efforts on key projects** that can help meet Europe's industrial competitiveness goals
- **Enhancing the technology verification process** in order to identify and remove obstacles to future market penetration
- **Pooling user requirements to guide investment in research and development** towards operational and marketable solutions
- Restrictive effect on competition: **enhance downstream competitiveness in key technologies by addressing market failures** (high costs and risks associated with long-term, pre-competitive, multidisciplinary research.)

The key operational objectives of the JTIs are to:

- **Define and implement a Research Agenda** for the development of key competences or technologies.
- Support the implementation of the R & D Activities notably by **awarding funding to participants in selected projects following competitive calls for proposals**.
- Promote a public-private partnership aimed at **mobilising and pooling Community, national and private efforts, increasing overall R & D investments**, and fostering collaboration between the public and private sectors.
- Achieve **synergy and coordination of European R & D efforts**
- **Promote the involvement of SMEs** in its activities in line with the objectives of the Seventh Framework Programme.

For pursuing a performance monitoring and evaluation of the JTIs, the Council Regulation establishing the JTIs determined the following evaluation requirements:

- Need for two interim evaluations, one in the 3rd financial year, and the second in the 6th financial year. Both interim evaluations should be carried out with the assistance of independent experts and should cover the quality and efficiency of the JTIs and the progress towards the objectives set.
- A final ex-post evaluation by the Commission has to take place no later than 6 months after the winding-up of the JTIs (after the 10th financial year).

The key evaluative areas to be addressed in evaluations of the JTIs are Relevance, Effectiveness, Efficiency, and research quality, and was defined in the particular case as following:

- **Relevance** is the continuing validity of the assumptions set at the start/ planning phase of the JTIs.
- **Effectiveness** is to be understood as the progress towards meeting the objectives set.
- **Efficiency** is the extent to which the JTI has been managed and operated efficiently, whether there has been good communication of objectives and progress, and the ability to address problems as they arose.
- **Research Quality** is the extent to which the JTI sponsors world-class research that helps propel Europe to a leadership position globally.

The first interim evaluation of the ARTEMIS and ENIAC undertaking[87] has shown that the JTIs have succeeded in bringing together a wider spread of the industrial community, not only in the execution of R&D but before that in the creation of their strategic research agendas. According to the evaluation results this helped to establish a coherent view across Europe.

It was positively noted that the JTIs have provided a focus for all stakeholders and some Member States even established national initiatives or re-oriented existing programmes to gain synergy with the JTI programme.

The establishment of industry-led tripartite industry-national-EU PPPs is considered to be a major achievement and they validate the general concept of the JTI: The SRAs provide a coherent view across industry, Member States, and the European Commission.

However, also major challenges have been identified by the evaluation. Among them are the following:

- the funding commitment by Member States is significantly below that which was expected, jeopardising the JTIs' ability to establish a critical mass of activity
- the process for selection of projects gives insufficient consideration to the JTIs' European strategic objectives;
- the JTIs have not so far implemented activities specifically targeted at improving the innovation environment in Europe;
- the JTIs are impeded by burdensome financial and administrative regulations
- the JTIs have to install monitoring processes to assess progress toward their strategic aims…and to guide implementation of their programmes and revision of their strategies;

Major recommendations of the evaluation were that the all parties contributing to the JTIs should recommit to the strategic aims of the JTIs. The JTIs should re-focus on evolving and implementing their strategic agendas and re-engage with the thought leaders in industry, government, and the scientific community that led the original drive to establish the JTIs.

The evaluation panel also made recommendations as regards the performance monitoring system of the JTIs. In this respect, the evaluation suggested to install

87 http://ec.europa.eu/research/jti/pdf/artemis_and_eniac_evaluation_report_final.pdf

monitoring processes to assess progress toward their strategic aims, including enhancement of the innovation ecosystem, and to guide implementation of their programmes and revision of their strategies.

5.3 A short comparative analysis of the cases with the SHOK programme

This section provides a short comparative analysis of the main findings of the international cases with the overall findings from the SHOK evaluation. The major aim of this section is to compare distinct programme features of the programmes with experiences of the SHOK programme as outlined in the main evaluation report.

The section follows the same structure as the description of the international cases. First, we synthesize and compare the findings on programme features and framework conditions, then we focus on the characteristics of the networks, the governance of the networks, and targets and performance measurement systems.

5.3.1 Programme features and framework conditions

The case studies show that the primary policy targets of science-industry cooperation programmes, and programmes geared at industrial innovation and internationalisation are important for virtually all programmes under consideration. Industrial renewal, strengthening of competitiveness, concentration of research efforts, and particularly provision of highly qualified human resources are of utmost importance for all industrialised countries in order to sustain their competitive edge. The targets of the SHOK programme are well in-line with the core targets of other research and innovation programmes alike. However, the international cases show that the means of operationalisation are quite different.

An important aspect in this regard is that apart from the Joint Technology Initiatives, which emerged from the European Technology Platforms, **all international cases were based upon truly competitive calls for proposals** in which clear selection criteria, implemented via calls for proposals, and two-step selection procedures had been set up.

The SHOK concept from 2006 delineates a number of selection criteria[88] such as sufficient human and financial resources, based upon research questions and applications that are vital with regard to the future of the field in question, the potential to be among the best in the world, international credibility, significance with regard to their potential for the national economy and society etc. However, already in 2006 the major fields of operation have been defined and the whole SHOK approach seems to have emerged from a top-down procedure (although based upon

88 http://www.minedu.fi/export/sites/default/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/erillisraportit/TTN/Strategic_Centres_of_Excellence_2006.pdf

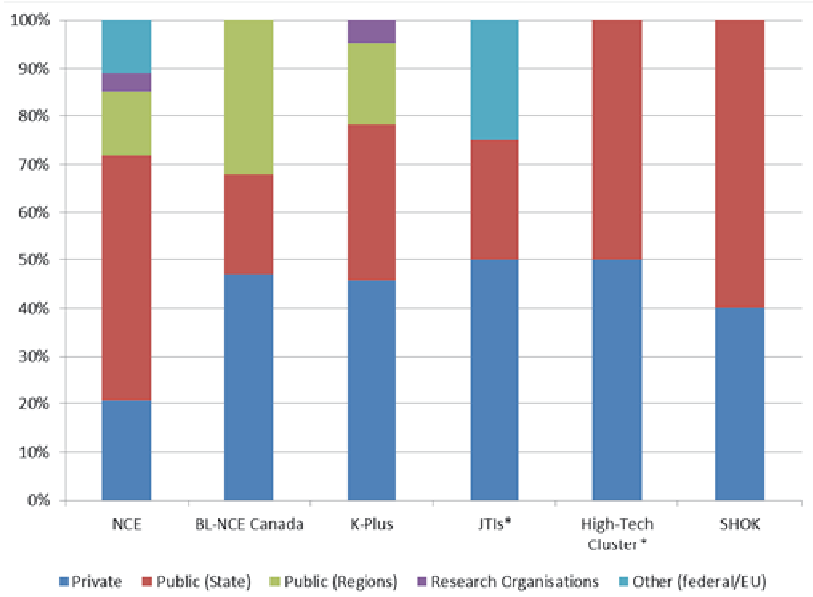
existing cluster initiatives etc.) rather than a competitive bottom-up approach based upon clear selection criteria an independent international reviews.

Selection procedures based upon competition, such as the German leading edge cluster competition and the Austrian competence centre programmes do not only **ensure that the best proposals are selected**, but also contribute ensuring **commitment and common understanding** of core partners.

In terms of funding, the SHOK research programmes internationally stand out because of their high annual funding volumes provided. While in the SHOK research programmes between 2008 and 2011 a total of 343 million €, with an estimated €40-60 million annually invested in research in each individual centre/network have been invested, both the Austrian Competence Centres and the Canadian BL-NCE operate at a much smaller scale. Also the German leading edge cluster competition only provides funding up to € 40 million per year. Considering the lean management of SHOKS as regards its administration, the indicated size and high volumes of funding might prevent a clear operationalisation of targets defined the strategic research agenda and pursued in R&D projects.

All international cases are characterised by a certain degree of public co-funding depending on the orientation of research (e.g. rather applied vs. strategic oriented basic research). Within the SHOK programme an average of 40% of research conducted by the SHOKs is co-funded by companies.

Figure 43. The benchmarking cases – partner distribution of funding



Source: Joanneum Research, Own compilation

A **public funding rate of 60% requires a substantial share of strategic oriented research** for ensuring the share of funding volume is duly justified. The figure below provides a comparison of the average SHOK funding with the international programmes. Therefore, the international cases from Canada, Austria and Germany have ensured strong participation from scientific communities in their programmes represented in governing boards, advisory boards for defining the strategic research agendas, and project selection committees.

For example, in the Austrian competence centre programme some competence centres introduced **eligibility criteria for conducting research projects with companies**: a certain amount of the project volume had to be reserved for long-term strategic oriented research, primarily fitting the need of further developing the R&D competences of the centres.

In terms of **target groups** addressed by the programmes, all programmes concentrate on fostering science industry linkages. Taking into account the industrial needs, only a strong involvement of the scientific communities seems to ensure the provision of medium-term strategic oriented research.

5.3.2 Characteristics of the networks

The international case studies show that different approaches for pursuing common objectives can be pursued. The JTIs are the truly international R&D networks within the sample of case studies, representing an international R&D network comprised of members of EU-27, while the German "Spitzenclusters" are basically regionally embedded networks within a very focused territory, and in the case of the Austrian Competence Centre programme, the Centres also act as regional knowledge hubs facilitating national and international cooperation. The experiences from the international case studies show that also within this comparatively small regional networks new co-operations can be achieved. For example, in the German case project leaders showed that in 87% of all cases new partners were integrated.

In particular for small and open economies such as Finland and Austria, fostering of regional clusters which include not only large enterprises but a considerable number of innovative SMEs are important for sustaining and fostering competitiveness of the economy. For many regional embedded SMEs cluster activities facilitate cooperation with universities and allow for R&D activities, which would not have occurred in the absence of a programme.

Also international cooperation plays a vital role in many of the programmes considered. For the SHOK programme, international cooperation is also intended to play an important role for the Strategic Centres. However, the findings of the programme evaluation do not provide a clear-cut picture on the level of international co-operation achieved by the SHOK programme.

On a programme level, data on international cooperation patterns, participation in EU-FPs etc. of the SHOKS are missing. Within the selected benchmarking countries,

the national Austrian Competence Centre programme and the Canadian Networks of Centres of Excellence programme set priorities in fostering international co-operation. The JTIs are of course truly international.

In the Austrian case, the monitoring system of the European Framework Programmes allowed to monitor international participation of the Competence Centres in FP6 and FP7. Also the reporting systems in the annual reports covered international cooperation activities. It turned out, that almost all Austrian Competence Centres engaged in FP6 or FP7 projects. Although Competence Centres did not play a very active role as project leaders, they nevertheless facilitated in FP7 a considerable participation of Austrian companies, in particular SMEs, in FP7.

So far, it did not become visible how far the SHOKS interacted on an international level and the monitoring systems incorporated in the SHOK system do not provide concrete statements on international engagement, which is a prerequisite for provision of further funding.

5.3.3 Governance aspects

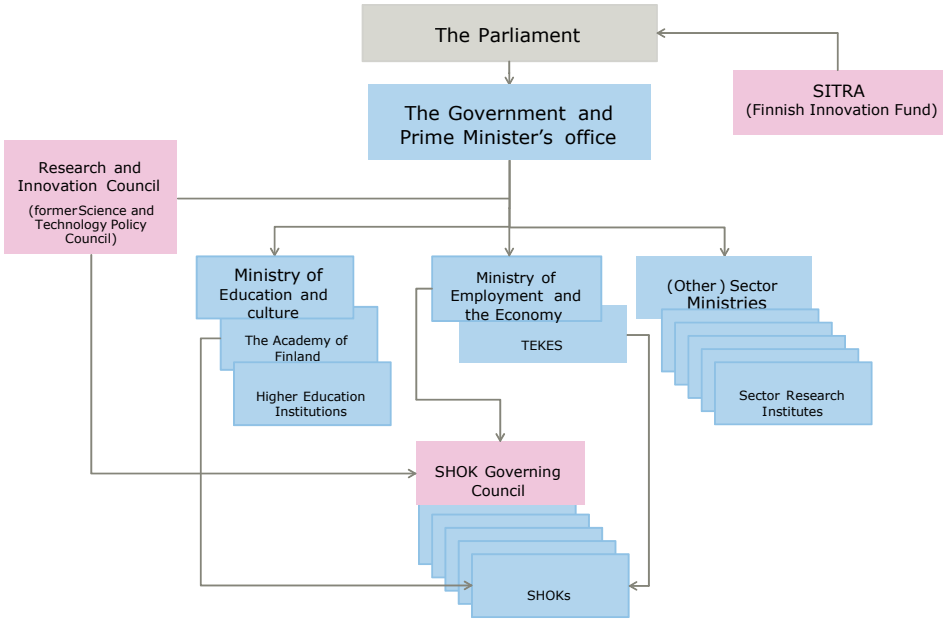
As the SHOKs are in principle independent legal entities, they are free to work within the borders set by the governing council. Nevertheless, they are subject to rules, or Terms and Conditions for funding, which mount to indirect governance.

In practical terms, the SHOK evaluation document details that Tekes funding criteria and programme monitoring play a large role in day to day management of SHOKs. Tekes has been involved in the inception of the SHOKs and monitors them through their programme funding applications and associated reporting. The bulk of SHOK operations are funded by Tekes, which has committed a considerable share of its budget to SHOK programmes.

During the establishment, the steering committee established under RIC was instituted as a governing council for the SHOK instrument under the aegis of the Ministry of Employment and the Economy (MEE). The governing council monitors and evaluates the SHOK instrument based on the early reported key performance indicators (see below for details) and evaluations. Its primary objective is to follow how the mission set in the SHOK strategy is fulfilled.[89] The monitoring data is gathered each year by the April 15th, processed in the Governing Council, whose chair gives a report on the progress of the SHOK strategy for RIC.

89 Anon. 8.6.2009. Ohje strategisen huippuosaamisen keskittymän raportoinnista (seurantajärjestelmä), (eng. A guide for yearly reporting for Strategic Centres of Science, Technology and Innovation (monitoring system))

Figure 44. Overview to governance of the SHOK instrument



Source: Shok Evaluation document

A commonality between the SHOK system and the international benchmarking case studies is that all programmes entail a high degree of self-organisation and responsibility in the centres/networks.

However, all international cases show that there are clear ownership structures, reporting duties and accountabilities: The networks have to report to the funding agencies monitoring data on a regular basis, including a pre-defined set of indicators and measures. The responsible funding organisations set the rules of the game and ensure that data gathering standards are maintained.

The Canadian Networks of Centres of Excellence Programme, distinguishes between network governance and network management in the following manner[90]:

"Management and governance should co-operate as a true partnership, but should not be confused as each plays a separate but equally important role in the organization. Management is defined as the "organization of tasks, people, relationships, resources and technology to achieve the organizational purpose." Good governance on the other hand, can be categorized as the following: vision; goal-setting; securing the necessary resources; monitoring; and accountability."

For assuring accountability, the Austrian Competence Centre Programme has established a two-stage application procedure with clearly specified criteria. For monitoring progress of the Centres the programme management team at FFG has

90 http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/NCE-RCE/ProgramGuide-GuideProgramme_eng.asp

set up a division comprising 5 members dealing exclusively with monitoring and call-management issues. Furthermore, for monitoring of scientific process each Centre has a scientific advisory board comprising independent members and clear intervals for mid-term evaluations, which are carried out by international peers.

Also the German Spitzencluster competition has set up a detailed system for continuous monitoring, in which the Spitzencluster have to report to the funding agencies, and independent accompanying evaluation which seeks to provide learning inputs to the clusters, and a half-time evaluation review by an independent expert jury.

The Canadian Networks of Centres of Excellence also emphasizes that the governance structure of the NCEs needs to be balanced in terms of stakeholders. The programming document specifies the size of the governing board, the composition of the governing board and the duties of the governing board[91]:

- Maintaining the commitment of board members requires that Board of Director activities be kept at an intellectually stimulating level… and not be overburdened by administrative details. This is usually best achieved by soliciting their involvement in:
  - updating both the strategic vision and plan of the Network;
  - participating in problem-solving activities; and
  - making decisions.
- Membership of the Governing Board must reflect the interests and concerns of the public, private and academic sectors involved in the Network, and selection of the right people is key to an effective governing body. The perspective of Network researchers who are not directly involved in the management of the research is also important. Therefore, the Board must have, as a voting member, one researcher from the Network who is not the scientific director or a member of any other Network committee.
- In order for a Governing Board to have adequate representation from all necessary stakeholders it should consist of no fewer than twelve members, a third of whom being independent members as described below. Generally, the Governing Board should be composed of:
  - a majority of members from the private or industrial sector and the Network's user community;
  - the Network Host (if applicable);
  - the NCE Secretariat representative (as an observer); and
  - members experienced in identifying and resolving situations of conflict of interest.

Overall, the cases show that **clear responsibilities of programme owners are key prerequisites for implementing network based multi-actor programmes.**

91 http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/NCE-RCE/ProgramGuide-GuideProgramme_eng.asp

Shared responsibilities between the ministries/policy authorities, programme management and centre/network management have to be set up.

The ministries are responsible for setting key priorities (strategic objectives) at the innovation system level.

Programme management is responsible for setting up concrete modes for operation of then networks and establish "performance contracts" with the networks. Therein key tasks of the networks including responsibilities, reporting duties etc. are defined

The case studies also show that steering committees/advisory boards which provide guidance on the overall strategy of networks and participate in performance reviews need to be established. Well-functioning science-industry cooperation programmes include all relevant stakeholders, in particular the Scientific Research Communities within the key decision making bodies of the networks, in order to avoid common problems related to the research agenda of business-led networks (e.g. short term, demand oriented R&D solutions).

5.3.4 Targets and performance measures

When comparing the overarching objectives of the programs under consideration, it turns out that these are quite some common among the different programs including:

- Development of an exceptional, innovative research profile with high degree of innovativeness and international visibility
- Development of strong forms of cooperation between science and industry in order to contribute to the research profile.
- Intensifying international relationships among firms and research institutions
- Targeted promotion human resources, in particular young talent with practical qualifications and the recruitment of specialist and managerial staff

As stated above, these key objectives are set at a policy level. All network based programmes considered elaborate strategic research aagendas. Importantly, the creation and revision of the SRA is usually a process, which is monitored by technology peers and subject to a validation process of the governing boards of the programmes.

In the international cases presented, the creation of a monitoring system and key performance indicators, is within the responsibility of programme management authorities. The key performance monitoring indicators (outputs, intermediate outcomes) are derived from an intervention logic of the programme. A fully operationalized example for an intervention logic has been provided by the Canadian BL-NCE programme.

In particular, the Canadian case study and the Austrian case study highlighted particular indicators for operationalisation. Apart from checking achievement of milestones and adherence to programme plans, frequently retrieved monitoring data included:

Research outputs:

- Number of scientific publications (Priority should be given to joint publications)
  - Publications by single authors
  - Joint publications among science-industry partners
  - Joint publications with international partners
- Number of patents granted (national, international)
- Conferences, workshops and visiting fellows

Network/centre activities

- Level of third party funding (national, international)
- Advice and direction to networks (opinions of key informants/network management)
- Reports on awards monitoring, performance reviews and evaluations (annually)
- Links between researchers and firms
- Address significant research challenges that meet business needs

Human resources

- Human Resources (Qualification of scientific offspring)
  - Number of Master/PhD Theses, Nr. of Post-Docs in Centres
  - Career steps of HR employed at centres and job mobility of employees
- High quality post-graduate and post-doctoral training in innovative research

Commercialisation outputs and innovation capacities

- Acceleration of commercialization
- Intermediate Outcome Measurement
  - Increased private sector capacity (including among SMEs) and receptivity to the results of R&D
    - Changes in number (and type) of employees dedicated to R&D
    - Changes in R&D expenditures
- Strengthened public-private sector collaboration
  - Changes in inventory of industry partners
  - Number of university-industry links within the network
  - Opinion of stakeholders
- Benefits spill over to a wide array of firms, sectors and regions of the country
  - Number and size of firms, sectors, provinces and regions using results of the network research
  - Number and nature of policies and practices of the user sector have been influenced by research findings
  - Evidence of economic impacts

Data gathering methods include annual reporting in electronic formats making use of relational data-bases, regular surveys among key stakeholders, self-assessment and site-visits by technology peers.

All programmes under consideration spent considerable time in developing and advancing their performance measurement systems in the phase of programme planning, in order to grant that all necessary data are collected and available for evaluative purposes.

5.4 Implications for the SHOK programme

This section details implications or lessons learned from the international experiences that might be interesting for further developing/elaborating the SHOK concept. The implications are laid out according to the evaluative questions posed in the very beginning of this report, and provided in a short and concise manner.

5.4.1 Evaluation domain: Relevance

What are the main technological, economic and societal challenges that the programmes seek to address?

The case studies show that the strategic objectives of the SHOK programme are will in-line with international practices. Programmes addressing societal challenges and fostering of industrial competitiveness are key challenges for industrialised economies in order to maintain their technology driven competitive edge.

However, the different programmes show that the means of operationalisation are quite different. In particular, the Austrian and the German case show that selection procedures based upon open competition without thematic steering, do not only ensure that the best proposals are selected, but also contribute ensuring commitment and common understanding of core partners. Furthermore, also this type of centres/networks managed to be in line with high level targets set by policy makers. Full-scale top-down programming might not be necessary for meeting desired challenges.

What are the main target groups addressed by similar research programmes? Is there a specific need to focus on balanced participation of e.g. large and small enterprises, international actors, research organisations?

In terms of target groups addressed, all programmes under consideration concentrate on fostering science industry linkages. Taking into account the industrial needs, only a strong involvement of the scientific communities seems to ensure the provision of medium-term strategic oriented research.

In particular for small and open economies such as Finland and Austria, fostering of regional clusters which include not only large enterprises but a considerable number of innovative SMEs are important for sustaining and fostering competitiveness of the economy. For many regional embedded SMEs cluster activities facilitate cooperation with universities and allow for R&D activities, which would not have occurred in the

absence of a programme. Also in terms of international cooperation, multi-actors programmes as presented may help to facilitate internationalisation activities of SMEs.

5.4.2 Evaluation domain: Effectiveness

What are key performance measures for network oriented research programmes similar to SHOK?

The international case studies have shown that programmes of this sort focus on multi-level performance measures which can be grouped as follows:

Research Outputs: This includes scientific publications, patents, etc. Also quality measures and cooperation patterns might be evaluated by making use of bibliometric analysis techniques. Therefore, some international programmes focus on joint publications by science industry partners.

Cooperation Outputs and Network/Centre activities: Cooperation outputs focus on the change of behaviour of participating institutions and researchers. Tighter links among scientific and industrial research communities, joint projects among large and small companies, joint internationalisation strategies and leverage of regional clusters are common performance targets set by this type of programmes. In addition network/centre activities might also contribute to a greater effectiveness of R&D activities by joint creation and use of research infrastructures.

Human Resources: Better trained human resources are a key performance target for all international case considered. This includes scientific qualifications (Master/PhD Theses, Nr. of Post-Docs in Centres), and career steps of HR employed at centres. An increased job mobility of employees is also a common goal of network based programmes.

Commercialisation outputs and innovation capacities: Acceleration of commercialisation, increased private sector capacity (including among SMEs) and receptivity to the results of R&D, changes in number (and type) of employees dedicated to R&D, changes in R&D expenditures, and spill-overs to a wide array of firms, sectors and regions of the country are also common performance targets and measures of this network type programmes.

Many of these performance targets are not easy to measure. Therefore, the international case studies have installed monitoring and performance review systems at the very beginning of programme implementation. Monitoring and evaluation has to be co-planned with programme development.

Which governance mechanisms can be chosen for operating the programmes?

All international cases have shown that clear ownership structures, reporting duties and accountabilities are pre-requisites for an effective governance. Networks have to report to the funding agencies monitoring data on a regular basis, including a

pre-defined set of indicators and measures. The responsible funding organisations set the rules of the game and ensure that data gathering standards are maintained.

For ensuring appropriate governance of networks/centres all relevant stakeholders have to be involved in decision making bodies of the networks. This does not refer to the day-to-day management of the network. Instead, it relates to provide steering as regards the definition and implementation of strategic areas of the networks such as: the research agendas, human resource policies, international activities etc.

Independence of a certain number of members of governance board also seems to be a pre-requisite for ensuring self-control and steering.

Furthermore, clear intervals for interim assessments, which make use of self-assessment procedures and external peers are also very important for making programmes alike work. Programme management needs to have strong capacities in order to be able to closely monitor the implementation process of activities and changes thereof.

Which assessment procedures have been implemented to ensure quality of strategic research agenda, research proposals, and progress of research endeavours?

The international case studies highlight some good principles in performance monitoring and evaluation:

- Network programmes need to put a lot of efforts on measurement „while projects are ongoing". Responsibilities have to be shared between programme management, network organisations, and external evaluators
- Intervention logic analyses form the basis for developing key performance measures. Once key performance measures are set up, data gathering methods, intervals for measurement, and responsibilities have to be specified. Well advanced network programmes define the framework for performance measurement in the programming document.
- Joint use of a variety of monitoring and evaluation procedures among which self-assessment and peer review assessments after a distinct time interval are most common. The scope of peer decisions includes Stop/Go decisions, revision of research agendas, human resources policy etc. Furthermore, data gathering methods include annual reporting in electronic formats making use of relational data-bases and regular surveys among key stakeholders.

Furthermore, all programmes under consideration spent considerable time in developing and advancing their performance measurement systems in the phase of programme planning, in order to grant that all necessary data are collected and available for evaluative purposes.

5.4.3 Evaluation domain: Efficiency

What are good principles for an efficient and appropriate management, administration and leadership of network oriented R&D programmes?

Some good principles for an efficient and appropriate management, administration and leadership can be distilled from the international experiences.

In order to **ensure commitment**, incentives have to be provided for all relevant stakeholders. For operationalisation of network programmes, financial contributions should be requested from all partners depending on their role: (e.g. industry 40%-60% of self-funding, universities 5%, in-kind contributions allowed).

Funding and continuation of funding should be based upon performance delivered. Therefore, **clear operational objectives of the networks have to be defined, and the progress towards meeting the objectives has to be monitored** by programme management authorities. Feedback mechanisms need to be institutionalised. Based upon the continuous performance monitoring results, strategic objectives for activities have to set on an annual basis.

The **steering committee and advisory boards** need to represent all relevant stakeholders and need to play an active role in research agenda setting and shaping the strategic orientation of the networks. A representation of programme authorities in the boards is required, and steering also needs to be provided by independent experts, who do not have stakes in the operational network activities.

Which costs have to be borne by constituents (Programme management, research participants) to ensure programme performance?

In order to ensure programme performance sufficient expertise and capacities have to exist at the level of programme management authorities and the networks. In the Canadian case and in the Austrian case strong management capacities have been built up at programme management authorities, whereas in the case of the German Spitzencluster, policy decided to complement reporting by networks with an external accompanying evaluation, which should guarantee provision of feedback to the networks.

Are there chances for a self-sustainability of the research activities?

Only in the Austrian case, self-sustainability of centres was an issue. Also there, it turned out that networks which are to provide strategic oriented R&D activities need to be publicly funded to some extent. Incentives for engaging in international R&D programmes and competitive calls among network partners allow for contributing to more efficient use of R&D funds. Also in this respect, targets for the networks might be set.

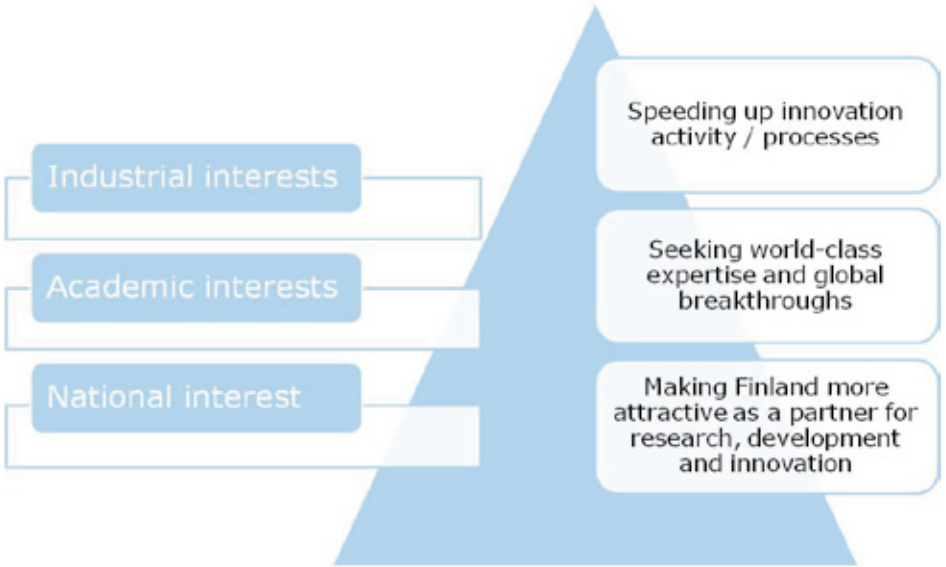
6 Conclusions and implications for the future

6.1 Overall conclusions

In the following we have summarised the key findings of the evaluation and drawn conclusions on our original evaluation questions. As well as structuring the conclusions around these questions we have tried to keep the analysis pragmatic, i.e. focused on the issues that need to be tackled most urgently and the most feasible options for doing this. Before addressing each of the evaluation questions in turn, a brief introduction with the key points underlying the more specific conclusions is given. Significant tensions clearly exist here stemming, predominantly, from the novelty of the SHOK concept and the fact that it seeks to address a number of urgent and ambitious parallel goals, which, in retrospect, it may not be possible to achieve with the same policy means.

The SHOK objectives undoubtedly reflect the differing interests of the stakeholders in relation to the activities involved. These are summarised in the figure below.

Figure 45. The objectives and interests of SHOK summarised



These interests have been promoted by different means, most significantly through the promotion of the excellence of research (core academic interest) and industrial relevance (company interest), both of which should help to promote Finnish RDI

and make Finnish research and industry, as well as the environments within which they are undertaken, more attractive internationally. These goals are not however easy to reconcile.

The fact that the SHOKs are still in the relatively early stages of development was an issue raised by many in the data gathering process. Therefore caution in respect of their envisaged impact is warranted. The first years have been a learning process and much has been achieved in terms of organising the partnership, creating processes of governance, management and programme implementation. The evaluation reported and summarised here provides a baseline or an interim assessment of the achievements in terms of simply getting the model established.

To summarise, the following points have come across as most pressing:

Firstly, the SHOK concept has been welcomed as an industry-driven instrument for promoting excellence and relevance. SHOKs have successfully formulated and implemented their strategic agendas and provide an important additional instrument for Finnish innovation policy. The fact that the intention of the evaluation task was to assess both the individual SHOKs and the concept or instrument as such, makes the final assessment very multifaceted: individual SHOKs were naturally evaluated in relation to their strategies, while the concept is assessed in relation to the original goals and the national and international benchmarks available.

There are however a number of acute tensions that have been identified in the SHOK analysis. These include the fact that there are too many parallel objectives for the SHOK, some of which are conflicting and could only be resolved by means of access to a wider portfolio of actions. Another such tension exists between short term incremental industrial research and leading edge academic research. Previous studies on SHOK have also identified the underlying conflict between open innovation and IP-based commercialisation. Similar unresolved tensions exist in terms of the strong desire for internationalisation within a highly national structure.

There are however a number of positive achievements and value added with the SHOK concept, such as the establishment of large business-driven consortia and the engagement of enterprises. Both of these should be viewed as necessary prerequisites for making the concept work.

Of the other issues yet to be resolved, the most pressing is the need to select what objectives are pursued and making sure these objectives are not contradictory. One practical issue that would help to achieve this is the clarification and definition of the SHOK logic model and metrics. Clearer metrics that have been defined in close collaboration and dialogue between the SHOK management, shareholders, steering bodies and financing organisations would help all parties to make better choices in terms of the options available.

The tension between excellence and relevance needs to be addressed and here processes need to be put in place across the SHOKs to ensure quality and industrial relevance and to assist in promoting renewal. The best means to more fully engage academia also need to be urgently identified.

Numerous critical points were raised in the evaluation with respect to the ways in which the SHOK concept could be improved, including for instance concerns that despite its success in engaging industry and in promoting a more ambitious research agenda, resources have been diluted, too little attention has been given to addressing the tension between relevance and excellence criteria, and consequently the SHOK 'brand' remains too weak within the academic community. Nevertheless, for many the establishment of the SHOKs and their original goals remain as valid as ever. The model thus needs to be fine-tuned and defined more clearly such that it does not become confused with, or diluted among, the portfolio of available RDI-instruments, concentrating instead on those issues where it makes the most important contribution (e.g. industry-driven, broad-based applied research).

Criticisms remain in relation to SHOK selection and their inclusiveness. This is regrettable and perhaps a more selective policy should have be utilised in establishing the SHOK topics while the SHOKs themselves might benefit from being internally more selective with respect to membership, both within focus areas and programmes. The general ethos of openness and inclusiveness moreover is not necessarily the best policy in developing excellence and cutting-edge innovation.

The selection processes (external and internal) have raised many questions. A significant amount of lobbying undoubtedly occurred during the SHOK selection process, though the first SHOKs emerged relatively uncontroversially based on the original RIC document, with the main focus here being on traditional industries. Built Environment succeeded in lobbying for SHOK status while health and well-being emerged as a kind of "counter balance" to the initial traditional industries focus.

The original working group that selected the focus areas worked from the starting point that despite the notion of industry relevance, the centres were not to be established with any one company's interests in mind, but rather with the aim (in ICT as well as in forestry) of creating something completely new and different.

One of the issues that has perhaps precipitated most discussion and no little scepticism is that of the "industrial renewal" – have the SHOKs, in effect, become a bastion of the old established industries rather than an instrument creating much needed new blood – new business and spin-offs?

Under each evaluation question we have summarised the key evaluative assessment of the evaluation team in bold and italics. This is followed by an explanation of what supports this assessment.

6.2 Conclusions per evaluation theme

Evaluation question 1: Are the general policy goals and premises set by RIC in 2005-6 still valid and relevant?

The overall policy goals and premises are still seen as highly valid and relevant, perhaps even more acutely felt with the economic situation and the accelerating speed of industrial change.

An industry-driven policy instrument is welcomed by the SHOK community. In the evaluators' view, being industry-driven should not however mean being over-focused on existing industrial structures and competences at the expense of renewal and agility in the innovation and industrial system. This element of the SHOK model clearly addresses an important issue for industrial and innovation policy, though in some cases it is not profiled clearly enough and in actual fact its profile is not clearly distinguishable from that of the Tekes programmes. SHOK instrument should provide a versatile, but targeted portfolio of measures and actions rather than seeking covering everything.

In the early stages, the universities and basic research were supposed to be more fully involved with the SHOKs. This turned out to be rather unrealistic, something which however ultimately led to the SHOKs inability to capitalise on what the academic partners could offer in RDI terms.

More efficient joint allocation of research investments from all sides was one of the key rationales for setting up SHOKs. This has not been fully achieved.

Investment has in the main been provided by Tekes and industry. Between 2008 and September 2012, Tekes funded the SHOK research programmes to a total of 343 million €. An average of 40% of research conducted by the SHOKs has however been co-funded by the companies involved. The Academy of Finland contributes to the strategic centres indirectly by funding leading-edge research carried out in the research areas covered by the SHOKs (EUR 31 million in 2011 and EUR 5 million for 2012–2014).

The original initiators of SHOK activity were Tekes (with the desire to renew the existing model of technology programmes) and the forest cluster (addressing the research needs of the sector in the post-KCL situation). Companies were quite cautious in the early stages, with the industry federations being clearly the more positive proponents of the SHOK concept. The academic community was originally quite ambivalent and has subsequently become largely marginalised from SHOK activity. The SHOKs have struggled to convince the academic community of the value of participation or of the concept as a whole. In many cases the agenda has been based more on a compromise between different actors and goals than on a shared commitment to achieving global excellence. Research excellence has in part been compromised due to the inability to build bridges between the SHOKs and the Centres of Excellence. The Academy of Finland's role has changed over the evaluation period and while Academy of Finland does not fund SHOKs directly, they do fund SHOK-related activity, in areas where SHOK research is active (estimated 22 mill€ in 2011, according to Academy of Finland information). While the SHOKs do not necessarily need Academy of Finland funding as such, they do need top researchers and their results in order to gain scientific credibility.

Despite the relevance of the original goals, there are concerns over the concept and its functionality and ability to provide value added. One of the main weaknesses here is the contradictory nature of the main objectives, which

necessitate clear strategic choices between the goals. There may be a need to revisit the original SHOK concept and think carefully about the ways in which it could better attract and involve the universities and sector research institutions. The fact that the Academy of Finland has been reluctant to allocate funding for SHOKs has been criticised by the SHOK companies in particular. The main concern of the evaluation team here is that this may have led to a situation where one of the key goals (excellence) was, in effect, compromised from the beginning. A more selective approach is required. In order to improve the societal relevance, SHOKs could introduce thematic cross-SHOK programmes addressing key topics of societal relevance (e.g. smart city, economic efficiency, preventive health, digital solutions for wellbeing etc.). This issue needs to be closely coordinated also with the reform of the public research institutes.

Evaluation question 2: Are each individual SHOKs' strategy and SRA relevant, focused and challenging enough to achieve the original policy goals?

The individual SRAs are highly relevant, though their ability to steer the programme content and by so doing the overall RDI activity within SHOKs is not sufficient.

The SHOKs are, for the most part, still at quite an early stage in their development and thus have not reached maturity in terms of the outputs and effects to be achieved with, perhaps, the exception of FIBIC, which has in a sense moved to the next phase of development ("SHOK 2.0"). The relevance of each SHOK's strategic focus is summarised in turn below:

- **The Cleen SRA is seen as relevant and up-to-date, though it may also be too all-encompassing.** The SRA places the focus of Cleen activities on joint applied research, though in individual cases more fundamental research or more market-oriented research can also be undertaken. This provides a solid ground upon which to build on the activities of this SHOK. The possibility of involving more societal perspectives and stakeholders should however be utilised more actively. The main stakeholder criticisms relate to the logic and philosophy of Cleen's activity and strategy: the combination and balance of addressing both research relevance and excellence in equal measure is seen by some of the partners in the Cleen network as an impossible circle to square. In addition, concerns remain over the breadth of the strategic focus: are the selected priorities those where Finland has most to give internationally, where research is most cutting edge and societal relevance the highest? The strategic focus has, moreover, been seen to be rather more consensual than actually priority-creating or selective.
- **The relevance of FIBIC SRA is high.** A particular strength here has been the fact that industrial renewal has been very much the focal point from the start and therefore the focus has been seen as correctly selected. FIBIC's

SRA is excellent from the renewal point of view and it is clear from all the data gathered in this analysis that FIBIC has had a seminal role to play in the renewal of forest industry research. At the same time however it appears that the value added created may be diminishing over time.

- **The relevance of the FIMECC SRA is estimated to be high.** More focussed programmes (with more room for risky projects) may however be required.
- **RYM SRA is seen as relevant, though it provides relatively little support for making choices.** The broad shareholder and stakeholder bases make it difficult to make pre-selection and the actual strategic choices are thus often left to the programmes themselves.
- **In the case of SalWe, an SRA update is under way, with a sharper focus being placed on brain disease, lifestyle diseases and internationalisation.** It has, moreover, been seen as particularly positive that SRA is genuinely based on recognised Finnish strengths.
- **In the case of TIVIT, the SRAs are drafted for the programmes rather than vice versa.** The lead companies have had a very positive experience of the SRA process, and value the support and guidance provided by TIVIT.

While the individual SRAs are perceived to the relevant, there are however a number of areas that need to be addressed further. These include interdisciplinarity, cross-sectoral opportunities missed and internationalisation.

Inter- and multi-disciplinarity has been insufficiently incorporated into the SRAs. Across the SHOK partnerships and industries involved there is a perception that the SHOKs have succeeded in formulating strategic visions that bring added value to the partners involved. It is also the perception within the partnerships that these SHOKs have succeeded in channelling the needs of their shareholders into the SRAs. It may however be that this has in some cases led to the favouring of stability over dynamism in terms of the choices made. At the same time, a certain discrepancy can be observed between the SRAs and the actual operations on the ground, the latter not necessarily having clear links to the SRAs.

Also the SRAs have in some cases become too all-encompassing, not making bold or sharp enough choices as to what could be the future success sectors and research fields in Finland and how the SHOKs could promote these as much as possible. A sharper focus is required in most SHOKs (and particularly as regards RYM, TIVIT, Cleen and SalWe). The shareholders are happy enough with the current state of affairs while the universities and other research organisations do not see the agenda as being sharply enough focused. In addition, the policy actors and strategic respondents also view the focus quite critically, which was also visible in the peer review panel assessments. There is little evidence of strategic alignment, i.e. of SHOK strategies influencing the strategic choices of their shareholders, universities or companies.

The potential for internationalisation is found in areas where there is interest in the international sphere and where the Finnish RDI profile is competitive enough to be internationally appealing. The high profile of the Finnish innovation policy brand provides a good starting point for activities of the "bridging" type – both across SHOKs and between communities etc.

Both the panels and the evaluation team found that the public sector decision-makers and consumer groups are among those stakeholder groups that should be better integrated into many of the SHOK's activities. Only in very few cases are public sector agents (e.g. cities) shareholders in SHOK activity, though future city/smart city -related topics in particular could easily accommodate areas of research from many SHOKs and in particular provide a platform for cooperation and multi-disciplinary research between and across them.

In light of the e-survey, issues that need to be addressed more actively if the SHOKs are to achieve their ambitious targets of igniting structural change and technological breakthroughs include

(i) Internationalisation (in various ways, e.g. ranging from reaching international quality in research, attracting international participation into RDI into Finland, making industries internationally competitive to international benchmarking.

(ii) cross-SHOK collaboration (with the potential for cross- and trans-disciplinary openings and interfaces) and

(iii) The cultural shift that is expected from both industry and academia and building up a professor infrastructure across the industries.

The SHOK survey respondents view the EU research funding instruments rather negatively which leads us to conclude that the SHOKs could be a competitive and attractive alternative option for internationalisation in this regard. The EU instruments are seen as exhibiting the heaviest administrative burden and least flexibility, while they are clearly also seen to be weakest in terms of the degree of technological and scientific risk. In addition, the research respondents perceive the EU funded research activities to be furthest away from the core competence area. For research organisations a similar distance exists in terms of industrial collaboration in relation to the SHOKs.

In light of the survey, research infrastructures and testing and piloting facilities are also areas where considerable untapped potential seems to lie, not least in the challenging areas where the potential interfaces between industries and disciplines could be more fully explored. TIVIT and Cleen have been more active in this area than have other SHOKs hitherto. This is also an area where closer collaborative efforts between the SHOKs should be promoted.

Unresolved IPR issues have been identified as a major problem in utilising some of the SHOK results (e.g. FIBIC). Though the evaluation team can conclude that the rules involved are clear, the perception that they are not nevertheless remains. While in some cases it has been argued that commercialisation is not among the main objectives to be attained, in some of the SHOKs (e.g. TIVIT) it has

clearly and unambiguously been set as a goal. As common results are usable by every programme partner across the SHOK programmes, there seems to be very little incentive for commercialisation. Some promising results may not even be utilised. IPR issues should be resolved immediately to increase the incentive to commercialise, and to increase the commitment. Benchmarking cases where open innovation has been the rule and where it has proven to work should be sought for.

In some sectors the catalysing role of SHOK activity has been essential (e.g. RYM and FIMECC). This entails the bringing together and gradual building of a research ecosystem in a new RDI area that has previously not existed. Both RYM and FIMECC are seen to have helped to create more systematic R&D -intensive activity and networking and the utilisation of available resources and, as such, the SHOKs are also said to have created value added which would otherwise not be available and would disappear without SHOK support.

Results as monitored and observed in terms of the key performance indicators are modest. This is, in part, explainable by the picture remaining blurred due to the lack of comparative data. While some SHOKs show real promise (e.g. FIMECC), others are less impressive or have not succeeded in reporting their results. This is also indicative of the lack of a consistent and systematic monitoring model, which would bring the SHOKs useful (benchmarking) information while also providing the funding agencies and SHOK steering and management on the national level with a means to assess the progress made. Benchmarking should be implemented in a more systematic fashion – perhaps through thematic benchmarking or through peer reviews with other European and international models of the SHOK type (the UK Catapult or the German and Austrian examples in the benchmarking undertaken in the context of this evaluation).

In sum, thus far the SHOKs have not been able to address topical areas stretching beyond their sectoral boundaries (between programmes or between the SHOKs) to a significant degree with perhaps FOREST turned BIOECONOMY being the primary exception here. Nevertheless, we cannot get away from the fact that one of the main hopes in respect of the SHOKs was to ignite trans-disciplinary, field-transgressing activities. Instead of the traditional clusters, it might have been better (and is perhaps still worthwhile thinking of) to organise the SHOKs along different thematic lines (e.g. new technology areas, new markets or societal demands).

The interfaces, which are potentially interesting for all SHOKs and where such activity has been launched by individual SHOKs include, for instance, digital services, smart city and well-being (TIVIT, SalWe and Cleen).

3: What is the strategic position of the SHOKs as a policy instrument in the Finnish economy and R&D&I system?

The position of the SHOKs, situated among traditional Tekes technology programmes and Academy of Finland research programmes, is not clear. The interviews and survey show that this lack of clarity exists among both the

stakeholders and the potential SHOK beneficiaries. While the ambition is to make SHOK the instrument that best combines industrial and academic interests in excellence and takes risks to discover future sources of innovation and growth for Finland, in some cases it ranks lower than Tekes programmes in terms of innovative results, testing new solutions and commercial potential and in most cases (with the possible exception of FIBIC) lower than the Academy of Finland's funding programmes in terms of scientific excellence.

SHOK as an instrument does not seem to have a sufficiently strong scientific profile and has not fulfilled its potential in light of the excellence criteria. On the strategic level the programme clearly remains in search of a "political champion", as ownership of the SHOK concept remains unclear. While the Ministry of Employment and the Economy and Tekes are reluctant to take on this responsibility, perhaps it is the Confederation of Finnish Industries that would be the most natural "owner". Such a 'solution' may however be at odds with ensuring the fuller involvement of the academic community. If the desired outcome is to be attained, the involvement and centrality of the academic community needs to be more fully ensured and this may instead require a model based on co-ownership.

In order to ensure the fuller involvement of the scientific community, issues relating to the excellence criteria and openness need to be specifically addressed. In order to strengthen the quality standards and criteria for excellence such that they are on a par with the high relevance criteria, quality assurance processes are welcomed by those stakeholders currently concerned with the inability to achieve credibility in terms of academic excellence of SHOK research. These types of peer review processes have thus far only been introduced in a few cases (e.g. Cleen) and a similar model would thus be welcomed across the SHOKs more generally.

The significance of building stronger ecosystems with the help of co-location should be investigated more thoroughly. The SHOK companies have already co-located, which supports the flow of information and ease of contact, but there may be grounds for investigating the possibility of "SHOK campuses" or similar. The significance of testing facilities, Living Labs and testing platforms has been seen as a means of sharpening the societal relevance and value added. FIMECC Factory is an interesting example of such initiatives.

4. To what extent have the general strategy, policy goals and premises set in 2005-6 by the RIC been achieved?

The concentration of resources in the selected areas has been achieved to some extent, the excellence and renewal aspects less so. As argued above, this is due to the conflicting objectives, which make it difficult to achieve the desired results. Perhaps one should therefore choose which of the three targets one most specifically wants to address or at least in which order and in which logic the different objectives

could be achieved. The whole impact model thus needs to be thought through more systematically.

The SHOK-specific starting points vary greatly, which is reflected in the goal attainment. The point of departure varies greatly and therefore within some SHOKs even more modest results can be seen as somewhat revolutionary. In some cases the mere fact that RDI activity has been developed more systematically has been an achievement (in particular RYM).

There seems to be clear lack of internationalisation and global dimensions. In their current state, the SHOKs neither serve as an attraction foci for talented researchers nor as research intensive RDI. The international dimension of their activities is certainly not given enough thought, and even their presence in respect of EU programmes and initiatives remains low. TIVIT is the only SHOK with a coordinating function in a European research programme for instance. No internationalisation strategy exists on the concept level, or within the individual SHOKs. It is hard therefore to see how the SHOKs can attain the goal of achieving breakthroughs without sufficient international linkages, though internationalisation as such shoudl not be the main target.

Many of the other aspects are simply impossible to assess, due to the fact that a functioning and transparent evaluation and monitoring system was not put in place to trace the outputs, inputs, results and effects. The KPIs have, crucially, not been systematically defined and perhaps also a more interactive model should now be put in place as regards monitoring. As limited companies SHOK companies are accountable to their shareholders in terms of standard business indicators, such as turnover and profit. Yet as far as the SHOKs use considerable amounts of public funds, they need to report on more than simply these business indicators. Thus far the SHOKs have interpreted the KPIs in various ways and reported on what they have felt best reflects their strategy. Perhaps this could be a model for the majority of activities, but since a considerable amount of public funding is used, the indicators used must be carefully selected. The SHOKs should be involved in selecting the indicators that best reflect their strategies while for the shared indicators, a bank of indicators could be developed where the SHOKs could select the 3-5 that best reflect their own activities. The facilitating and networking functions should also be included in the indicator package, reflecting the character of SHOKs as bridge-builders and facilitators within the innovation system or innovation ecosystems.

Monitoring systems have to be built into programme design and be used as a basis for continuous quality assurance, performance assessment and overall evaluation. Similarly to some of the international benchmarking cases introduced, also in the SHOK context the timeframe should be carefully considered (e.g. 3-4 years, bearing in mind that the overall timeframe set is 5-10 years). Peer reviews could be used as an additional resource here, especially in deciding on new programmes, focus areas, cross-SHOK initiatives etc.

5. To what extent have the goals and objectives outlined in the SRAs been achieved? How central are the SHOK activities in promoting these goals, when compared to other policy instruments that the shareholders and programme actors have at their disposal?

The goals have been achieved when it comes to committing the shareholders and industries, yet the results are less impressive when it comes to the academic community. SHOKs were unable to provide the panels and the evaluators with sufficient information on their concrete overall results. This cannot be explained by confidentiality or IPR issues, as all the panelists and experts were bound by a confidentiality agreement. In light of all the evaluation data the SHOKs are seen as being central to the shareholder companies and their RDI. They are on the other hand relatively invisible among the academic community and in the society at large. This is, in part, due to the long lead time originally required to get the SHOKs up and running. In addition evidence on the results and effectiveness remains insufficient. This may be more a function of the poor standard of monitoring and assessment than anything else, yet it is nonetheless an issue to be addressed, both within individual SHOKs and across the SHOK governance structure as a whole.

The indicator picture is fragmented. There are numerous Key Performance Indicators (30 in total) being reported, though without a transparent logic model making clear the linkages between outputs, inputs and results. Some of the core issues that could make the SHOKs truly unique and highly relevant are not however included or are not sufficiently covered by the KPIs. One such issue is the focus on cross-disciplinary and sector-transgressing themes and research substance. This is welcomed in the original goal setting and rationale of the SHOKs, and could be a way of focusing on the future success areas, in line with "grand challenges" thinking. These challenges should be identified from a Finnish perspective, in the sense that they should be areas where Finland already has a potential global excellence, which could be nurtured further into an international level area of excellence.

There are indications that SHOKs have enabled the integration of new partners and broader consortia and partnerships. Sometimes however the breadth of the partnerships has been won at the expense of the depth and intensity of the collaboration. Often, SHOK programmes seem to have even become too large to allow for efficient collaboration.

Based on the interviews and survey findings, SHOKs are seen to fill an important gap in the repertoire of research and innovation instruments, yet the profile of the instrument is low. The survey reflects the perceptions of the stakeholders and shows that in many cases the SHOK instruments are seen as very close to the Tekes programmes. The perception is that there is no clear / transparent process and criteria for why some topics end up as Tekes programmes, others as Academy of Finland programmes and only some, as SHOK programmes. This is undoubtedly a negative indication of the fact that the SHOK position has simply not been defined, clarified and communicated clearly enough.

6. Is the SHOK concept an appropriate and effective way of organising R&D&I collaboration (in comparison with other well-known instruments nationally and across international benchmarks)? What are the strengths and weaknesses of the SHOKs compared to other funding and networking instruments? (Tekes and Academy of Finland programmes, EU FP7, competence clusters, Centre of Expertise etc)?

The KPI data available, benchmarking analysis, interviews and the survey each witness a low attainment level. The intensity of collaboration is perceived positively however and seen as qualitatively more advanced than in previous programme contexts. There are some indications that the preconditions for future success may - in some cases - be in place, in particular when it comes to industry-based RDI. The survey provides a rather revealing picture in this regard, where the intensity of collaboration is clearly highest among the SHOKs (both company and research respondents feel this way).

There is a clear contradiction between the perceptions of appropriateness and effectiveness between the different stakeholder groups. Industry respondents are most positive as to the suitability of SHOK as a way of organising R&D&I collaboration. For the industry respondents, SHOK activities importantly exhibit the highest degree of risk, scientific complexity and best quality selection mechanisms, when compared to Tekes or EU research instruments. For research respondents SHOKs represent the weakest quality and transparency of selection criteria, which is seen as critical. The selection issue thus needs to be addressed as swiftly as possible. Contrary to the perception among the academic community, for industry respondents, the SHOKs are perceived as the best instrument of profiling oneself among the academic community. For industry respondents SHOK supports best the involvement of well-established researchers. For research respondents, SHOK is equal to Tekes programmes as an instrument for doing research, for company respondents it is the best approach.

Even for company respondents of the evaluation survey, Tekes funding has an important role in supporting applied research, more so than the SHOKs. According to the research respondents, Tekes funding has the most transparent selection process, while the company respondents perceive the process as least transparent! Certain perceived advantages with the Tekes instruments for undoubtedly exist for industry respondents, as most testing takes place here and the funding mechanisms are seen as least bureaucratic.

For research respondents the Academy of Finland instruments have remained most positive and appropriate. In the interviews many described the SHOK model as too 'closed' and uncommunicative and felt that it was more of a closed club than an open forum for innovation. In order to assess this challenge a major shift in the prevailing culture of SHOKs and in the selection processes implemented is required.

There are important lessons to be learnt from the numerous **international benchmarks** available. One question that has been actively discussed during

the evaluation was the question of ownership. Lessons to be learnt from the benchmarking undertaken by Joanneum are relevant here, for instance in relation to ownership and governance models:

- The benchmarking analysis concludes that clear responsibilities of programme owners are key prerequisites: the current model where in some cases the programme management is outsourced. It needs to be assessed which model is actually more effective and efficient.
- Shared responsibilities between stakeholders have to be set up, with the ministries/public authorities being responsible for the definition of priority areas for the intervention and the key expected outcomes and impacts of the programme, and the programme management setting up performance contracts with networks (tasks, responsibilities, reporting periods of the networks/ centres), as well as setting up an electronic Monitoring system including key performance indicators (outputs, intermediate outcomes) which are reflected in an intervention logic of the programme.
- Steering committees/advisory boards which provide guidance on overall strategy of networks and participate in performance reviews. Well functioning programmes include all relevant stakeholders – particularly the Scientific Research Community.
- The Centres and their networks have as their main function the definition of a strategic research agenda, which delineates a medium and long term R&D strategy for the networks (Common problem: „Short term, demand oriented R&D solutions“) and seeking to ensure coordination and commitment among industrial partners and academia. (See the benchmarking appendix for more examples.)

7. How appropriate is the SHOK approach to governance? How do the management and governance processes used facilitate the making of such decisions? How does the SHOK level cooperation work? How efficient is the management, leadership and administration? Which particular bottlenecks or problems have affected goal-achievement? How have these problems been solved? What were the facilitating factors in goal-achievement? How have these been mainstreamed?

The SHOK leadership and management are generally seen to be professional with the SHOKs on many occasions praised for their 'lean' management approach. In some SHOKs there may even be understaffing issues. Yet sometimes this 'efficiency' and lean character has been at the expense of openness and open competition. It is therefore essential that SHOK management practice is developed to ensure the inclusion of, and access to, the best research groups and established researchers. One should also carefully assess which functions are most central for the SHOKs to deal with on their own, and thus also which could be outsourced. A more considered model in respect of the key functions of the SHOKs and their

collaborative networks could thus bring considerable value added to the SHOK model as a whole. This would involve for instance making sure that the programme management is organised in the most efficient way available, Senior researchers and professors are involved as Principal Investigators and only the programme and project management is left to the SHOK management, whco concentrate in the most professional and efficient portfolio management possible.

The necessary move to strengthen the utilisation of excellence criteria requires further attention also through governance mechanisms. One way of supporting this is the introduction of international peer review as a method, following the example of Cleen. Open competitions, transparency and high-profile research groups, as well as the utilisation of top researchers for peer review and planning stages are among the best ways to support the step-change required to move from industry-driven relevant, but safe and often not path-breaking research to high-profile international research where future research areas are only now being defined and articulated. This is where the SHOKs should be active and all governance innovation that can support such a change is to be welcomed.

8. How appropriate is the SHOK concept for business renewal?

In some cases (most notably FIBIC) renewal has been achieved in an exemplary fashion. Yet in most cases the SHOKs have not been able to help in the renewal of business to the degree intended. This is due to the agenda and activities being, in the main, driven by the large incumbent companies. There is e.g. little incentive for participants to promote spin-offs and new companies and new business with the current IP practice and rules presenting significant barriers here. It is unrealistic to expect large companies to choose research topics that are beyond their current core competence and that do not serve their medium- or short term interests in the context of this type of instrument (large collaborations / platforms).

9. What kinds of impacts have been achieved and can be further expected? What are the impacts in the participating companies? Societal impacts according to the impact model of Tekes and Academy of Finland: Economy and renewal, environment, Well-being, Knowledge and competences

The societal impacts are not measured nor are they available. Clearer metrics and a systematic logic model should be developed in order to provide such an assessment. As noted previously, such metrics need to be defined in close collaboration and dialogue between the SHOK management, shareholders and steering bodies and financing organisations. This would help all parties to make more informed choices between the options available.

Based on the panels and interviews, it seems that many of the opportunities for promoting societal impacts need more attention. In many cases the research content is such that the societal interests can easily be identified and promoted,

though this connection remains invisible, as the targets and goals have not been set in a way that would chart the impact chains in this regard. The evaluation team acknowledges the difficulty of such an endeavour, but at the same time insists that the effort needs to be made in order to be able to assess the rate of progress and the value added for the investors, financing organisations and in the last instance, for the tax payers.

10. What is the added value of the SHOKs? Does it make Finland more attractive as a research and business / innovation environment? Does the SHOK concept bring more or less potential value added to the stakeholders than do other policy instruments? How can such differences be explained?

It is clear that the qualitative leap to global leadership and excellence still remains to be attained in this regard and that the much vaunted societal effects are not yet visible enough. There is also a notable absence of international activity, international staff and partners.

On the most basic level the question of value added can be posed as a question of what is missing from the innovation system and what research would not find funding if it was not for the SHOK instrument. The principal achievement is the industry-driven qualitatively more ambitious, open and committed research. This may not warrant such high level public sector intervention and investment however. The SHOKs have had a quite slow start in terms of getting a fully-fledged portolfolio management in place, while the consortia and activities as such have emerged very efficiently and rapidly. More delay was due to the time it took to form the consortia and to sort out expectations and the various roles of the participants. This may be due to the difficulties in communicating and explaining a novel approach, but it may also reflect inherent problems in respect of the instrument. Even now, some years into the programme, ambiguities and uncertainties clearly persist among the participants. There are concerns that if the programme is in need of further explanation after years of discussion – and in fact operation – this is due to a significant design fault and to the unclear nature of the goals.

The formation of, and value added produced by, the consortia seem to be something of a double-edged sword. Participation was originally sought by the industrial partners simply 'not to be left out' but, crucially, this was done without a real strategic approach to participation being formulated. Universities were however largely uninterested and in some cases even suspicious of the new instrument. With time some universities did become more engaged (especially the technological universities, Tampere and Lappeenranta), while others in the early stages in particular remained largely absent and felt left out, as programmes were not launched as open competitive calls. There seems to be no grounds for this lack of open competition within the SHOK research.

While significantly broader than previous partnerships, there may be a risk of diluting the resources. Questions may be raised whether the type of instrument

(large, multi-actor collaborative pre-competitive R&D) lends itself to the goals (industrial renewal, alignment of R&D strategies, breakthrough innovations) of the programme. Numerous previous evaluations (e.g. of the EU Framework Programmes) have indicated that companies tend to reserve their core-business, centre-of-strategy activities for other settings than large collaborative programmes. The same risk may apply to the SHOKs.

11. What are the key results and impacts of a SHOK among its stakeholders (achieved/expected)? Have SHOKs enabled and/or inspired new forms of collaboration? Have the SHOKs enabled access to partners or knowledge sources previously unavailable?

The SHOKs have not affected the volume of participants' RDI in monetary terms or person years, though this may be an unrealistic expectation in the current economic situation. Importantly, at least in the case of TIVIT, the availability of SHOK resources may have slowed the steep decline in RDI investment.

New partnerships have clearly been forged, though mainly within Finland. International collaboration needs much more effort if it is to be forged. Thus far the networks have been more based on existing ones than radically novel combinations.

There is, to date, little indication of RDI impacts, with the exceptions of RYM and FIMECC, where SHOK RDI has reportedly resulted in the development and/or introduction of new-to-the firm products or services.

The SHOK organisations have thus far been unable to solve the problems associated with collaborative RDI. The experience of many respondents and interviewed persons was quite negative in this regard and the openness approach may have led to the most novel and path-breaking research remaining outside the SHOK context. The IPR rules have been clearly defined and major effort has been put into communicating these rules, though it seems that this has been insufficient while the SHOKs remain too open for the partners to engage in highly sensitive research.

In terms of attractiveness, it is important to ensure that the new generation of researchers and business leaders become engaged and use the SHOKs as a springboard. At the moment it seems that the SHOK networks are mostly built around already established mid-career professionals, or in the case of programme management, PhD students.

6.3 Summary of SHOK specific conclusions

The picture that emerges from the above analysis is a diverse one, with many positive perceptions and outcomes of the processes taking place in and around the SHOK companies, thir research programmes and activities. We briefly summarise some of the key findings of this multi-layered analysis below.

Evaluation questions / dimensions	CLEEN	FIBIC	FIMECC	RYM	SALWE	TIVIT
Validity of the original goals set for SHOK concept	Yes, though more focus is wanted, with explicit attention for unique Finnish strengths, competencies and needs	Yes; though main focus in enhancing industrial renewal and targeting the resources	Especially the need for renewal and concentration of resources. Internationally high level research more contradictory (raising the level of research more important). Not clear how much to promote industrial renewal (Question of absorptive capacity)	Yes, though "targeting the resources to strategically selected focus areas" least so	Too broad, lack of focus	Yes, digital services the core. Potentially too consensus-oriented and not focussed enough programmes.
Relevance of individual SHOK's SRA	Yes, though as the goals are in some cases conflicting, there needs to be a conscious and explicit balancing between the interests of industry and academia by the Cleen management	High, industrial renewal very much the focal point	High, though more focussed programmes (more room for risky projects) may be required	Difficult to pre-select, very broad shareholder + stakeholder base makes the field very fragmented	Update under way, with sharper focus on brain disease and lifestyle diseases and internationalisation. Positive that SRA genuinely based on recognized Finnish strengths	The lead companies of the SRAs have a very positive experience from the SRA process, and value the support and guidance provided by TIVIT
Strategic position of SHOKs	Highly effective for the industry. Bridge-building potential, but this needs to be systematically fostered	Strengthened RDI collaboration remarkably; laid foundations for potential industrial change; despite this company top management commitment uncertain	Highly effective for the industry. Important especially as a tool to promote more long-term research agenda in the private sector	SHOKs have found a place in the innovation ecosystem where they complement some gaps that have existed there	Too isolated from the rest of research ecosystem	More market-oriented than other SHOKs, time horizon similar to Tekes programmes

To what extent have the policy goals been achieved?	Targeting resources through collaborative projects and broad consortia yes. As argued by the panel, “ management must ensure that the consortium is open for new partners” and “ More potential for genuinely innovative combinations and inter-disciplinary work should be nourished within and between the SHOKs”	To a high degree. New forms of cooperation, Challenges in industrial renewal and in committing the old industry to new agenda	Targeting the resources to key research groups effective (although concerns if the mechanism finds all right groups) Catalyst, able to attract industrial partners to broader and deeper collaboration than previously. Internationalisation only partly. Doubts if FIMECC (and SHOKs in general) the right tool for internationalisation	Too early to judge	Too early to judge	TIVIT has been effective in organizing research in a way that allows for the stakeholders to share a vision where TIVIT should be headed. TIVIT also offers services to its constituents, which are generally highly satisfying to the participants as portrayed in the survey results. At its best, TIVIT can effective help renewal of the ICT industry and create new capabilities. However, the activities are innovation oriented, and scientific research plays a relatively small role, and scientific quality is mediocre

How actively have the SHOKs promoted these goals, when compared to other instruments?	Actively, though the academic community and its most cutting edge excellence has not been integrated	Very actively; main instrument in long term renewal; stakeholder commitment concerns	Actively, important catalysing role in transforming metals and mechanical engineering industry into a more R&D oriented direction. Internationalisation activities, own monitoring framework and key indicators to monitor research output and quality	Very actively, the main instrument	Very actively, though too isolated	Commercially disappointing, see above. If compared to Tekes programmes, TIVIT programmes have contributed less commercially exploitable IPRs as corresponding programs. The commercial results are also relatively rare, not many tangible products and services are directly
Is the SHOK concept an appropriate way of organising RDI?	As argued by the panel, “and internal progress and quality assessment process is urgently needed. The Cleen management and the WP leaders must develop a meaningful set of performance metrics to assess the quality, productivity and relevance of programme outputs against the Cleen SHOK’s ambitions”	Professional and appropriate, though the panel raised a concern over the “too lean management” of the programmes	Very appropriate, industry academia interaction more strategic and research oriented than before. Easy and efficient way to organise collaborative RDI. Deeper an more “participatory” collaboration. Concerns over “patience” to allow more risky initiatives	Yes, very strong ownership	Yes	Professional and appropriate

How appropriate is SHOK governance?	Professional management, though more attention needed for internal and external review. Size of consortia is potentially diluting the resources too much	Efficient, professional and appropriate; more focus and resources in the programme management possibly needed	Highly efficient and professional, assistance in international activities a possibility	Professional and appropriate, more collaboration across programmes called for. new foresight and valuation services of significance for creating long term visions and to build up the capacity to create high quality research ecosystems welcomed.	Professional, lean administration seen positively, overall the stakeholders "pleased"	Professional and appropriate, the size of the consortia may dilute the resources too much, as resources are dissipated to too large a host of actors
How appropriate is the SHOK concept to renew business?	Largely serves the interests of the big companies, less focus on business renewal, perhaps also exacerbated by the quasi- absence of other than engineering expertise (and other than technical universities) in the academic partnerships, Clear incentives for ipr required	For the main stakeholders, very appropriate. The globally unique organizational concept has had a central role in bringing longer value chains together, and in linking research and industry closer to each other, and thus in its part it is catalyzing renewal. For companies lower in the value chain, the added value is not that evident. Important for existing research organizations in renewal, too	Yes, in particular the user experience and global networks are seen as highly relevant for industrial renewal. However, these programmes are the most challenging in terms of utilisation since industry absorptive capacity may be lower than in more "traditional" fields in other programmes	Early to judge, though positive signs: Some companies involved in RYM Ltd have substantially become more interested in research that meets international quality criteria, but there is still a long way to go to take the strategic research thinking to a new level and to see some changes that would lead to industry renewal	Yes, collaboration on service business and digital services between Salwe and TIVIT seen as particularly important	Large companies have a strong position in TIVIT and mostly involve mid-senior management, whose time horizon is shorter than 5-10 years. The programmes are geared towards sustaining existing business models in the industry, rather than radical renewal and cannibalisation of present business. IPR issues may have lead to the most interesting and innovative research content to be developed outside the SHOK context

What kind of impacts have been achieved and can be expected? (incl. societal impacts)	Metrics largely missing to assess this. Technological competitiveness and visibility and reputation of industry-driven research seen positively. The industry share of funding / in kind an important indicator for commitment.	Overall early to judge. Catalysed the structural change and been able to open eyes and change ways of thinking. No changes in stakeholder strategies yet. FIBIC has had a seminal role in industrial renewal, despite the fact that there have been severe problems with the IPR issues.	Impacts mostly too early to judge. Deeper mutual understanding between research and business. Making RDI policy in key companies more strategic (change in mindsets and long-term approach)	Early to judge. Main future challenge for RYM Ltd is to focus on fewer areas with fewer partners but with higher commitment and larger volume	Too early to judge, thus far mainly the collaborative efforts can be seen as significant. An important indicator of the companies' commitment to collaboration has been concretized as efforts invested in the programmes	While the SHOK objective is to conduct transformational research and create innovations that renew industries, according to the interviews, the agendas and particularly programmes are largely set by people preoccupied with the present problems and a short time focus, approximately under 4 years, instead of 5-10
What is the value added of SHOKs in the longer term? Does it make Finland more attractive?	More attention required to assess the potential for international activity and means of making Finnish research environments more internationally attractive	New forms of industry-academia research, increased cooperation, value chains drawn together. No direct international aspects	More attention required, to quote the panel: "a world class research centre also needs world class research facilities and links with the international leaders in the field and links with international collaborators, as well as visits of key researchers. This was not demonstrated." FIMECC makes Finland more attractive for existing companies but probably not for foreign businesses At this stage the greatest value added may be the significant role in turning the mindset of the industry to become more R&D oriented in their quest for global competition	Realism required as to the expectations: The researchers and companies should be able to set their visions for future at least with a 10 year perspective. Also the policy makers should have the same or even longer time horizon in their mind when the results are monitored and the success assessed	Precompetitive industry-driven research with a societal impact. In order to realise the societal potential, currently lacking collaboration between SalWe Ltd and service providers such as municipalities and hospitals needs to be addressed	From an academic standpoint, two major disincentives for participating in SHOK research: the funding model and the content in the agendas. These two combined do not make SHOK funding and participation attractive for many researchers. "Unconventional" IPR rules and funding T&C make it unlikely to international partners to become involved in the present form

What are the key results and impacts?	Higher R&D intensity, Commitment of the industrial partners, Increase of visibility and scientific reputation of the firms as a competent partner in R&D, Overall technological competitiveness	To quote an interviewed person: “Six years ago nobody talked about the structural change in the forest industry. FIBIC has enabled the change”. Now at critical point: can the SHOK draw the industry to the real change? Ipr and commercialisation serious problems	Higher R&D intensity, more long-term approach to RDI in companies, deeper and more hands-on industry participation in collaborative research, strengthening of key research units	Empowering the companies to develop their RDI strategically, change in culture	Important co-operation between research institutes and industrial partners in societally relevant field. Interdisciplinarity and cross-sectional collaboration	Greatest added value of TIVIT is associated with networking among the industry’s key actors and creation on new business ecosystems. In quantitative terms the outputs of the program do not match traditional Tekes technology programmes

EVALUATIVE DIMENSION	CLEEN	FIBIC	FIMECC	RYM	SALWE	TIVIT
DEGREE OF VARIETY WITHIN THE INDUSTRY	HIGH	LOW	HIGH	HIGH	HIGH	HIGH
NEED OF FURTHER FOCUS WITH THE SRA (IN ALL CASES THE FOCUSSING PROCESS IS CONNECTED TO THE PROGRAMMES, BUT THERE IS A DIFFERENCE IN THE DEGREE IN WHICH THIS ADDITIONAL FOCUS)	YES	NO	NO (IN THE PROGRAMMES)	NO/YES (mixed viewpoints, more focus needed but mostly overall satisfaction with broad SRA, focus through selection of programmes)	YES	YES (IN THE PROGRAMMES)
BENEFITS OF SHOK FOR INTERNATIONALISATION (=VALUE ADDED OF SHOK)	RELATIVELY LOW, HIGH POTENTIAL	LOW	RELATIVELY HIGH	RELATIVELY LOW	LOW	LOW, NATIONAL FOCUS
TRADITION OF R&D&I – IMPORTANT OR MODEST	IMPORTANT	IMPORTANT	INCREASING	MODEST, THOUGH INCREASING	IMPORTANT	IMPORTANT
FACILITATOR / NETWORK ROLE (IMPORTANT VS. WEAK)	IMPORTANT	WEAK COMPARED TO OTHER LINKS, (BUT IMPORTANT IN UNITING VALUE CHAINS)	IMPORTANT	IMPORTANT	IMPORTANT	IMPORTANT
(POTENTIAL) ROLE OF PUBLIC SECTOR AS A CLIENT	HIGH POTENTIAL, CURRENTLY LOW	N/A?	N/A?	HIGH	HIGH POTENTIAL, CURRENTLY LOW	HIGH POTENTIAL, LOW UTILIZATION
RELEVANCE FOR RESEARCHER TRAINING / FUTURE SCIENTISTS	HIGH	HIGH (POTENTIAL)	HIGH	HIGH	LOW	LOW
BREDTH OF THE STAKEHOLDER BASE (BROAD/NARROW)	BROAD	NARROW, IS UNDER BROADENING	BROAD	(TOO?) BROAD	BROAD	BROAD
ECOSYSTEM ORIENTATION (INCLUDING SME ROLE)	HIGH	LOW AT THE MOMENT	HIGH	LOW	LOW	HIGH
ABILITY / CAPACITY FOR RENEWAL OF INDUSTRY	LOW	HIGH	HIGH	LOW	LOW	LOW
STRATEGIC ALIGNMENT (SHOK INFLUENCE ON STRATEGIES OF THE INDUSTRIAL PARTNERS AND UNIVERSITIES THUS FAR)	LOW	LOW	HIGH	LOW	LOW	MEDIUM-LOW, HIGH IN SOME PROGRAMMES
INTERFACES (INCL. INTERDISCIPLINARITY, IMPORTANT FUTURE POTENTIAL IN ALL SHOKS)	LOW	LOW	LOW	LOW	HIGH	MEDIUM-LOW
PROGRAMME SCOPE – APPROPRIATENESS OF FOCUS	LOW	LOW	LOW	LOW	HIGH	MEDIUM-LOW
SRA RELEVANCE AND LEVEL OF AMBITION	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH RELEVANCE, MEDIUM AMBITION
ABILITY TO CAPTURE AND PROMOTE INDUSTRIAL INTERESTS	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
ABILITY TO CAPTURE AND PROMOTE ACADEMIC INTERESTS	LOW	HIGH	LOW	LOW	HIGH	LOW

7 Implications for the future and future recommendations

7.1 Implications for the future and future recommendations

"To whom it may concern"

The following recommendations need to be seen in the context of different possible **scenarios for the redesigning of the SHOK concept and structures**. The choice between scenarios can and should be based on the findings of this report, though naturally this remains ultimately a political decision. The main thrust of the evaluation team's proposals would best fit into scenarios B and C, while the scenarios of *Business as usual or Complete phasing out* are extremes, which should not be ruled out completely, but are seen to have some major drawbacks. Thus, the recommendations presented below could be seen as a menu of choice which would – in different combinations – serve different scenarios.

The following recommendations need to be seen in the context of **scenarios proposed for the redesigning of the SHOK concept and structures**. As argued above, the evaluation team proposes options mainly between scenario B and C, less so for A and D, which are the more extreme options *"Business as usual"* or *"Complete phasing out"*.

The degree to which this redesign implies a re-organisation within the individual SHOKs varies. Based on the monitoring data available, one could fundamentally restructure the programme in the next instance, in close collaboration with the SHOK steering group. This should be done by focusing on the areas which have proven to work quite well and identifying the positive aspects of SHOK (such as industry-driven large scale collaboration with new partners, SRA process etc.). In addition to adjustments within the SHOK concept itself, one may also choose to transfer such parts that are worth pursuing to other programme contexts (Tekes Programmes, JTIs etc.).

The recommendations also seek to make concrete suggestions for governance within the SHOK concept, including the dialogue between the research and innovation organisations, from the Innovation and Research Council, SHOK Steering Group, Ministry of Employment and the Economy, Tekes and Academy of Finland, as well as the individual SHOK companies.

On top of the overarching assumptions, which should be met by the SHOK as a concept, as well as some generic recommendations, the below-given recommendations are likely to have different levels of implications. Hence, the recommendations for the SHOKs can considered in the light of four alternative development scenarios, as described below. Each of these scenario options should be applicable at the SHOK

concept level, at individual SHOK level, as well as at the individual SHOK Programme level. The decision on which of the alternative development scenarios appear most suitable in each case relies largely on the hands of the SHOK steering group and the stakeholders of each individual SHOK.

Scenario option	Implications
A. Continue with minor modifications	Fine-tuning in objectives, focus and strategy. Minor changes in implementation.
B. Continue with major improvements	Maintaining original goals, but changes in focus and strategy. Major changes in implementation.
C. Re-launch with a new approach	More extensive changes in rationale, overall approach and structures / governance.
D. Phase out	Phasing-out SHOKs, planned transformation into another type of activity (programme, network, etc.)

Option C could imply, besides adoption of an ambitious, but different rationale (such as the promotion of cross-cutting and challenge driven approach) lowering the ambition level and concentrating on short-term incremental innovation-driven programmes (as the situation is currently in some SHOKs) and abandoning the original ambitious goals including promoting world-class research.

Option B could, by contrast, imply retaining the original ambitious goals (world-class research, internationalisation, excellence and the SRA approach where the SRAs are created in cooperation by industry and the academia). The implementation of this option would, however, require the reforms the following recommendations suggest.

RECOMMENDATION 1: The basic rationale, as originally drafted is still as valid as ever, though the current SHOK concept, despite certain achievements, contains contradictory elements that need to be clarified however.

The contradictions should addressed by the SHOK steering group and those involved in the governance structure. For the publicly funded share of the activity, the accountability of this clarification is best ensured through a contractual arrangement between the individual SHOK companies and the national steering bodies (MEE, RIC and SHOK steering group).

The rationale is commendable, but the tools implemented are insufficient and need to be further developed. The evaluation has shown that this type of instrument has some benefits, especially in specific areas (such as in low R&D intensive areas where RDI and collaboration in RDI is a less frequent practice). However, these achievements have been achieved at the expense of other goals such as internationalisation, wider engagement with leading edge research and commercialisation of results. This indicates that the SHOK concept is not clear and carries some inherent ambiguities.

In order to live up to the ambitious goals it is necessary to clarify the concept, to overcome the apparent implementation problems and introduce better selection process, portfolio management, governance and operationalisation of the SHOK

level objectives at the level of individual SHOK-specific strategies. A more focused strategy means sacrificing some ambitions to ensure that others are fully achieved. A more focussed strategy would also enable a better brand development, as currently the brand is underdeveloped and unclear.

In order to ensure the accountability of the SHOK concept in conjuncture with the clarification proposed, all SHOKs should form a contractual agreement with the MEE. The agreement should entail the few selected KPIs where all SHOKs should report on (annually), as well as SHOK specific KPIs. This would at the same time ensure the accountability that is required due to the high level of public funding involved in SHOK activity, while at the same time allowing for the freedom that SHOKs require in order to pursue their industry-specific strategies.

RECOMMENDATION 2: The SHOK strategy should reflect wider interests than just those of incumbent large firms and this should be ensured by the SHOK management, as well as the national steering group.

The original expectations of high quality RDI and its contribution to industrial renewal and competitiveness in international markets are not likely to be realised within a programme if its agenda formation is dominantly led by incumbent large firms, as shown by the evaluation. Incumbent large firms are inclined to incremental improvements, which is further aggravated by the sector-based approach. It is important to have a sufficiently varied palette of support to activities that have potentially high social returns, but which would not be implemented because of risks and uncertainties, if left without public support. Finland undoubtedly needs both incremental and radical innovation and renewal of its existing industries as well as the creation of new industries. The subsequent recommendations propose ways to introduce incentives for more transformative innovation.

The SHOKs should be more open to outside influences and in the name of accountability and excellence open their processes more in the early stages of launching new programmes, so as to ensure that all research and industry partners that can bring added value to the programme and SHOK in question can be involved in SHOK activity.

For continuing SHOKs, the SRA approach and the top-down establishment of the strategic agenda has proven efficient and should be maintained. SHOK has been important in introducing new, industry-driven, ideas and methods into the public RDI portfolio. The research agendas capture the interests of the SHOK stakeholders and have a relatively high commitment from the industrial participants. On the negative side, the current system overemphasises the role of the incumbents in the SRA process and the agenda building is limited to the industrial partners to the detriment of academic partners. This is likely to impede the usefulness of SHOKs if the current goals are maintained. A more effective steering mechanism is needed for challenging these strategies to ensure that they meet wider national needs.

RECOMMENDATION 3: The SHOKs should have to compete for their status and funding and in order to do so the quality and competitive character of

selection processes ensured, while at the same time ensuring sufficient commitment across time (5-year commitment originally set). The steering groups and MEE should ensure that such an evaluation structure is put into place.

The evaluation proposes that decisions on the current status and level of public funding of SHOKs are issues that should be re-assessed regularly. The basis should be the SHOKs ability to achieve their targets as compared with other RDI instruments. The activity of SHOKs that are unable to prove their value added over other available instruments should be stripped of the SHOK-status after the initial 5-years period has passed. The status could then be made available to new contenders that are able to prove their ability to meet the need for high quality industrially driven RDI in internationally appealing strategic cross-disciplinary and cross-sector areas that have the potential to become new markets and areas of Finnish high class excellence and expertise. Funding should be granted for the whole programme in the inception phase, while there still should be yearly control posts to ascertain that the programme lives up to the set goals. This may require introducing and notifying a new funding instrument and changes in the governance model.

There are a number of ways in which the scientific and technological quality of the programme could be improved. They would require substantial changes in the procedures of programme formation and project selection. The selection process needs to have a broader and more multifaceted knowledgebase upon which to rest upon. The major shareholders would not have the only (final) say in project selection. Rather, outside expertise would be used to a much greater degree. This type of external peer review is one of the areas where improvements on governance could and should be introduced immediately. Improving the procedures and overall quality would promote the level of attainment in respect of the other goals of the programme (e.g. industrial renewal through higher quality projects).

The utilisation of international peer review where introduced has been widely welcomed. Internal reviews are also perceived as important and one of the key questions should be to ensure that risks are taken, high standards set and value added created (e.g. no unnecessary overlap with Tekes or Academy of Finland programmes). To reduce conflicts of interest, the industry-academic peer review of the programmes would be best implemented as an international panel review when the programmes are proposed to Tekes for funding. Concrete best practice in quality assurance need to be mainstreamed into all SHOKs as soon as possible. Further, the appointment of international Scientific Advisory Councils / Boards as suggested by some of the evaluation panels and already implemented in Cleen could also contribute to the promotion of better quality across the programme. Such councils should have international members who have experience of scientific and industrial research. The governance and steering model on the national level should also be re-structured, ideally with international elements introduced to it. This could be combined with more systematically developed benchmarking activities.

RECOMMENDATION 4: There should be considerably more attention given to developing mechanisms to induce more cross-cutting activities within and between them, both by the national steering group and the SHOKs themselves.

This is also a question of accountability, as publicly funded SHOK activities as a whole should concentrate on activities where they currently bring most added value. In order for the SHOK concept to evolve in the direction of platform for breakthrough/game-changing research on a larger scale, other sources that are more versatile to meet the needs of a broader stakeholder groups should be introduced.

There needs to be a sharper focus on the stage of RDI in which SHOK-type funding is at its most effective, i.e. where it brings the most important benefits when compared to other funding sources, such as Tekes technology programmes. So far, most value added seems to be connected to low-RDI intensive areas and pockets of intensive industry-academia collaboration, and as such, this is where the focus should be placed, not close-to-market commercialisation activities or mainstream applied research. There should perhaps be a possibility to introduce within cross-SHOK programmes more challenge-driven themes that could be defined more in terms of the medium-term needs of international markets.

RECOMMENDATION 5. The positioning of SHOKs within the Finnish innovation system (and for that matter also within the system of funding) needs to be clarified by the RIC and the steering group, in order to ensure that SHOKs are capable of meeting the expectations and bring value added.

In order to ensure that the targets are met, there needs to be a closer collaboration of the different funding organisations and a national level dialogue and agreement should be established and enacted at the level of Research and Innovation Council. The strategic research instrument at the Academy of Finland suggested by the recent report on reorganising the public sector research institutes[92], as well as the new strategic openings financed by Tekes could both be a means of addressing the possible funding sources for break-through research within SHOKs.

The current highly domestic structure and nature of activities is in stark contrast with the proposed international ambitions. The SHOKs should be developed into bridging organisations, which could facilitate and mobilise research activities for their members on a more strategic and scientifically demanding and ambitious level. One of the areas in which the facilitation would be warmly welcomed is in respect of international activities, as well as the activities seeking to take advantage of interfaces, between sectors, networks, disciplines and importantly also between the SHOKs themselves. To start with, SHOKs should develop more deliberate approaches to involving the most ambitious and capable actors in their networks and programmes, instead of the most 'suitable' or convenient.

92 Research and Innovation Council 2012: State Research Institutes and Research Funding: proposal on comprehensive reform, Research and Innovation Council.

SHOK is clearly not the best instrument for internationalisation. There are four main dimensions or alternative definitions of internationalisation within SHOK activities, where separate recommendations are suggested:

1. Reaching international quality in research:
   The quality assurance and review processes proposed for the SHOK governance level (TEM / SHOK steering group) addresses this dimension, as do the SHOK-specific suggestions for peer review and international Quality Assurance.
2. Attracting international participation into RDI into Finland:
   This is one of the original objectives of SHOK concept as such. One of the best means of addressing this them is the **FiDiPro** funded by Academy of Finland and Tekes. Additional activities should be undertaken within programmes and this topic should be included in the monitoring system, with participation of international experts and researchers set as indicators for all SHOKs.
3. Making industries internationally competitive:
   This is also one of the original SHOK objectives and the very rationale of the SHOK as a whole. This should be addressed across the portfolio of actions and included in the KPIs and peer reviews. In many cases qualitative indicators should be introduced, as the impact can be rather lessening the blow of external changes and pressures rather than growth-inducing.
4. International comparison of the instrument itself (e.g. in the benchmarking section undertaken as part of the evaluation):
   The SHOK steering group should regularly undertake benchmarking activities with similar instruments internationally. Benchmarking should also be built into the SHOK-specific peer review practice.

RECOMMENDATION 6: The IPR question should be more effectively addressed across SHOKs and by Tekes.

Unresolved IPR issues have been identified as a major problem in utilizing some of the SHOK results. While in many cases commercialisation is not amongst the main objectives to be attained, in some of the SHOKs (e.g. FIBIC) it has been set as a goal. As common results are usable by every programme partner across the SHOKs, there seems to be very little incentive for commercialization and some promising results may even fail to be utilised. IPR issues should be resolved immediately to increase the incentive to commercialize, and to increase the commitment. The rules are clear, but need to be even more actively communicated by the SHOKs themselves and Tekes.

RECOMMENDATION 7: A funding model ensuring the effective participation of the academic community needs be introduced, in collaboration and in close dialogue by the SHOKs, national steering group and Tekes.

If the academic community is to be an equal partner, agenda definition, project selection and programme development need to include academic scientific experts. This would make the funding model of the Academy of Finland more appropriate for the scientifically more risky and ambitious parts of the SHOK programmes and

could better utilise the scientific knowledge base in the country for the benefit of industrial renewal.

One suitable way of involving the academic scientific community more fully and by so doing also supporting internationalisation would be utilising the FiDiPro system more actively within the SHOK activities. The FiDiPro should be linked more closely with the SHOKs by Tekes and Academy of Finland who fund the instrument.

RECOMMENDATION 8: In order to promote the participation of innovative SMEs (e.g. new entrants and young firms) in the programmes, more flexible contract models for these firms in SHOK projects need to be introduced by the SHOKs and Tekes.

Innovative SMEs and incumbent large firms have different needs in terms of research support and different incentives and interests in terms of intellectual property. Even though the current SHOK projects do not provide long-term research support the current length is still often too long for traditional SMEs, which need to obtain economic returns on their R&D more quickly than large firms.

One way of bringing the SME perspective more into focus is to involve them more closely in the SHOK governance system, both nationally and within individual SHOK companies.

RECOMMENDATION 9: The SHOKs should also in the future be given the possibility to pursue different strategies, as the needs and opportunities vary across industries. It is important to be transparent about the strategy selected by the individual SHOKs. It is equally important for the SHOKs to have some shared objectives and criteria.

For instance, if industrial renewal is maintained among the top targets, one should ensure that ground-breaking (basic) research is part of the effort, as well as making sure that the efforts undertaken include the best available international partners and are oriented toward international/global markets and value-chains. Utilisation and maintenance of research infrastructure should also be addressed. Also, as identified in the conclusions section, the interfaces should be carefully and thoroughly investigated. Research issues within more cross-cutting and novel areas should be identified by focusing on grand societal challenges or other cross-cutting topics, with more linkages to the public sector as major stakeholders. Synchronisation of indicators is the main responsibility of the national SHOK steering group.

RECOMMENDATION 10: The achievements of each SHOK need to be evaluated at regular intervals. This requires a logic model and a more selective and flexible monitoring system, with appropriate KPIs, to be developed.

Since the SHOKs are still quite recent creations it would seem appropriate to give them a few years to improve their procedures and performance levels. However, within at the latest 5 years after establishment of a SHOK there needs to be a smaller review process, after which a decision should be taken whether to continue or discontinue individual SHOKs, or indeed the whole form of support. The baseline provided by this evaluation needs to be complemented with a more selected set of

key indicators that are shared by all SHOKs and a smaller set of indicators that are SHOK-specific.

SHOKs, in collaboration with MEE and the national SHOK steering group should pursue towards suitable indicator frameworks and sets of KPIs to demonstrate the actions taken, outcomes reached and impacts noted. Such indicators would most likely help also SHOKs position themselves in the long run and keep this position. In the view of the evaluation, the SHOK steering group is best placed to select these indicators.

This is the main responsibility of the national SHOK steering group. The original timeframe set for the SHOKs was 5-10 years. Based on the current evaluation, the first assessment can be made on those that have already been in operation for 5 years, the others should be revisited when they have done so. One could model the timeframe for evaluation in a similar way to Academy of Finland's Centres of Excellence, where the centres are assessed in a turn, rather than each at the same time.

Appendix 1

Materials used in the analysis

Overview of SHOK
Partners with short descriptions, governance model
Quantitative data of SHOK (by RMC)
Summary of SHOK's strategy and its development (written materials + interviews)
Summary of SHOK's SRA and its development (written material + interviews)
Description of research programmes (goals, partners, status report)
Central scientific results in the programmes (as presented by SHOK)
Central business related results in the programmes (as presented by SHOK)
Preliminary assessment of SHOK's strategy & SRA (Q2 & Q5) (to be moved to final assessment below)
Preliminary assessment of SHOK's governance (Q7,Q8) (to be moved to final assessment below)
Final assessment of SHOK's strategy & SRA on the basis of preliminary analysis
Final assessment of SHOK's governance on the basis of preliminary analysis
Key results & impacts of the SHOK (Q11)
Added value of the SHOK (Q10)
Conclusions (Conclusions from matrix)

Per each SHOK

The following Strategic documents (such as the SRA and SRA updates, Tavoitteet 2011 [Objectives 2011, Finnish], Tavoitteet 2010 [Objectives 2010, Finnish], Tavoitteet 2010 Liite [Objectives 2010 Appendix, Finnish], Tavoitteet 2009 [Objectives 2009, Finnish], Annual reports.

- Annual report 2010 [English]
- Annual report 2010 to TEM [English]
- Annual report 2011 [English]
- Governance and management documents
- Programme governance reports
- SHOK-arviointikriteerit (Tekes) [SHOK evaluation criteria, Finnish]
- SHOK-rahoitusperiaatteet (Tekes) [SHOK funding principles (Tekes)]
- SHOK tutkimusohjelman toteutus (Tekes) [SHOK programme implementation (Tekes)]
- SHOK rahoitusmallit [SHOK funding models]
- Toimintaperiaatteet (2009) [Operational principles, Finnish]

Where available, also materials such as:

- Tutkimusohjelman läpivienti (Cleen, 2009) [Programme implementation (Cleen), Finnish]

- Tutkimusohjelmavalmistelu (2009) [Programme preparation, Finnish]
- Tutkimusohjelmien arviointi (2009) [Programme evaluation, Finnish]
- Members of SC and SABs
- Scientific Excellence Assessment Process [English]
- Tutkimustoiminnan laadunvarmennus [Research programme quality assurance, Finnish]

Selected results and achievements per programme
Programme plans
Background paper (15.6.2006, Tekes translation May 2012)

Other literature

IEA (2010): Clean Energy, Progress Report, IEA Input to the Clean Energy Ministerial.
Kohl, Johanna et al. (2012): Näkymiä Suomen mahdollisuuksista uusiutuvaan energiaan liittyvässä globaalissa liiketoiminnassa, TEM:N julkaisuja, kilpailukyky, 24/2012. [Perspectives into Finnish business possibilities in renewable energy field, report commissioned by the Ministry of Employment and the Economy]
Lähteenmäki-Smith, Kaisa, Halme, Kimmo & Salminen, Vesa (2012): Cleen Oy:n verkostojohtaminen ja –strateginen verkoston hallinta, [Cleen's network leadership and strategic network management], unpublished project report of 12th February 2012.
Ministry of the Employment and the Economy (2009): Pitkän aikavälin ilmasto- ja energiastrategia, Valtioneuvoston selonteko eduskunnalle 6. päivänä marraskuuta 2008. [Long-term climate and energy strategy given to the parliament 6th November 2008).
Evaluation of the Finnish National Innovation System, 2009. Full Report and Policy Report. [2 separate documents]
National-level research infrastructures. Present State and Roadmap. Ministry of Education report, 2009.
Network governance and the Finnish Strategic Centres for Science, Technology and Innovation. Tekes Review 280/2011.
The Strategic Centres for Science, Technology and Innovation (SHOKs) Cleen, FIMECC, Forestcluster and TIVIT from the Company Perspective. Technology Industries report, 2011. –Nikulainen & Tahvanainen: Towards Demand Based Innovation Policy? – The introduction of SHOKs as an innovation policy instrument. ETLA Discussion Papers 1182, 2009.
WWF report of 2012 : The Global Cleantech Innovation Index 2012

Appendix 2

List of interviewed persons

STRATEGIC LEVEL

Eva-Mari Aro, University of Turku
Mats Benner, University of Lund
Ritva Dammert, Aalto University
Liisa Ewart, Tekes
Sakari Immonen, Ministry of Employment and the Economy
Anita Lehikoinen, Ministry of Education
Petri Lehto, Ministry of Employment and the Economy
Markku Leskelä, University of Helsinki
Esko Lukkari, Kauppalehti
Markku Mattila, Academy of Finland
Yrjö Neuvo, FIMECC Board Member
Tuomas Parkkari, Research and Innovation Council
Anneli Pauli, European Commission
Marja Pulkkinen, Ministry of Education
Jari Romanainen, Tekes
Petri Rouvinen, ETLA
Aino Sallinen, University of Jyväskylä
Esko-Olavi Seppälä, previously of Science and Technology Policy Council
Ilkka Turunen, Science and Innovation Council
Raimo Väyrynen, ex-Academy of Finland

Cleen

Individual interviews:

Professor Ronnie Belmans (Katholieke Universite Leuven, SGEM SAB)
Dr. Andreas Ciroth, GreenDelta TC GmbH, MMEA SAB
Marja Englund, Fortum
Professor Mikko Hupa, Åbo Akademi
Tommy Jacobsson, Cleen CEO
Professor Lassi Linnanen (Lappeenranta University of Technology)
Professor Heli Jantunen (University of Oulu)
Jussi Palola, Helen, Chair of Cleen's "National Goals" group
Jukka-Pekka Nieminen, Neste, Chair of Cleen's "Business Objectives" Group
Professor Peter Lund, Aalto University, Chair of Cleen's "Quality and Scientific Excellence" Group
Kai Sipilä (VTT), Chair of Cleen's "Policies and Procedures" Group
Teija Lahti-Nuuttila, Tekes

Involved in the panel interviews and hearings:

Dr Tommy Jacobson, Cleen CEO
Dr Jatta Jussila-Suokas, CTO (Cleen, as the council secretary)
Erkko Fontell, Director, Fuel Cells, Wärtsilä
Measurement, Monitoring and Environmental Efficiency Assessment (MMEA):
Programme Director Tero Eklin (PhD, Development Manager, MIKES)
Technology Manager Ville Kotovirta (Senior Research Scientist, VTT)
Smart Grids and Energy Markets (SGEM):
Programme Director Jani Valtari (Research Manager, ABB)
Future Combustion Engine Power Plants (FCEP):
Programme Director Matti Kytö, Lic. Tech (Senior Scientist, VTT)
Professor Martti Larmi, Aalto University
Carbon Capture and Storage Program (CCSP):
Programme Director Antti Arasto (Senior Scientist, Team leader, VTT)
Sebastian Teir (Research Scientist, VTT)
Energy Efficient Use (EFEU):
Professor Jero Ahola, Lappeenranta University of Technology
Chairman of the Scientific Council Professor Peter Lund, Aalto University
Professor Jarmo Partanen, Lappeenranta University of Technology
Dr Ari-Matti Harri, Head of Radar and Space Technology Research Division, Finnish Meteorological Institute
Dr Kimmo Forsman (Technology Manager, ABB Ltd)
Professor Riitta Keiski (University of Oulu)

FIBIC

Individual interviews

Jan Bäckman, Academy of Finland
Jouko Yli-Kauppila, Metso Pulp and Paper
Jouko Niinimäki, University of Oulu
Kari Tuominen, Andritz Plc
Markku Karlsson, UPM-Kymmene Plc
Juha Mäkimattila, Stora Enso Plc
Suvi Nenonen, Talent-Vectia Ltd
Pauliina Tukiainen, VTT
Hannu Raitio, Forest Research Institute METLA
Jaana Sandström, Technical University of Lappeenranta
Petri Silenius, Kemira Plc
Mikko Ylhäisi, Tekes
Christine Hagström-Näsi, FIBIC
Markku Leskelä, FIBIC
Lars Gädda, FIBIC

Persons attending the evaluation panel

Christine Hagström-Näsi, CEO, FIBIC
Markku Leskelä, CTO, FIBIC
Lars Gädda, senior adviser, FIBIC
Programme manager Pauliina Tukiainen, VTT
Professor Teemu Teeri University of Helsinki
Dr. Jari Hynynen, Finnish Forest Research Centre
Dr. Kari Kovasin, Metsä Fibre Ltd
Dr. Erkki Hellén, VTT
Professor Risto Ritala, Tampere University of Technology
Programme Manager Niklas von Weymarn, VTT
Professor Ilkka Kilpeläinen, University of Helsinki
Professor Herbert Sixta, Aalto University, School of Chemical Technology
Jonni Ahlgren, Kemira Plc
Dr. Peter Richard, VTT
Heikki Vuorikoski, Montisera Ltd
Dr. Suvi Nenonen, Talent-Vectia Ltd
Professor Minna Halme, Aalto University, School of Business
Eff Programme board chair Raino Kauppinen, Stora Enso Plc
Fubio Programme board member Kari Saari, Kemira Plc
R&D Council present chair Petri Silenius Kemira Plc
R&D Council former chair Leena Paavilainen, Metla Finnish Forest research Institute
Professor and Rector emerita Aino Sallinen, University of Jyväskylä
Professor and Dean Outi Krause, Aalto University School of Chemical Technology
Juha Mäkimattila, Board Chair FIBIC
Heikki Ilvespää, UPM-Kymmene Plc

FIMECC

Individual interviews

Kimmo Forsman, ABB
Tapani Kiiski, Raute Oy
Markku Kivikoski, Tampereen teknillinen yliopisto
Risto Kuivanen, VTT
Harri Kulmala, FIMECC
Aki Mikkola, Lappeenranta University of Technology
Jussi Oijala, Kone Oyj
Patrik Rautaheimo, STX Finland Oy
Matti Sommarberg, Cargotec Oyj
Niilo Suutala, Outokumpu Oyj
Seppo Tikkanen, FIMECC
Asmo Vartiainen, Outotec Oyj

Persons involved in the evaluation panel

Involved in the panel work

Pekka Pesonen, Tekes
Harri Kulmala, FIMECC
Arto Ranta-Eskola, Rautaruukki Oyj
Risto Kuivanen, VTT
Matti Sommarberg, Cargotec
Niilo Suutala, Outokumpu,
Tapani Halme (LIGHT - Light and Efficient Solutions Program)
Seppo Tikkanen (DEMAPP) - Demanding Applications Program
Pekka Helle (FutIS - Future Industrial Services)
Matti Nallikari (Innovations & Network)
Maaria Nuutinen (UXUS - User Experience and Usability in Complex Systems)
Jarmo Söderman (ELEMET - Energy and Lifecycle Efficient Metal Processes)
Katri Valkokari (GP4Variants)
Ismo Vessonen, (EFFIMA - Energy and Life Cycle Cost Efficient Machines)
Paul H. Andersson, Tampere University of Technology

Researchers participating in hearings:

Professor Pentti Karjalainen (University of Oulu)
Professor Veli-Tapani Kuokkala (Tampere University of Technology)
Professor Kenneth Holmberg (VTT)
University Lecturer Antti Pulkkinen (Tampere University of Technology)
Professor Kim Wikström (Åbo Akademi)
Professor Timo Fabritius (University of Oulu)
Professor Kalevi Huhtala (Tampere University of Technology)

RYM

Individual interviews

Ari Ahonen, RYM Oy
Anssi Salonen, RYM Oy
Kaj Hilding Hedvall, Senaatti-kiinteistöt
Ilari Eero Emil Aho, Uponor Oy
Mika Sakari Halttunen, Halton Oy
Tuomas Antero Kaarlehto, Rapal Oy
Juha Mikael Kostiainen, Sitra
Matti Antero Kokkala, VTT
Ilkka Romo, Skanska Oy
Antti Tuomela, Newsec Oy
Ari-Pekka Manninen, Aalto yliopisto
Kirsti Lonka, Helsingin yliopisto

INTERVIEWED DURING THE PANEL WORK

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Jarmo Heinonen, Digital Eco City Oy
Kaj Hedvall, Senaatti Properties
Risto Kosonen, Halton Ltd
Johanna Kuusisto, VTT
Anssi Salonen, RYM Ltd
Matti Sivunen, Boost Brothers Ltd
Jarmo Suominen, Aalto University

SALWE

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Mika Päivärinta, GE Healthcare Finland Oy
Jukka Kirjavainen,Tieto Healthcare& Welfare Oy
Sari Tikanoja, Thermo Fisher Scientific Oy
Tuula Romppanen, Orion Diagnostica Oy
Anu Turpeinen, Valio Oy
Antti Ahonen, Elekta Oy
Kimmo Kontula, University of Helsinki

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Mika Päivärinta, GE Healthcare Finland Oy
Bill Östman, Thermo Fisher Scientific Oy
Anu Turpeinen, Valio Oy
Sari Tikanoja, Thermo Fisher Scientific Oy
Kari Aranko, Finnish Red Cross Blood Service
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Hanna Viertiö-Oja, GE Healthcare Finland Oy
Jouko Haapalahti, Orion Diagnostica Oy

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Reijo Paajanen, CEO
Kari Tilli, TIVIT/Tekes

Programme directors:
Wilhelm Rauss (Ericsson), Internet of Things
Eskoensio Pipatti (Sanoma Entertainment), Next Media
Jukka Ahtikari, Data to intelligence

Industries
Jukka-Petri Sahlberg, HiQ Finland
Atso Haapaniemi, HiQ Finland
Jyrki Koskinen, IBM Finland
Juha Hulkkonen, IBM Finland
Anssi Vanjoki, Individual multi-contributor
Tuomas Syrjänen, Futurice

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Auer Timo, TeliaSonera
Hakalahti Hannu, Elektrobit
Heistermann Sven, Sanoma
Huopaniemi Jyri, Nokia
Jokinen Jukka, Technopolis & Technopolis Ventures
Kanner Janne, CSC
Koljonen Tatu, VTT (deputy chair)
Mäkinen Pasi, Culminatum Innovation
Paakki Jukka, Helsinki University
Pentikäinen Kimmo, Elisa
Raisamo Roope, Tampere university
Salo Jukka, Nokia Siemens Networks
Vuopionperä Raimo, Ericsson, Chair of board

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Jukka Ahtikari, Focus Area Director (Logica)
Janne Järvinen, Focus Area Director (F-Secure)
Roope Takala, Focus Area Director (Nokia)

Wilhelm Rauss, Focus Area Director (Ericsson)
Eskoensio Pipatti, Focus Area Director (Sanoma Entertainment)
Pekka Abrahamsson, CSW (University of Helsinki)
Petri Myllymäki, D2I, University of Helsinki/Helsinki Institute for Information Technology
Juha-Pekka Soininen, DIEM (VTT)
Sasu Tarkoma, IoT (University of Helsinki)
Nils Enlund, NM (Kungliga Tekniska Högskolan)
Ilkka Niemelä, Aalto University, Vice President
Raimo Vuopionperä, Chairperson of the TIVIT Board (L.M. Ericsson)
Hannu Hakalahti, Board Member (Elektrobit)

Appendix 3

Evaluation panel members

CLEEN – INTERNATIONAL PANEL MEMBERS

Margot Weijnen, Professor of Process and Energy Systems Engineering, Delft University of Technology, the Netherlands (panel chair)
Fraser Armstrong, Professor of Chemistry and a Fellow of St John's College, Oxford, UK
Peter Pearson, Director of the Low Carbon Research Institute of Wales, Cardiff University, UK.
Bengt Johansson, Professor in Internal Combustion Engines, Lund University, Sweden
Jyrki Kettunen, Da Wo Ltd, Finland

FIBIC - INTERNATIONAL EVALUATION PANEL MEMBERS

Professor Hans Theliander, Chalmers University, Sweden; Chair
Professor Torbjörn Fagerström, Swedish University of Agricultural Sciences, Sweden
Professor Arthur Ragauskas, Georgia Institute of Technology, Georgia, USA
Professor Gail Taylor, University of Southampton, Great Britain
Professor Patrice Mangin, University of Quebec, Canada

FIMECC – INTERNATIONAL EVALUATION PANEL MEMBERS

Jan-Gunnar Persson, Professor em in Machine Design, KTH Royal Institute of Technology, Sweden
F.J.M van Houten, Chair of Design Engineering at the faculty of Engineering Technology, University of Twente, the Netherlands
Herbert Birkhofer, Prof. Dr. h. c. Dr.-Ing., Product Development and Machine Element, Technical University Darmstadt, Germany
Panos Tsakiropoulos, Professor of Metallurgy and POSCO Chair in Iron and Steel Technology University of Sheffield, UK
Ahti Salo, Professor and Vice Head of Department, Systems Analysis Laboratory, Aalto university, Finland

RYM - INTERNATIONAL EVALUATION PANEL MEMBERS

Sture Herbert Blomgren (Panel Chair), previously Director General for Research Council Formas, Chaiman for the virtual University of Building Sciences (Cooperation between KTH, Chalmers, Lund and Luleå Technical Universities in Civil Engineering), Sweden
Stuart Green, Professor of construction management and Head of the School of Construction Management and Engineering at the University of Reading., UK
Fariborz Haghighat, Professor at the Department of Building, Civil and Environmental Engineering – Concordia University, Canada.

Johannes (Joop) I.M. Halman, Professor in Innovation Processes at the University of Twente, the Netherlands.
H. L. S. C. Hens, Professor Emeritus, Department of Physics, KULeuven

SalWe - INTERNATIONAL EVALUATION PANEL

Jussi Huttunen, Professor, Director General (emer.) of the National Public Health Institute, Finland, Chair of the Panel
Robert Istepanian, Professor of Data Communications for Healthcare, Kingston University, UK
Kay-Tee Khaw, Professor of Clinical Gerontology, University of Cambridge, UK
Wim Saris, Professor of Nutrition, Maastricht University, The Netherlands
Michael Sendtner, Professor of Neurobiology, University of Würzburg, Germany

TIVIT - INTERNATIONAL EVALUATION PANEL

João Schwarz DaSilva, Research Fellow with the Center for Interdisciplinary Research on Security, Reliability and Trust, University of Luxembourg, Luxembourg
Schahram Dustdar, Professor of Computer Science (Informatics), Vienna University of Technology, Austria
Serge Fdida, Professor at Network and Performace Group, LIP6 Laboratory, University Pierre et Marie Curie, France
Graham Vickery, Independent Consultant, France (Panel chair)
Pekka Ylä-Anttila, Research Advisor, Research Institute for Finnish Economy – ETLA, Finland

Appendix 4

List of acronyms

3GPP	the 3rd Generation Partnership Project
ACM	Association of Computing Machinery
ArboraNano	Canadian Forest NanoProducts Network
ARTEMIS	ARTEMIS Embedded Computing Systems (JTI)
B.Sc	Bachelor In Science
BL-NCE	Business-Led Networks of Centres of Excellence
BMWV	Bundesministerium für Wissenschaft und Verkehr (Austria) = Ministry of research and transport
BoD	Board of Directors
BoP	Bottom of the Pyramid
CCSP	Carbon Capture and Storage Program
CDF	Christian Doppler Research Association
CECR	Centres of Excellence for Commercialization and Research
CFO	Chief Financial Officer
CTO	Chief Technical Officer
CIHR	The Canadian Institutes of Health Research
CleanSky	Aeronautics and Air Transport (JTI)
Cleen	Cluster for Enery and Environment
COMET	Competence Centres for Excellent Technologies (Austria)
CONCORD	Facilitation and Support action for the EU-funded Future Internet Public-Private Partnerships (FI PPP) programme
COPD	Chronic Obstructive Pulmonary Disease
CQDM	Quebec Consortium for Drug Discovery
CRP	C-Reactive Proteine
CSW	Cloud Software
CT	Cooperative Traffic
D2I	Data to intelligence
D2S	Data to Security
DEMAPP	Demanding applications
DESY	Distributed Energy Systems
DIEM	Devices and Interoperability Ecosystem
DPS	Data-processing system
DS	Digital services
EEG	electroencephalography
EFEU	Efficient Energy Use
EFF FIBRE	Value through intensive and efficient fibre supply
EFFIMA	Energy and life-cycle efficient machines
EFFNET	Efficient Networking towards Novel Products and Processes

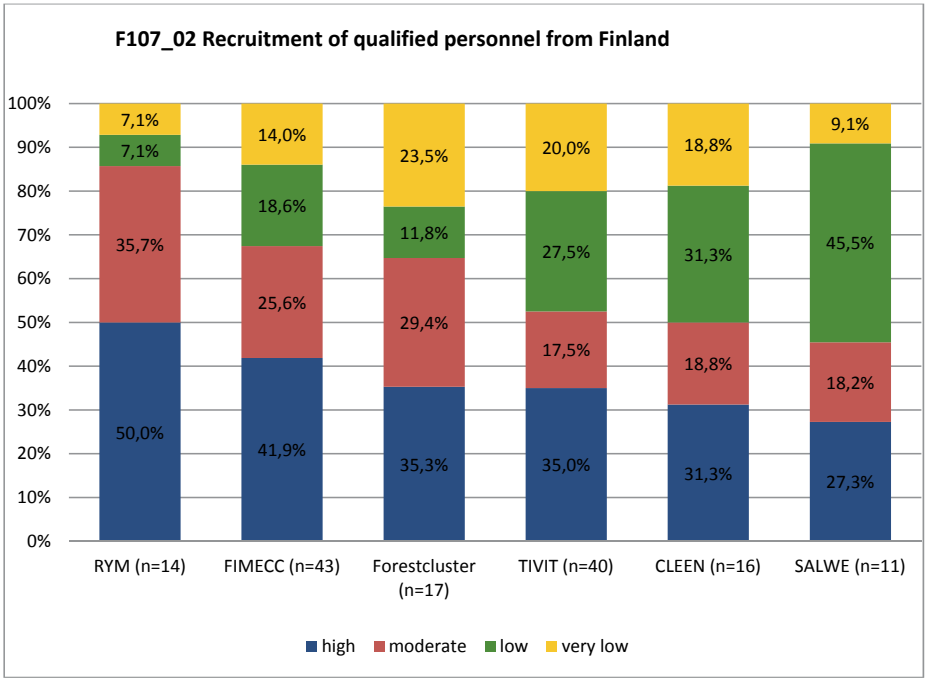
EffTech	Resource- and energy-efficient technologies
EG	Expert Group
EIT	European Institute of Technology
ELEMET	Energy and life-cycle efficient metal processes
ENIAC	Nanoelectronics Technologies 2020 (JTI)
EnYm	Energia ja ympäristö = Energy and Environment Strategic Centre for Science, Technology and Innovation
ERC	European Research InCouncil
ETLA	Elinkeinoelämän Tutkimuslaitos = the Research Institute of the Finnish Economy
EU	European Union
EUE	Energizing Urban Ecosystems
FAD	Focus Area Director
FAMBSI	Finnish Association of Mechanical Building Services Industries
FCEP	Future Combustion Engine Power Plant
FCH	FCH Hydrogen and Fuel Cells Initiative (JTI)
FFG	Austrian Research Promotion Agency
FI	Future Internet
FI PPP	Future Internet Public Private Partnership
FIBIC	Finnish Bioeconomy Cluster
FiDiPro	Finnish Distinguished Professor
FoCus	Customer solutions for the future
FORGE	Development laboratory for digital services (within TIVIT)
FP	Framework Programme
FS	Flexible services
FTO	Freedom to operate
FuBio	Future Biorefinery
FutIS	Future Industrial Services
FWF	Austrian Science Fund
GARDN	Green Aviation Research and Development Network
GIGA	Converging Networks Programme (Tekes Programme)
GP4VARIANTS	Global processes for high variety production
I&N	Innovations and Network
ICT	Information and Communication Technology
ICU	Intensive Care Unit
IE	Indoor environment
IEEE	The Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IMI	Innovative Medicines Initiative (JTI)
IMO	Intelligent Monitoring of Health and Wellbeing
INPRED	Intelligent travel time prediction for demand responsive transport
IoT	Internet of Things

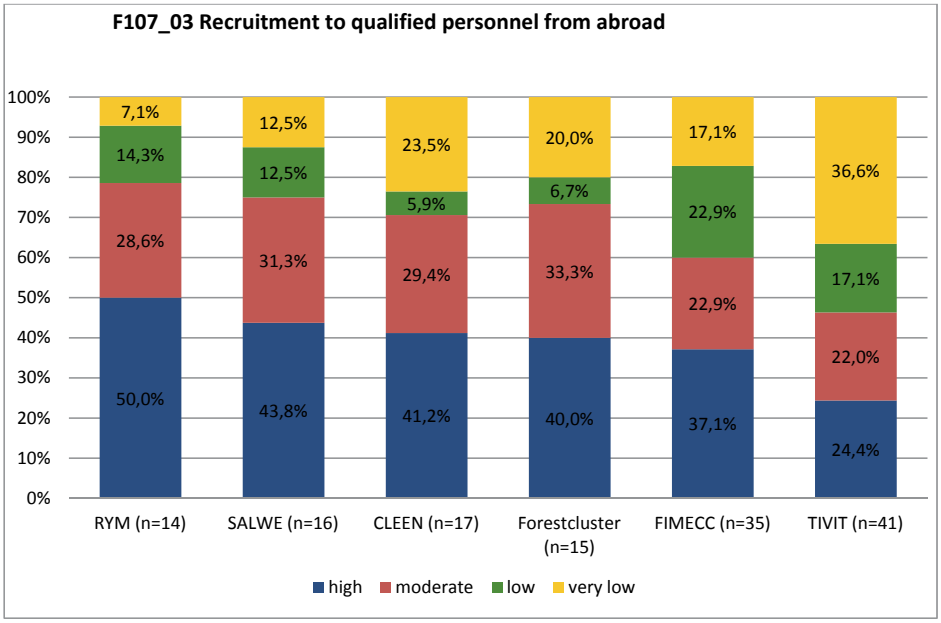
IPR	Intellectual Property Rights
IRDI	Industrial Research and Development Internships
IRTF	Internet Research Task Force
ISI	Institute for Scientific Information
JTIs	Joint Technology Initiative
KCL	Finnish Pulp and Paper Research Institute
KPIs	Key performance indicators
L.sc.	Licentiate in Science
LIGHT	Light and efficient solutions
LUT	Lappeenranta University of Technology
M.Sc	Master in Science
MEE	Ministry of Employment and the Economy
MEKO-SHOK	Metalli- ja koneteollisuuden SHOK = embryo stage of FIMECC
Metla	Metsätutkimuslaitos = the Finnish Forest Research Institute
MMEA	Measurement, Monitoring and Environmental Efficiency Assessment
MRI_MEG	Magnetic Resonance Imaging_Magnetoencephalography
MTT	MTT Agrifood Research Finland
NCE	Canadian Networks of Centres of Excellence
NCERC	Natural Sciences and Engineering Research Council
NFC	Near Field Communication
NIALM	Non-intrusive application load monitoring
NM	Next Media
NRA	National Research Agenda
NSERC	Natural Sciences and Engineering Research Council
OECD	The Organisation for Economic Co-operation and Development
OSKE	Osaamiskeskus = Centre of Expertise
PGA	Programme General Assembly
PhD	Doctor of Philosophy
PI	Principal Investigator
PM	Programme Manager
PMC	Programme Management Committee
POCT	Point-of-care-testing
PRE	Process Re-engineering
PSG	Programme Steering Group
R&D	Research and Development
RAKLI	Asunto-, toimitila- ja rakennuttajaliitto = Finnish Association of Building Owners and Construction Clients
RAMI	Radical Market Innovations
RDI	Reseach, Development and Innovation
RFID	Research Forum in Identifying Things (within TIVIT's programme Internet of Things)
RIC	Research and Innovation Council

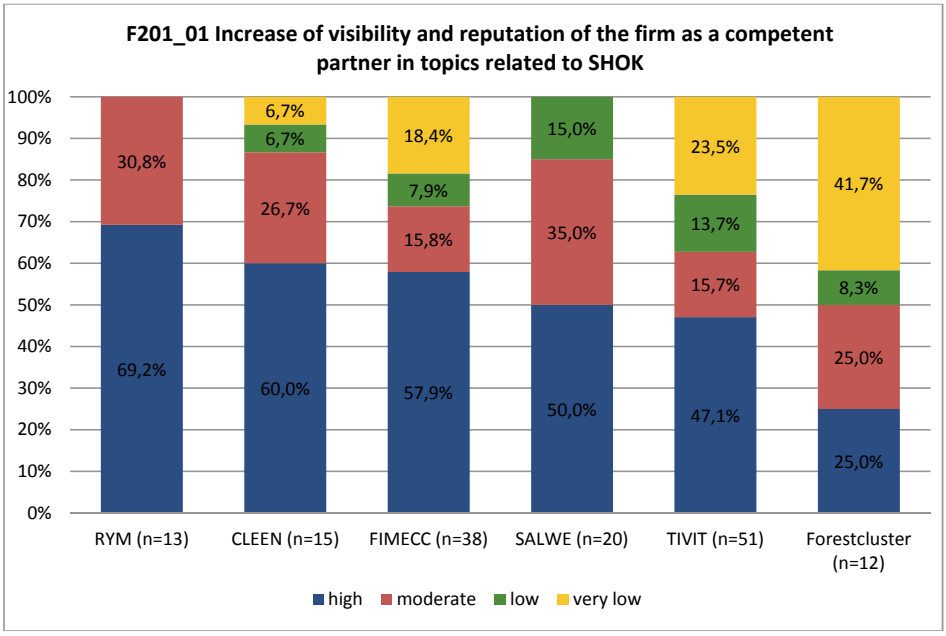
RIL	Suomen Rakennusinsinöörien liitto = Finnish Association of Civil Engineers
ROI	Return on Investment
RT	Rakennusteollisuus = Confederation of Finnish Construction Industries RT
RWTH	Rheinisch-Westfaelische Technische Hochschule Aachen, Technical Univeristy of Aachen
RYM	Rakennetun ympäristön strategisen huippuosaamisen keskittymä = Built Environment Innovations
SAB	Scientific advisory board
SalWe	Strategic Centre for Health and Well-being
SCW	Leading Edge Cluster Competition
SGEM	Smart Grids and Energy Market
SHOK	Strategisen Huippuosaamisen Keskittymät (FI) = Strategic Centres for Science, Technology and Innovation (EN)
SITRA	Suomen Itsenäisyyden Juhlarahasto = Finnish Innovation Fund
SPR	Strategic Platform Research
SRA	Strategic Research Agenda
SSHRC	Social Sciences and Humanities Research Council
STEPS	Sustainable Technologies for Energy Production Systems
TEK	Tekniikan Akateemiset = Academic Engineers and Architects of Finland
Tekes	Teknologian ja innovaatioiden kehittämiskeskus = the Finnish Funding Agency for Technology and Innovation
TIVIT	Tieto- ja Viestintäteollisuuden Tutkimus TIVIT Oy (FI) = translation of the Strategic Centre for Science, Technology and Innovation in the Field of ICT.
TUT	Tampere University of Technology
UXUS	User Experience and usability in complex systems
WG	Working group on centers of expertise
WP	Working Package
VTT	Valtion Teknillinen Tutkimuskeskus = Technical Research Centre of Finland

Appendix 5

1 Outputs and results (company respondents)






F201_01 Increase of visibility and reputation of the firm as a competent partner in topics related to SHOK
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80%
70%
60%
50%
40%
30%
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10%
0%
30,8%
69,2%
6,7%
6,7%
26,7%
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18,4%
7,9%
15,8%
57,9%
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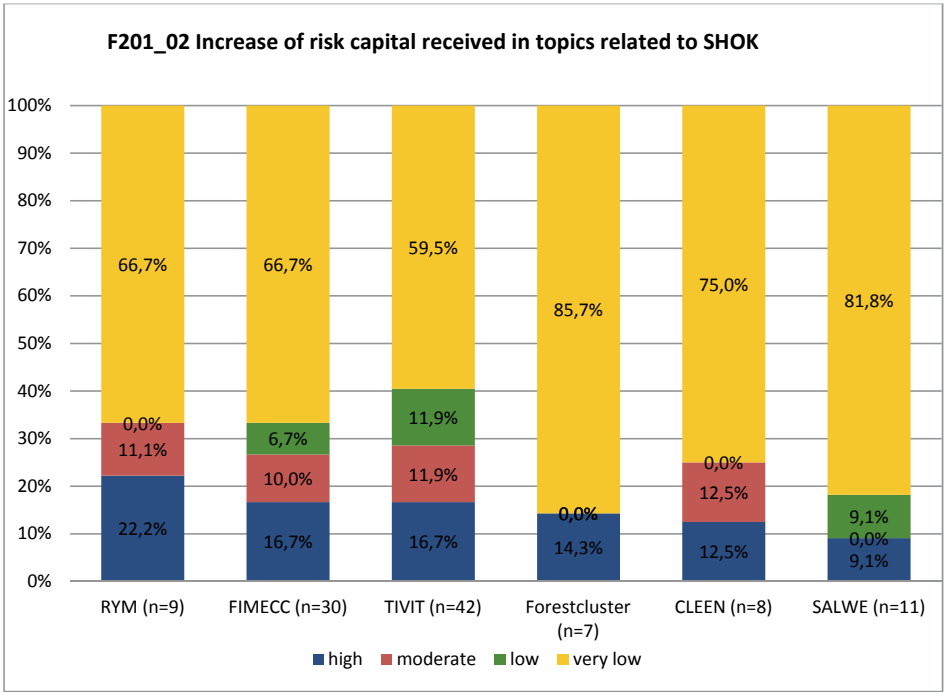
35,0%
50,0%
23,5%
13,7%
15,7%
47,1%
41,7%
8,3%
25,0%
25,0%
RYM (n=13)
CLEEN (n=15)
FIMECC (n=38)
SALWE (n=20)
TIVIT (n=51)
Forestcluster (n=12)
high
moderate
low
very low


F201_02 Increase of risk capital received in topics related to SHOK
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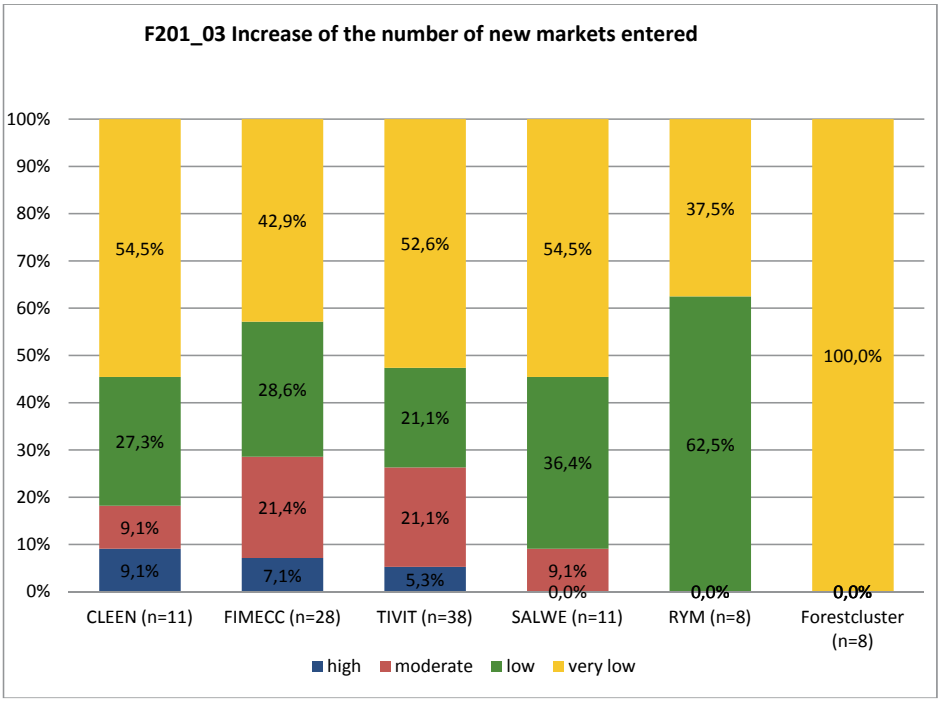
70%
60%
50%
40%
30%
20%
10%
0%
66,7%
0,0%
11,1%
22,2%
66,7%
6,7%
10,0%
16,7%
59,5%
11,9%
11,9%
16,7%
85,7%
0,0%
14,3%
75,0%
0,0%
12,5%
12,5%
81,8%
9,1%
0,0%
9,1%
RYM (n=9)
FIMECC (n=30)
TIVIT (n=42)
Forestcluster (n=7)
CLEEN (n=8)
SALWE (n=11)
high
moderate
low
very low


F201_03 Increase of the number of new markets entered
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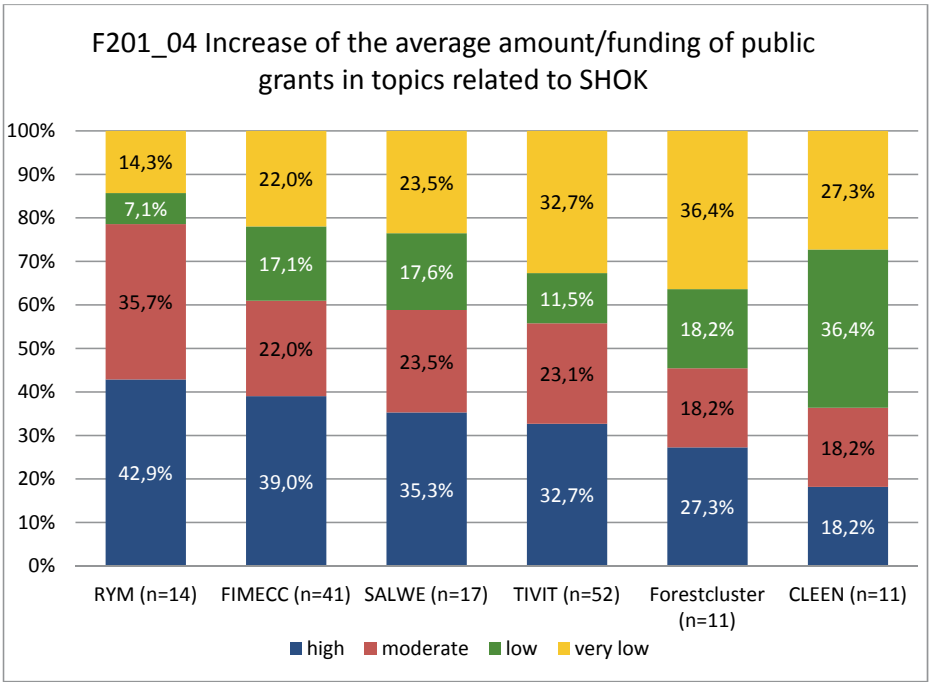
80%
70%
60%
50%
40%
30%
20%
10%
0%
54,5%
27,3%
9,1%
9,1%
42,9%
28,6%
21,4%
7,1%
52,6%
21,1%
21,1%
5,3%
54,5%
36,4%
9,1%
0,0%
37,5%
62,5%
0,0%
100,0%
0,0%
CLEEN (n=11)
FIMECC (n=28)
TIVIT (n=38)
SALWE (n=11)
RYM (n=8)
Forestcluster (n=8)
high
moderate
low
very low


F201_04 Increase of the average amount/funding of public grants in topics related to SHOK
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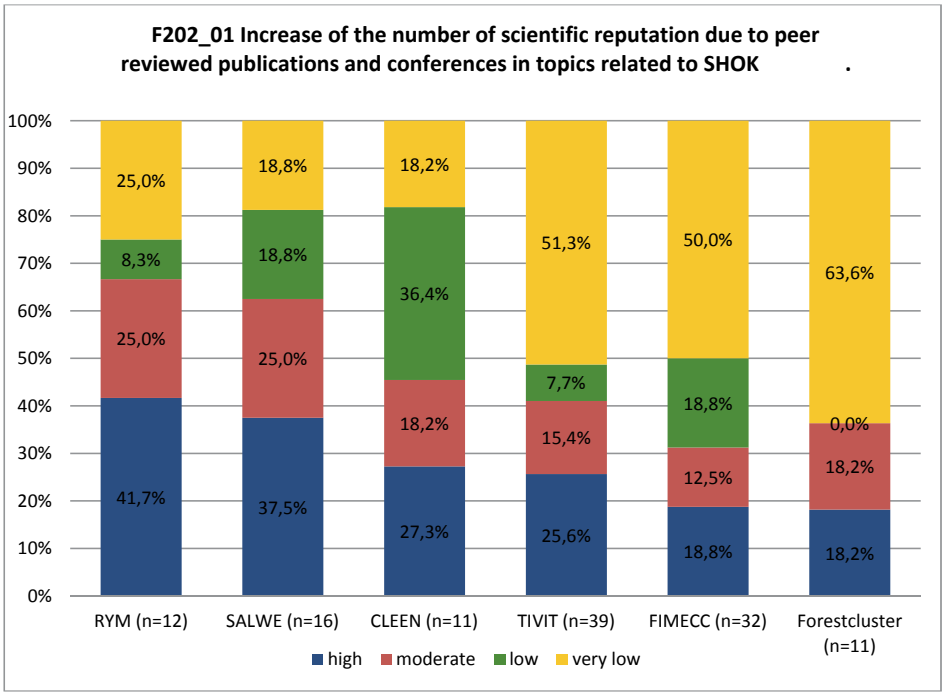
70%
60%
50%
40%
30%
20%
10%
0%
14,3%
7,1%
35,7%
42,9%
22,0%
17,1%
22,0%
39,0%
23,5%
17,6%
23,5%
35,3%
32,7%
11,5%
23,1%
32,7%
36,4%
18,2%
18,2%
27,3%
27,3%
36,4%
18,2%
18,2%
RYM (n=14)
FIMECC (n=41)
SALWE (n=17)
TIVIT (n=52)
Forestcluster (n=11)
CLEEN (n=11)
high
moderate
low
very low


F202_01 Increase of the number of scientific reputation due to peer reviewed publications and conferences in topics related to SHOK .
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60%
50%
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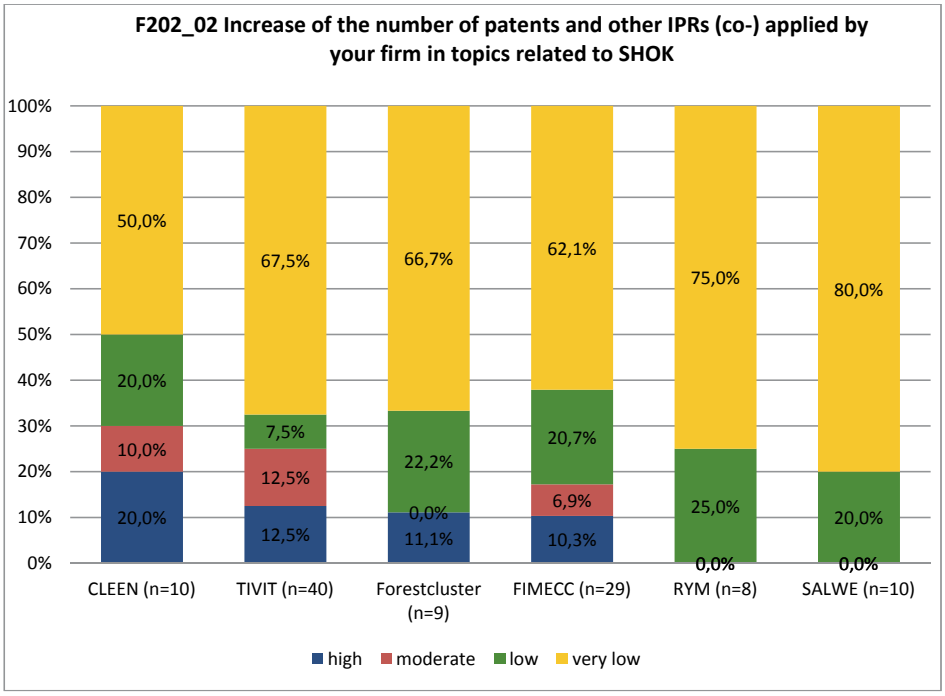
20%
10%
0%
25,0%
8,3%
25,0%
41,7%
18,8%
18,8%
25,0%
37,5%
18,2%
36,4%
18,2%
27,3%
51,3%
7,7%
15,4%
25,6%
50,0%
18,8%
12,5%
18,8%
63,6%
0,0%
18,2%
18,2%
RYM (n=12)
SALWE (n=16)
CLEEN (n=11)
TIVIT (n=39)
FIMECC (n=32)
Forestcluster (n=11)
high
moderate
low
very low


F202_02 Increase of the number of patents and other IPRs (co-) applied by your firm in topics related to SHOK
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70%
60%
50%
40%
30%
20%
10%
0%
50,0%
20,0%
10,0%
20,0%
67,5%
7,5%
12,5%
12,5%
66,7%
22,2%
0,0%
11,1%
62,1%
20,7%
6,9%
10,3%
75,0%
25,0%
0,0%
80,0%
20,0%
0,0%
CLEEN (n=10)
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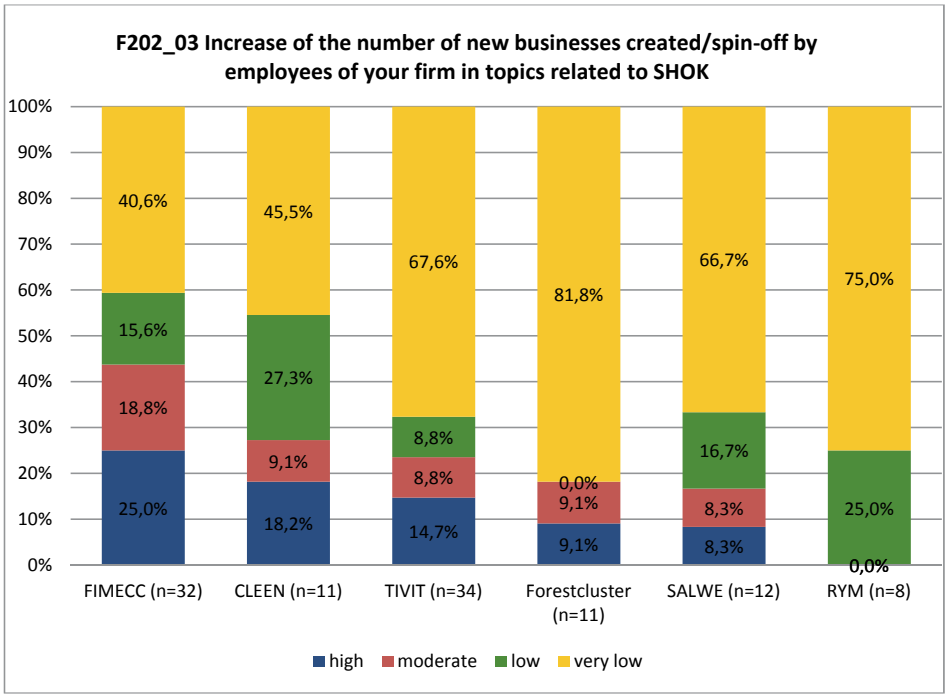
Forestcluster (n=9)
FIMECC (n=29)
RYM (n=8)
SALWE (n=10)
high
moderate
low
very low


F202_03 Increase of the number of new businesses created/spin-off by employees of your firm in topics related to SHOK
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50%
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30%
20%
10%
0%
40,6%
15,6%
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45,5%
27,3%
9,1%
18,2%
67,6%
8,8%
8,8%
14,7%
81,8%
0,0%
9,1%
9,1%
66,7%
16,7%
8,3%
8,3%
75,0%
25,0%
0,0%
FIMECC (n=32)
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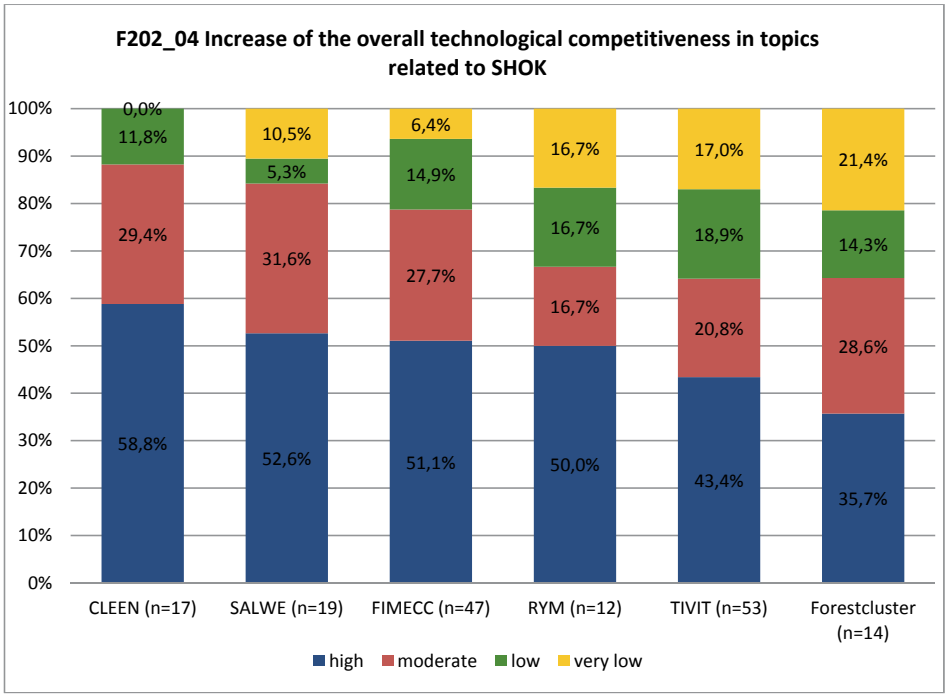
Forestcluster (n=11)
SALWE (n=12)
RYM (n=8)
high
moderate
low
very low


F202_04 Increase of the overall technological competitiveness in topics related to SHOK
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0%
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11,8%
29,4%
58,8%
10,5%
5,3%
31,6%
52,6%
6,4%
14,9%
27,7%
51,1%
16,7%
16,7%
16,7%
50,0%
17,0%
18,9%
20,8%
43,4%
21,4%
14,3%
28,6%
35,7%
CLEEN (n=17)
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RYM (n=12)
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Forestcluster (n=14)
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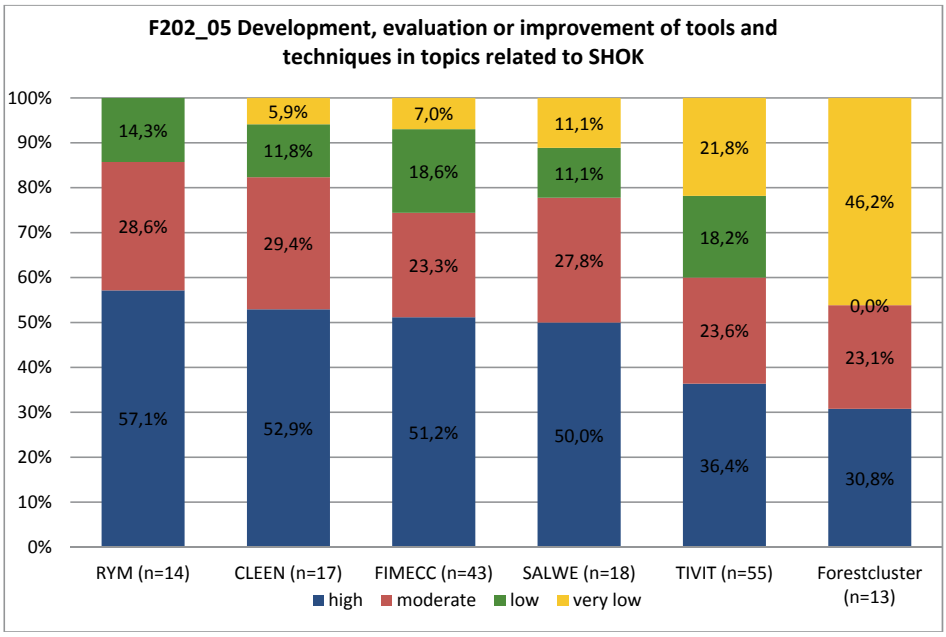
moderate
low
very low


F202_05 Development, evaluation or improvement of tools and techniques in topics related to SHOK
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14,3%
28,6%
57,1%
5,9%
11,8%
29,4%
52,9%
7,0%
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23,3%
51,2%
11,1%
11,1%
27,8%
50,0%
21,8%
18,2%
23,6%
36,4%
46,2%
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23,1%
30,8%
RYM (n=14)
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low
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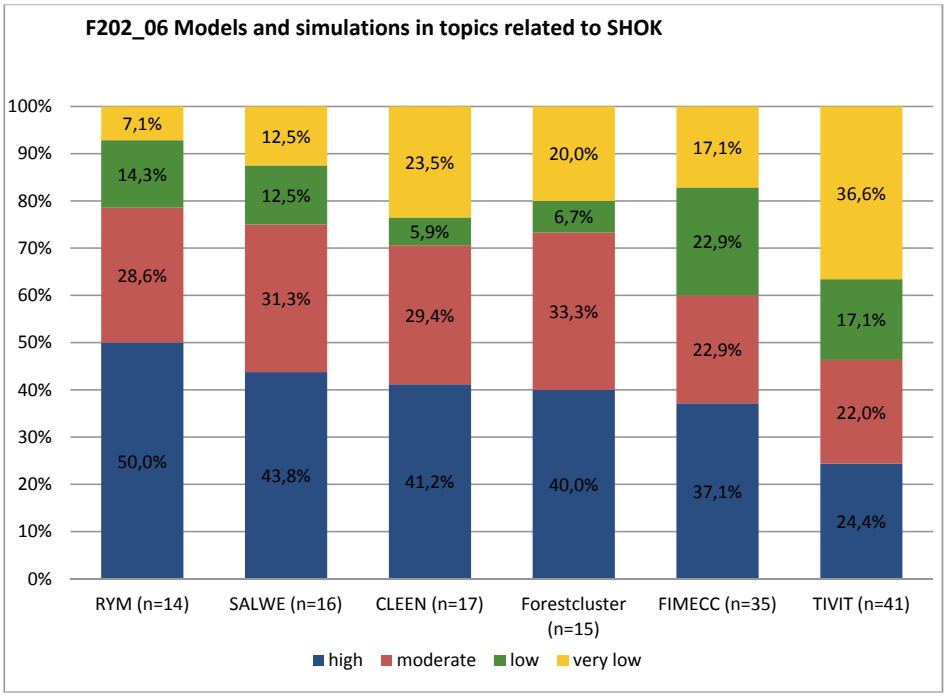
F202_06 Models and simulations in topics related to SHOK
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12,5%
31,3%
43,8%
23,5%
5,9%
29,4%
41,2%
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6,7%
33,3%
40,0%
17,1%
22,9%
22,9%
37,1%
36,6%
17,1%
22,0%
24,4%
RYM (n=14)
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Forestcluster (n=15)
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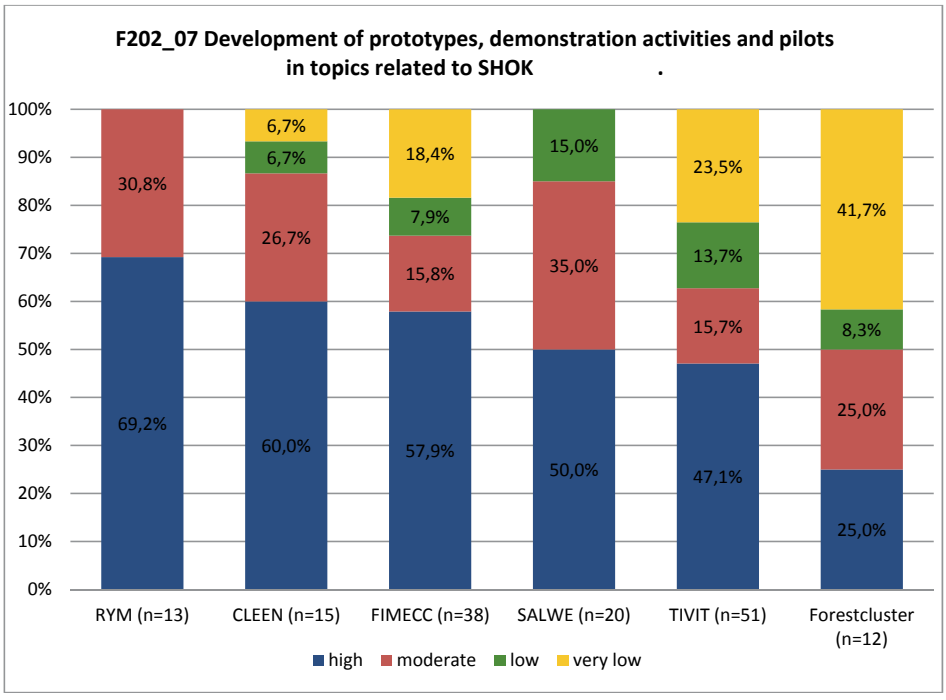
moderate
low
very low


F202_07 Development of prototypes, demonstration activities and pilots in topics related to SHOK .
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50%
40%
30%
20%
10%
0%
30,8%
69,2%
6,7%
6,7%
26,7%
60,0%
18,4%
7,9%
15,8%
57,9%
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TIVIT (n=51)
Forestcluster (n=12)
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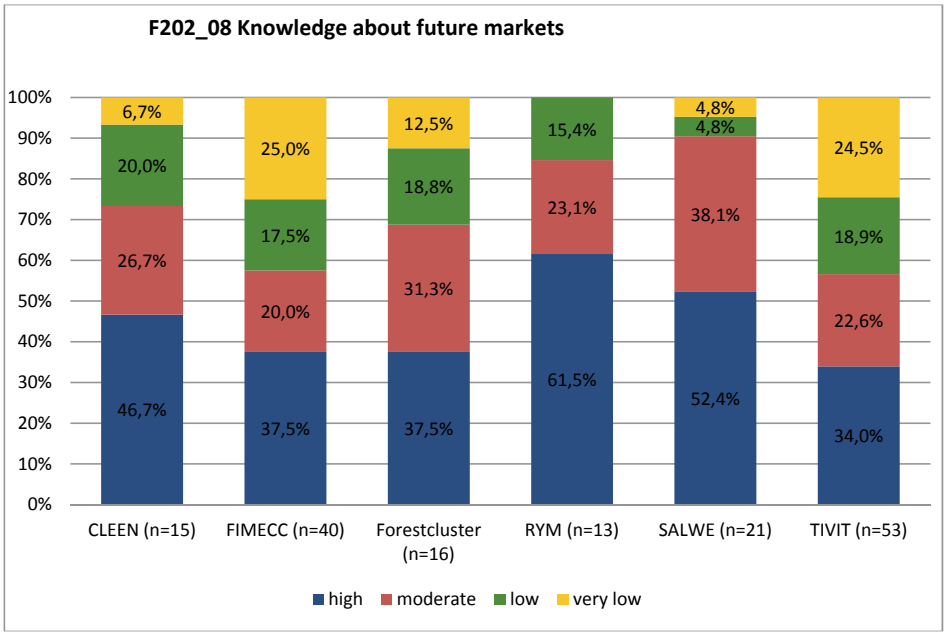
moderate
low
very low


F202_08 Knowledge about future markets
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50%
40%
30%
20%
10%
0%
6,7%
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26,7%
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23,1%
61,5%
4,8%
4,8%
38,1%
52,4%
24,5%
18,9%
22,6%
34,0%
CLEEN (n=15)
FIMECC (n=40)
Forestcluster (n=16)
RYM (n=13)
SALWE (n=21)
TIVIT (n=53)
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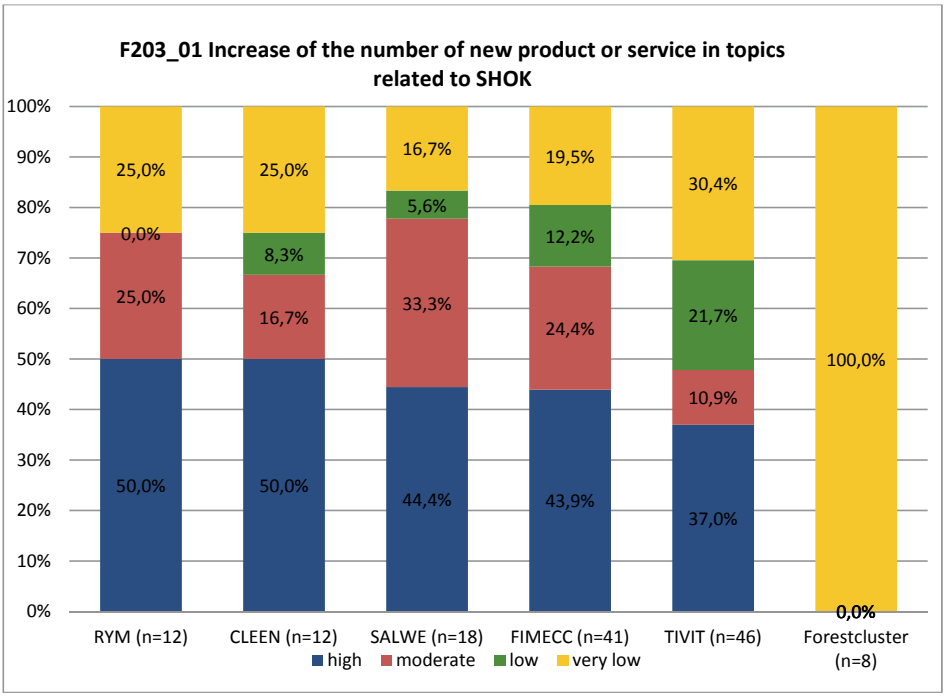
moderate
low
very low


F203_01 Increase of the number of new product or service in topics related to SHOK
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30%
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0%
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25,0%
8,3%
16,7%
50,0%
16,7%
5,6%
33,3%
44,4%
19,5%
12,2%
24,4%
43,9%
30,4%
21,7%
10,9%
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0,0%
RYM (n=12)
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FIMECC (n=41)
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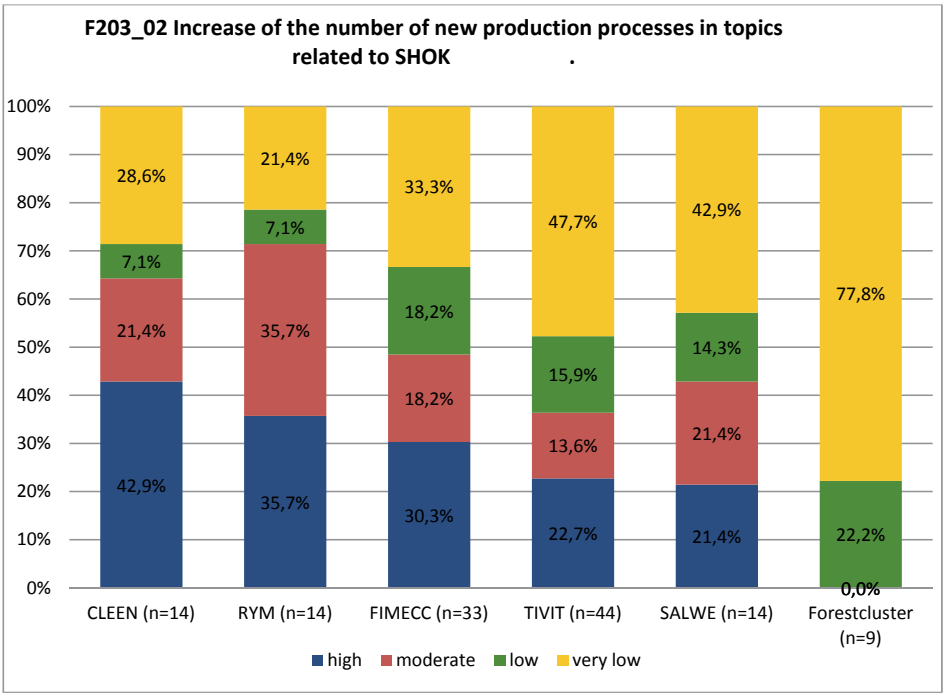
Forestcluster (n=8)
high
moderate
low
very low


F203_02 Increase of the number of new production processes in topics related to SHOK .
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60%
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40%
30%
20%
10%
0%
28,6%
7,1%
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35,7%
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18,2%
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47,7%
15,9%
13,6%
22,7%
42,9%
14,3%
21,4%
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22,2%
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CLEEN (n=14)
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FIMECC (n=33)
TIVIT (n=44)
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Forestcluster (n=9)
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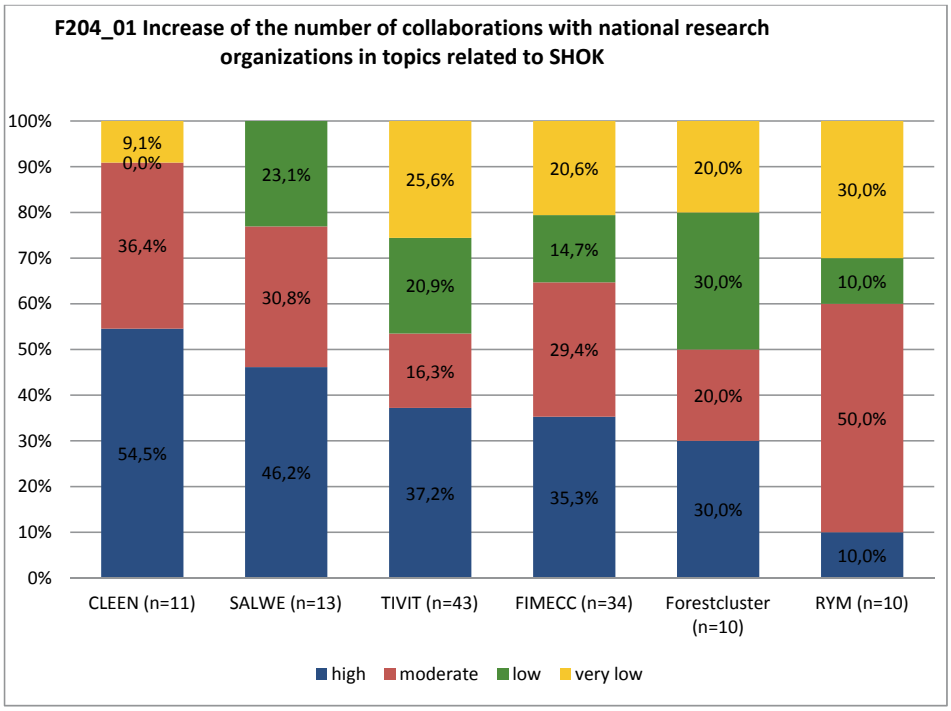
moderate
low
very low


F204_01 Increase of the number of collaborations with national research organizations in topics related to SHOK
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9,1%
0,0%
36,4%
54,5%
23,1%
30,8%
46,2%
25,6%
20,9%
16,3%
37,2%
20,6%
14,7%
29,4%
35,3%
20,0%
30,0%
20,0%
30,0%
10,0%
50,0%
10,0%
CLEEN (n=11)
SALWE (n=13)
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FIMECC (n=34)
Forestcluster (n=10)
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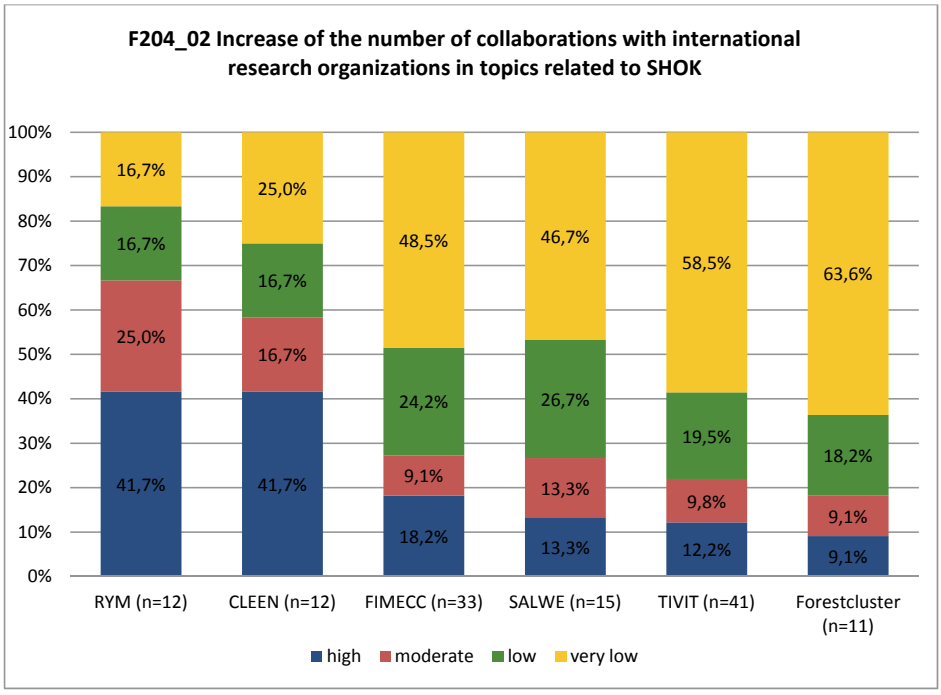
high
moderate
low
very low


F204_02 Increase of the number of collaborations with international research organizations in topics related to SHOK
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90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
16,7%
16,7%
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41,7%
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16,7%
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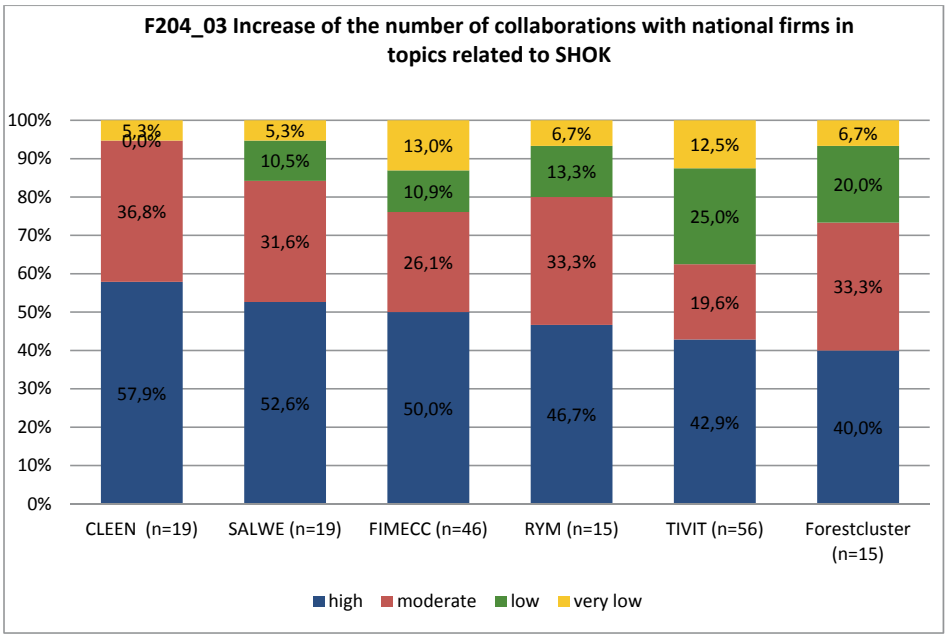
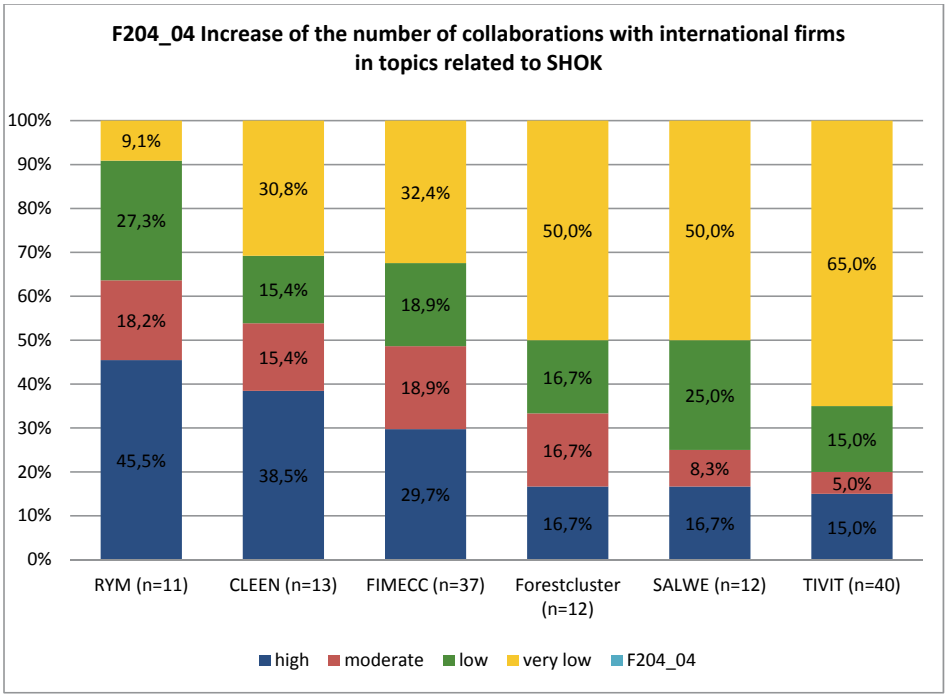
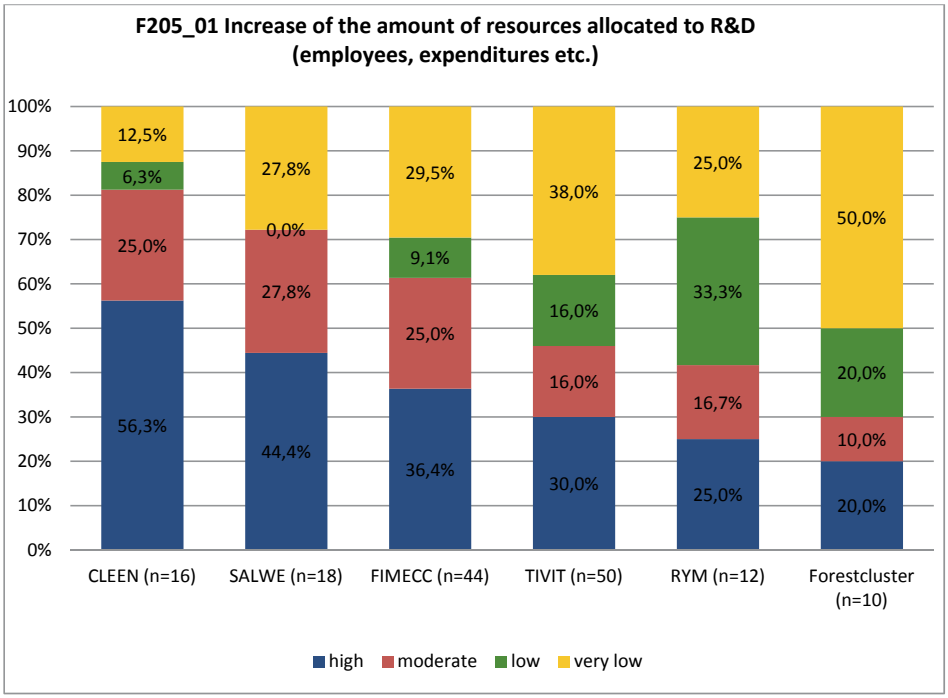
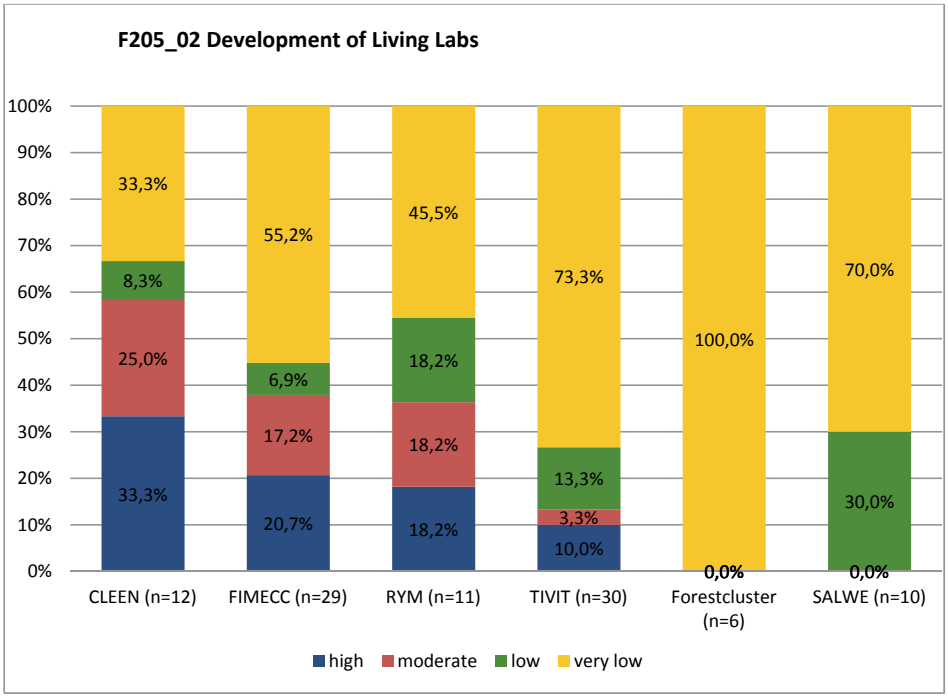
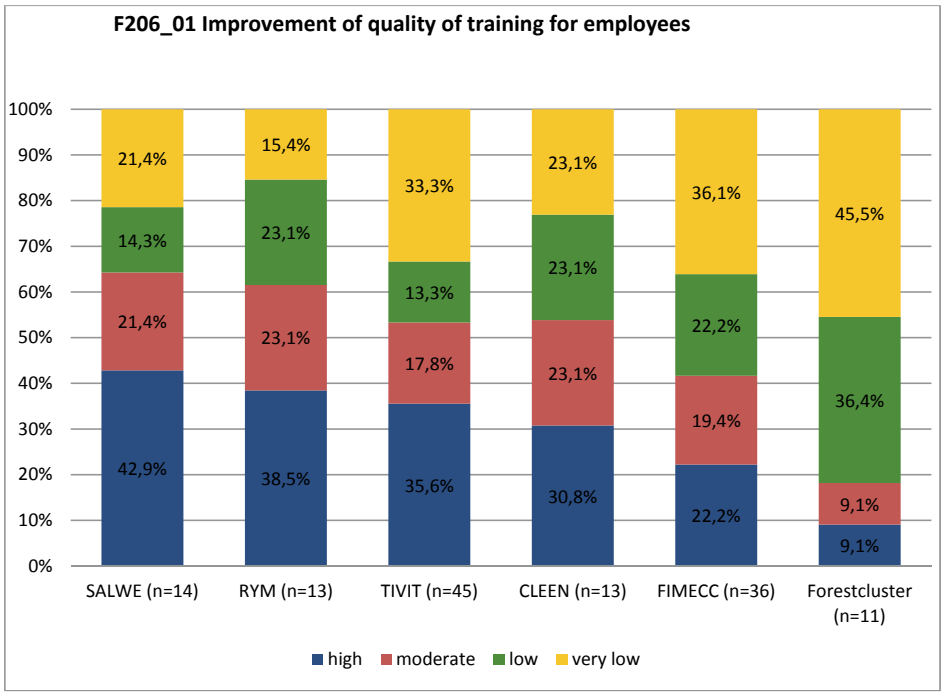
41,7%
48,5%
24,2%
9,1%
18,2%
46,7%
26,7%
13,3%
13,3%
58,5%
19,5%
9,8%
12,2%
63,6%
18,2%
9,1%
9,1%
RYM (n=12)
CLEEN (n=12)
FIMECC (n=33)
SALWE (n=15)
TIVIT (n=41)
Forestcluster (n=11)
high
moderate
low
very low

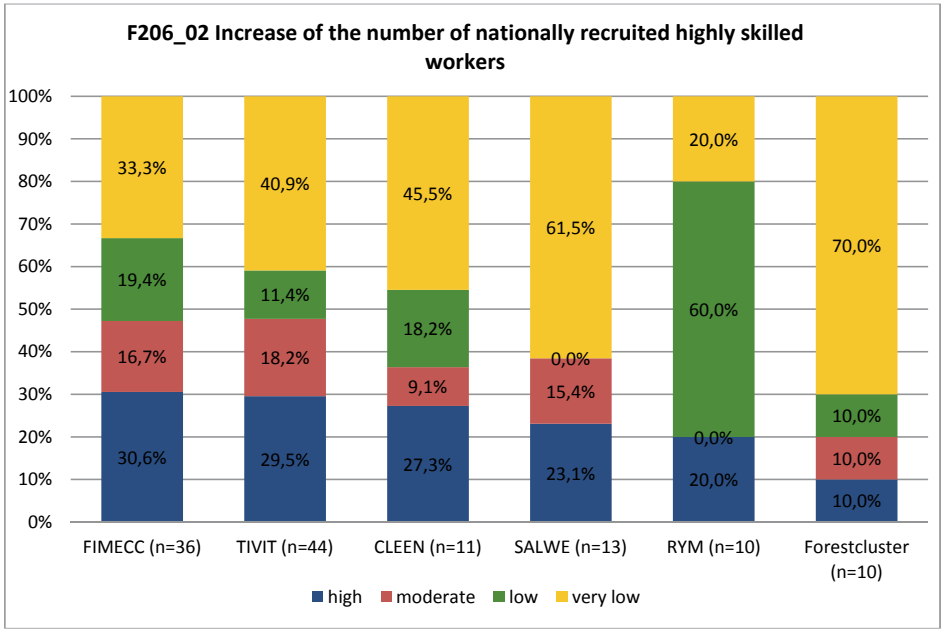

F204_03 Increase of the number of collaborations with national firms in topics related to SHOK
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5,3%
0,0%
36,8%
57,9%
5,3%
10,5%
31,6%
52,6%
13,0%
10,9%
26,1%
50,0%
6,7%
13,3%
33,3%
46,7%
12,5%
25,0%
19,6%
42,9%
6,7%
20,0%
33,3%
40,0%
CLEEN (n=19)
SALWE (n=19)
FIMECC (n=46)
RYM (n=15)
TIVIT (n=56)
Forestcluster (n=15)
high
moderate
low
very low

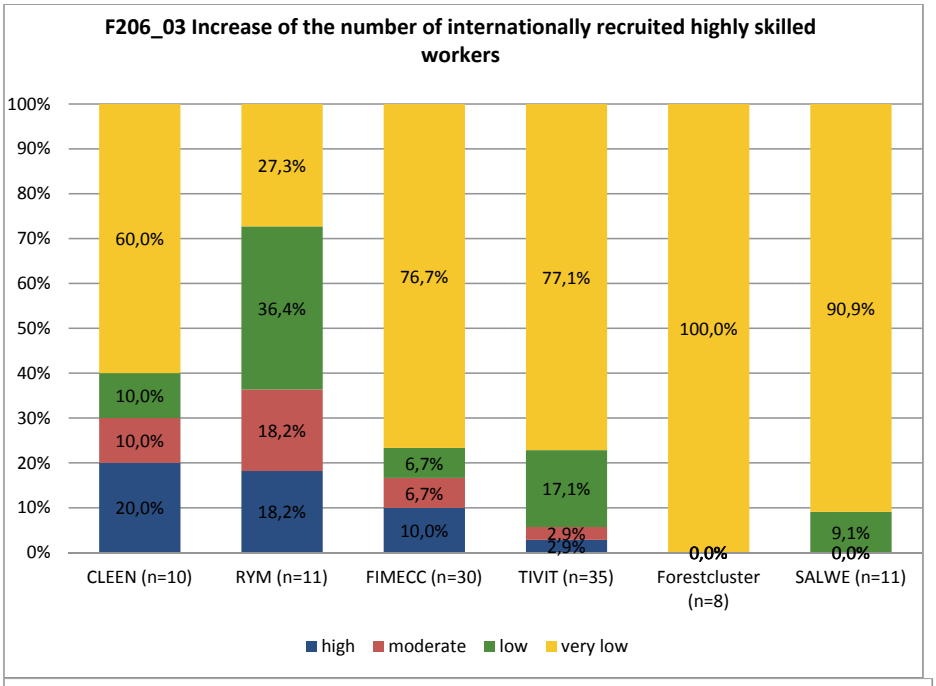

F204_04 Increase of the number of collaborations with international firms in topics related to SHOK
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9,1%
27,3%
18,2%
45,5%
30,8%
15,4%
15,4%
38,5%
32,4%
18,9%
18,9%
29,7%
50,0%
16,7%
16,7%
16,7%
50,0%
25,0%
8,3%
16,7%
65,0%
15,0%
5,0%
15,0%
RYM (n=11)
CLEEN (n=13)
FIMECC (n=37)
Forestcluster (n=12)
SALWE (n=12)
TIVIT (n=40)
high
moderate
low
very low
F204_04

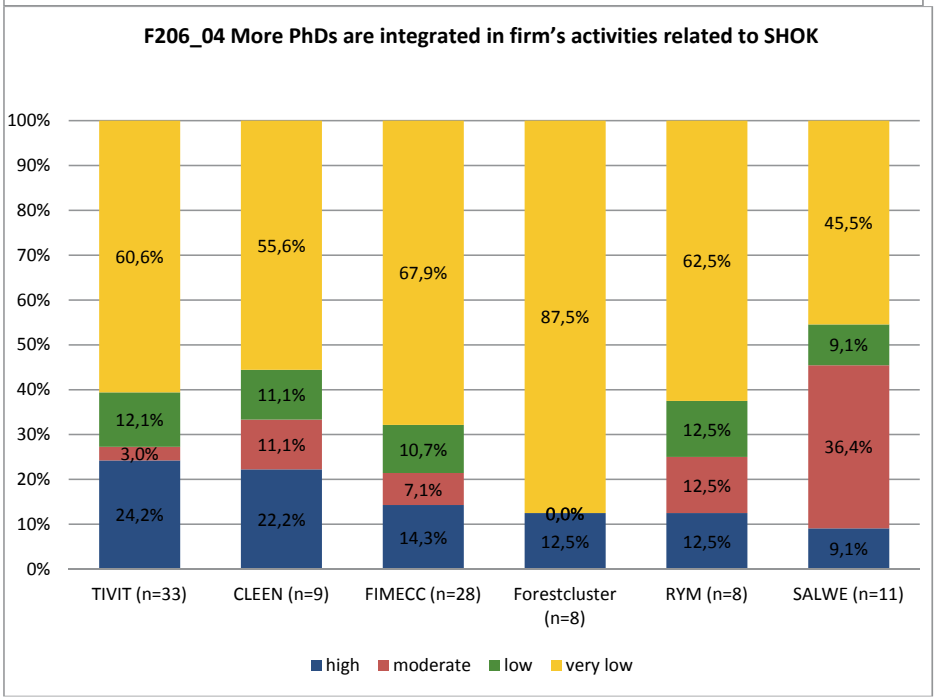

F205_01 Increase of the amount of resources allocated to R&D (employees, expenditures etc.)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
12,5%
6,3%
25,0%
56,3%
27,8%
0,0%
27,8%
44,4%
29,5%
9,1%
25,0%
36,4%
38,0%
16,0%
16,0%
30,0%
25,0%
33,3%
16,7%
25,0%
50,0%
20,0%
10,0%
20,0%
CLEEN (n=16)
SALWE (n=18)
FIMECC (n=44)
TIVIT (n=50)
RYM (n=12)
Forestcluster (n=10)
high
moderate
low
very low


F205_02 Development of Living Labs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
33,3%
8,3%
25,0%
33,3%
55,2%
6,9%
17,2%
20,7%
45,5%
18,2%
18,2%
18,2%
73,3%
13,3%
3,3%
10,0%
100,0%
0,0%
70,0%
30,0%
0,0%
CLEEN (n=12)
FIMECC (n=29)
RYM (n=11)
TIVIT (n=30)
Forestcluster (n=6)
SALWE (n=10)
high
moderate
low
very low

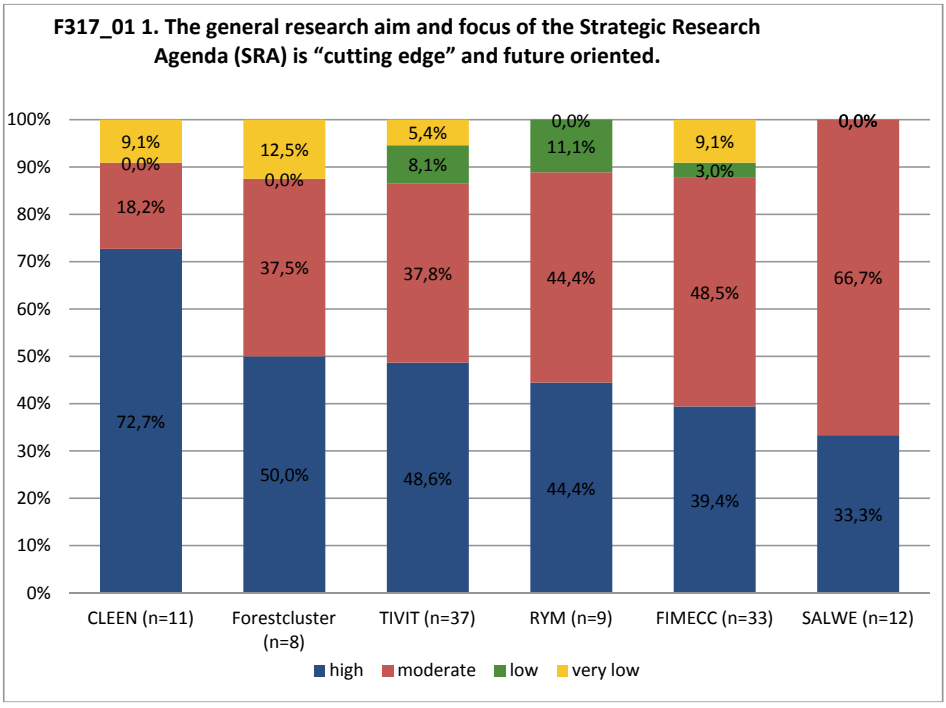

F206_01 Improvement of quality of training for employees
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
21,4%
14,3%
21,4%
42,9%
15,4%
23,1%
23,1%
38,5%
33,3%
13,3%
17,8%
35,6%
23,1%
23,1%
23,1%
30,8%
36,1%
22,2%
19,4%
22,2%
45,5%
36,4%
9,1%
9,1%
SALWE (n=14)
RYM (n=13)
TIVIT (n=45)
CLEEN (n=13)
FIMECC (n=36)
Forestcluster (n=11)
high
moderate
low
very low

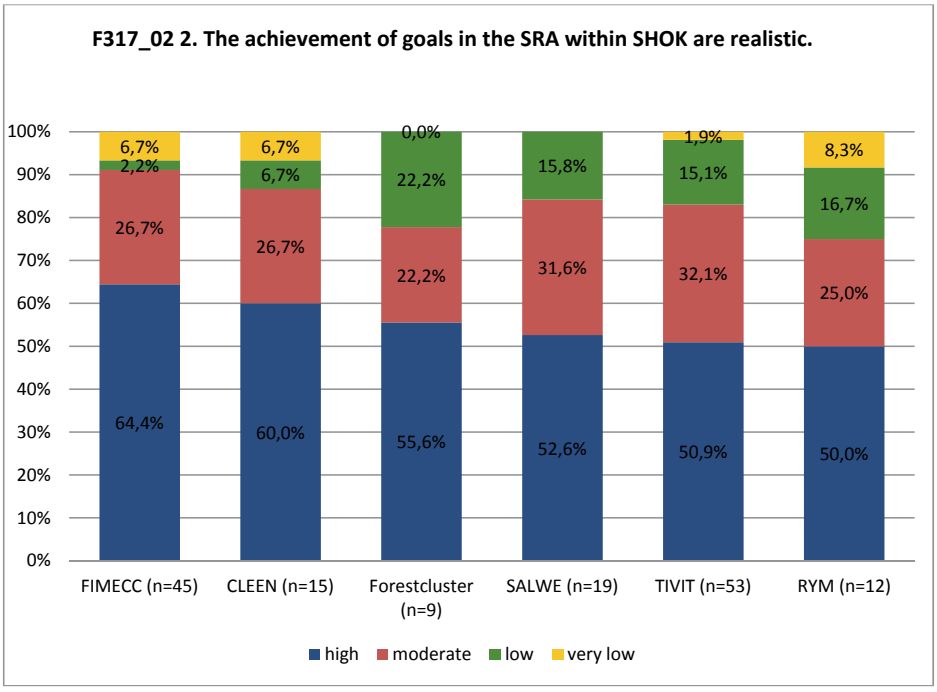

F206_02 Increase of the number of nationally recruited highly skilled workers
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
33,3%
19,4%
16,7%
30,6%
40,9%
11,4%
18,2%
29,5%
45,5%
18,2%
9,1%
27,3%
61,5%
0,0%
15,4%
23,1%
20,0%
60,0%
0,0%
20,0%
70,0%
10,0%
10,0%
10,0%
FIMECC (n=36)
TIVIT (n=44)
CLEEN (n=11)
SALWE (n=13)
RYM (n=10)
Forestcluster (n=10)
high
moderate
low
very low

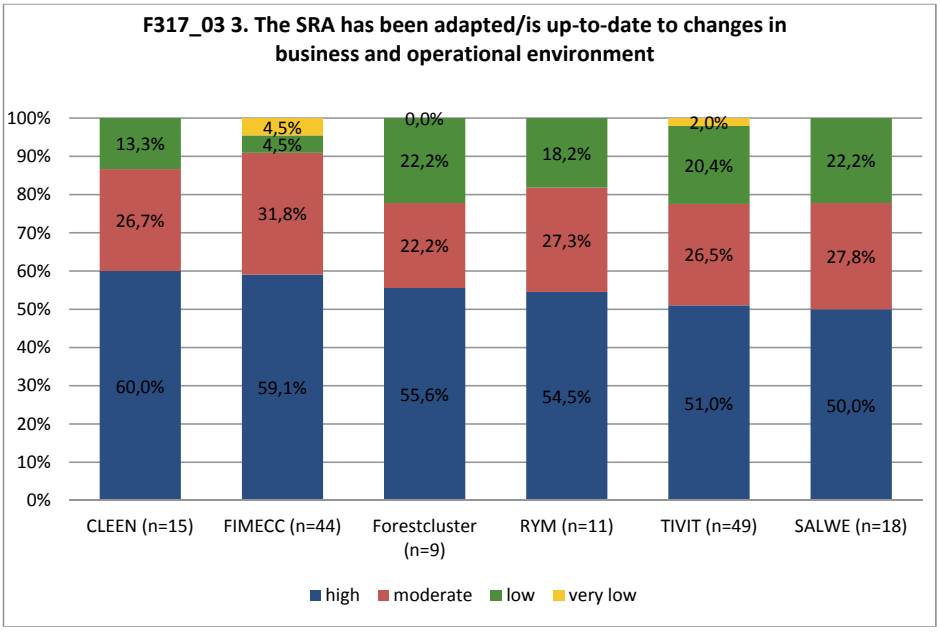

F206_03 Increase of the number of internationally recruited highly skilled workers
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
60,0%
10,0%
10,0%
20,0%
27,3%
36,4%
18,2%
18,2%
76,7%
6,7%
6,7%
10,0%
77,1%
17,1%
2,9%
2,9%
100,0%
0,0%
90,9%
9,1%
0,0%
CLEEN (n=10)
RYM (n=11)
FIMECC (n=30)
TIVIT (n=35)
Forestcluster (n=8)
SALWE (n=11)
high
moderate
low
very low

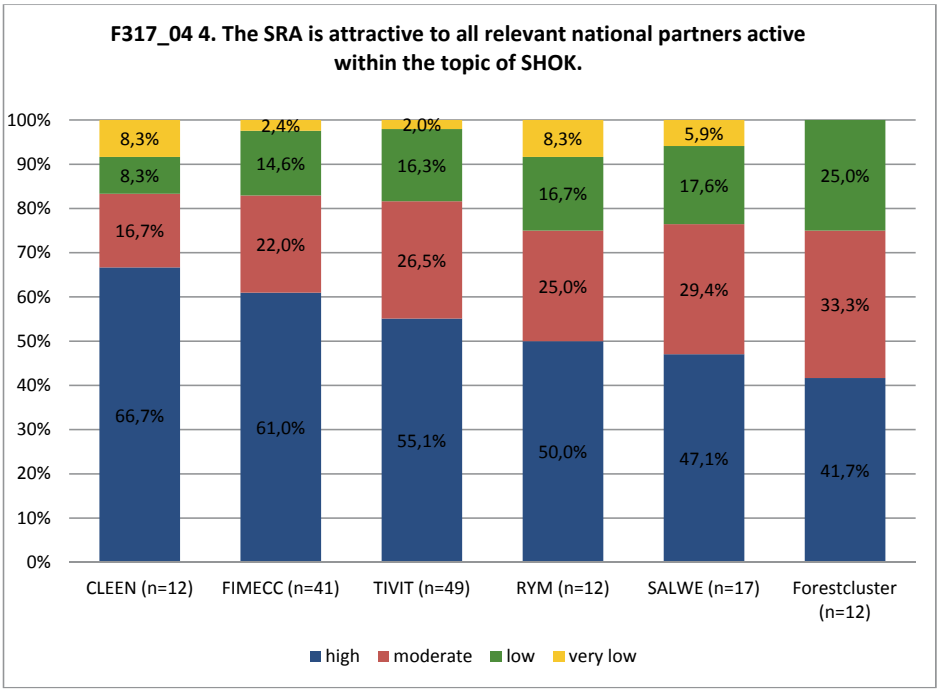

F206_04 More PhDs are integrated in firm's activities related to SHOK
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
60,6%
12,1%
3,0%
24,2%
55,6%
11,1%
11,1%
22,2%
67,9%
10,7%
7,1%
14,3%
87,5%
0,0%
12,5%
62,5%
12,5%
12,5%
12,5%
45,5%
9,1%
36,4%
9,1%
TIVIT (n=33)
CLEEN (n=9)
FIMECC (n=28)
Forestcluster (n=8)
RYM (n=8)
SALWE (n=11)
high
moderate
low
very low

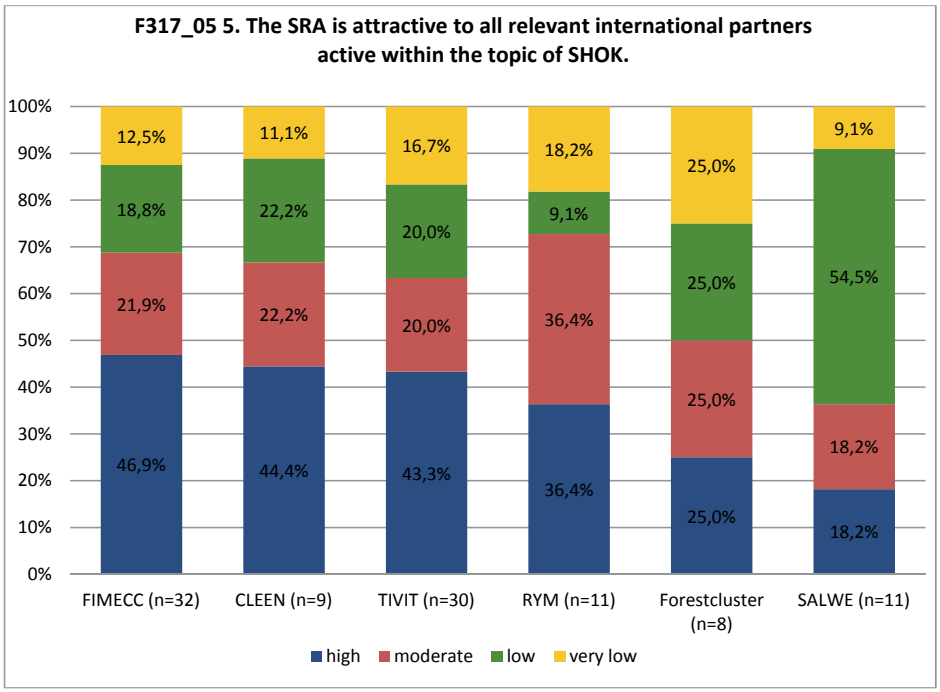
2 Agreement with statements (company respondents)

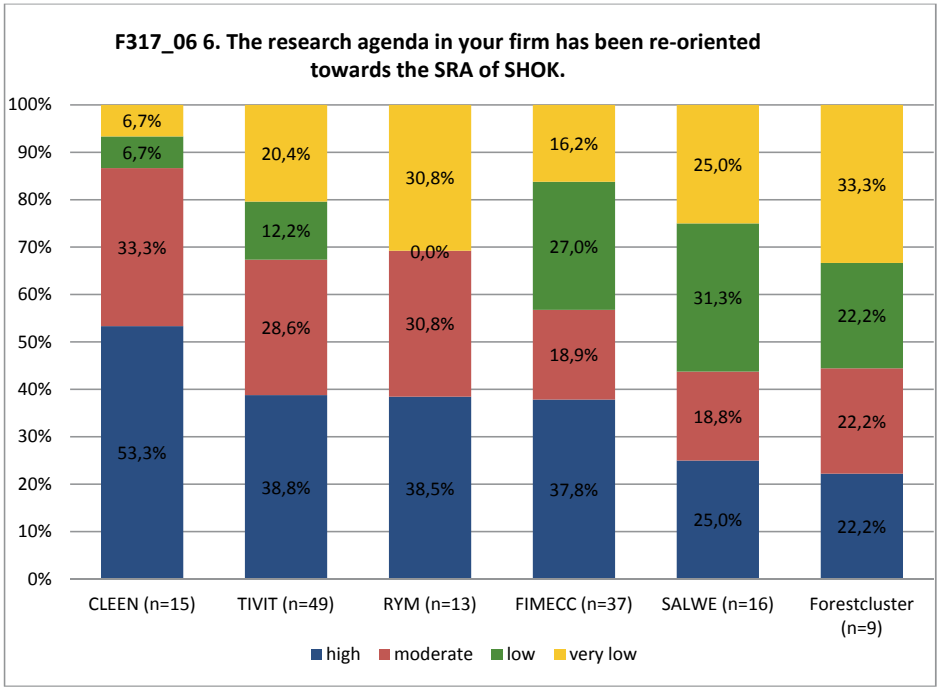


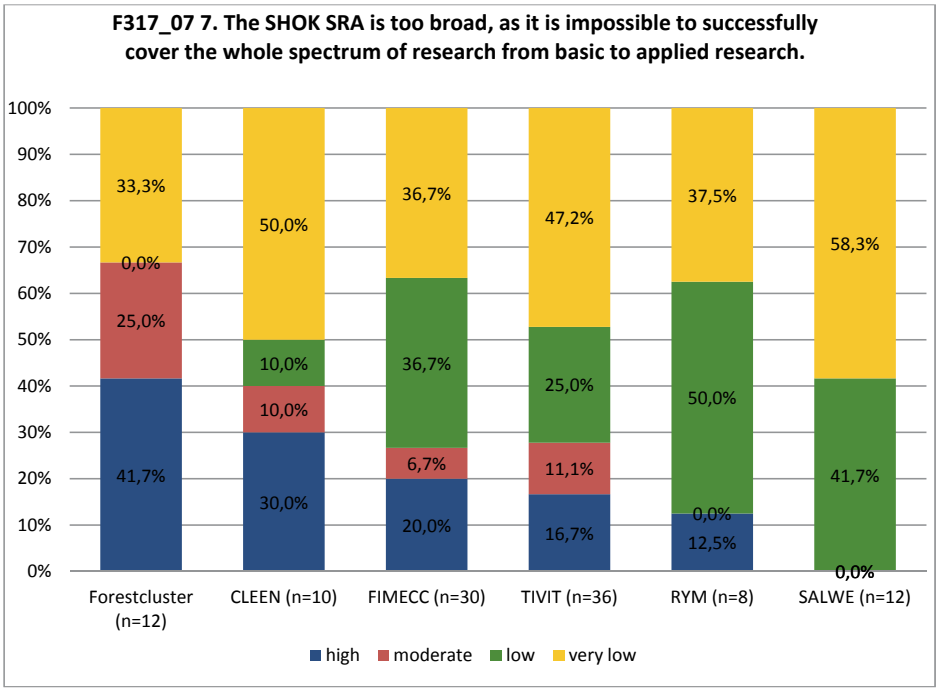


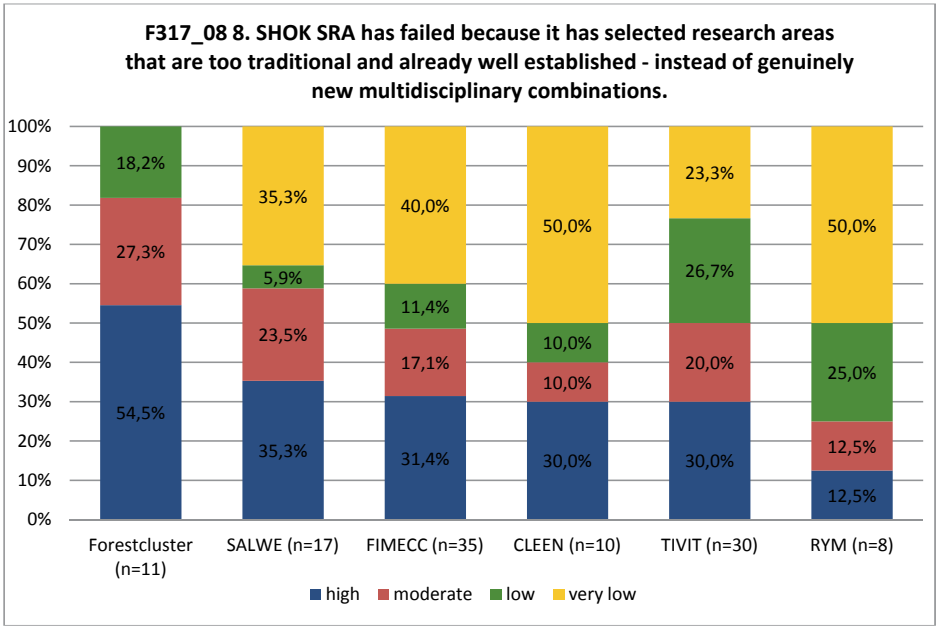

F317_03 3. The SRA has been adapted/is up-to-date to changes in business and operational environment
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
13,3%
26,7%
60,0%
4,5%
4,5%
31,8%
59,1%
0,0%
22,2%
22,2%
55,6%
18,2%
27,3%
54,5%
2,0%
20,4%
26,5%
51,0%
22,2%
27,8%
50,0%
CLEEN (n=15)
FIMECC (n=44)
Forestcluster (n=9)
RYM (n=11)
TIVIT (n=49)
SALWE (n=18)
high
moderate
low
very low

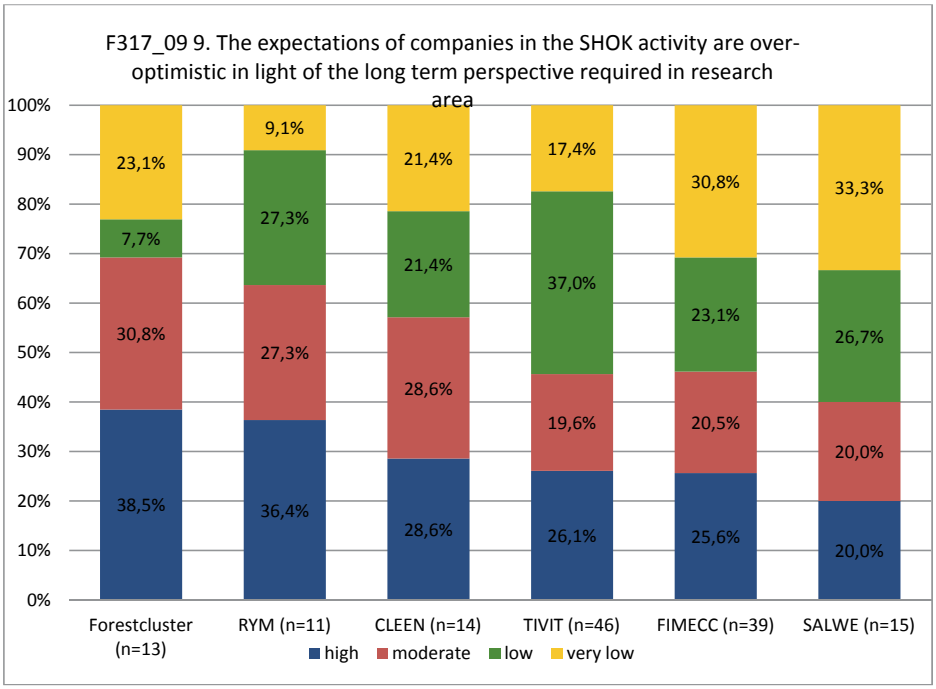

F317_04 4. The SRA is attractive to all relevant national partners active within the topic of SHOK.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
8,3%
8,3%
16,7%
66,7%
2,4%
14,6%
22,0%
61,0%
2,0%
16,3%
26,5%
55,1%
8,3%
16,7%
25,0%
50,0%
5,9%
17,6%
29,4%
47,1%
25,0%
33,3%
41,7%
CLEEN (n=12)
FIMECC (n=41)
TIVIT (n=49)
RYM (n=12)
SALWE (n=17)
Forestcluster (n=12)
high
moderate
low
very low

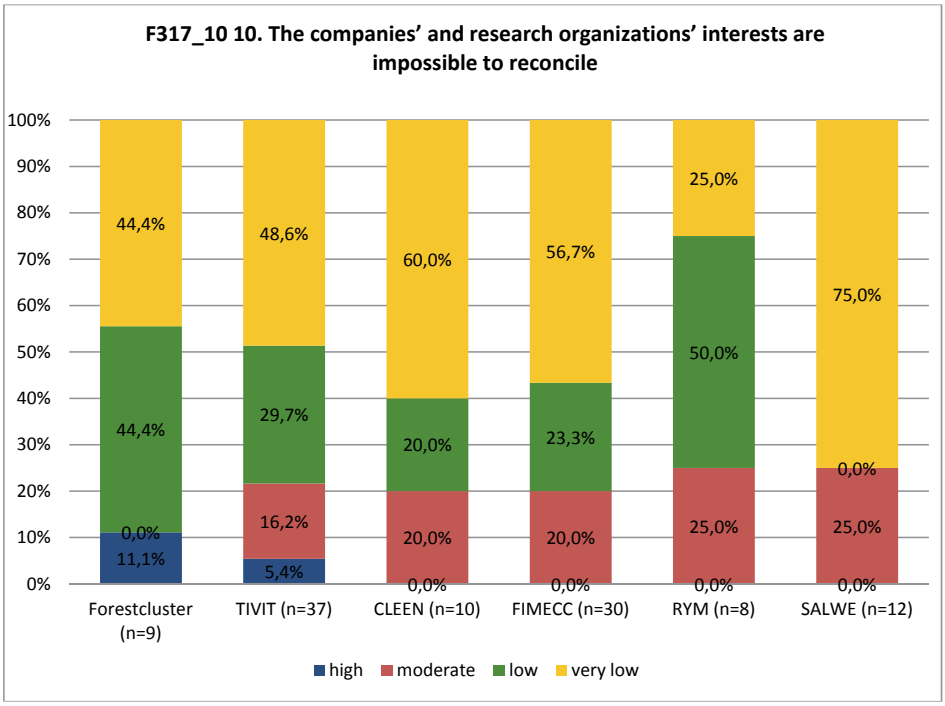

F317_05 5. The SRA is attractive to all relevant international partners active within the topic of SHOK.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
12,5%
18,8%
21,9%
46,9%
11,1%
22,2%
22,2%
44,4%
16,7%
20,0%
20,0%
43,3%
18,2%
9,1%
36,4%
36,4%
25,0%
25,0%
25,0%
25,0%
9,1%
54,5%
18,2%
18,2%
FIMECC (n=32)
CLEEN (n=9)
TIVIT (n=30)
RYM (n=11)
Forestcluster (n=8)
SALWE (n=11)
high
moderate
low
very low

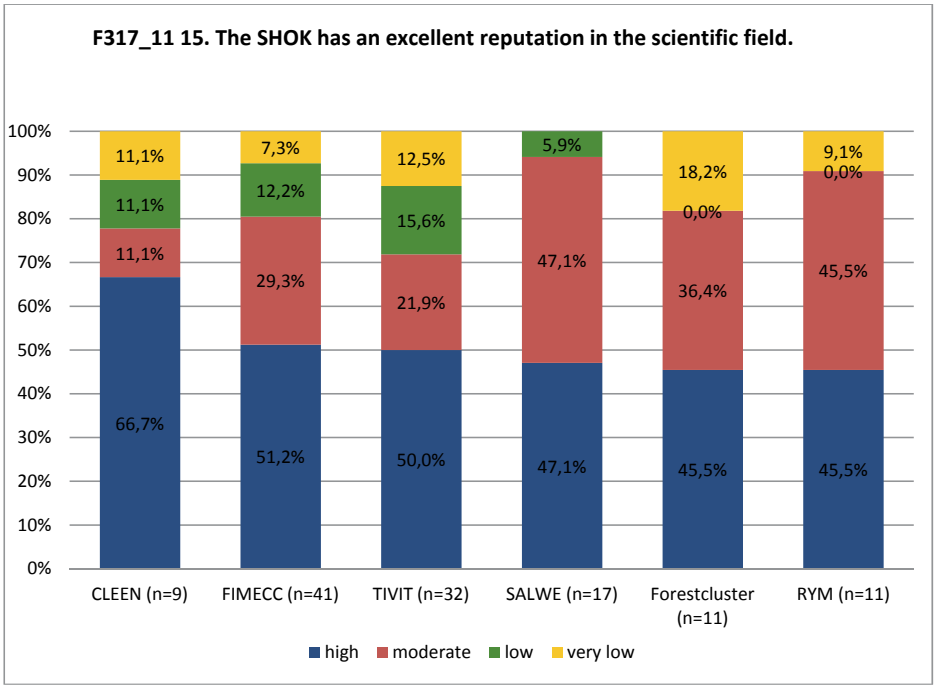

F317_06 6. The research agenda in your firm has been re-oriented towards the SRA of SHOK.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6,7%
6,7%
33,3%
53,3%
20,4%
12,2%
28,6%
38,8%
30,8%
0,0%
30,8%
38,5%
16,2%
27,0%
18,9%
37,8%
25,0%
31,3%
18,8%
25,0%
33,3%
22,2%
22,2%
22,2%
CLEEN (n=15)
TIVIT (n=49)
RYM (n=13)
FIMECC (n=37)
SALWE (n=16)
Forestcluster (n=9)
high
moderate
low
very low

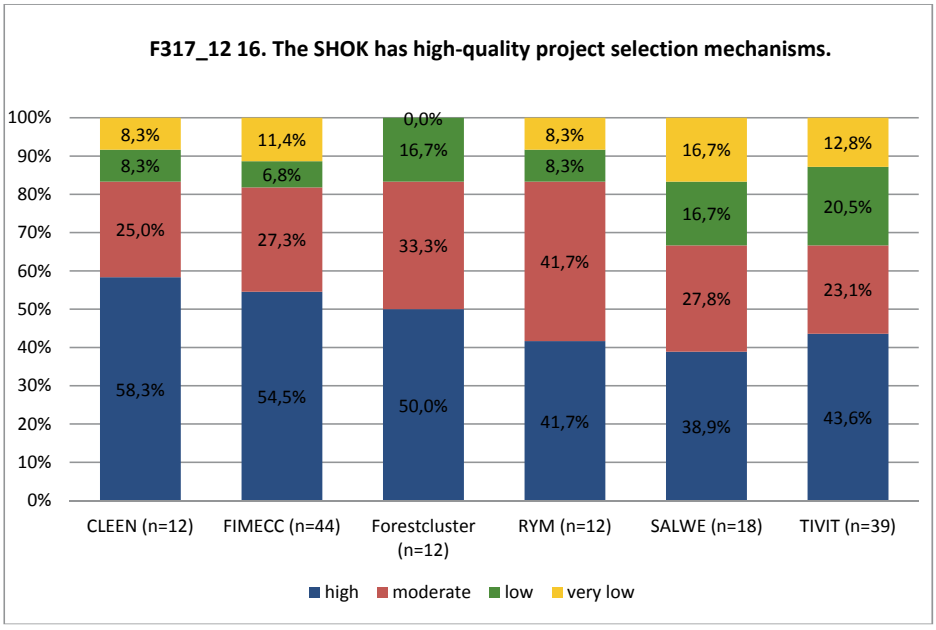

F317_07 7. The SHOK SRA is too broad, as it is impossible to successfully cover the whole spectrum of research from basic to applied research.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
33,3%
0,0%
25,0%
41,7%
50,0%
10,0%
10,0%
30,0%
36,7%
36,7%
6,7%
20,0%
47,2%
25,0%
11,1%
16,7%
37,5%
50,0%
0,0%
12,5%
58,3%
41,7%
0,0%
Forestcluster (n=12)
CLEEN (n=10)
FIMECC (n=30)
TIVIT (n=36)
RYM (n=8)
SALWE (n=12)
high
moderate
low
very low

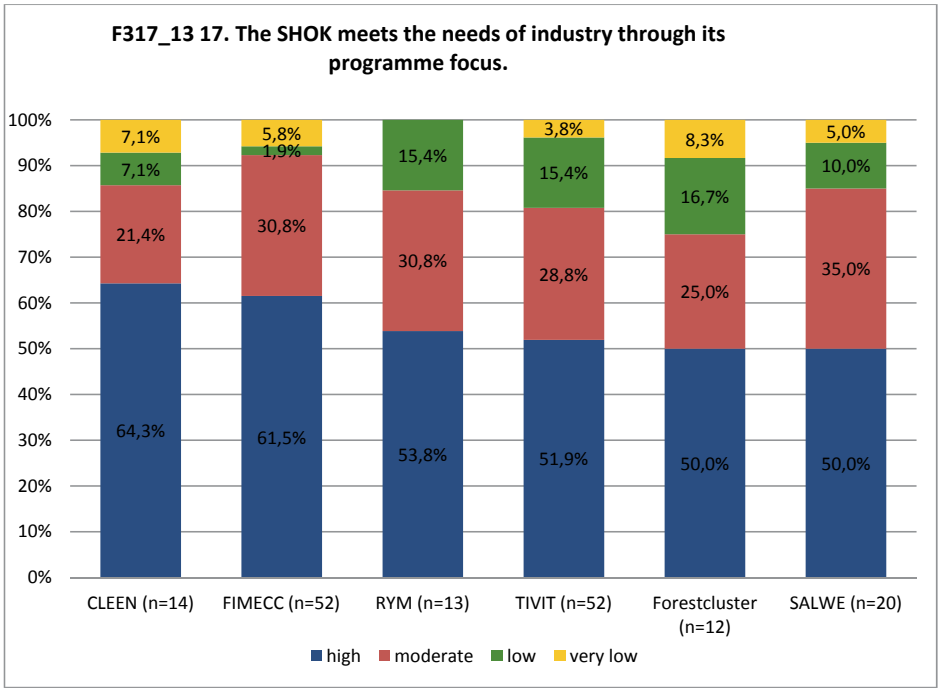

F317_08 8. SHOK SRA has failed because it has selected research areas that are too traditional and already well established - instead of genuinely new multidisciplinary combinations.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
18,2%
27,3%
54,5%
35,3%
5,9%
23,5%
35,3%
40,0%
11,4%
17,1%
31,4%
50,0%
10,0%
10,0%
30,0%
23,3%
26,7%
20,0%
30,0%
50,0%
25,0%
12,5%
12,5%
Forestcluster (n=11)
SALWE (n=17)
FIMECC (n=35)
CLEEN (n=10)
TIVIT (n=30)
RYM (n=8)
high
moderate
low
very low

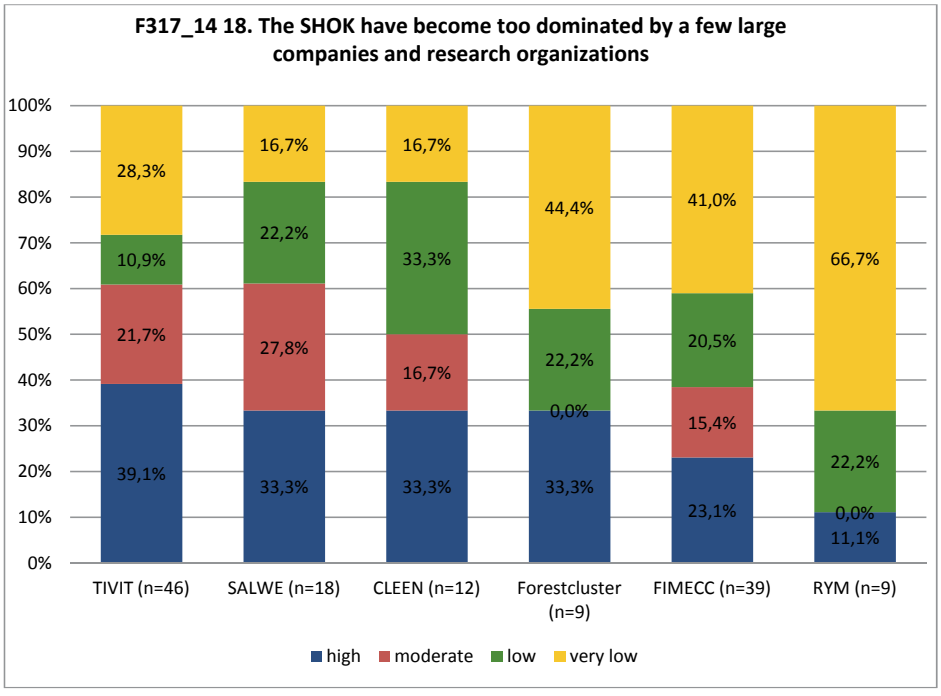

F317_09 9. The expectations of companies in the SHOK activity are over-optimistic in light of the long term perspective required in research area
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
23,1%
7,7%
30,8%
38,5%
9,1%
27,3%
27,3%
36,4%
21,4%
21,4%
28,6%
28,6%
17,4%
37,0%
19,6%
26,1%
30,8%
23,1%
20,5%
25,6%
33,3%
26,7%
20,0%
20,0%
Forestcluster (n=13)
RYM (n=11)
CLEEN (n=14)
TIVIT (n=46)
FIMECC (n=39)
SALWE (n=15)
high
moderate
low
very low

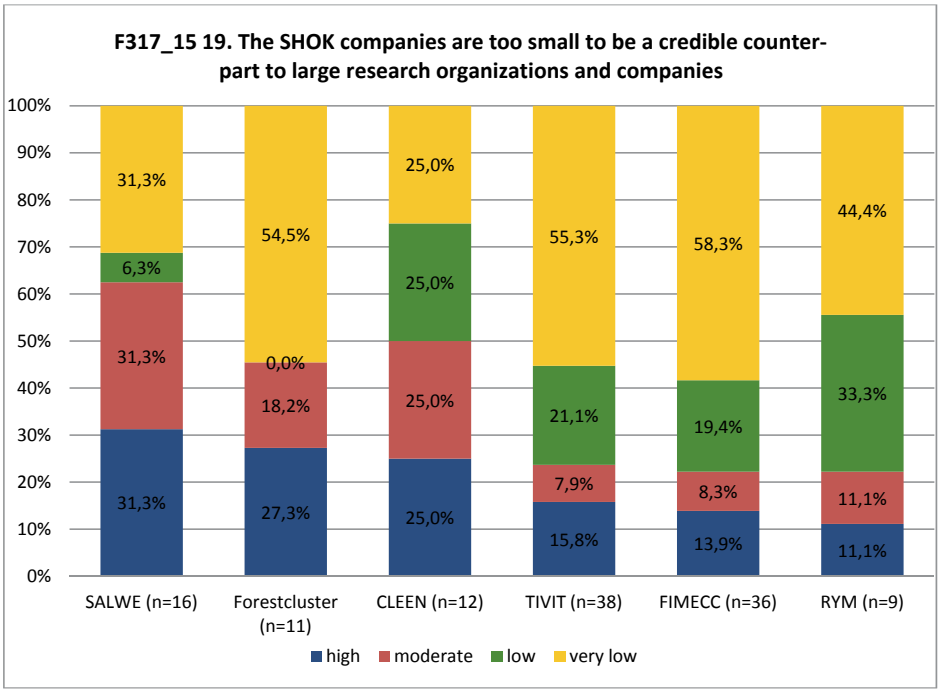

F317_10 10. The companies' and research organizations' interests are impossible to reconcile
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
44,4%
44,4%
0,0%
11,1%
48,6%
29,7%
16,2%
5,4%
60,0%
20,0%
20,0%
0,0%
56,7%
23,3%
20,0%
0,0%
25,0%
50,0%
25,0%
0,0%
75,0%
0,0%
25,0%
0,0%
Forestcluster (n=9)
TIVIT (n=37)
CLEEN (n=10)
FIMECC (n=30)
RYM (n=8)
SALWE (n=12)
high
moderate
low
very low

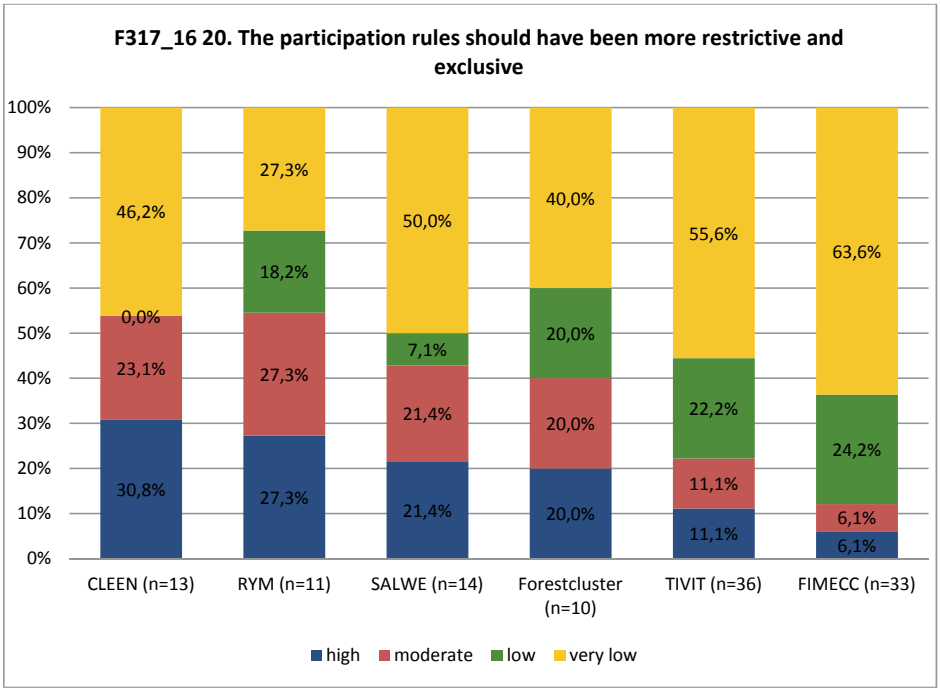

F317_11 15. The SHOK has an excellent reputation in the scientific field.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
11,1%
11,1%
11,1%
66,7%
7,3%
12,2%
29,3%
51,2%
12,5%
15,6%
21,9%
50,0%
5,9%
47,1%
47,1%
18,2%
0,0%
36,4%
45,5%
9,1%
0,0%
45,5%
45,5%
CLEEN (n=9)
FIMECC (n=41)
TIVIT (n=32)
SALWE (n=17)
Forestcluster (n=11)
RYM (n=11)
high
moderate
low
very low

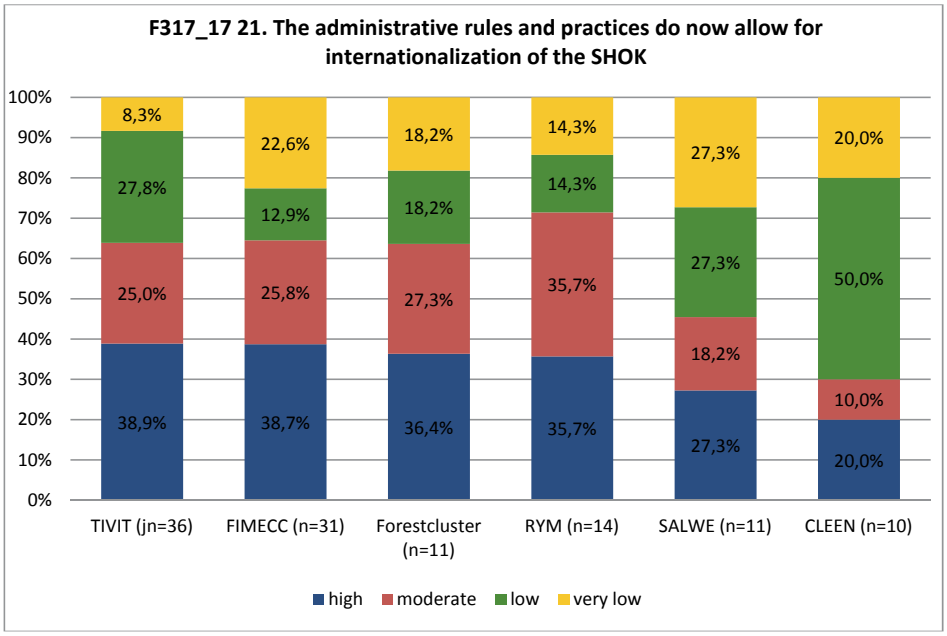

F317_12 16. The SHOK has high-quality project selection mechanisms.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
8,3%
8,3%
25,0%
58,3%
11,4%
6,8%
27,3%
54,5%
0,0%
16,7%
33,3%
50,0%
8,3%
8,3%
41,7%
41,7%
16,7%
16,7%
27,8%
38,9%
12,8%
20,5%
23,1%
43,6%
CLEEN (n=12)
FIMECC (n=44)
Forestcluster (n=12)
RYM (n=12)
SALWE (n=18)
TIVIT (n=39)
high
moderate
low
very low

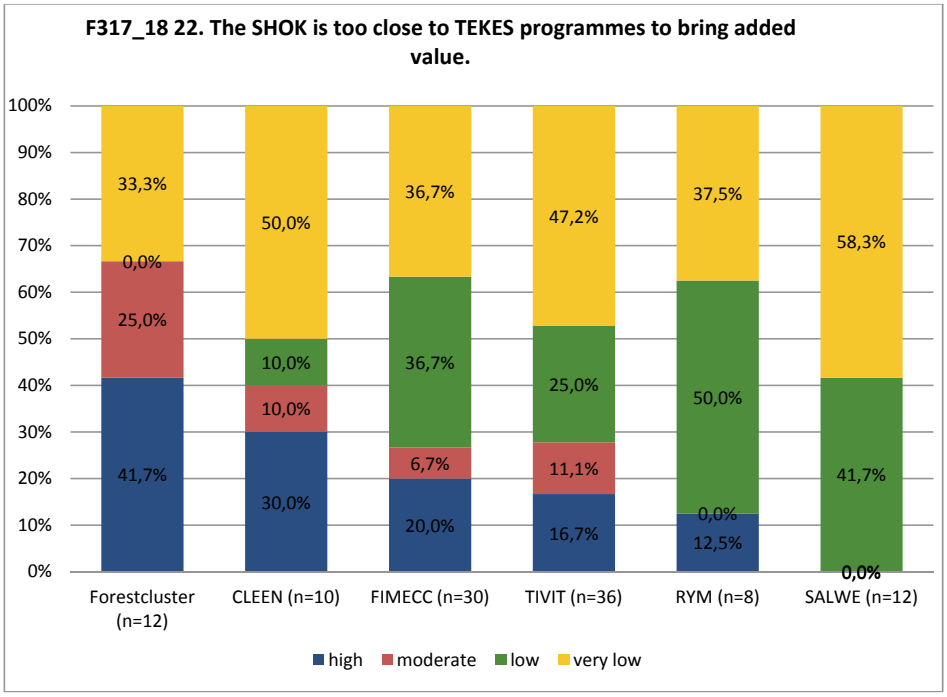

F317_13 17. The SHOK meets the needs of industry through its programme focus.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
7,1%
7,1%
21,4%
64,3%
5,8%
1,9%
30,8%
61,5%
15,4%
30,8%
53,8%
3,8%
15,4%
28,8%
51,9%
8,3%
16,7%
25,0%
50,0%
5,0%
10,0%
35,0%
50,0%
CLEEN (n=14)
FIMECC (n=52)
RYM (n=13)
TIVIT (n=52)
Forestcluster (n=12)
SALWE (n=20)
high
moderate
low
very low

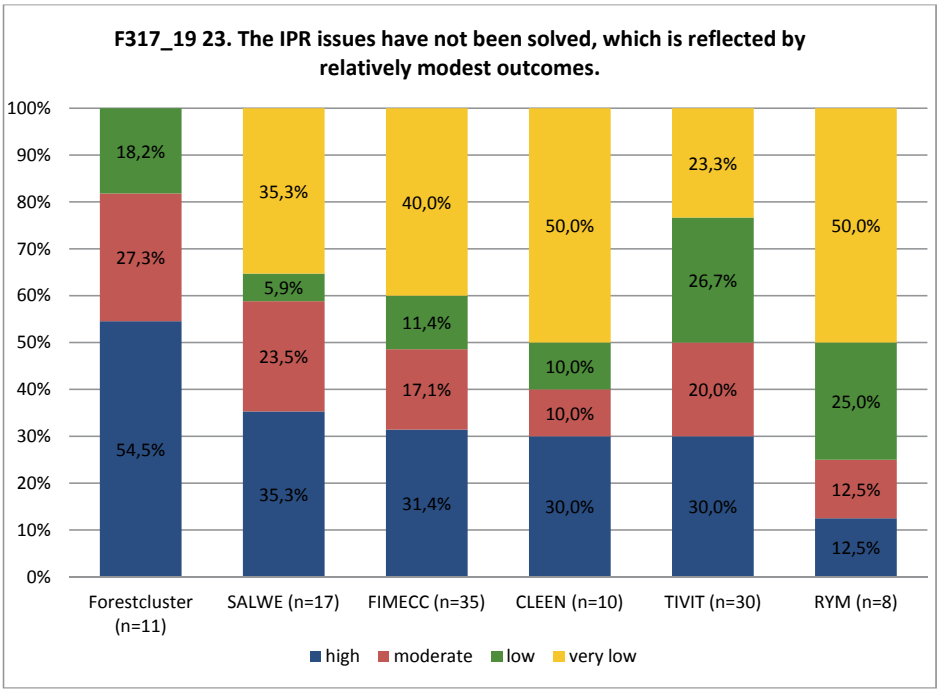

F317_14 18. The SHOK have become too dominated by a few large companies and research organizations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
28,3%
10,9%
21,7%
39,1%
16,7%
22,2%
27,8%
33,3%
16,7%
33,3%
16,7%
33,3%
16,7%
33,3%
44,4%
22,2%
0,0%
33,3%
41,0%
20,5%
15,4%
23,1%
66,7%
22,2%
0,0%
11,1%
TIVIT (n=46)
SALWE (n=18)
CLEEN (n=12)
Forestcluster (n=9)
FIMECC (n=39)
RYM (n=9)
high
moderate
low
very low

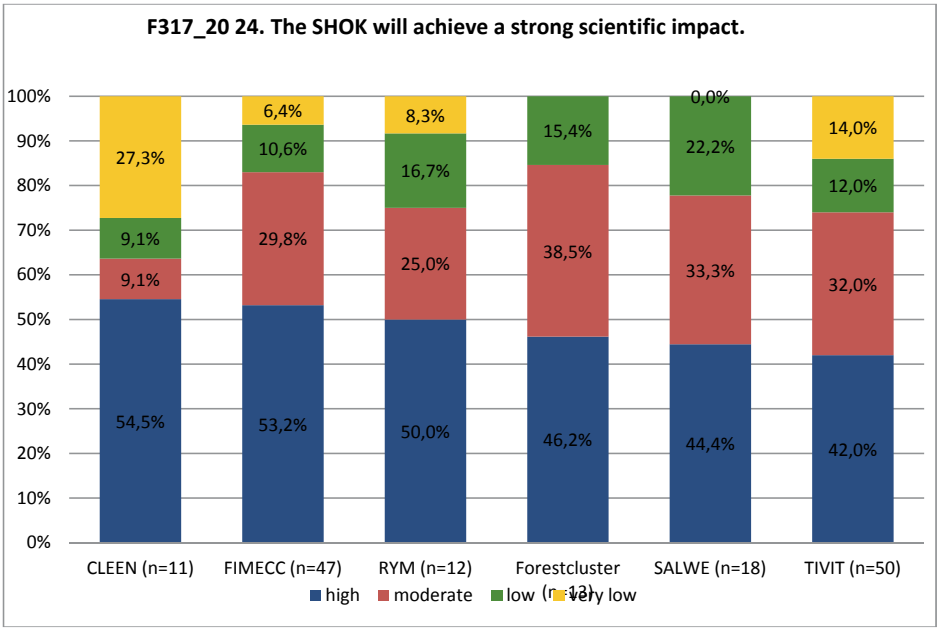

F317_15 19. The SHOK companies are too small to be a credible counter-part to large research organizations and companies
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
31,3%
6,3%
31,3%
31,3%
54,5%
0,0%
18,2%
27,3%
25,0%
25,0%
25,0%
25,0%
55,3%
21,1%
7,9%
15,8%
58,3%
19,4%
8,3%
13,9%
44,4%
33,3%
11,1%
11,1%
SALWE (n=16)
Forestcluster (n=11)
CLEEN (n=12)
TIVIT (n=38)
FIMECC (n=36)
RYM (n=9)
high
moderate
low
very low

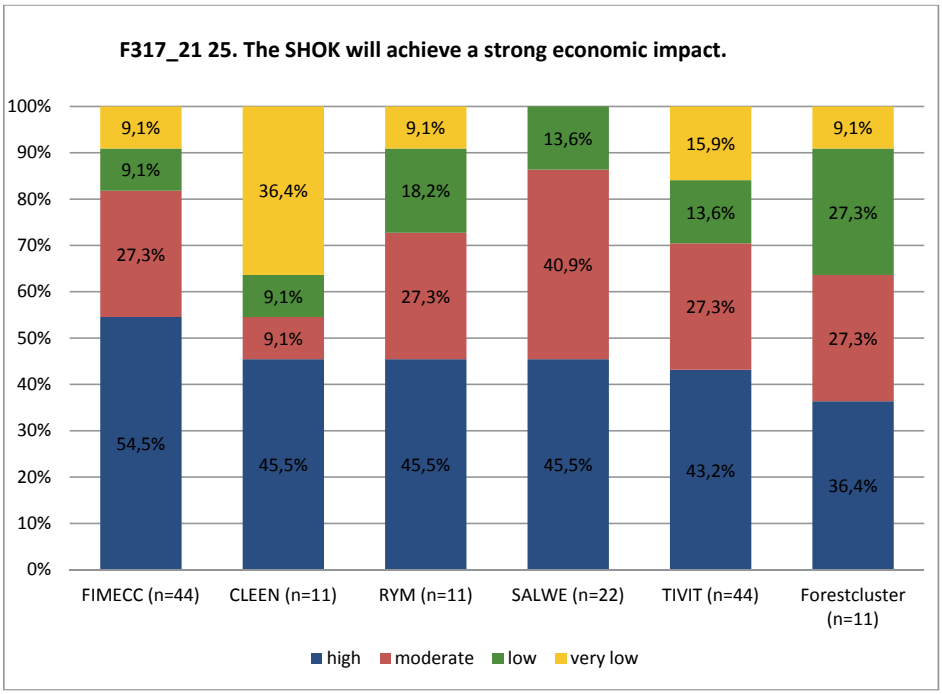

F317_16 20. The participation rules should have been more restrictive and exclusive
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
46,2%
0,0%
23,1%
30,8%
27,3%
18,2%
27,3%
27,3%
50,0%
7,1%
21,4%
21,4%
40,0%
20,0%
20,0%
20,0%
55,6%
22,2%
11,1%
11,1%
63,6%
24,2%
6,1%
6,1%
CLEEN (n=13)
RYM (n=11)
SALWE (n=14)
Forestcluster (n=10)
TIVIT (n=36)
FIMECC (n=33)
high
moderate
low
very low

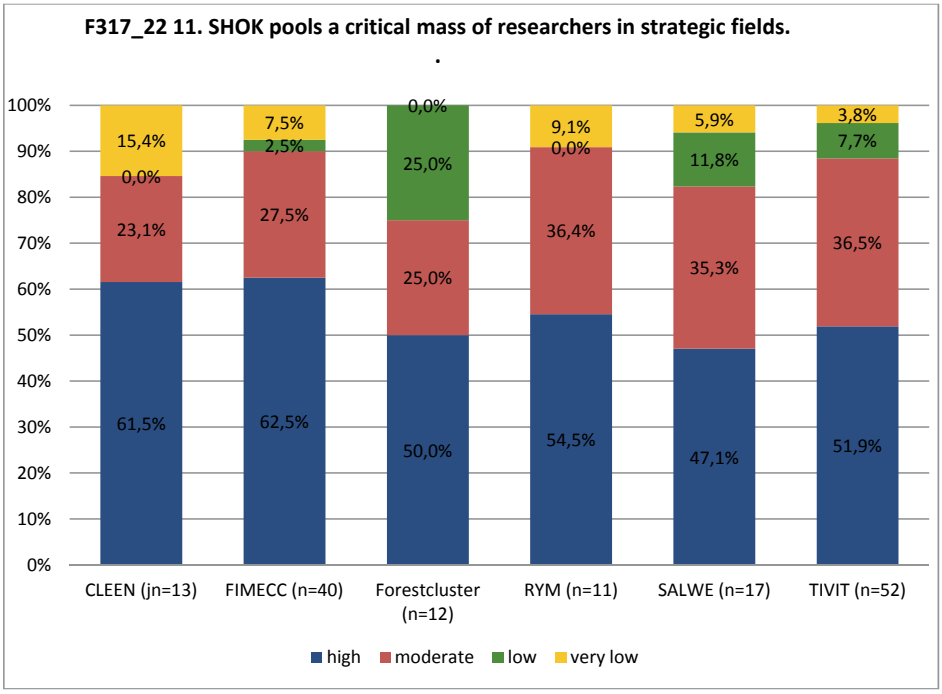

F317_17 21. The administrative rules and practices do now allow for internationalization of the SHOK
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
8,3%
27,8%
25,0%
38,9%
22,6%
12,9%
25,8%
38,7%
18,2%
18,2%
27,3%
36,4%
14,3%
14,3%
35,7%
35,7%
27,3%
27,3%
18,2%
27,3%
20,0%
50,0%
10,0%
20,0%
TIVIT (jn=36)
FIMECC (n=31)
Forestcluster (n=11)
RYM (n=14)
SALWE (n=11)
CLEEN (n=10)
high
moderate
low
very low

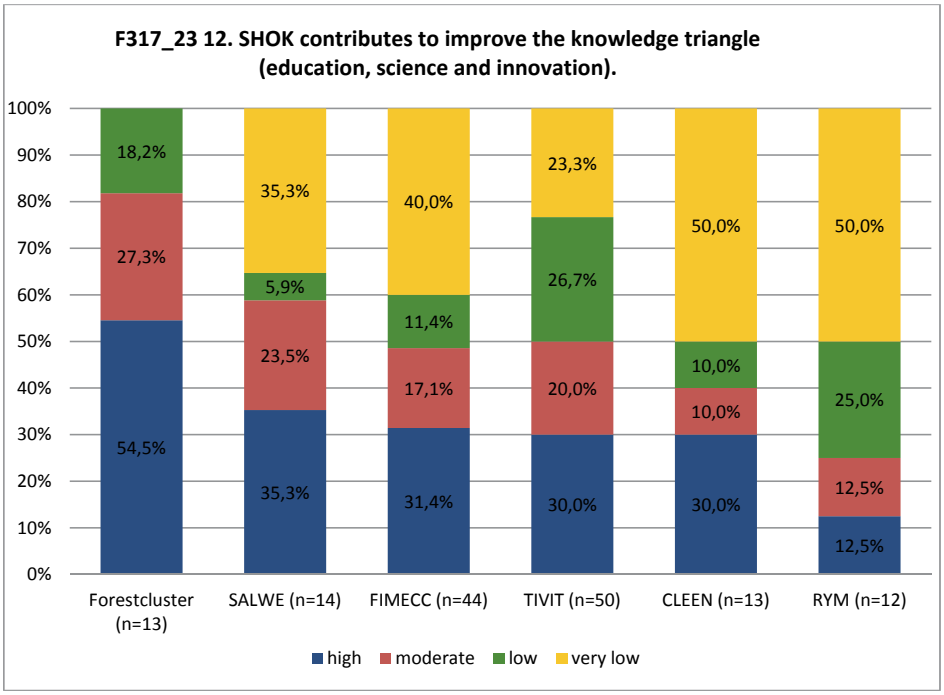

F317_18 22. The SHOK is too close to TEKES programmes to bring added value.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
33,3%
0,0%
25,0%
41,7%
50,0%
10,0%
10,0%
30,0%
36,7%
36,7%
6,7%
20,0%
47,2%
25,0%
11,1%
16,7%
37,5%
50,0%
0,0%
12,5%
58,3%
41,7%
0,0%
Forestcluster (n=12)
CLEEN (n=10)
FIMECC (n=30)
TIVIT (n=36)
RYM (n=8)
SALWE (n=12)
high
moderate
low
very low

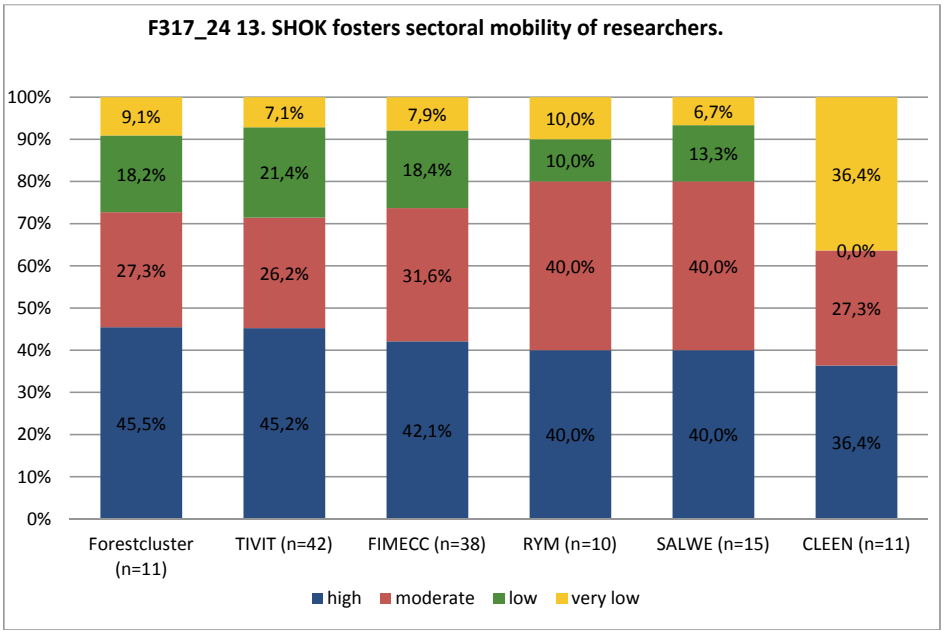

F317_19 23. The IPR issues have not been solved, which is reflected by relatively modest outcomes.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
18,2%
27,3%
54,5%
35,3%
5,9%
23,5%
35,3%
40,0%
11,4%
17,1%
31,4%
50,0%
10,0%
10,0%
30,0%
23,3%
26,7%
20,0%
30,0%
50,0%
25,0%
12,5%
12,5%
Forestcluster (n=11)
SALWE (n=17)
FIMECC (n=35)
CLEEN (n=10)
TIVIT (n=30)
RYM (n=8)
high
moderate
low
very low

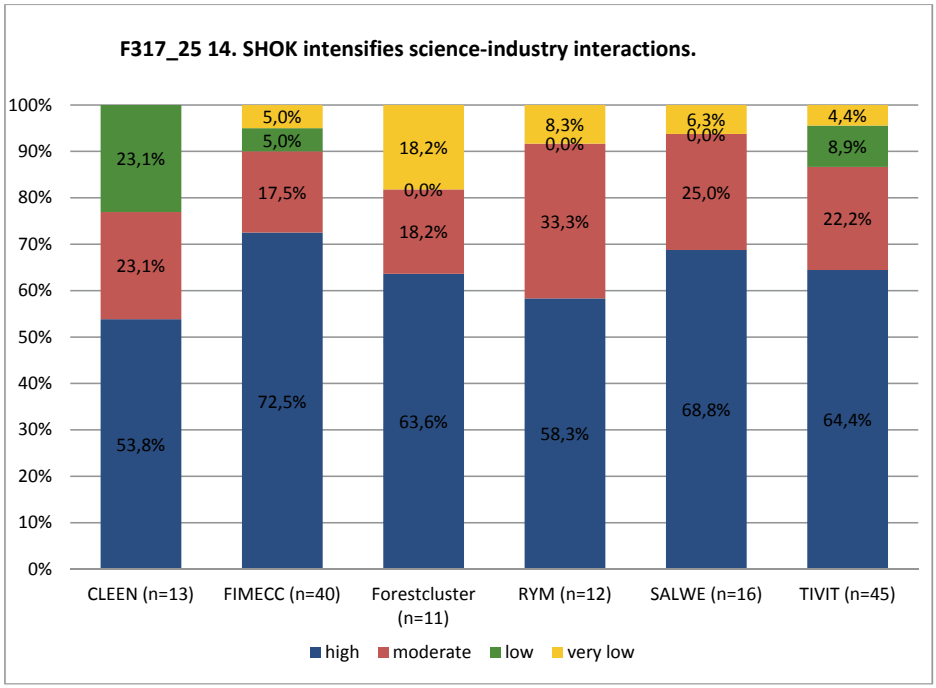

F317_20 24. The SHOK will achieve a strong scientific impact.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
27,3%
9,1%
9,1%
54,5%
6,4%
10,6%
29,8%
53,2%
8,3%
16,7%
25,0%
50,0%
15,4%
38,5%
46,2%
0,0%
22,2%
33,3%
44,4%
14,0%
12,0%
32,0%
42,0%
CLEEN (n=11)
FIMECC (n=47)
RYM (n=12)
Forestcluster (n=13)
SALWE (n=18)
TIVIT (n=50)
high
moderate
low
very low


F317_21 25. The SHOK will achieve a strong economic impact.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9,1%
9,1%
27,3%
54,5%
36,4%
9,1%
9,1%
45,5%
9,1%
18,2%
27,3%
45,5%
13,6%
40,9%
45,5%
15,9%
13,6%
27,3%
43,2%
9,1%
27,3%
27,3%
36,4%
FIMECC (n=44)
CLEEN (n=11)
RYM (n=11)
SALWE (n=22)
TIVIT (n=44)
Forestcluster (n=11)
high
moderate
low
very low

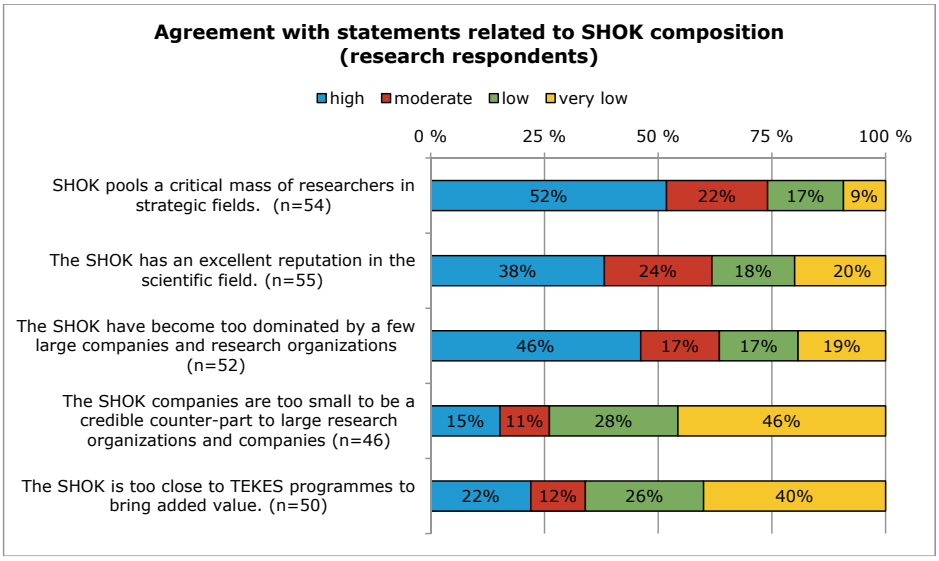

F317_22 11. SHOK pools a critical mass of researchers in strategic fields.
.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
15,4%
0,0%
23,1%
61,5%
7,5%
2,5%
27,5%
62,5%
0,0%
25,0%
25,0%
50,0%
9,1%
0,0%
36,4%
54,5%
5,9%
11,8%
35,3%
47,1%
3,8%
7,7%
36,5%
51,9%
CLEEN (jn=13)
FIMECC (n=40)
Forestcluster (n=12)
RYM (n=11)
SALWE (n=17)
TIVIT (n=52)
high
moderate
low
very low

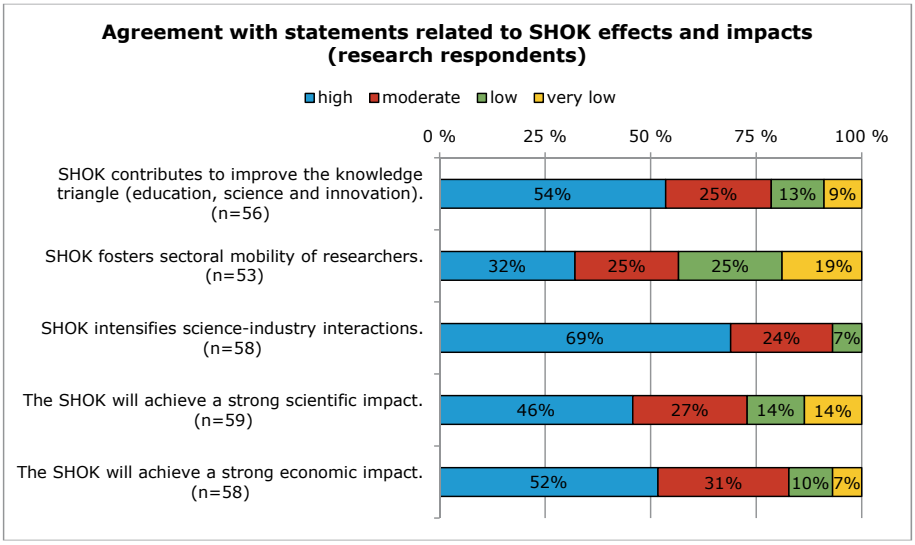

F317_23 12. SHOK contributes to improve the knowledge triangle (education, science and innovation).
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
18,2%
27,3%
54,5%
35,3%
5,9%
23,5%
35,3%
40,0%
11,4%
17,1%
31,4%
23,3%
26,7%
20,0%
30,0%
50,0%
10,0%
10,0%
30,0%
50,0%
25,0%
12,5%
12,5%
Forestcluster (n=13)
SALWE (n=14)
FIMECC (n=44)
TIVIT (n=50)
CLEEN (n=13)
RYM (n=12)
high
moderate
low
very low

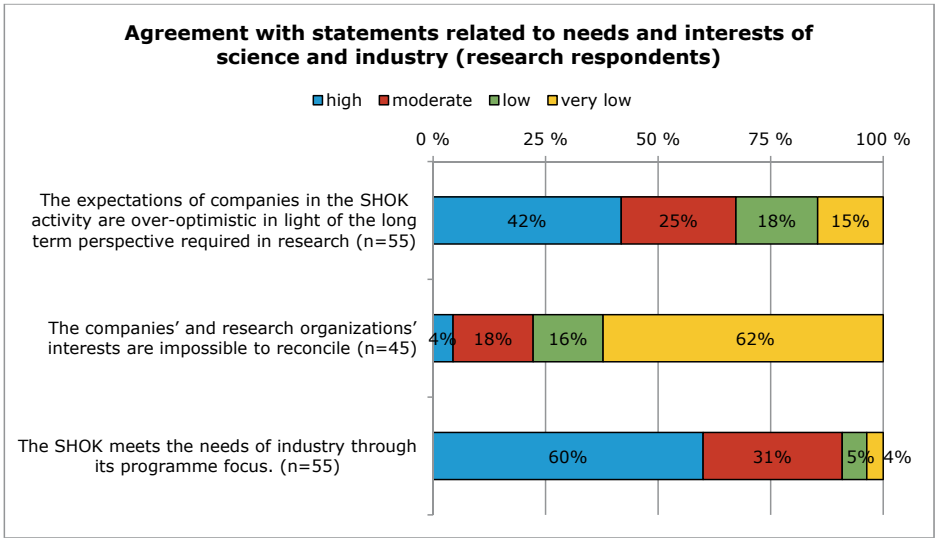

F317_24 13. SHOK fosters sectoral mobility of researchers.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9,1%
18,2%
27,3%
45,5%
7,1%
21,4%
26,2%
45,2%
7,9%
18,4%
31,6%
42,1%
10,0%
10,0%
40,0%
40,0%
6,7%
13,3%
40,0%
40,0%
36,4%
0,0%
27,3%
36,4%
Forestcluster (n=11)
TIVIT (n=42)
FIMECC (n=38)
RYM (n=10)
SALWE (n=15)
CLEEN (n=11)
high
moderate
low
very low

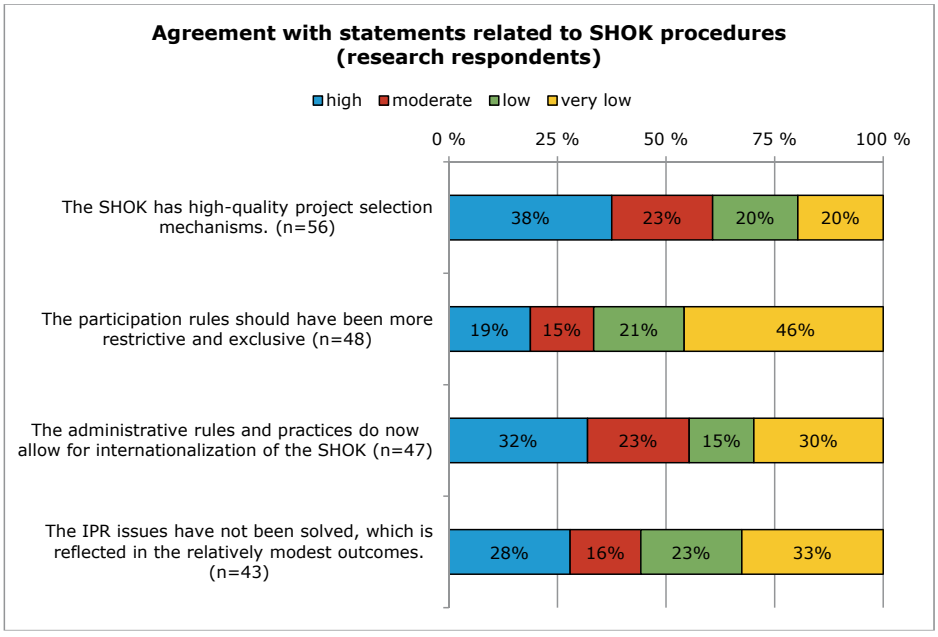

F317_25 14. SHOK intensifies science-industry interactions.
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
23,1%
23,1%
53,8%
5,0%
5,0%
17,5%
72,5%
18,2%
0,0%
18,2%
63,6%
8,3%
0,0%
33,3%
58,3%
6,3%
0,0%
25,0%
68,8%
4,4%
8,9%
22,2%
64,4%
CLEEN (n=13)
FIMECC (n=40)
Forestcluster (n=11)
RYM (n=12)
SALWE (n=16)
TIVIT (n=45)
high
moderate
low
very low

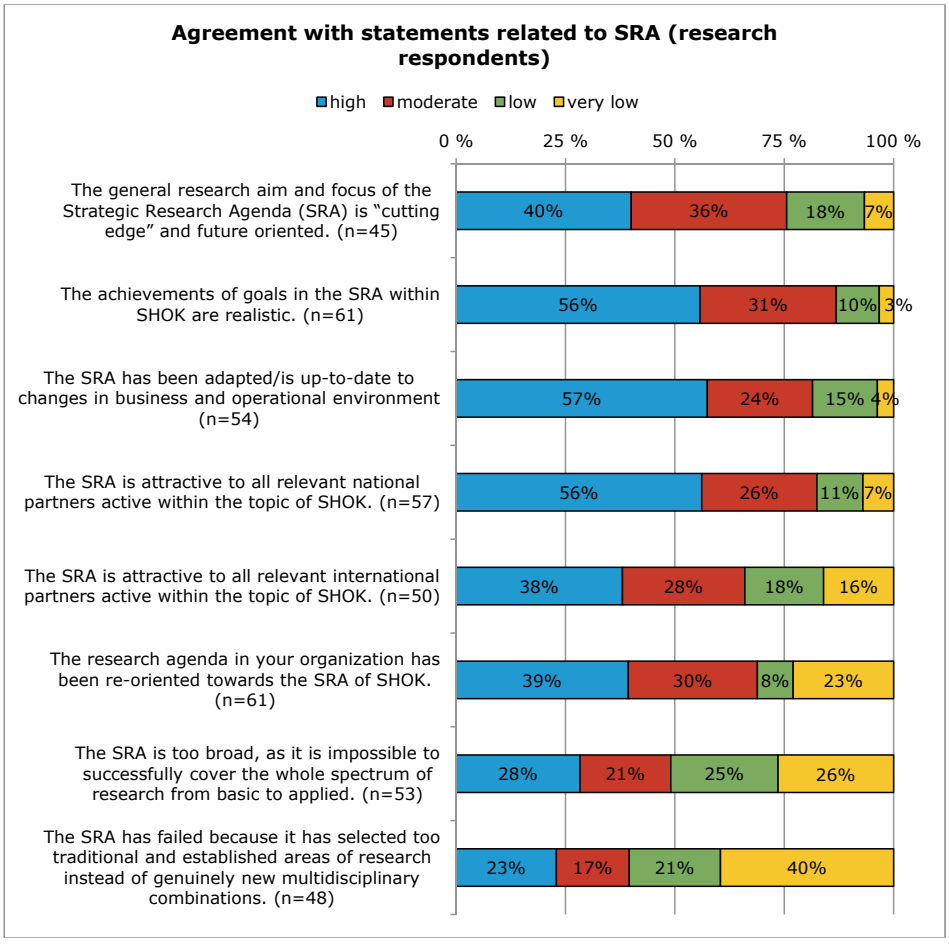
3 Agreement with statements (research respondents)

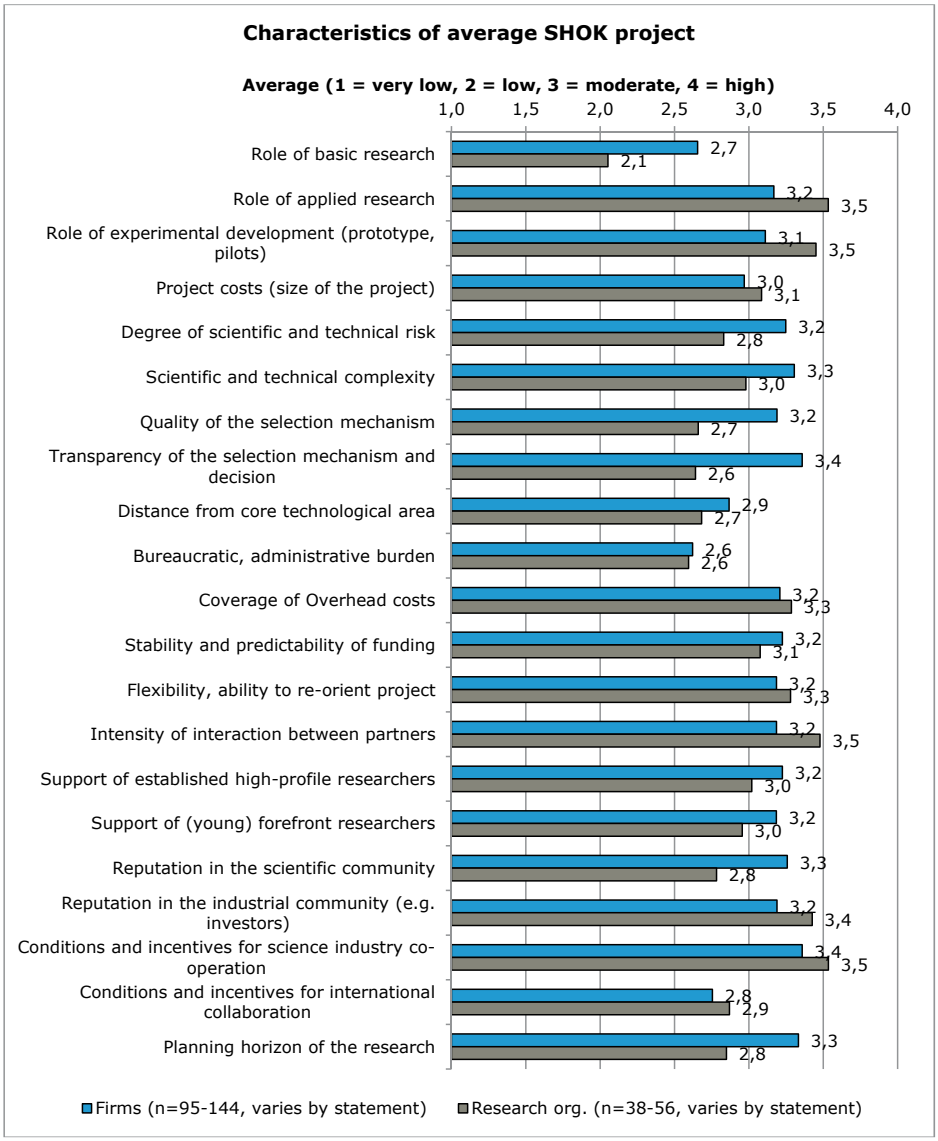


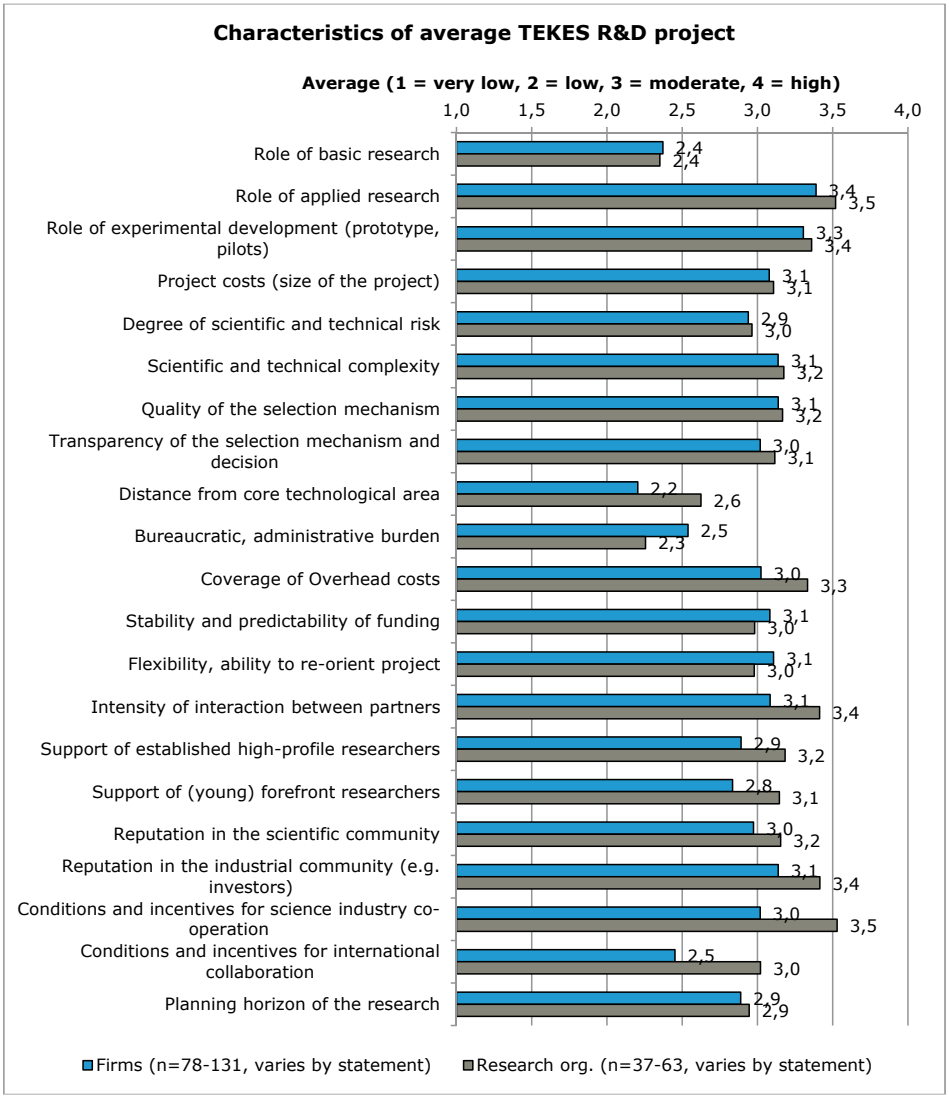


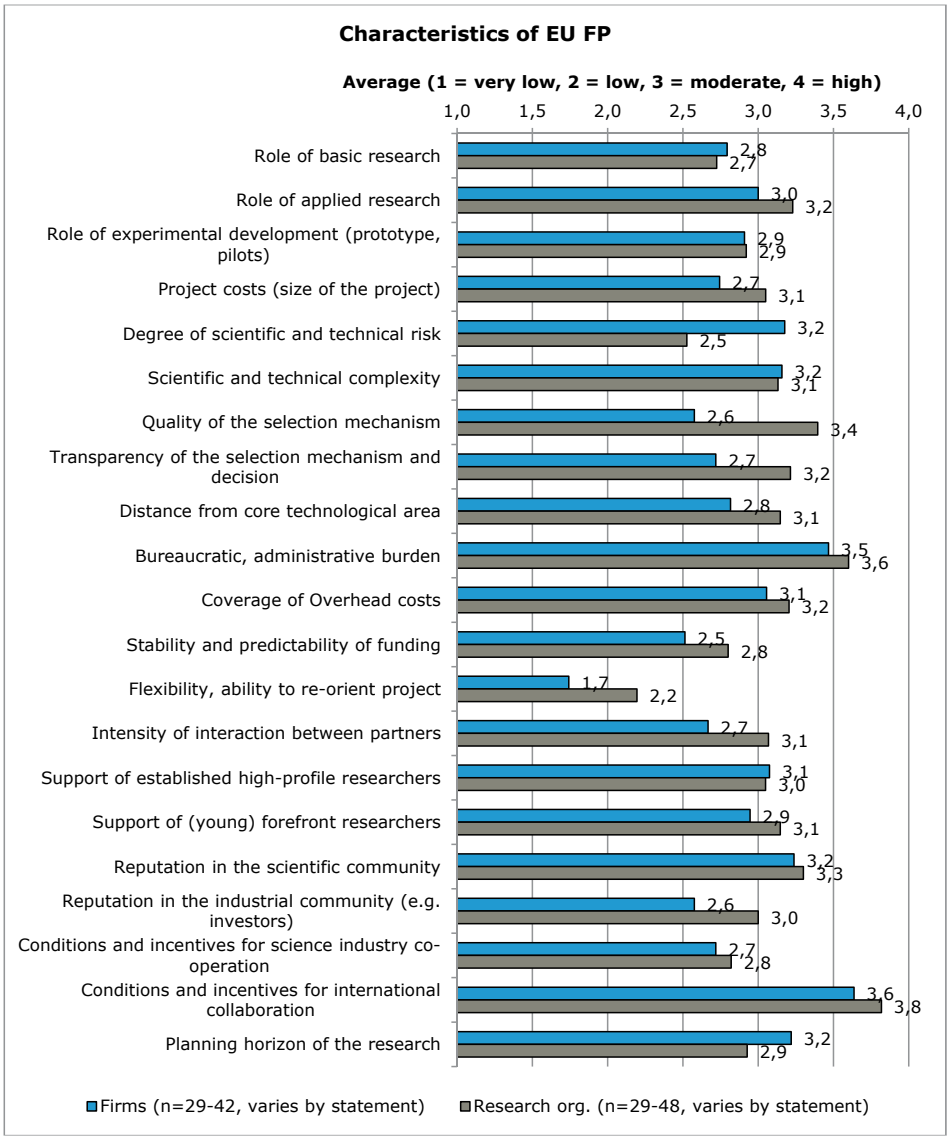

Agreement with statements related to needs and interests of science and industry (research respondents)
high
moderate
low
very low
0 %
25 %
50 %
75 %
100 %
The expectations of companies in the SHOK activity are over-optimistic in light of the long term perspective required in research (n=55)
42%
25%
18%
15%
The companies' and research organizations' interests are impossible to reconcile (n=45)
4%
18%
16%
62%
The SHOK meets the needs of industry through its programme focus. (n=55)
60%
31%
5%
4%

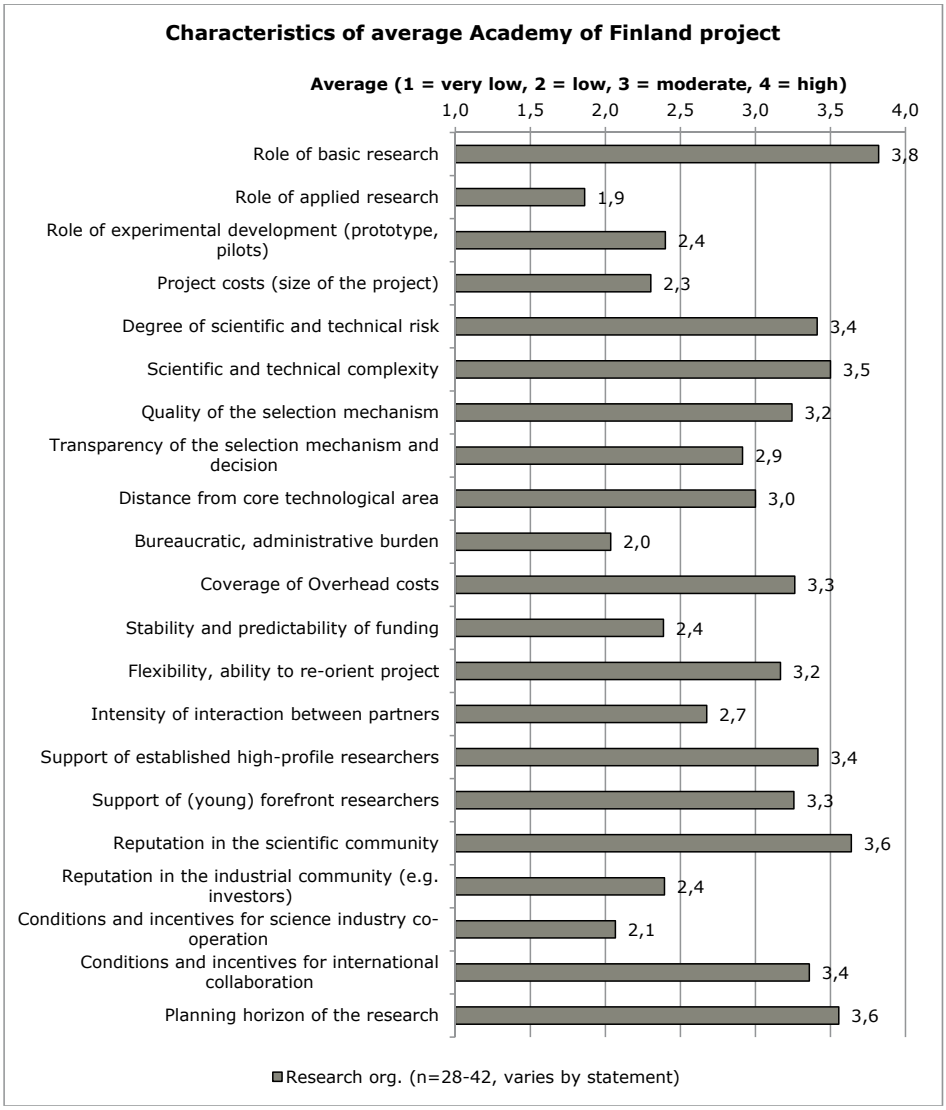

Agreement with statements related to SHOK procedures (research respondents)
high
moderate
low
very low
0 %
25 %
50 %
75 %
100 %
The SHOK has high-quality project selection mechanisms. (n=56)
38%
23%
20%
20%
The participation rules should have been more restrictive and exclusive (n=48)
19%
15%
21%
46%
The administrative rules and practices do now allow for internationalization of the SHOK (n=47)
32%
23%
15%
30%
The IPR issues have not been solved, which is reflected in the relatively modest outcomes. (n=43)
28%
16%
23%
33%

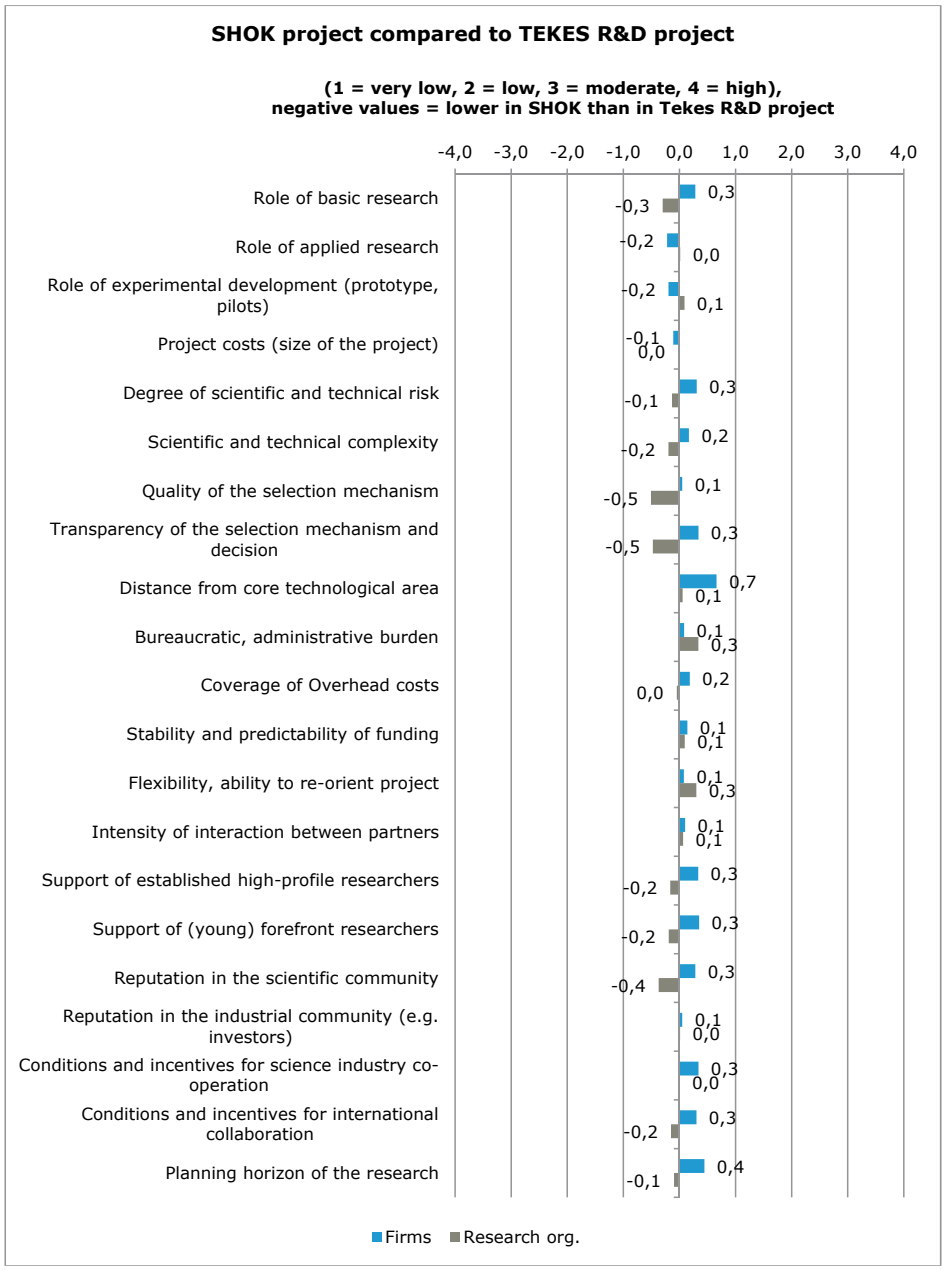

Agreement with statements related to SRA (research respondents)
high
moderate
low
very low
0 %
25 %
50 %
75 %
100 %
The general research aim and focus of the Strategic Research Agenda (SRA) is "cutting edge" and future oriented. (n=45)
40%
36%
18%
7%
The achievements of goals in the SRA within SHOK are realistic. (n=61)
56%
31%
10%
3%
The SRA has been adapted/is up-to-date to changes in business and operational environment (n=54)
57%
24%
15%
4%
The SRA is attractive to all relevant national partners active within the topic of SHOK. (n=57)
56%
26%
11%
7%
The SRA is attractive to all relevant international partners active within the topic of SHOK. (n=50)
38%
28%
18%
16%
The research agenda in your organization has been re-oriented towards the SRA of SHOK. (n=61)
39%
30%
8%
23%
The SRA is too broad, as it is impossible to successfully cover the whole spectrum of research from basic to applied. (n=53)
28%
21%
25%
26%
The SRA has failed because it has selected too traditional and established areas of research instead of genuinely new multidisciplinary combinations. (n=48)
23%
17%
21%
40%

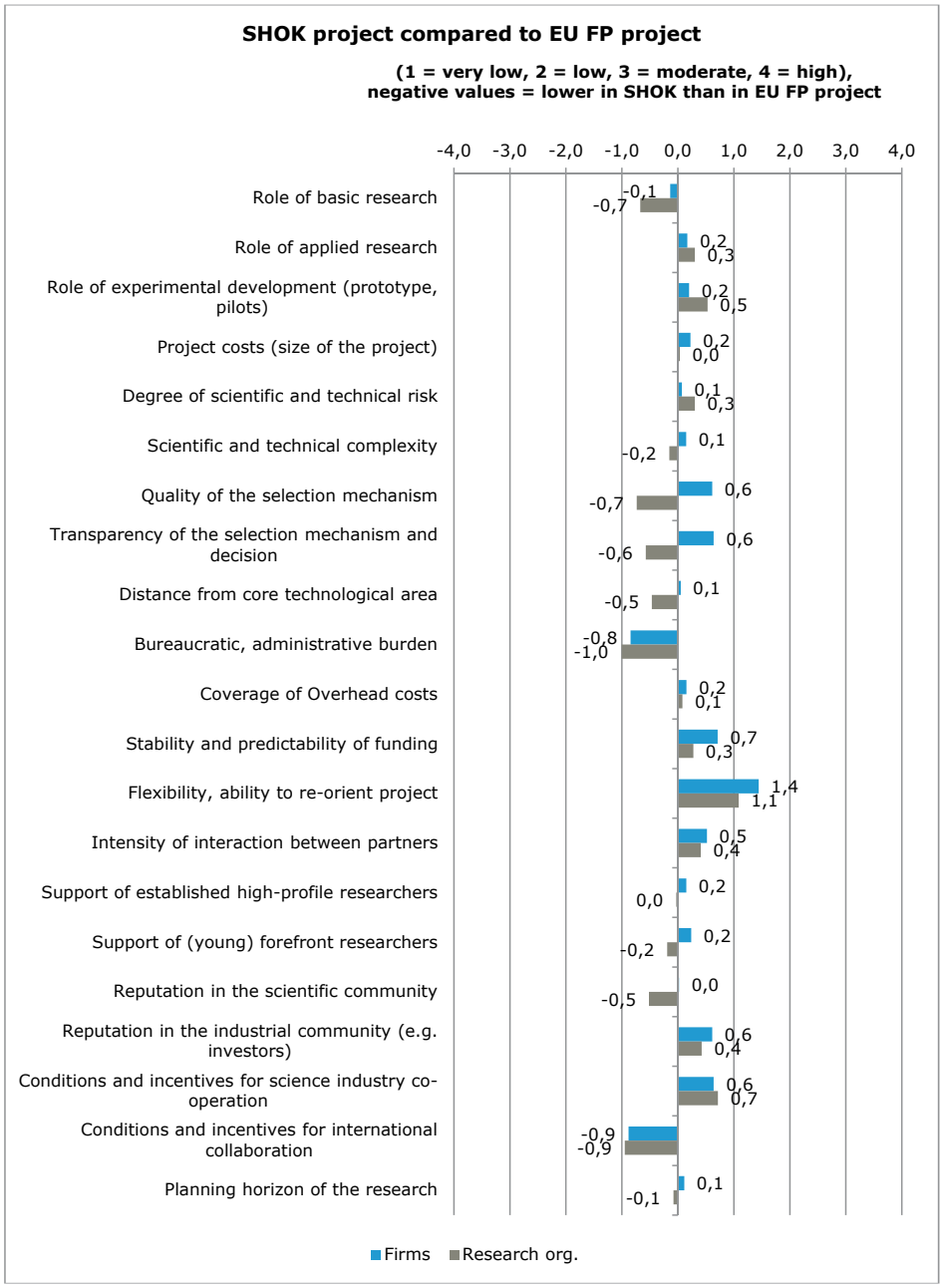

Characteristics of average SHOK project
Average (1 = very low, 2 = low, 3 = moderate, 4 = high)
1,0
1,5
2,0
2,5
3,0
3,5
4,0
Role of basic research
2,7
2,1
Role of applied research
3,2
3,5
Role of experimental development (prototype, pilots)
3,1
3,5
Project costs (size of the project)
3,0
3,1
Degree of scientific and technical risk
3,2
2,8
Scientific and technical complexity
3,3
3,0
Quality of the selection mechanism
3,2
2,7
Transparency of the selection mechanism and decision
3,4
2,6
Distance from core technological area
2,9
2,7
Bureaucratic, administrative burden
2,6
2,6
Coverage of Overhead costs
3,2
3,3
Stability and predictability of funding
3,2
3,1
Flexibility, ability to re-orient project
3,2
3,3
Intensity of interaction between partners
3,2
3,5
Support of established high-profile researchers
3,2
3,0
Support of (young) forefront researchers
3,2
3,0
Reputation in the scientific community
3,3
2,8
Reputation in the industrial community (e.g. investors)
3,2
3,4
Conditions and incentives for science industry co-operation
3,4
3,5
Conditions and incentives for international collaboration
2,8
2,9
Planning horizon of the research
3,3
2,8
Firms (n=95-144, varies by statement)
Research org. (n=38-56, varies by statement)

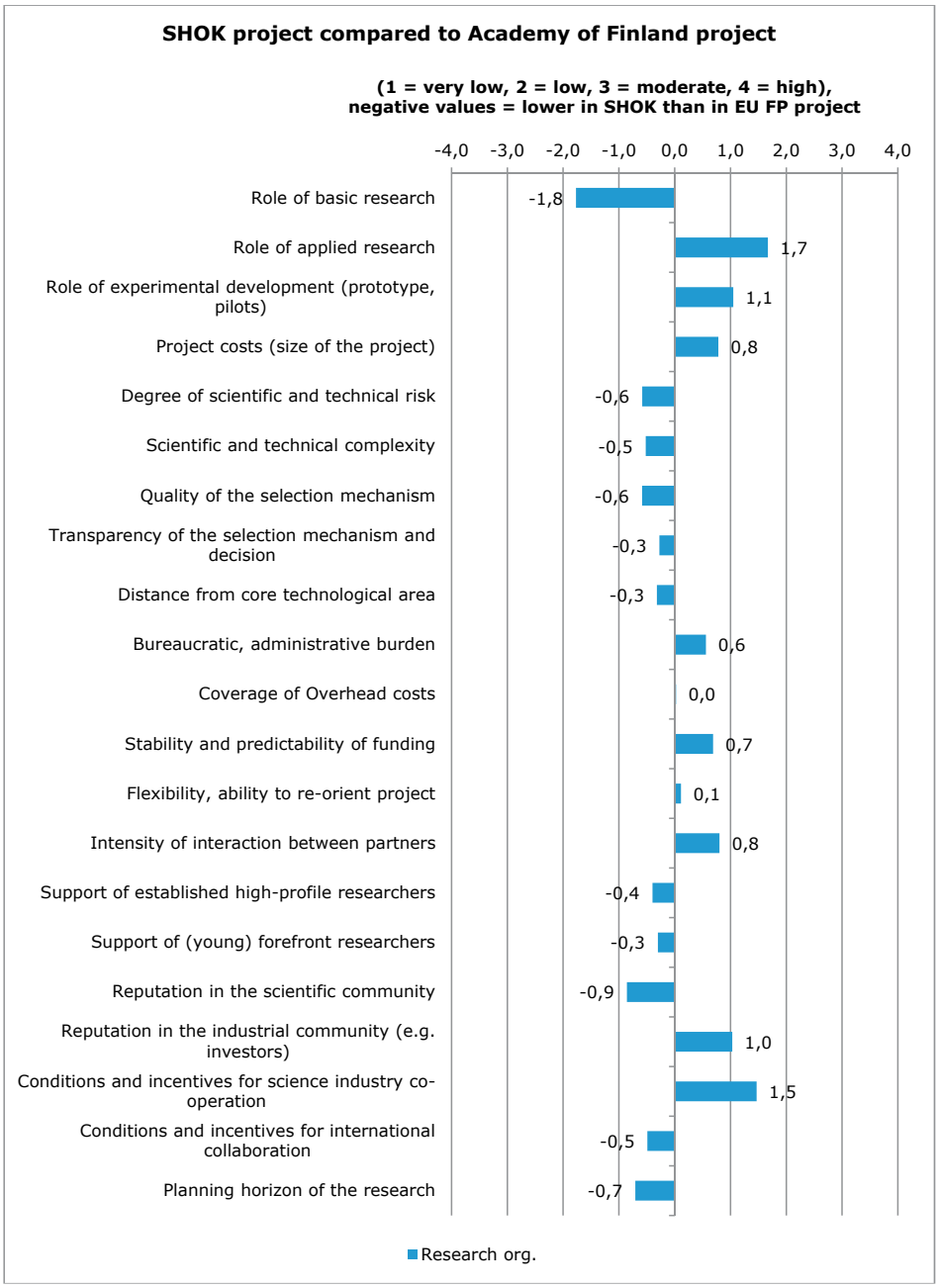

Characteristics of average TEKES R&D project
Average (1 = very low, 2 = low, 3 = moderate, 4 = high)
1,0
1,5
2,0
2,5
3,0
3,5
4,0
Role of basic research
2,4
2,4
Role of applied research
3,4
3,5
Role of experimental development (prototype, pilots)
3,3
3,4
Project costs (size of the project)
3,1
3,1
Degree of scientific and technical risk
2,9
3,0
Scientific and technical complexity
3,1
3,2
Quality of the selection mechanism
3,1
3,2
Transparency of the selection mechanism and decision
3,0
3,1
Distance from core technological area
2,2
2,6
Bureaucratic, administrative burden
2,5
2,3
Coverage of Overhead costs
3,0
3,3
Stability and predictability of funding
3,1
3,0
Flexibility, ability to re-orient project
3,1
3,0
Intensity of interaction between partners
3,1
3,4
Support of established high-profile researchers
2,9
3,2
Support of (young) forefront researchers
2,8
3,1
Reputation in the scientific community
3,0
3,2
Reputation in the industrial community (e.g. investors)
3,1
3,4
Conditions and incentives for science industry co-operation
3,0
3,5
Conditions and incentives for international collaboration
2,5
3,0
Planning horizon of the research
2,9
2,9
Firms (n=78-131, varies by statement)
Research org. (n=37-63, varies by statement)

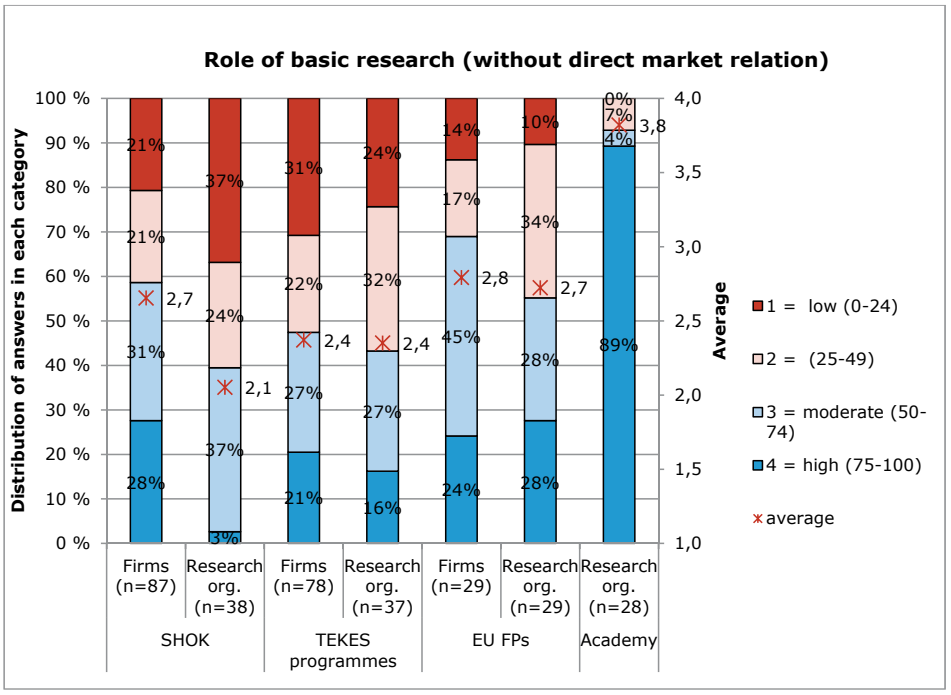

Characteristics of EU FP
Average (1 = very low, 2 = low, 3 = moderate, 4 = high)
1,0
1,5
2,0
2,5
3,0
3,5
4,0
Role of basic research
2,8
2,7
Role of applied research
3,0
3,2
Role of experimental development (prototype, pilots)
2,9
2,9
Project costs (size of the project)
2,7
3,1
Degree of scientific and technical risk
3,2
2,5
Scientific and technical complexity
3,2
3,1
Quality of the selection mechanism
2,6
3,4
Transparency of the selection mechanism and decision
2,7
3,2
Distance from core technological area
2,8
3,1
Bureaucratic, administrative burden
3,5
3,6
Coverage of Overhead costs
3,1
3,2
Stability and predictability of funding
2,5
2,8
Flexibility, ability to re-orient project
1,7
2,2
Intensity of interaction between partners
2,7
3,1
Support of established high-profile researchers
3,1
3,0
Support of (young) forefront researchers
2,9
3,1
Reputation in the scientific community
3,2
3,3
Reputation in the industrial community (e.g. investors)
2,6
3,0
Conditions and incentives for science industry co-operation
2,7
2,8
Conditions and incentives for international collaboration
3,6
3,8
Planning horizon of the research
3,2
2,9
Firms (n=29-42, varies by statement)
Research org. (n=29-48, varies by statement)

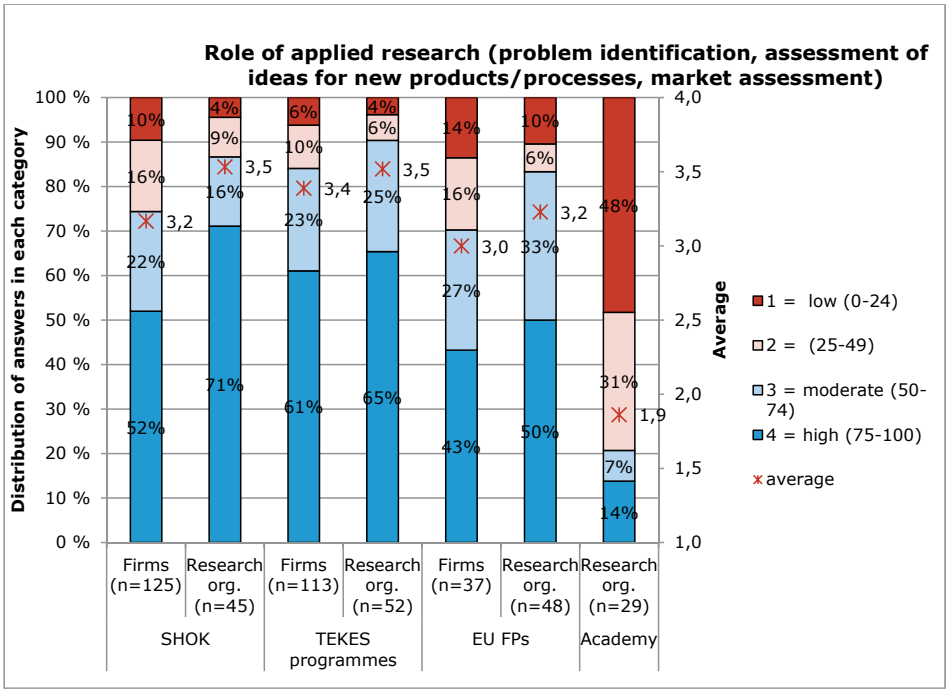

Characteristics of average Academy of Finland project
Average (1 = very low, 2 = low, 3 = moderate, 4 = high)
1,0
1,5
2,0
2,5
3,0
3,5
4,0
Role of basic research
3,8
Role of applied research
1,9
Role of experimental development (prototype, pilots)
2,4
Project costs (size of the project)
2,3
Degree of scientific and technical risk
3,4
Scientific and technical complexity
3,5
Quality of the selection mechanism
3,2
Transparency of the selection mechanism and decision
2,9
Distance from core technological area
3,0
Bureaucratic, administrative burden
2,0
Coverage of Overhead costs
3,3
Stability and predictability of funding
2,4
Flexibility, ability to re-orient project
3,2
Intensity of interaction between partners
2,7
Support of established high-profile researchers
3,4
Support of (young) forefront researchers
3,3
Reputation in the scientific community
3,6
Reputation in the industrial community (e.g. investors)
2,4
Conditions and incentives for science industry co-operation
2,1
Conditions and incentives for international collaboration
3,4
Planning horizon of the research
3,6
Research org. (n=28-42, varies by statement)

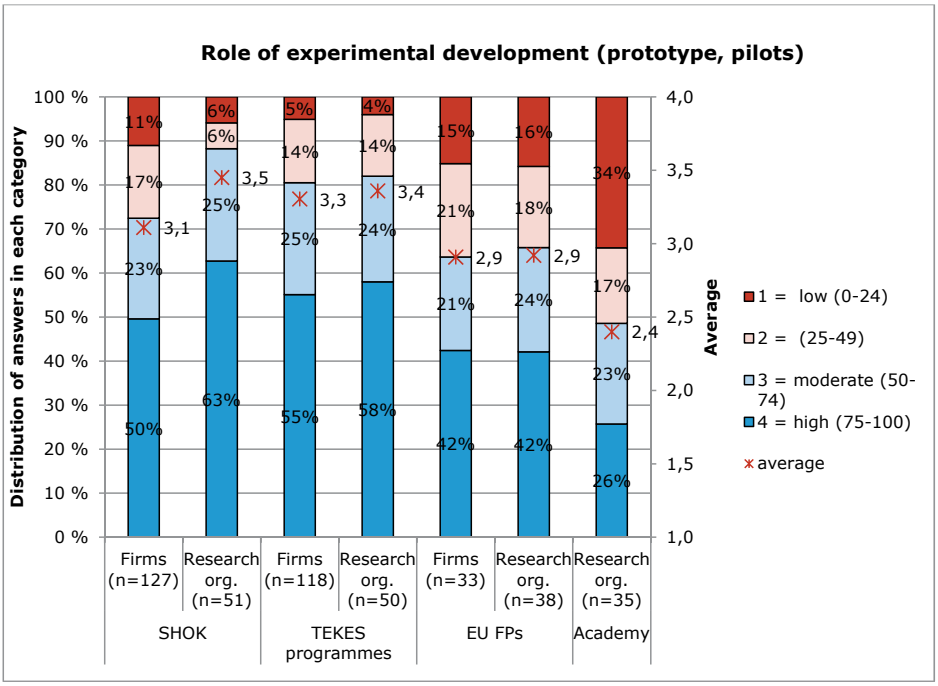

SHOK project compared to TEKES R&D project
(1 = very low, 2 = low, 3 = moderate, 4 = high),
negative values = lower in SHOK than in Tekes R&D project
-4,0 -3,0 -2,0 -1,0 0,0 1,0 2,0 3,0 4,0
Role of basic research 0,3 -0,3
Role of applied research -0,2 0,0
Role of experimental development (prototype, pilots) -0,2 0,1
Project costs (size of the project) -0,1 0,0
Degree of scientific and technical risk 0,3 -0,1
Scientific and technical complexity 0,2 -0,2
Quality of the selection mechanism 0,1 -0,5
Transparency of the selection mechanism and decision 0,3 -0,5
Distance from core technological area 0,7 0,1
Bureaucratic, administrative burden 0,1 0,3
Coverage of Overhead costs 0,2 0,0
Stability and predictability of funding 0,1 0,1
Flexibility, ability to re-orient project 0,1 0,3
Intensity of interaction between partners 0,1 0,1
Support of established high-profile researchers 0,3 -0,2
Support of (young) forefront researchers 0,3 -0,2
Reputation in the scientific community 0,3 -0,4
Reputation in the industrial community (e.g. investors) 0,1 0,0
Conditions and incentives for science industry co-operation 0,3 0,0
Conditions and incentives for international collaboration 0,3 -0,2
Planning horizon of the research 0,4 -0,1
Firms
Research org.

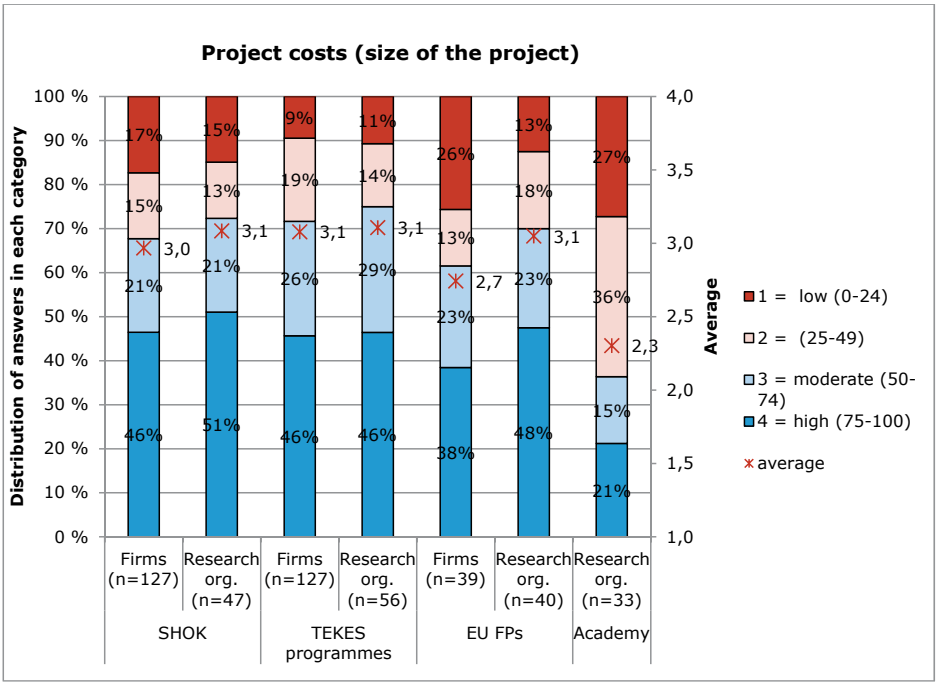

SHOK project compared to EU FP project
(1 = very low, 2 = low, 3 = moderate, 4 = high),
negative values = lower in SHOK than in EU FP project
-4,0 -3,0 -2,0 -1,0 0,0 1,0 2,0 3,0 4,0
Role of basic research
-0,1
-0,7
Role of applied research
0,2
0,3
Role of experimental development (prototype, pilots)
0,2
0,5
Project costs (size of the project)
0,2
0,0
Degree of scientific and technical risk
0,1
0,3
Scientific and technical complexity
0,1
-0,2
Quality of the selection mechanism
0,6
-0,7
Transparency of the selection mechanism and decision
0,6
-0,6
Distance from core technological area
0,1
-0,5
Bureaucratic, administrative burden
-0,8
-1,0
Coverage of Overhead costs
0,2
0,1
Stability and predictability of funding
0,7
0,3
Flexibility, ability to re-orient project
1,4
1,1
Intensity of interaction between partners
0,5
0,4
Support of established high-profile researchers
0,2
0,0
Support of (young) forefront researchers
0,2
-0,2
Reputation in the scientific community
0,0
-0,5
Reputation in the industrial community (e.g. investors)
0,6
0,4
Conditions and incentives for science industry co-operation
0,6
0,7
Conditions and incentives for international collaboration
-0,9
-0,9
Planning horizon of the research
0,1
-0,1
Firms
Research org.

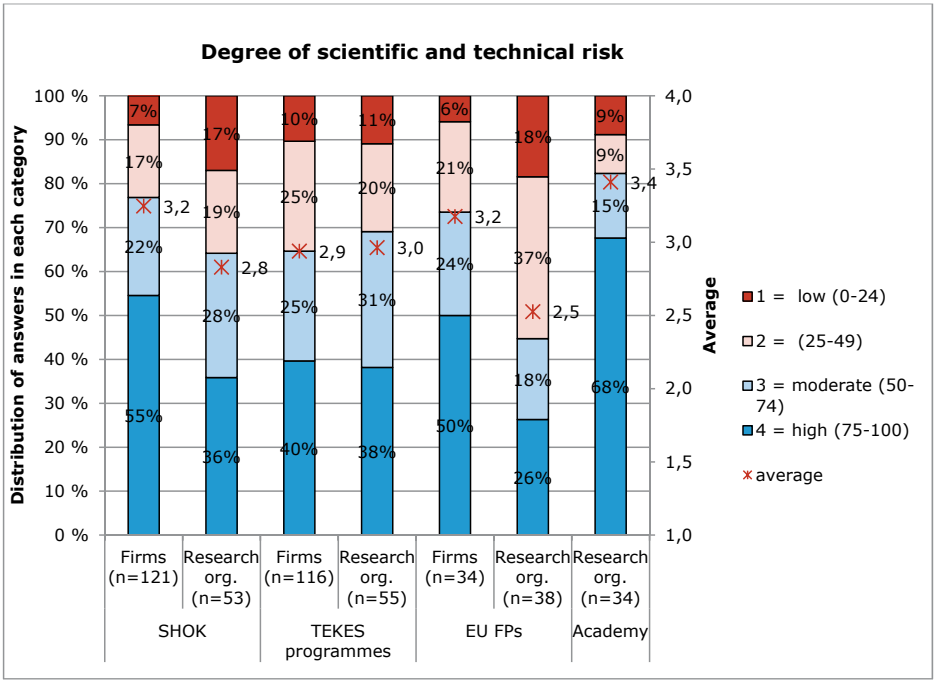

SHOK project compared to Academy of Finland project
(1 = very low, 2 = low, 3 = moderate, 4 = high),
negative values = lower in SHOK than in EU FP project
-4,0
-3,0
-2,0
-1,0
0,0
1,0
2,0
3,0
4,0
Role of basic research
-1,8
Role of applied research
1,7
Role of experimental development (prototype, pilots)
1,1
Project costs (size of the project)
0,8
Degree of scientific and technical risk
-0,6
Scientific and technical complexity
-0,5
Quality of the selection mechanism
-0,6
Transparency of the selection mechanism and decision
-0,3
Distance from core technological area
-0,3
Bureaucratic, administrative burden
0,6
Coverage of Overhead costs
0,0
Stability and predictability of funding
0,7
Flexibility, ability to re-orient project
0,1
Intensity of interaction between partners
0,8
Support of established high-profile researchers
-0,4
Support of (young) forefront researchers
-0,3
Reputation in the scientific community
-0,9
Reputation in the industrial community (e.g. investors)
1,0
Conditions and incentives for science industry co-operation
1,5
Conditions and incentives for international collaboration
-0,5
Planning horizon of the research
-0,7
Research org.

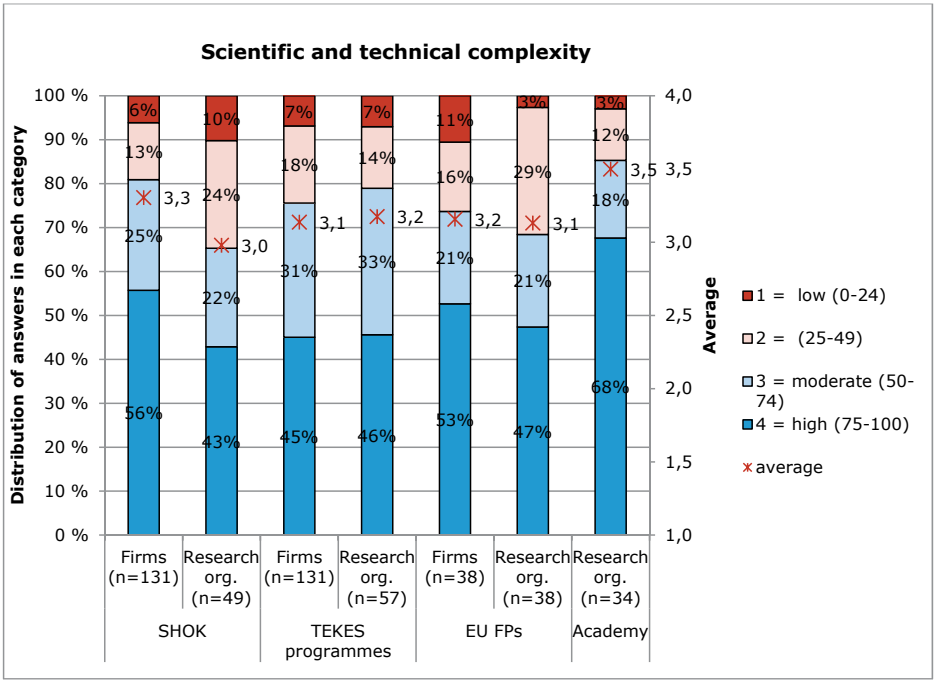

Role of basic research (without direct market relation)
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
21%
21%
31%
28%
2,7
37%
24%
37%
3%
2,1
31%
22%
27%
21%
2,4
24%
32%
27%
16%
2,4
14%
17%
45%
24%
2,8
10%
34%
28%
28%
2,7
0%
7%
4%
89%
3,8
Firms (n=87)
Research org. (n=38)
Firms (n=78)
Research org. (n=37)
Firms (n=29)
Research org. (n=29)
Research org. (n=28)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

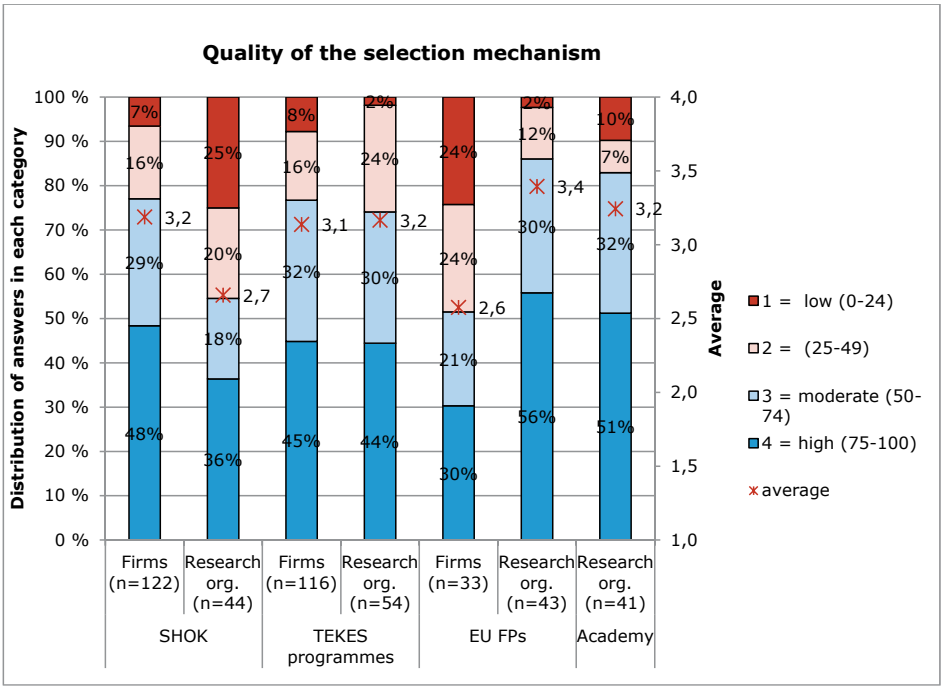

Role of applied research (problem identification, assessment of ideas for new products/processes, market assessment)
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
10%
16%
22%
52%
3,2
4%
9%
16%
71%
3,5
6%
10%
23%
61%
3,4
4%
6%
25%
65%
3,5
14%
16%
27%
43%
3,0
10%
6%
33%
50%
3,2
48%
31%
7%
14%
1,9
Firms (n=125)
Research org. (n=45)
Firms (n=113)
Research org. (n=52)
Firms (n=37)
Research org. (n=48)
Research org. (n=29)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

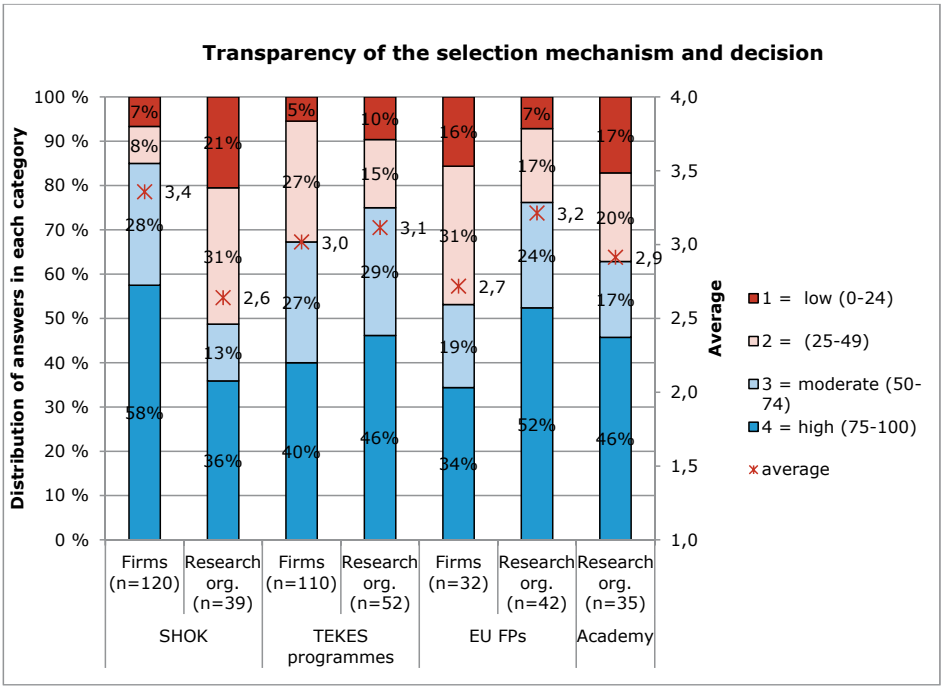

Role of experimental development (prototype, pilots)
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
11%
17%
23%
50%
3,1
6%
6%
25%
63%
3,5
5%
14%
25%
55%
3,3
4%
14%
24%
58%
3,4
15%
21%
21%
42%
2,9
16%
18%
24%
42%
2,9
34%
17%
23%
26%
2,4
Firms (n=127)
Research org. (n=51)
Firms (n=118)
Research org. (n=50)
Firms (n=33)
Research org. (n=38)
Research org. (n=35)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

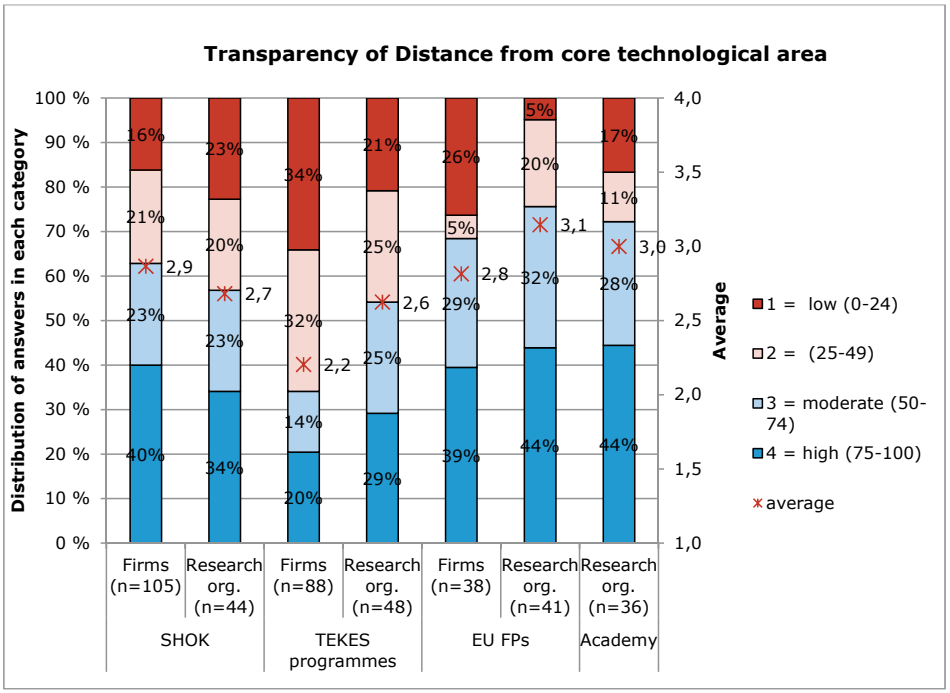

Project costs (size of the project)
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
17%
15%
21%
46%
3,0
15%
13%
21%
51%
3,1
9%
19%
26%
46%
3,1
11%
14%
29%
46%
3,1
26%
13%
23%
38%
2,7
13%
18%
23%
48%
3,1
27%
36%
15%
21%
2,3
Firms (n=127)
Research org. (n=47)
Firms (n=127)
Research org. (n=56)
Firms (n=39)
Research org. (n=40)
Research org. (n=33)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

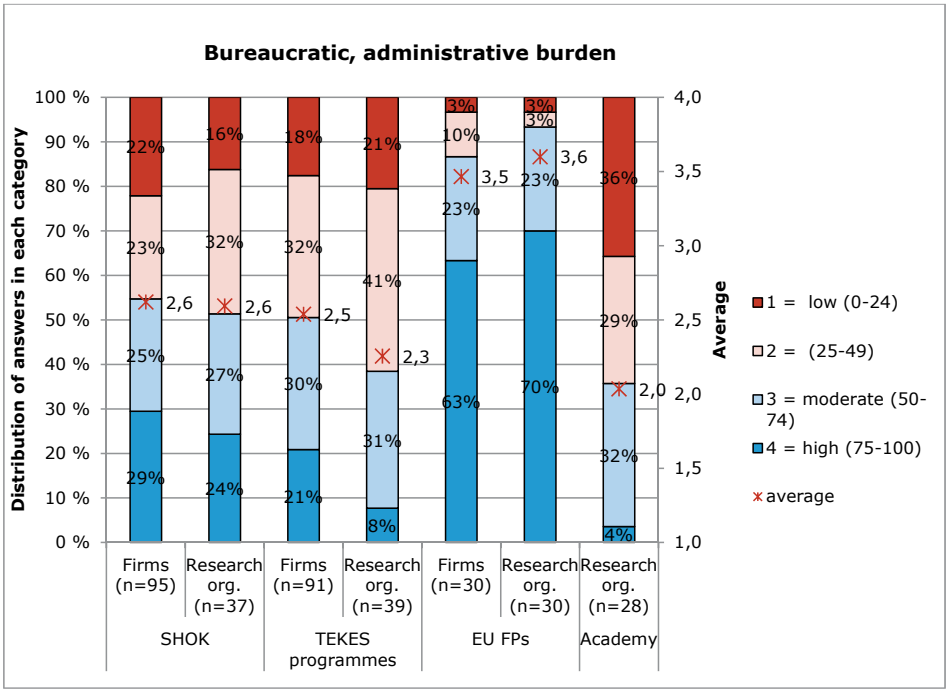

Degree of scientific and technical risk
Distribution of answers in each category
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
Average
7%
17%
22%
55%
3,2
17%
19%
28%
36%
2,8
10%
25%
25%
40%
2,9
11%
20%
31%
38%
3,0
6%
21%
24%
50%
3,2
18%
37%
18%
26%
2,5
9%
9%
15%
68%
3,4
Firms (n=121)
Research org. (n=53)
Firms (n=116)
Research org. (n=55)
Firms (n=34)
Research org. (n=38)
Research org. (n=34)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

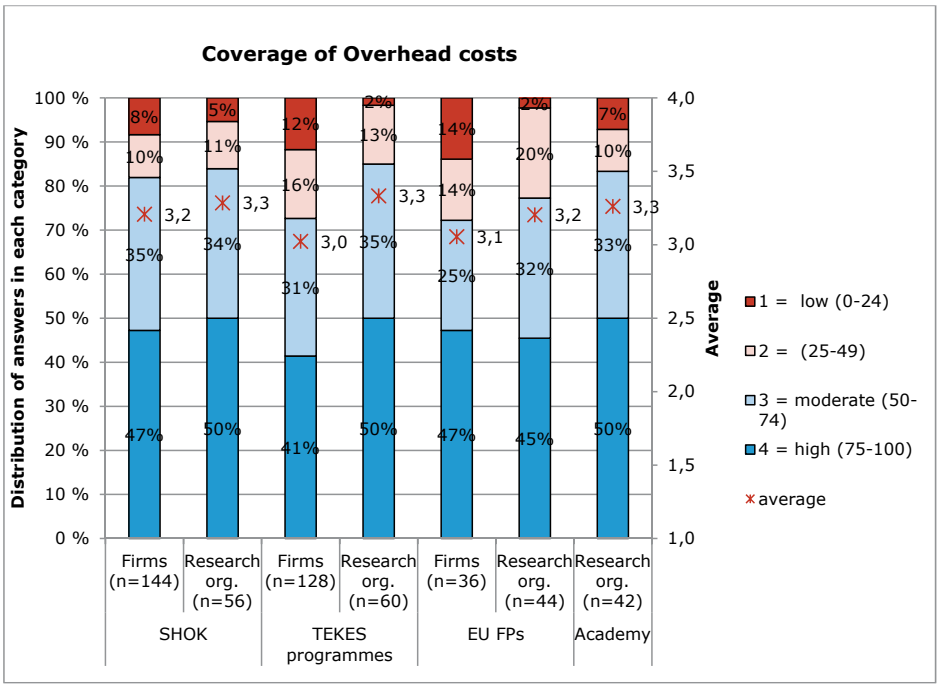

Scientific and technical complexity
Distribution of answers in each category
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
Average
6%
13%
25%
56%
3,3
10%
24%
22%
43%
3,0
7%
18%
31%
45%
3,1
7%
14%
33%
46%
3,2
11%
16%
21%
53%
3,2
3%
29%
21%
47%
3,1
3%
12%
18%
68%
3,5
Firms (n=131)
Research org. (n=49)
Firms (n=131)
Research org. (n=57)
Firms (n=38)
Research org. (n=38)
Research org. (n=34)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

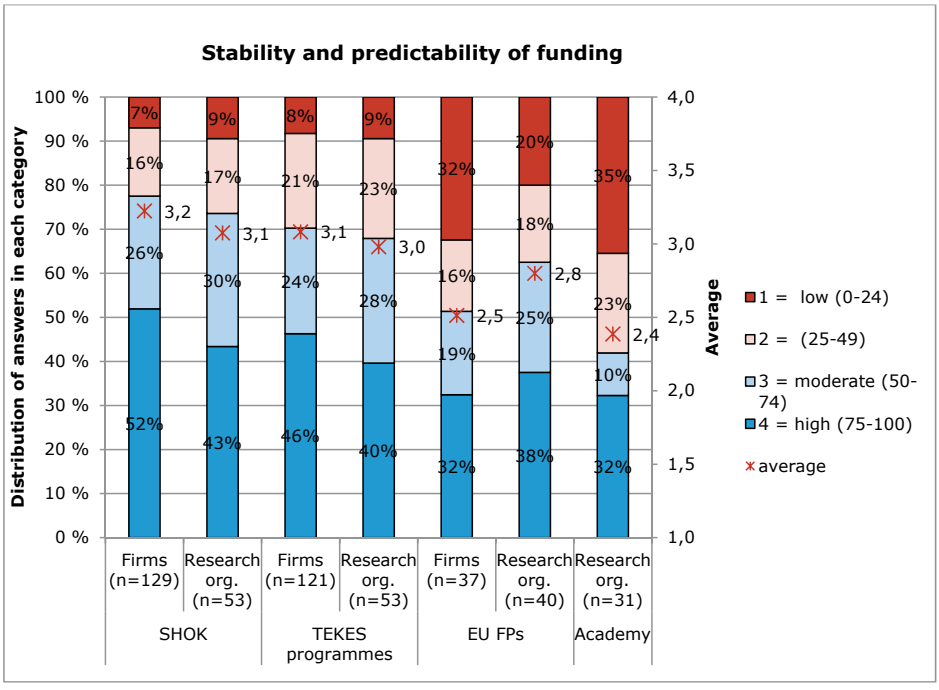

Quality of the selection mechanism
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
7%
16%
29%
48%
3,2
25%
20%
18%
36%
2,7
8%
16%
32%
45%
3,1
2%
24%
30%
44%
3,2
24%
24%
21%
30%
2,6
2%
12%
30%
56%
3,4
10%
7%
32%
51%
3,2
Firms (n=122)
Research org. (n=44)
Firms (n=116)
Research org. (n=54)
Firms (n=33)
Research org. (n=43)
Research org. (n=41)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

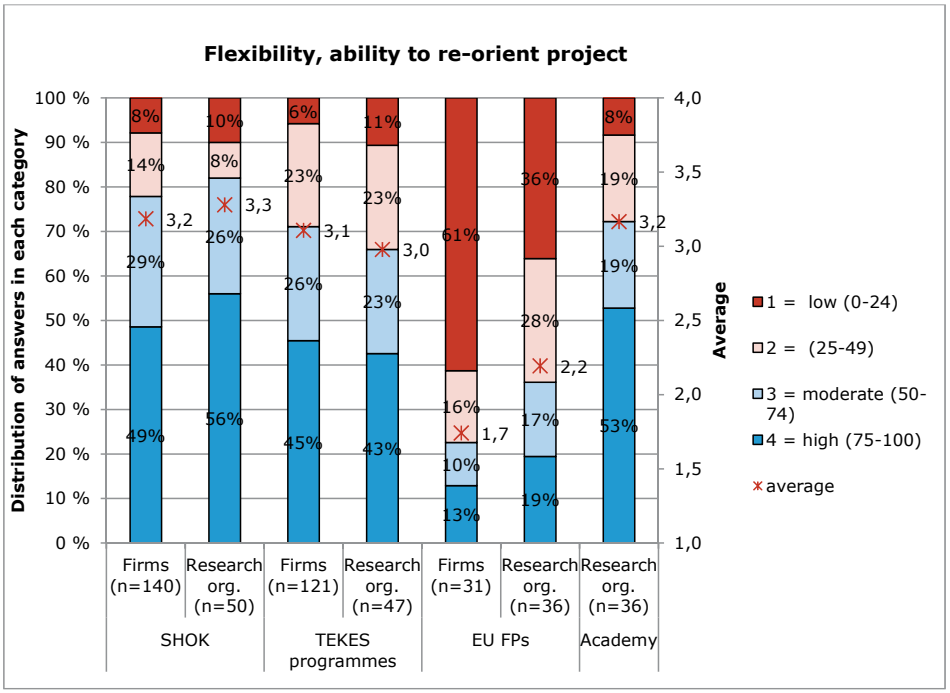

Transparency of the selection mechanism and decision
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
7%
8%
28%
58%
3,4
21%
31%
13%
36%
2,6
5%
27%
27%
40%
3,0
10%
15%
29%
46%
3,1
16%
31%
19%
34%
2,7
7%
17%
24%
52%
3,2
17%
20%
17%
46%
2,9
Firms (n=120)
Research org. (n=39)
Firms (n=110)
Research org. (n=52)
Firms (n=32)
Research org. (n=42)
Research org. (n=35)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

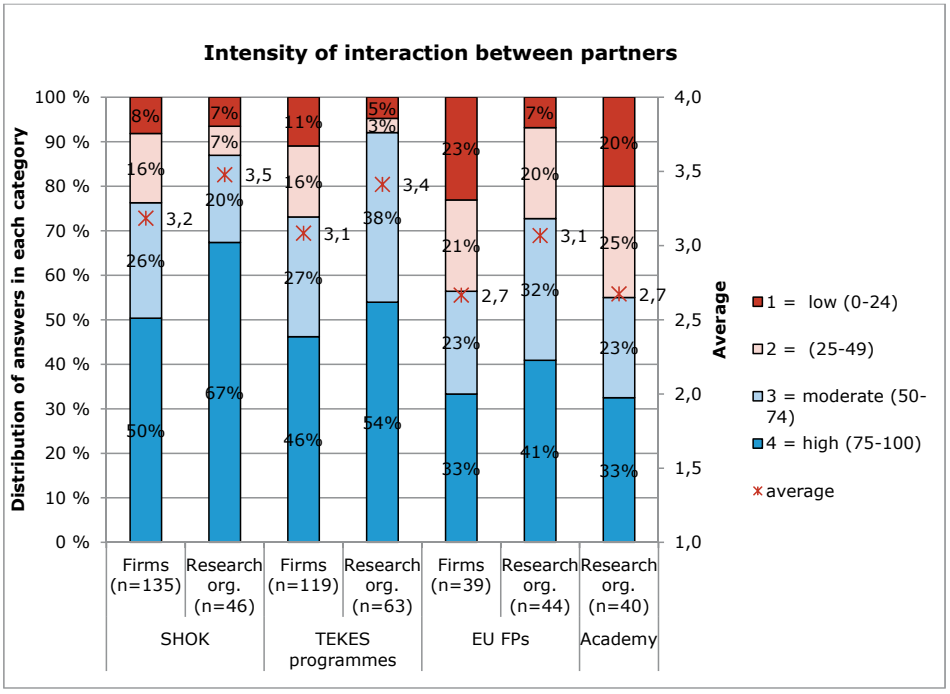

Transparency of Distance from core technological area
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
16%
21%
23%
40%
2,9
23%
20%
23%
34%
2,7
34%
32%
14%
20%
2,2
21%
25%
25%
29%
2,6
26%
5%
29%
39%
2,8
5%
20%
32%
44%
3,1
17%
11%
28%
44%
3,0
Firms (n=105)
Research org. (n=44)
Firms (n=88)
Research org. (n=48)
Firms (n=38)
Research org. (n=41)
Research org. (n=36)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

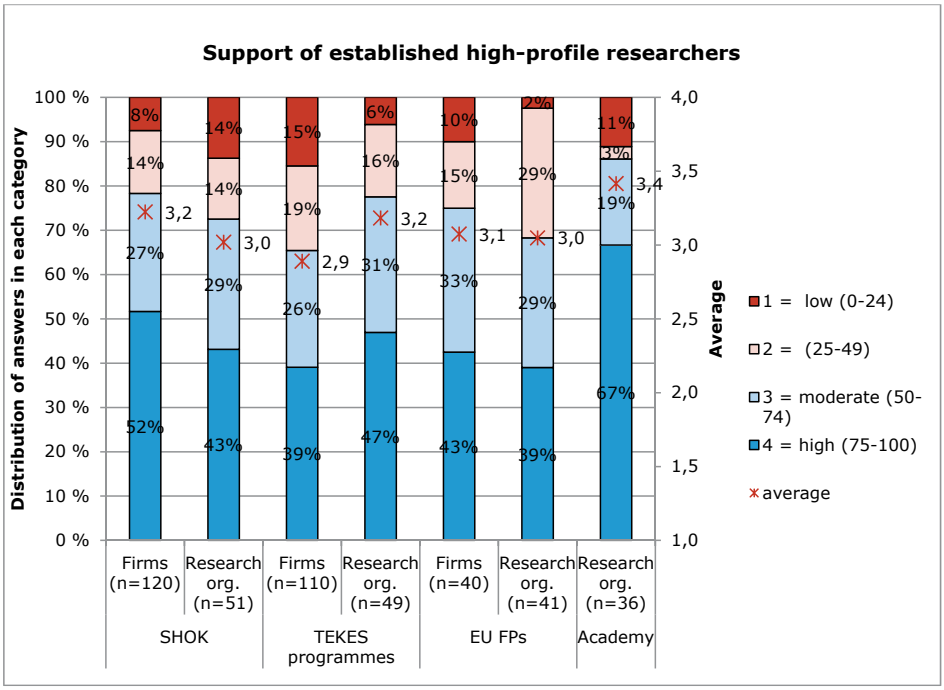

Bureaucratic, administrative burden
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
22%
23%
25%
29%
2,6
16%
32%
27%
24%
2,6
18%
32%
30%
21%
2,5
21%
41%
31%
8%
2,3
3%
10%
23%
63%
3,5
3%
3%
23%
70%
3,6
36%
29%
32%
4%
2,0
Firms (n=95)
Research org. (n=37)
Firms (n=91)
Research org. (n=39)
Firms (n=30)
Research org. (n=30)
Research org. (n=28)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

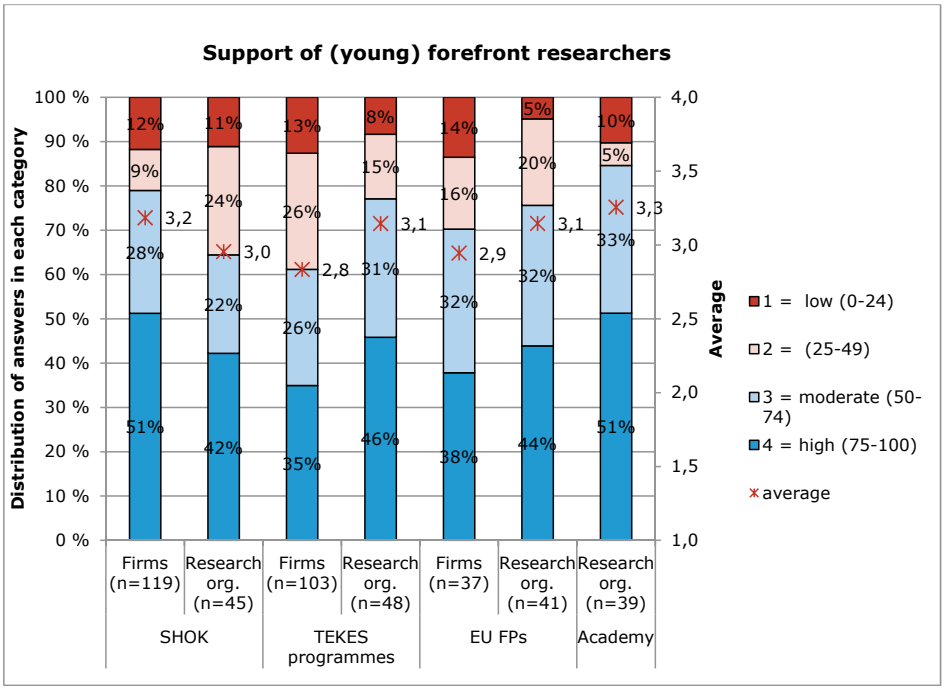

Coverage of Overhead costs
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
8%
10%
35%
47%
3,2
5%
11%
34%
50%
3,3
12%
16%
31%
41%
3,0
2%
13%
35%
50%
3,3
14%
14%
25%
47%
3,1
2%
20%
32%
45%
3,2
7%
10%
33%
50%
3,3
Firms (n=144)
Research org. (n=56)
Firms (n=128)
Research org. (n=60)
Firms (n=36)
Research org. (n=44)
Research org. (n=42)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

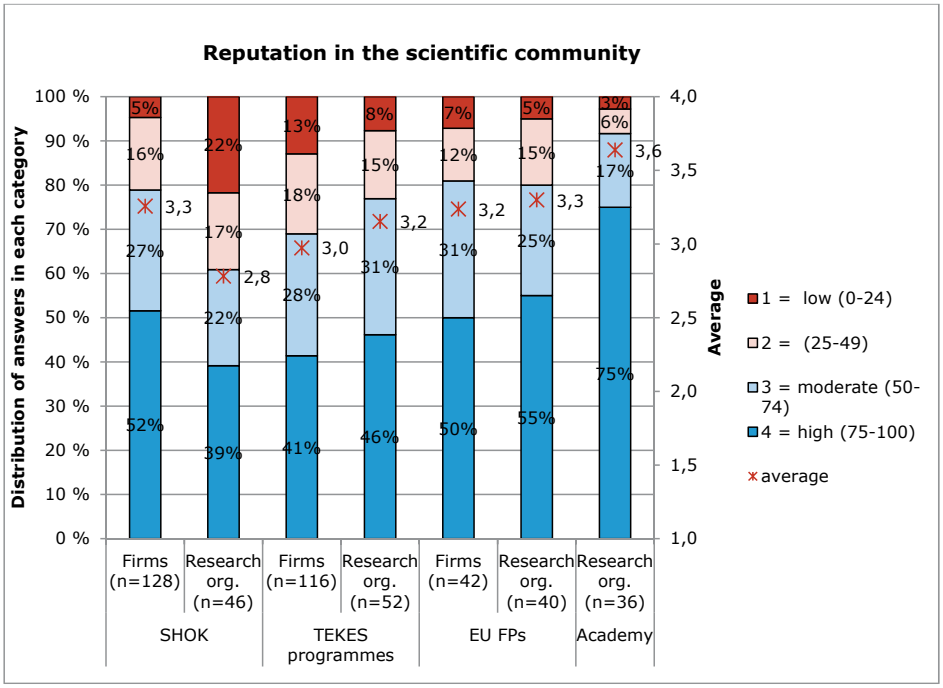

Stability and predictability of funding
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
7%
16%
26%
52%
3,2
9%
17%
30%
43%
3,1
8%
21%
24%
46%
3,1
9%
23%
28%
40%
3,0
32%
16%
19%
32%
2,5
20%
18%
25%
38%
2,8
35%
23%
10%
32%
2,4
Firms (n=129)
Research org. (n=53)
Firms (n=121)
Research org. (n=53)
Firms (n=37)
Research org. (n=40)
Research org. (n=31)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average

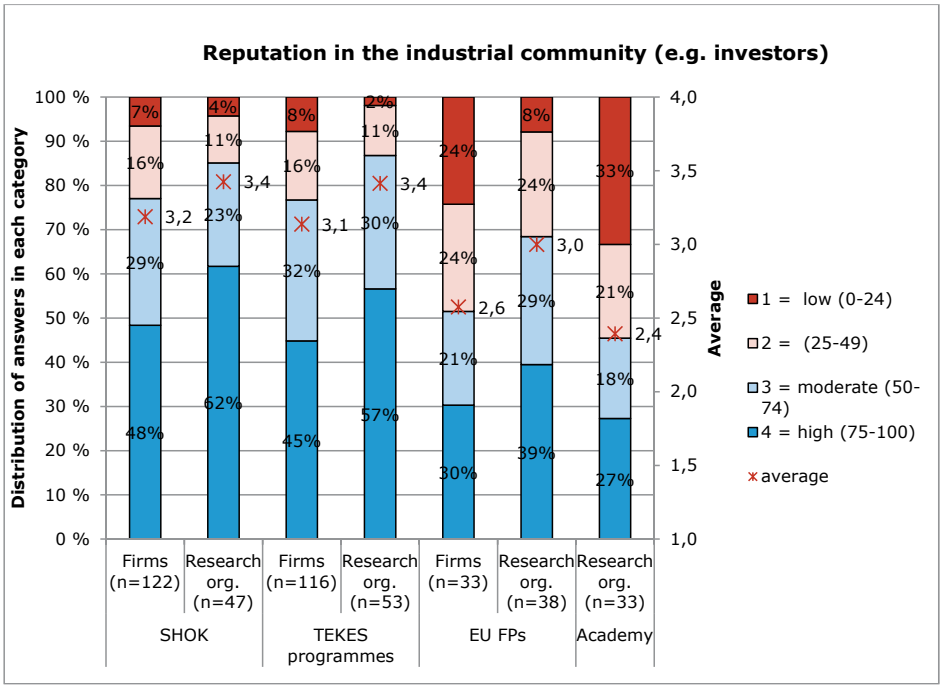

Flexibility, ability to re-orient project
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
8%
14%
3,2
29%
49%
10%
8%
3,3
26%
56%
6%
23%
3,1
26%
45%
11%
23%
3,0
23%
43%
61%
16%
1,7
10%
13%
36%
28%
2,2
17%
19%
8%
19%
3,2
19%
53%
Firms (n=140)
Research org. (n=50)
Firms (n=121)
Research org. (n=47)
Firms (n=31)
Research org. (n=36)
Research org. (n=36)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Intensity of interaction between partners
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
8%
16%
3,2
26%
50%
7%
7%
3,5
20%
67%
11%
16%
3,1
27%
46%
5%
3%
3,4
38%
54%
23%
21%
2,7
23%
33%
7%
20%
3,1
32%
41%
20%
25%
2,7
23%
33%
Firms (n=135)
Research org. (n=46)
Firms (n=119)
Research org. (n=63)
Firms (n=39)
Research org. (n=44)
Research org. (n=40)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Support of established high-profile researchers
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
8%
14%
27%
52%
3,2
14%
14%
29%
43%
3,0
15%
19%
26%
39%
2,9
6%
16%
31%
47%
3,2
10%
15%
33%
43%
3,1
2%
29%
29%
39%
3,0
11%
3%
19%
67%
3,4
Firms (n=120)
Research org. (n=51)
Firms (n=110)
Research org. (n=49)
Firms (n=40)
Research org. (n=41)
Research org. (n=36)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Support of (young) forefront researchers
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
12%
9%
28%
51%
3,2
11%
24%
22%
42%
3,0
13%
26%
26%
35%
2,8
8%
15%
31%
46%
3,1
14%
16%
32%
38%
2,9
5%
20%
32%
44%
3,1
10%
5%
33%
51%
3,3
Firms (n=119)
Research org. (n=45)
Firms (n=103)
Research org. (n=48)
Firms (n=37)
Research org. (n=41)
Research org. (n=39)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Reputation in the scientific community
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
5%
16%
27%
52%
3,3
22%
17%
22%
39%
2,8
13%
18%
28%
41%
3,0
8%
15%
31%
46%
3,2
7%
12%
31%
50%
3,2
5%
15%
25%
55%
3,3
3%
6%
17%
75%
3,6
Firms (n=128)
Research org. (n=46)
Firms (n=116)
Research org. (n=52)
Firms (n=42)
Research org. (n=40)
Research org. (n=36)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Reputation in the industrial community (e.g. investors)
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
7%
16%
29%
48%
3,2
4%
11%
23%
62%
3,4
8%
16%
32%
45%
3,1
2%
11%
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57%
3,4
24%
24%
21%
30%
2,6
8%
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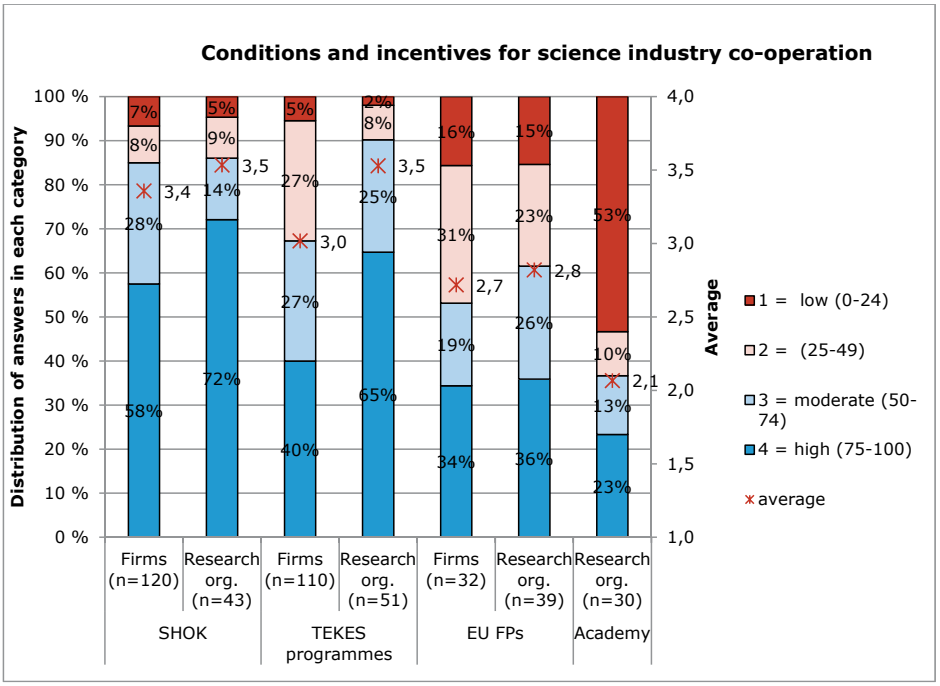
29%
39%
3,0
33%
21%
18%
27%
2,4
Firms (n=122)
Research org. (n=47)
Firms (n=116)
Research org. (n=53)
Firms (n=33)
Research org. (n=38)
Research org. (n=33)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Conditions and incentives for science industry co-operation
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
7%
8%
28%
58%
3,4
5%
9%
14%
72%
3,5
5%
27%
27%
40%
3,0
2%
8%
25%
65%
3,5
16%
31%
19%
34%
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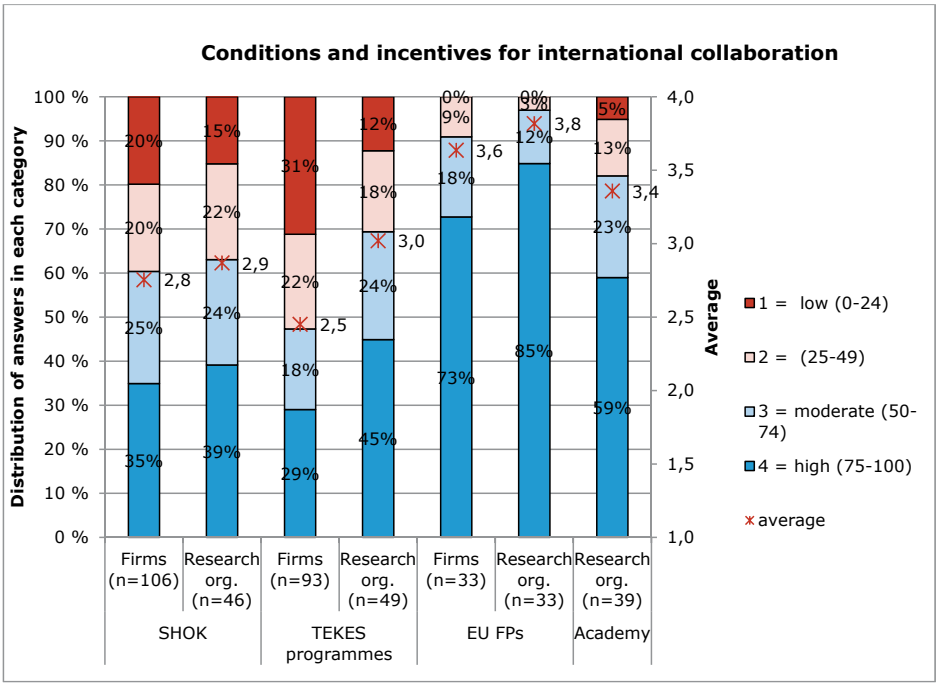
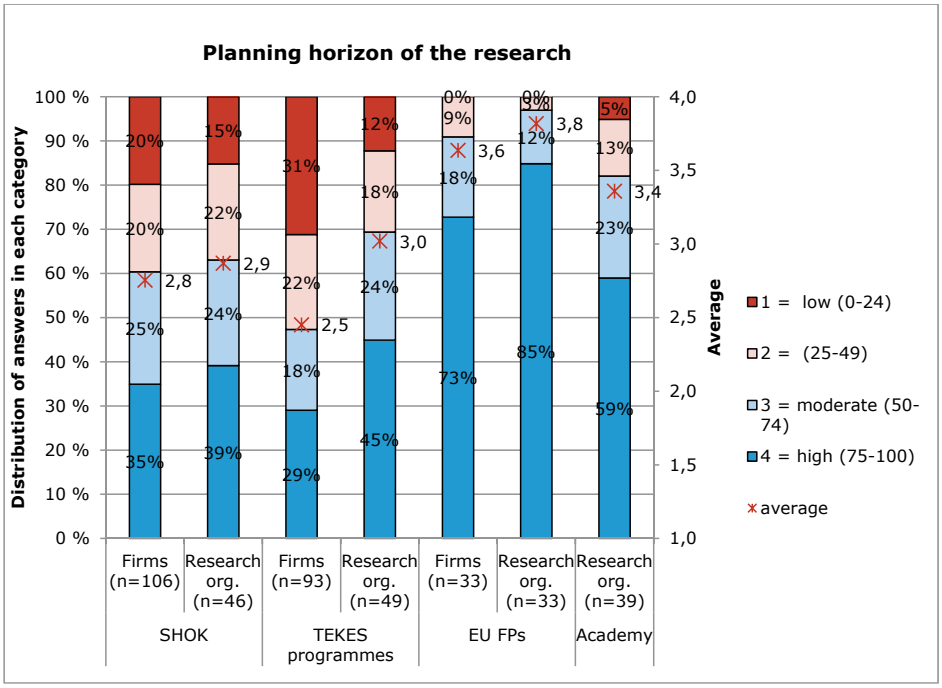
15%
23%
26%
36%
2,8
53%
10%
13%
23%
2,1
Firms (n=120)
Research org. (n=43)
Firms (n=110)
Research org. (n=51)
Firms (n=32)
Research org. (n=39)
Research org. (n=30)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Conditions and incentives for international collaboration
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
20%
20%
25%
35%
2,8
15%
22%
24%
39%
2,9
31%
22%
18%
29%
2,5
12%
18%
24%
45%
3,0
0%
9%
18%
73%
3,6
3%
12%
85%
3,8
5%
13%
23%
59%
3,4
Firms (n=106)
Research org. (n=46)
Firms (n=93)
Research org. (n=49)
Firms (n=33)
Research org. (n=33)
Research org. (n=39)
SHOK
TEKES programmes
EU FPs
Academy
1 = low (0-24)
2 = (25-49)
3 = moderate (50-74)
4 = high (75-100)
average


Planning horizon of the research
Distribution of answers in each category
Average
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
4,0
3,5
3,0
2,5
2,0
1,5
1,0
20%
20%
25%
35%
2,8
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22%
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39%
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31%
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2,5
12%
18%
24%
45%
3,0
0%
9%
18%
73%
3,6
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3%
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85%
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5%
13%
23%
59%
3,4
Firms (n=106)
Research org. (n=46)
Firms (n=93)
Research org. (n=49)
Firms (n=33)
Research org. (n=33)
Research org. (n=39)
SHOK
TEKES programmes
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Academy
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4 = high (75-100)
average

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Arbets- och näringsministeriets publikationer Innovationer 1/2013
MEE Publications Innovation 1/2013

Tekijät | Författare | Authors

Lähteenmäki-Smith Kaisa, Halme Kimmo, Lemola Tarmo, Piirainen Kalle, Viljamaa Kimmo, Haila Katri, Kotiranta Annu, Mari Hjelt, Tuomas Raivio, Polt Wolfgang, Dinges Michael, Ploder Michael, Meyer Susanne, Luukkonen Terttu, Georghiou Luke

Julkaisuaika | Publiceringstid | Date

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Ministry of Employment and the Economy

Toimielimen asettamispäivä | Organets tillsättningsdatum | Date of appointment

Julkaisun nimi | Titel | Title

”Licence to SHOK?” Strategisen huippuosaamisen keskittymien ulkoinen arviointi

Tiivistelmä | Referat | Abstract

Julkaisu tiivistää arvion suomalaisen tutkimus- ja innovaatiopolitiikan rahoitus- ja kehittämisvälineen ***strategisen huippuosaamisen keskittymien*** (SHOK) toiminnasta, organisoitumisesta ja tuloksellisuudesta.

Arvioinnin kohteena on kuusi yhtiömuotoista SHOK-keskittymää: Cleen Oy (energia- ja ympäristöala), FIMECC Oy (metallituotteet ja koneenrakennus), SalWe Oy (terveys- ja hyvinvointiala), TIVIT Oy (tieto- ja viestintäteollisuuden tutkimus), RYM Oy (rakennettu ympäristö) sekä FIBIC (biotalous, aiemmin metsäklusteri). Keskittymät on organisoitu osakeyhtiöiksi julkisen ja yksityisen sektorin välisten kumppanuuksien ympärille ja niiden tavoitteena on synnyttää uutta tietoa, vauhdittaa innovaatioprosesseja ja teollisuuden uudistumista hyödyntämällä yhteistyön, vuorovaikutuksen ja yhteiskehittämisen menetelmiä. Toiminnan on tarkoitus tukea myös kansainvälisesti kilpailukykyisten ja houkuttelevien innovaatioympäristöjen rakentamista Suomeen. SHOK tutkimus perustuu teollisuuden ja akateemisen yhteisön yhdessä määrittelemille tutkimusagendoille, joiden tavoitteena on vastata teollisuuden ja yhteiskunnan uudistustarpeisiin viidestä kymmeneen vuoden aikajänteellä.

SHOKien rahoituksesta noin 60% tulee Tekesistä ja 40% yrityksistä. Vuodesta 2008 vuoteen 2012 Tekes on rahoittanut SHOK-tutkimusohjelmia yhteensä noin 340 miljoonalla eurolla.

SHOK-toimintamalli on tervetullut yrityslähtöisen tutkimuksen edistäjä. Keskittymät ovat onnistuneesti muotoilleet omat tutkimusagendansa ja niiden toimeenpanossa tarjonneet innovaatio- ja tutkimuspolitiikalle uuden työvälineen. SHOK-tutkimustoiminnan kriteereissä tieteellinen laatu ja yritysrelevanssi kohtaavat. Keskittymien nykyiseen toimintamalliin liittyy haasteita, joihin arvioinnissa on ehdotettu parannuksia. Näitä ovat muun muassa SHOKien moninaiset ja osin keskenään ristiriitaiset tavoitteet, joiden selkeytymättömyys on haaste myös toiminnan ohjaukselle. Jännitteitä liittyy myös lyhyen aikajänteen yritystutkimuksen ja eturivin tieteellisen uraauurtavan tutkimuksen samanaikaiseen tavoitteluun. Keskittymien kansainvälistyminen on korkeista odotuksista huolimatta on jäänyt vähäiseksi.

Arvioinnin suosituksissa ehdotetaan täsmennyksiä myös keskittymien tavoitteisiin, valintaprosessiin, hallintomalliin, toimenpanoon ja seurantaan. Näistä keskeiset kehittämisehdotukset liittyvät SHOK toimintamallin tavoitteiden selkeyttämiseen, akateemisen tutkimusyhteisön nykyistä parempaan mukaan saaminen SHOK-toimintaan sekä olemassa olevien tutkimusrahoituksen instrumenttien laajempaa hyödyntämistä SHOK-toiminnassa.

Työ- ja elinkeinoministeriön yhdyshenkilö: Elinkeino- ja innovaatio-osasto/Marko Laiho, puh. +358 29 506 64215

Asiasanat | Nyckelord | Key words

Strategisen huippuosaamisen keskittymät, SHOK, innovaatiopolitiikka ja sen instrumentit

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Julkaisun nimi | Titel | Title

”Licence to SHOK?” Extern utvärdering av de strategiska centren för vetenskap, teknologi och innovation

Tiivistelmä | Referat | Abstract

Publikationen sammanfattar utvärderingen av de ***strategiska centren för vetenskap, teknologi och innovation*** (SHOK), som är ett finansierings- och utvecklingsinstrument för den finländska forsknings- och innovationspolitiken. Utvärderingen gällde centrens verksamhet, dess organisering och resultat.

Föremål för utvärdering var sex strategiska center i bolagsform: Cleen Oy (energi- och miljösektorn), FIMECC Oy (metallprodukter och maskinbyggnad), SalWe Oy (hälso- och välfärdssektorn), TIVIT Oy (forskning inom informations- och kommunikationsindustrin), RYM Oy (den byggda miljön) samt FIBIC (bioekonomi, tidigare skogsklustret). Centren har organiserats som aktiebolag runt partnerskap mellan den offentliga och den privata sektorn och deras mål är att ge upphov till ny kunskap, sätta fart på innovationsprocesserna och industrins förnyelse genom att utnyttja metoder för samarbete, växelverkan och samutveckling. Verksamheten avser också att bidra till att internationellt konkurrenskraftiga och attraktiva innovationsmiljöer byggs upp i Finland. SHOK-undersökningen baserar sig på forskningsagendor som industrin och det akademiska samfundet har fastställt tillsammans och som syftar till att svara på industrins och samhällets förnyelsebehov i ett tidsperspektiv mellan fem och tio år.

Cirka 60 % av centrens finansiering kommer från Tekes och 40 % från företag. Mellan åren 2008 och 2012 har Tekes finansierat SHOK-forskningsprogram med sammanlagt cirka 340 miljoner euro.

SHOK-modellen är en välkommen främjare av företagsorienterad forskning. Centren har på ett lyckat sätt utformat sina egna forskningsagendor och i genomförandet av dem gett innovations- och forskningspolitiken ett nytt verktyg. I kriterierna för SHOK-forskningen möts vetenskaplig kvalitet och företagsrelevans. Centrens nuvarande verksamhetsmodell är förknippad med utmaningar och i utvärderingen har föreslagits förbättringar för att de ska kunna bemötas. Det är fråga om bl.a. centrens många olika och delvis motstridiga mål, vars oklarhet är en utmaning också för styrningen av verksamheten. Spänningar uppstår också på grund av samtidig aspiration på kortsiktig företagsanalys och främsta banbrytande vetenskapliga forskning. Centrens internationalisering har trots höga förväntningar förblivit anspråkslös.

I rekommendationerna i utvärderingen föreslås också preciseringar av centrens mål, urvalsprocesser och förvaltningsmodell samt i genomförandet och uppföljningen. De viktigaste utvecklingsförslagen gäller förtydligande av målen i SHOK-modellen, en bättre integrering av den akademiska forskningen i verksamheten och ett större utnyttjande av de befintliga instrumenten för forskningsfinansieringen i centrens verksamhet.

Kontaktperson vid arbets- och näringsministeriet: Närings- och innovationsavdelningen, Marko Laiho, tfn 050 396 1322

Asiasanat | Nyckelord | Key words

Strategiska center för vetenskap, teknologi och innovation, SHOK, innovationspolitiken och dess instrument

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"Licence to SHOK?" – External Evaluation of the Strategic Centres for Science, Technology and Innovation

The report summarises the findings and recommendations of the evaluation of the Strategic Centres for Science, Technology and Innovation (SHOK). As the SHOKs are at different stages of maturity and in different fields, the intention of the evaluation has not been to compare or rank the six SHOK Centres in operation. The intention has rather been to assess each of them in light of how they have been able to operationalise the policy goals set on the concept level, as well as to assess their state of the art in relation to their Strategic Research Agendas (SRAs).

Part I contains the summary of conclusions and recommendations, both in English and in Finnish. Proposals are made to improve the accountability and effectiveness of the Centres. The recommendations also make concrete suggestions for SHOK governance, including the dialogue between the research and innovation organisations, in particular the Research and Innovation Council, SHOK Steering Group, Ministry of Employment and the Economy, Tekes and Academy of Finland, as well as the individual SHOK companies.

Part II reports the findings per SHOK, based on the documentary analysis, monitoring data, interviews and electronic survey. There are also summaries of the reports from the external evaluation panels that were convened to bring together expert assessment of the scientific quality of SHOK activities. The conclusions of the panel the relevance and level of attainment of the SHOKs, as well as proposing improvements to relevance, excellence, efficiency and effectiveness.

Part III summarises the key results of the electronic survey, reflecting the perceptions and experiences of SHOK stakeholders. In light of the survey SHOKs have succeeded in forming a strategic research agenda, and providing a platform for research collaboration. The impact of SHOKs to strategies of the participants varies greatly between the SHOKs.

In Part IV of the report, findings of the international benchmarking from Germany, Austria, Canada and EU level are presented.

Final two sections summarise the conclusions and recommendations.

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