Securing Australia's Future - Project 9
Translating research for economic and social benefit: country comparisons

Finland

A Study of Measures to Encourage the Translation of Public Sector Research for Economic and Social Benefit in Finland

Professor Ron Johnston FTSE
Australian Centre for Innovation

Suggested Citation
Johnston, R (2015). *A Study of Measures to Encourage the Translation of Public Sector Research for Economic and Social Benefit in Finland.* Report for Securing Australia's Future Project *"Translating research for economic and social benefit: country comparisons"* on behalf of the Australian Council of Learned Academies, www.acola.org.au.

Table of Contents

1. Introduction

Population: 5.4 million (2015)
GDP per capita: €29,100 (2012)
R&D intensity (GERD/GDP, %): 3.45 (2014)
Private sector share of R&D: 69% (2012)[1]

Finland, despite a small population, troubled history and challenging climate, has been recognised over the past decade as an outstanding economic performer. Over the past fifty years it has transformed from a farm/forest economy to a diversified modern industrial economy dominated by high and medium-high technology. Per capita income is among the highest in Western Europe. Exports accounted for over one-third of GDP in recent years. Finland is historically competitive in manufacturing - principally the wood, metals, engineering, telecommunications, and electronics industries. Finland excels in export of technology and the promotion of start-ups in the ICT, gaming, clean-tech, and biotechnology sectors. Except for timber and several minerals, Finland depends on imports of raw materials, energy, and some components for manufactured goods. Because of the climate, agricultural development is limited to maintaining self-sufficiency in basic products. Forestry, an important export earner, provides a secondary occupation for the rural population.

Finland had been one of the best performing economies within the EU before 2009 and its banks and financial markets avoided the worst of global financial crisis. However, the world slowdown hit exports and domestic demand hard in that year, with Finland experiencing one of the deepest contractions in the euro zone. A recovery of exports, domestic trade, and household consumption stimulated economic growth in 2010-12. However, continued recession within the EU dampened the economy in 2012-14. It has an industrial structure.[2]

Finland's STI system has been highly ranked in international comparisons over many years. Its economy is open and its businesses have good international links, although its research system is largely domestic. It is regularly placed in the top five of the Global Innovation Index.[3]At 3.55% of GDP in 2012, BERD is well above the OECD median. Finland has a strong and sustained performance in ICT, and has improved in emerging and environmental technologies over the past decade, though these are still below the OECD medians. There are strong links between industry and science, and much public research is funded by industry. International co-operation in science and innovation is mixed: 50% of scientific articles, slightly above the OECD median, but 19% of PCT patents, below the OECD median, are produced with foreign counterparts. Human capital indicators are sound, with 38% of the adult population tertiary-qualified and 37% of persons employed in S&T occupations. Finland leads the OECD with 23 researchers per thousand employees.[4]

In September 2013, the Finnish government adopted a Resolution on Comprehensive Reform of State Research Institutes and Research Funding, which focused on building up multidisciplinary, high-level research of significant societal relevance and research in support of government decision making. The resolution covered reorganisation of PRIs, reallocation of some public research funding to competitive research funding, and creation of a new, strategic research funding instrument within the Academy of Finland to support long-term research on challenges facing Finnish society.[5] A new funding model for

universities was introduced in 2013, with greater emphasis on quality, effectiveness and internationalisation, and strategic funding to support universities' profiles and their diversity has been increased. The new funding model is to be reviewed in 2015.

In 2014, The Research and Innovation Policy Council conducted a policy review which set the directions for policies to 2020.[6] Noting the many challenges of long-term uncertainty in the global economy, together with Finland's dimming economic outlook, they have argued for significant change to revive confidence in Finland as an innovation-driven economy. Key elements of their argument are:

> "Raising the quality of education and research plays a key role in sustainable competitiveness. Higher education institutions will be reformed by determined efforts to terminate overlapping programmes and through closer cooperation with government research institutes and economic life. A crucial question revolves around either developing the current higher education system (dual model) or discontinuing separate higher education sectors. The structural reform of universities must progress without delay. Universities need to have globally visible profiles. It must be decided what to do, what to invest in and what to give up. At the same time, internationally attractive clusters of expertise will be created and supported and joint public and private sector development measures will be implemented.
>
> The exploitation and societal impact of R&I results will be enhanced. Higher education institutions, government research institutes and companies will adopt new methods that support the exploitation of research results and create working practices and incentives to support their closer cooperation with each other. A brisk change in the operating culture and attitudes of all actors is expected. Models should also be found for the further development and commercialisation of usable ideas that companies have not utilised. The R&I knowledge base, and methods for measuring and evaluating the impacts of R&I, will be developed to serve decision-making and to guide actors in the innovation system.
>
> The ingredients of new growth will be created through specialisation. Success will be based on R&D-driven expertise that exploits intangible capital. Intangible value creation, bioeconomy, clean-tech and digitalisation will offer Finland new opportunities for growth. The public sector will take on a new role as an active promoter and exploiter of innovations. In addition to horizontal, inter-administrative development measures, this will require changes in the practices, statutes and competence of public actors. The innovation system must provide incentives for new initiatives, experiments, innovations and (growth) entrepreneurship. The structure of business life will be diversified, and continuous renewal of companies will be supported. The capital market for start-ups and growth enterprises will be boosted by public measures.
>
> R&D funding will be increased in response to international competition, emphasising the regeneration of the Finnish economy, knowledge base and employment. This carries an important message about the Government's commitment to developing a society based on knowledge and expertise."[7]

The extent of the challenge is reflected in their analysis of their current position:

Strengths

- Operating environment
  - Political stability; a safe and reliable environment for people and enterprises
  - A reliable public sector and good governance; a well-functioning regulatory environment
  - Social capital; openness, trust, interaction, networking
  - An anticipatory approach to major social and environmental challenges

- Knowledge
    - An effective educational system; a high educational level of the population; lifelong learning; plenty of R&D personnel
    - Equality in education and working life
- R&I activities and policy
    - R&D investments remain high by international comparison
    - Public-private partnerships, companies cooperating with universities and polytechnics
    - Research with a relatively high quality and impact
    - A strong evaluation culture
    - A large number of international patents

Weaknesses

- Internationalisation
    - Small number of foreign students, researchers and experts
    - Low volume of foreign direct investments and international R&D funding
- A limited domestic market; scarcity of capital
- Finland's exports are dominated by large companies and rest on a narrow base; shrinking role of high technology
- Relatively low level of R&D and patents in sectors outside ICT
- Low volume of exports of knowledge-intensive services and creative industry products
- Lack of vision: companies fail to notice opportunities for growth
- Holding on to old structures; lack of know-how in how to dismantle units and functions and renew through reallocating resources
- Universities and polytechnics do not have internationally visible profiles in their areas of strength; higher education institutions' resources are still often scattered into small units
- Difficulties in the overall development of the innovation system and the implementation and governance of horizontal R&I policy

Opportunities

- Improving quality, risk-taking and experiments in R&I
- Enhancing the impact of research, promoting demand for innovations by public measures
- Skilful foresight; creating a continuous multilateral foresight process within the R&I policy domain
- Choices and prioritisation; combining and reallocating resources
    - Continuation of the reform of the structures and activities of public education and research organisations
- Promoting growth entrepreneurship and skills and funding related to it; providing support for the internationalisation of companies
- High quality education and working life skills
    - Scaling and needs-driven orientation of education
    - developing researcher training and researcher careers
- Digitalisation: wide exploitation of ICT competence and public data reserves in society, in companies and at the individual level
- Specialisation in knowledge-intensive growth sectors (including the environment, energy, clean-tech, safety and security, wellbeing)

Threats

- Continuously declining R&D expenditure of companies and the public sector
- Dropping standard of knowledge, crumbling of wellbeing based on high quality expertise
- Finland loses its position and attraction in the key fields of science and business compared to competitors

- Traditional areas of strength continue to lose their foothold in the global market, and adequate numbers of growth sectors and enterprises cannot be found to replace them
- Inefficient response to great social and economic challenges; shortcomings in strategic cooperation and coordination between branches of administration
- Finland's international cooperation becomes marginalised, small-scale and low in potential
- Radical changes in the operating environment:
    - Finland becomes excluded in the global economy; high added-value production fades out, slow recovery of the global economy
    - The EU is driven into a social and economic crisis
    - increasing public debt and growing costs of an ageing population
    - Finnish labour force is insufficient to guarantee growth
    - introversion: failure to join international cooperation initiatives, society fails to become more open[8]

However, at least as expressed in this report, the initiatives are largely aspirational, with no detail of how they are to be achieved. Thus:

> "There is scope for improvement in recognizing and taking up possibilities of developing further the research results of higher education institutions and government research institutes. The challenge of exploiting the results partly lies in the structures, but even more so, in operating methods and a lack of skills, incentives and a supportive atmosphere. Public research organisations and, in particular, large enterprises generate usable ideas that remain unexploited. Their wider utilisation is an important objective.
>
> - Promoting the exploitation of new knowledge and expertise will be included in the funding criteria of universities and polytechnics.
> - Measurements and evaluations will be developed to demonstrate the impact of research. In the future, information about impact will be used to target the funding of higher education institutions.
> - Their efforts to develop impact evaluation methods with higher education institutions and government research institutes, also internationally. Higher education institutions and the Academy of Finland will develop their data collection and reporting practices to demonstrate the impact of their activities.
> - The relevant ministries will work together to prepare an act on inventions made in higher education institutions, which will contain provisions that promote the exploitation of results.
> - Research organisations will improve their business skills. Higher education institutions will set up joint service units that combine their expertise and resources (including technology transfers). They will improve the researchers' skills in exploiting their results and the identification and further development of R&D results that lend themselves to further application. We need measures for facilitating the open supply of R&D results and, in particular, encourage SMEs to exploit the results more actively.
> - Higher education institutions will encourage entrepreneurship. Fixed-term arrangements will be put in place that makes it possible for a researcher to try out entrepreneurism and then return to his or her prior role.
> - More effective commercialisation of research results will be ensured by means of dialogue between higher education institutions, businesses and industries, VTT Technical Research Centre of Finland and ministries. The objective is to generate a support and service unit for the commercialisation of research that has strong expertise and resources.
> - The process of translating R&D results into start-ups will be facilitated by creating funds that invest in R&D spin-offs and operate on the interface between research and business. These funds could involve higher education institutions, VTT, Finnish and foreign business angels, funds and other financiers.

- The Academy of Finland and Tekes will work more closely together. For example, by using international experts, an experiment for identifying innovation opportunities among projects funded by the Academy of Finland will be carried out, links between research and innovation will be strengthened by means of programme activities, and interaction will be intensified in international cooperation."[9]

2. Tekes – the Finnish Funding Agency for Innovation

Tekes has primary responsibility for promoting innovation, including commercialisation of public sector research, in Finland. It has a long history - Tekes partnership programs have supported R&D involving businesses and research groups since 1983. Tekes describes itself as "an active game builder bringing about renewal in the business sphere". [10] Tekes does not see itself as a funding agency. Rather it is a highly interventionist intermediary which uses its resources to shape knowledge-based business.[1]

Tekes' mission is to promote the development of industry and services by means of technology, innovations and growth funding. This is designed to help to renew industries, increase the value added and productivity, improve the quality of working life, as well as boost exports and generate employment and wellbeing.

Tekes programs are used as funding instruments to direct the national research and development efforts of enterprises, research institutions and universities into selected technologies, priority themes or similar missions. Compared with broad, openly managed research programs and networks, Tekes programs are in principle target- or mission-oriented schemes.

It is important to note that Tekes programs are not generated by a centralised strategic planning mechanism. Rather initiatives for new programs come from universities, research institutes, firms, and industry associations, and are dealt with informally or semi-informally in various co-operation bodies with representatives from these organisations.

In 2015, there were 16 Tekes programs in operation. The size and focus of Tekes programmes vary considerably across the programme portfolio. The duration of programmes is usually between 4–6 years and their budgets range from a few million to over €200m. Tekes typically funds approximately 50% of the programme budgets.[11]

Their major areas of focus are:

- Natural resources and resource efficiency
- Digitalism renewing business and industry
- Wellbeing and health
- New business ecosystems
- Market access

[1] "We operate as an active game builder and contribute towards renewal of business and industry through our opinions and outlook … we participate actively in the development of new business eco-systems, we emphasise experimentation and pilot programmes, we establish with our partners new areas of focus."

The current list of Tekes Programs is provided in the Table below:

Program	Years of Operation	Objective	Value (€M)[2]
5th Gear	2014-19	The 5thGear program aims to solve challenges related to the next generation wireless data communications, the creation of new business, and rocketing Finland as the leading target for international investments.	3.1
Arctic Seas	2014-17	The aim of the program is to turn Finland into an internationally attractive concentration of Arctic know-how.	5.9
BEAM – Business with impact	2015-19	The joint program of Tekes and Ministry for Foreign Affairs of Finland. Its aim is sustainable growth for Finland and the developing world.	0
Bits of Health	2014-18	The program is mainly intended for companies that utilise digitalisation and strive for international growth and that develop products and services promoting health, the early diagnosis of illnesses, health monitoring and personalized treatment.	0
EVE – Electrical Vehicle Systems	2011-15	The aim of the Electric Vehicle Systems program is to create a community of electric vehicle and support system developers in order to develop new technology, business and service competence.	10.5
Feelings – Intangible Value Creation	2012-18	The program wants to raise customer experience, emotions and meanings as key business drivers besides technology and expertise. In addition to emotions and customer experience, the programme encourages companies to exploit all of their intangible assets better, including brands, reputation and knowledge capital.	12.8
Green Growth	2011-15	The aim of the Green Growth program is to support the generation of innovations enabling significant leaps in energy and material efficiency and to create foundation for the development of new value networks based on green growth.	5.5
Green Mining	2011-16	The main objective of the Green Mining program is to make Finland a global leader of sustainable mineral industry by 2020	18.5
Industrial Internet	2014-19	The program aims to renew the business operations of companies through the Industrial Internet and encourage companies from different fields to engage in new kinds of cooperation.	0.2
Innovation in Social and Healthcare Services	2008-15	Based on its vision, the program will renew health and social services and increase business opportunities through innovative activities.	15.5
Innovative Cities	2014-20	The aim of the program is to create internationally attractive innovation clusters in Finland based on top-notch talent. Innovation clusters include companies aiming for growth that are capable of creating brand-new products and services for the international market.	0.1
Learning Solutions	2011-15	The objective of the program is to develop internationally important learning solutions in cooperation with participants in the sector, to develop new operating approaches, create new skills and develop products, services and comprehensive packages for international markets.	8.5

[2] Abstracted from the Tekes Open Data Storehouse, identifying public research and corporate projects; Tekes funding is identified only for research projects – many enterprise projects without a funding amount are also listed - https://extranet.tekes.fi/ibi_apps/WFServlet?IBIF_ex=o_projekti_htm1&IBIAPP_app=openraho&YKIELI=E;accessed 7/7/15

LIIderj – Business, Productivity and Joy at Work	2012-18	The vision of the program is that in 2020 Finland will have Europe's best workplaces. Making this vision a reality will require radical changes to management methods and new forms of work organisation and working.	11.5
Skene – Games Refueled	2012-15	The aim of the program is to make Finland a gaming and entertainment industry centre of international importance.	2.2
Smart Procurement	2013-16	The program will speed up the introduction of innovations through procurement excellence and the development of markets.	3.3
Witty City	2013-17	The aim of the Smart City program is to provide people with better living and working environments and companies with opportunities to bring new products and services on the market.	5.8

In 2014, Tekes funded 2,750 projects to the value of 550 million Euros, 40% to companies and public organisations, 30% to universities and 30% loans to start-up companies.

Tekes has been the subject of regular reviews, and actively reports its achievements across all programs. For example, for 2014:

- For every €1 invested by Tekes, companies increase their R&D investment by €2
- SMEs expect projects to produce €5.8B in turnover
- For SMES funded by Tekes, the annual growth of exports was €1b
- More than 80% of Tekes clients whose innovation activity has been successful state that Tekes funding was a significant factor in their success
- Over 50% of SME projects funded by Tekes are commercially successful
- In growth companies funded by Tekes, the rate of turnover growth between 2010 and 2013 was 24% greater than other SMES
- Projects resulted in 1,130 patents or patent applications
- Projects generated 1,500 products, services or processes
- Nine of the ten fastest growing companies in Finland were Tekes customers.[12]

A detailed evaluation of Tekes[13] concluded:

> "There is clear empirical evidence of Tekes impacts. Many evaluations and impact studies show these. ETLA studies show 'input additionality' i.e. companies doing Tekes-funded R&D invest more of their own money in R&D than those without Tekes funding…this increased R&D funding is associated with increased employment, patenting, innovations and productivity…

Overall:

- Tekes funding has direct and positive impacts upon innovative activities
- Tekes funding has increased the quality and quantity of innovation activities, increasing firms' knowledge capital as well as the extent of spill-overs. These affect, among other things, productivity, renewal of innovation activities and networking.
- Tekes funding has triggered innovations that increase the rate of growth, support globalisation of Finnish industry, commercialise products, services and new business processes. It contributes to building networks, cooperation, new research areas and knowledge bases.
- There is evidence that Tekes funding helps increase firm-level productivity and business renewal."
- Every year approximately 1% of Tekes customers go bankrupt.

However, the most recent Government Programme has announced on 6 June 2015:

> **"Funding cuts to affect Tekes – cooperation between universities and business will bear the brunt of cuts"**
>
> The Government Programme will involve cuts of €138 million in Tekes' research, development and innovation funding from the beginning of 2016. Research funding for universities and research institutes, which will shrink by €100 million, will bear the brunt of the cuts. The cuts will affect grant-based funding. In the first instance, they will be directed at Strategic Centre for Science, Technology and Innovation or SHOK programmes, the Innovative Cities or INKA programme, and the funding of large companies and public research organisations. Tekes funding for SMEs and start-ups will remain as before, as will Tekes' loan-based funding.
>
> "The cuts will lead to concrete changes in the public funding of innovation activities and in Tekes operations. The greatest impact will be felt in networking and collaboration between universities, research institutes and the private sector. We will need to completely rethink our programme activities and how Tekes can best move the business ecosystem forward," says **Pekka Soini**, Director General of Tekes.[14]

3. Specific Measures

The Tekes Programs represent the major focus of activity. However, aligned with these and operating through them are four measures with a very specific focus on the translation of public sector research for economic and social benefits. These are 'Public Research Networked with Companies', ' New Knowledge and Business from Research Ideas', 'Strategic Research Openings' and 'Funding for Young Innovative Companies', and they will be examined in turn below.

In addition, over the past decade, a major vehicle to promote closer cooperation between business and the world of research has been the Strategic Centres for Science, Technology and Innovation (SHOK). They are designed to generate top-level expertise and critical mass on a global scale in strategically selected fields, and are an appropriate measure for examination.

3.1. Public Research Networked with Companies Program

http://www.tekes.fi/en/funding/research_organisations/public-research-networked-with-companies/

The aim of public research networked with companies is to achieve competence and results that can be used as a springboard for the companies' own research and development projects.

Calls for funding are linked to Tekes Programs. These programs are targeted at financial and expert service areas. Within the programmes and initiatives, businesses and public research units can develop new know-how, build networks and have an impact on the development of their field.

As noted above, calls for funding are linked to Tekes Programs. There were 10 calls for proposals throughout 2014, on topics such as scalable clean-tech, business digitalisation and health and well-being, each typically being open for 2-3 months.

Companies and research organisations can create a joint R&D project together. In this case the starting point of the project must be companies' research needs. In joint projects the applications can be submitted to Tekes at any time. Tekes funds typically 60 % of the project costs.

Interest expressed by businesses in the project contents is a precondition for being granted Tekes research funding. Ensuring the commitment of companies potentially utilising the results and their active participation in the work of the project's steering group is vital. A company taking part in a project may show its interest and commitment by:

- Taking part in the preparation and application phase
- Project management and work of the steering group
- Project costs, mainly by providing funding.

Public research results are required to serve as a springboard for research and development in individual companies. The research project cannot be directed to product development for a company. The funders may not receive an immediate return on their money, but they will have the right of first refusal to using the results.

Tekes experts evaluate the project proposals and compare them to other competing funding applications. Important evaluation criteria are:

- The technology or competence developed in the project is mainly new and challenging
- The impact of the project to future business opportunities and the society
- The company's role in implementing the project and utilizing the research results
- Project resources, competence, and international cooperation.

Tekes specifies a number of roles and tasks in the management of projects they fund. The first of these is a project manager. The tasks are specified as:

- Manages the project implementation and organisation
- Is the secretary of the steering group
- Accountable to the project leader
- Responsible for the research content and scientific quality of the project
- Supervises the project's implementation and management and ensures that project reporting is organised according to the requirements set by Tekes.

In addition, there is a requirement for a steering group, with specified roles:

- Steers the project within the terms and conditions of the funding decision
- The chairperson of the steering group acts as a coach/mentor of the project manager
- Steering group members represent organisations that potentially utilize the project results, especially organisations that provide co-funding for the project.

The organisation and tasks are identified as:

Forming the steering group for a project:

- In the application phase, the research organisation (applicant) suggests a composition of the steering group and its chairperson
- The Tekes project officer invites the proposed steering group chairperson to join the meeting organised during the evaluation of the project proposal
- Tekes sets the steering group in its funding decision, the composition of the steering group is confirmed in its first meeting
- In a joint project, a common steering group is formed for all sub-projects included.

The steering group guides the project within the terms and conditions of the funding decision:

- Supports the research team in meeting the project's objectives
- Fosters utilisation of research results

- Confirms the research plan, budget and financing plan of the project and supervises their realisation
- Decides about changes in the project (subject to approval by Tekes)
- The decisions of the first steering group meeting and major changes have to be approved by all parties providing co-funding for the project

A Tekes representative (project officer) guides the project and ensures that the funding conditions are fulfilled. If the research project is funded within a Tekes programme, the programme manager and coordinator support the project manager in their role.
Funding can be used to cover the following costs: wages and salaries, indirect personnel costs, indirect costs (overheads), travel expenses, material and supplies costs, machinery and equipment costs and purchased services.[15]

No explicit ex-post evaluation activities of this specific program have been identified. The emphasis is apparently on the active management of projects to achieve outcomes, rather than evaluation of results at the program level after the event.

3.2. New knowledge and business from research ideas

http://www.tekes.fi/en/funding/research_organisations/new-knowledge-and-business-from-research-ideas/

This program aims to support research projects, where scientists take the development of an idea further while preparing for the commercialisation of the idea into new business. The research projects are intended to create new high-level competences in areas expected to be important for businesses in the future.

An eligible project should seek to examine possible paths to utilisation and the most promising route and method for taking the idea further. In addition, the possibilities of using the idea in the business of start-ups to be set up or developing it into new business in an existing company are investigated.

The project produces knowledge and competence that are significant for utilising a research idea. The research part of the project focuses on issues that play a key role in the commercialisation of the concept.

In these projects, the preparation of commercialisation plays a significant role: at minimum it must account for 30 percent of project costs in all phases. Expertise in preparing commercialisation may also be outsourced.

The applicant must have adequate rights to use the background material and the research results to be produced in order to commercialise the knowledge and competence. The research organisation must be able to transfer the rights to the results to the party commercialising the idea after the project.

The scale of the new business for which the preparation of commercialisation aims in the project must be significant. The application must contain an estimate of the scale of the business operations aimed for.

The project must examine several alternative commercialisation possibilities. The project's direct aim may not be preparing the business operations of a single company, either a start-up or an existing company.

The project must have adequate resources for preparing the commercialisation of an idea. The application must describe the competence and prior references of the persons responsible for the commercialisation.

If one option for preparing commercialisation is starting a new company, the application must describe the composition of the team behind the start-up. It must also describe how the commitment of the persons and competence needed in the start-up to the operations of the new company can be ensured.

New knowledge and business from research projects usually are relatively short, approximately one year in duration.

Eligible costs include:

- Examination of the research idea from the perspective of commercialisation (Proof of Relevance)
- Examinations of novelty determination of customer value surveys of competitors
- Examinations of intellectual property rights
- Experimental verification of the viability of an idea (Proof of Concept)
- Mapping of funding models
- Mapping of business models.

No business participation is required in this project type. However, companies may lend their expertise to the work of the project's steering group. It should be noted that a participating company does not have a right of first refusal to the project results.

Two application rounds for research projects take place annually, in the spring and the autumn. To apply for funding, an online application must be submitted. If necessary, funding is granted as phased funding, in which case eligibility for further funding will be assessed at the end of each phase. In addition to the results achieved, the assessment will look at new paths forward and whether or not the results achieved so far lend credibility to continuing the project.

As for the previous program, no explicit ex-post evaluation activities of this specific program have been identified. The emphasis is apparently on the active management of projects to achieve outcomes, rather than evaluation of results at the program level after the event.

3.3. Strategic research openings

http://www.tekes.fi/en/funding/research_organisations/strategic-research-openings/

These research projects are designed to create new high-level competences in areas expected to be important for businesses in the future. Strategic research openings are projects aspiring for breakthroughs, creating new high-level competences and aiming at the creation of significant new areas of growth in Finland.

This program looks for bold visionaries and a multidisciplinary approach. The starting point is a vision of a new, challenging solution which, when implemented, would mean significant and extensive new opportunities for businesses and industries and increase the pull factor of Finnish competence.

The vision must include an idea of the type of new business, the new knowledge and competence that the research opening will generate, including:

- A vision of how the results can be applied in Finland
- A vision of possible means for reaching a level of competence that could be utilised.

The objective is to identify and support projects that "point to a new direction". For example:

- Research openings that look at issues and competence from a new perspective, or
- Key researchers with a vision of a future competence need, the significance of the competence to be developed for the regeneration of business life, and an ability to enhance the impact of the competence.

Up till 2013, Tekes has funded eleven strategic research openings. At June 2014, there were eight in operation[16]:

Title	Topic	Partners	Tekes funding €	Duration
Neo-carbon energy	Large-scale energy storage	VTT, Lappeenranta and Turku Universities	5M	2014-16
Digital Health Revolution	Health data management	VTT, Oulo, Helsinki, Aalto, Tampere Universities	4M	2014-16
Living Factories	Synthetic biology	VTT, Aalto, Turku Universities	4M	2014-16
Frugal and Reverse Innovation	Building Finnish capacity	Aalto University	1.8M	2014-15
3i Innovative Induction	Cell generation in the heart and brain	Helsinki, Aalto Universities	4.8M	2014-16
Revolution of Knowledge Work	Information management	Aalto and Helsinki Universities	1.7M	2014-15
Cellulose Value Chains	Refined cellulose-based products	VTT, Aalto University	3M	2014-16
Human Spare Parts	Tissue engineering solutions	Tampere University	9.9M	2011-14

No business participation is required in this project type. However, companies may lend their expertise to the work of the project's steering group. It should be noted that a participating company does not have a right of first refusal to the project results.

Applications are called for twice yearly, and are typically open for three months. Applications to strategic research openings are accepted for Tekes' strategy focus areas, which are considered important for the Finnish economy. No business participation is required. Tekes usually funds 60 % of the project's costs.

The application process begins with conversations with Tekes. Tekes will organise an information day for applicants. During the day the applicants will have an opportunity to discuss the project proposal with a Tekes expert, who can give advice about the proposals suitability for the call.

The application is required to contain a presentation of a vision of what kinds of new business can be created with the new knowledge and competence achieved during the project how the research results can be utilised the methods used in the project to achieve the aspired level of competence

The criteria used to evaluate the applications are:

- **Novelty**: A vision of a future requirement for competence as well as the significance of the developed competence for the renewal of the economy. Novelty here refers to truly new perspectives, unique combinations of topics or novelty in itself. Applying existing competence to new areas of study is not sufficient.
- **Strategy**: Strategy means that the opening has the potential of creating significant and lasting change in the Finnish economy.
- **Challenge**: The vision must be challenging and it should require long-term development of competence. The implementation of the project will create competence that can be used to achieve goals that seem impossible at the moment.
- **Impact**: The implementation of the vision would significantly and widely affect the renewal of the Finnish economy. The changes would probably happen over a long period of time – companies may become interested in the matter even during or after the project itself.
- **Feasibility**: The vision is clear and concrete enough for its progress to be clearly mapped. The project's roadmap must include a description of the possible challenges of the operational environment (for example changes in legislation) that must be solved in order for the project to be successful. The roadmap should contain descriptions of all parties involved in the implementation of the vision.
- **Management and resources**: The strategic research opening should have a good leader, committed organisational management and a team of competent experts.
- **Co-operation and scope**: A good vision is often multidisciplinary; developing competence into expertise requires co-operation with international experts. The joint venture must include the best expertise available in the field. Description of the level of expertise worldwide as well as all partners must be included.

Short-listed projects are examined by an international group of evaluators.

Detailed guidelines are provided for the preparation of proposals, which are reproduced as an Appendix to this Report.[17]

3.4. Funding for young innovative companies

http://www.tekes.fi/en/funding/companies/funding-for-young-innovative-growth-companies/

Tekes offers funding for young innovative companies for comprehensive development of their business activities. The aim is to substantially accelerate the global growth of the most promising small companies. Funding is meant for a company that has operated for a few years and has proven its business concept so that it already has customers.

The requirements for eligibility to this program are for companies that have:

- The opportunity for fast growth in international markets
- Evidence of promising business activities and customer references
- A clear plan to grow to international markets and capacity to implement these plans
- A competitive edge with which it is possible to reach an important market position
- A committed and competent management team
- The ability attract venture capital
- The capacity to manage its IP rights

- Be less than five years old (funding is only available up to five years after the first registration of the company, regardless of when the application is made)
- Classification as a small company and be registered in Finland (the number of personnel in a small company is less than 50 and either its maximum annual turnover is €10 million or its maximum final balance is €10 million).
- A strong focus on research and development activities. To show evidence of this, the company must, at the application phase, provide a confirmation of an auditor that the company has invested at least 10 percent of all its business costs in research and development during at least one of the previous three years
- Not distributed profits and not formed through a merger.

The maximum amount of Tekes funding for young innovative companies is €1.25 million euros, of which maximum of €500,000 may be funded as a grant and €700,000 as a loan.

Tekes funds 75% of the eligible project costs in at least three phases. The funding for the first phase is a €250,000 grant typically for the period of 6-12 months. The funding is granted for business development.

Tekes sets goals for the company in its funding decision, which, if realised, enable the company to move on to the next phase of funding. Companies that have progressed during the first phase in accordance with the targets will be allowed to present their company and idea to an evaluation panel convened by Tekes. The panel is typically scheduled to make it appearance towards the end of the first funding phase.

The task of the evaluation panel is to assess:

- The company's business potential
- Its globalisation potential and development needs
- Its suitability as an investment target.

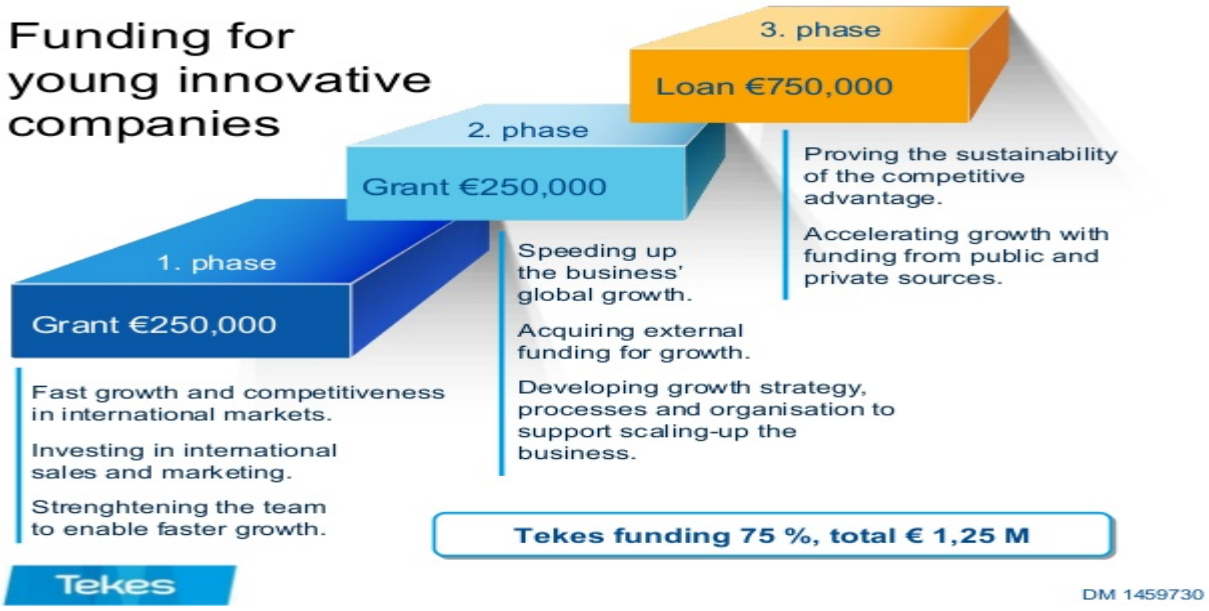
The panel members provide Tekes with a statement regarding the company's suitability as an investment target. The evaluation is performed on the basis of the material provided by the company and on the basis of a corporate presentation. The companies participating in the panel draw up an English-language summary of their business plan and a panel presentation using standard templates.

The panel has an advisory role in relation to Tekes funding activities. The panel members are capital investors, business angels or board professionals. The pool has about fifty members, and 3–5 experts at a time participate in the evaluation event convened about once a month.

Eligible costs include:

- Direct salary and wage costs and the associated indirect personnel costs (maximum 30%)
- Purchases (travel, outsourcing of services, materials, supplies, machinery and equipment).

The stages of the funding process are captured below[18]:

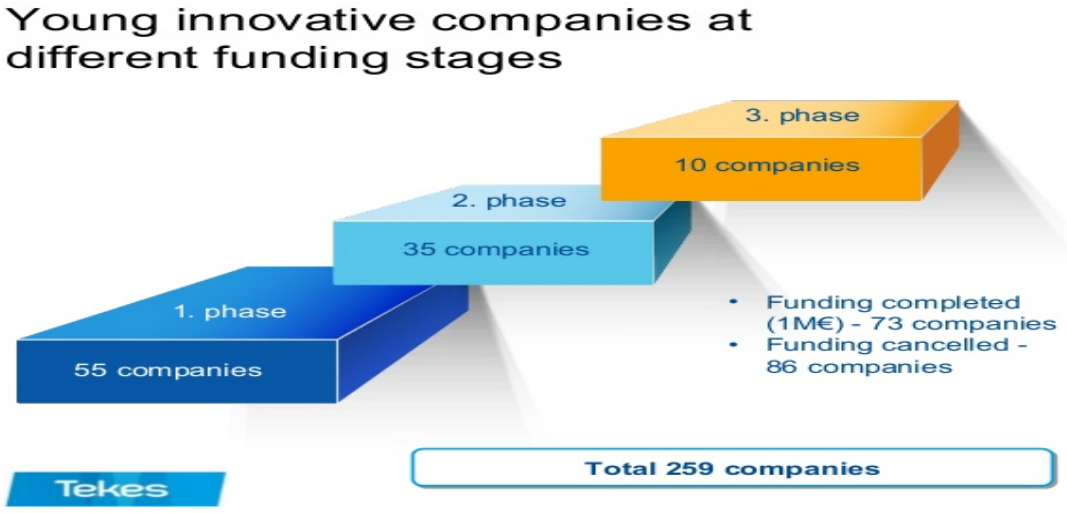


Since 2008, 260 start-ups have been selected for the YIC Program, and 75 have passed successfully through all three funding phases and attained 'Champion 'status. The numbers of participating start-ups by industry sector, as of 2015, are shown below:

Young Innovative Company Scheme Participants[19]

Industry	Phase 1	Phase 2	Phase 3	Champion
B-to-B Software and Services	22	13	6	33
clean-tech, Energy and Industrial Services	7	8	3	18
Consumer Products and Services	5	4	0	2
Digital Media, Games and B-to-C Software	8	6	1	12
Life Science, Medical Technology and Wellbeing	1	3	1	10

The progression through the stages is also reflected in the diagram below:



3.5. Strategic Centres for Science, Technology and Innovation (SHOK)

http://www.tekes.fi/en/programmes-and-services/strategic-centres/

http://www.shok.fi/en/

The decision to set up the Strategic Centres for Science, Technology and Innovation was made by the Science and Technology Policy Council chaired by the Prime Minister in 2006. The centres represent national choices to assist in appropriate direction of limited resources.

The roots of the SHOK concept can be dated back to the deep economic recession in the early 1990s. The Science and Technology Policy Council argued that the recession must be overcome in a way that preserved Finland's knowledge base. Their central recommendation was to support the Academy of Finland and the Finnish Universities to establish international centres of excellence in key areas. This led to a rapid expansion of Centres of Excellence, and to the establishment of eight national cluster programs in forestry, food products, telecommunications, transport, well-being, environment and development of working life.[20] The cluster program was launched with high expectations, but the results were modest and the last cluster program was closed in 2009.

However, the need to boost innovation in fields most relevant to the Finnish economy and societal development became even more urgent, albeit within the limited resources of a small country, and hence requiring specialisation and concentration to achieve necessary internationally competitive scale. Building on the long and relatively successful experience of Tekes programs, six SHOK centres were established between 2007 and 2009. They have all continued to operate since their establishment, and no new SHOK Centres have been formed since.

The promotion of even closer cooperation between business and research was set as the key objective. The centres focus on producing globally new information and its efficient utilisation. Their activities aim at increasing the global appeal of Finland and, consequently, increasing the volume of international cooperation and funding.[21]

They take the form of public-private partnerships for speeding up innovation processes and renewing the Finnish industry clusters and to create radical innovations. In Strategic Centres, companies and research units work in close cooperation, carrying out research that has been jointly defined in the strategic research agenda of each Centre. The research is targeted to meet the needs of Finnish industry and society within a 5-10 year timeframe.

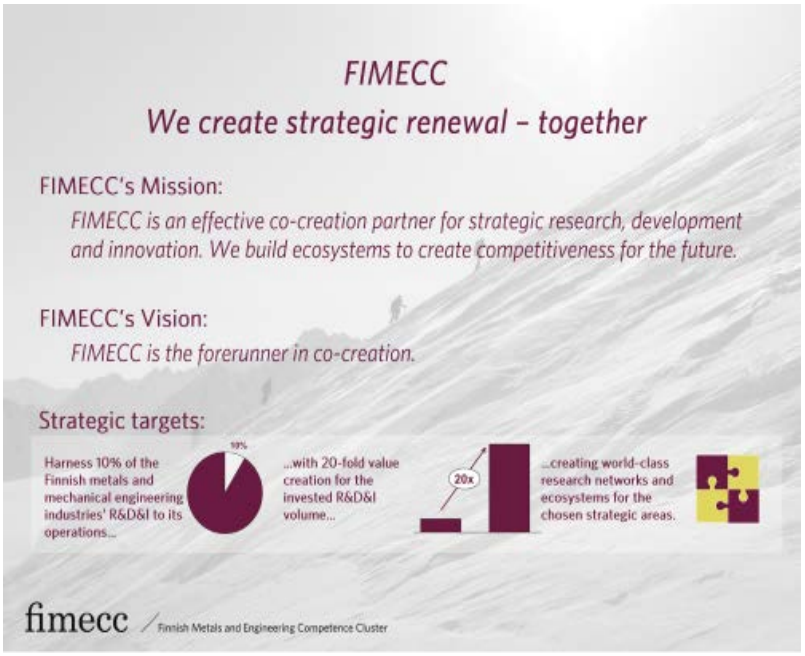
The six SHOK centres are:

- **CLEEN Ltd**[22]. - Cluster for Energy and the Environment was established in 2008 to facilitate and coordinate world class industry driven research in the field of energy and environment. It has 44 shareholders (28 companies and 16 research institutions) consisting of the major international companies which are technology and market leaders globally and which have significant energy and environmental related R&D activities in Finland, and the most relevant national research institutes.

- **FIBIC Ltd**[23] **–** The Finnish Bioeconomy Cluster was established in 2007. It is based on the premise that the most important renewable resources are sustainably managed forest assets. The objective is to become a pioneer in sustainable development and the future bioeconomy, where wood and other biomass sources will be used for an even wider array of applications, from paper,

packaging and buildings to biofuels and a broad spectrum of biomaterials and bioproducts. It has 19 shareholders (9 companies and 10 research institutes)**.** It has activities in three different strategic focus areas: Intelligent, Resource-efficient Production Technologies, Future Biorefinery and Sustainable Bioenergy Solutions.[3]

- **FIMECC Ltd**[24]. - Cluster Metal Products and Mechanical Engineering was established in 2008. Its focus is shown in:



It has 32 shareholders (20 companies and 12 research institutes).

- **RYM Ltd**[25] **–** Built Environment Innovations was established in 2009. Its research programs are in the built environment process re-engineering, indoor environment and energising urban ecosystems. RYM Ltd has 53 shareholders, representing the real estate and construction sector, four cities and six research institutes. Shareholders have invested €2.3M in the company.

- **TIVIT Ltd**[26] - renamed DIGILE, and established in 2008, aims to increase the pace of development of Finnish ICT and digital business, which in turn will ensure growth of the business of the whole sector, and therein the creation of new jobs. It has 50 shareholders (25 companies and 25 research institutes)

- **SalWe Ltd –** health and wellbeing, established in 2009.

[3] A merger has been announced between CLEN Ltd and FIBIC Ltd in response to the cut to SHOK funding in June 2015

A summary of their status and performance as of 2012 is provided below. The low numbers employed by the Centres reflects their operation through their stakeholders.

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 share-holders (the three figures summarise the total made of companies + rese-arch 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 (Measure-ment, Moni-toring and Environmental Efficiency Assessment) SGEM (Smart Grids and Energy Markets) CCSP (Car-bon Capture and Storage Program) FCEP (Future Combustion Engine Power Plant) EFEU (Effi-cient 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 Competive-ness 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 Cellu-lose - FuBio Products from Dissol-ved Cellulose (2011-2014) RAMI-Radical Market Innovations (ended in 2011)	Built Environment Process Re-engineering (PRE) (2010 - 2013), Indoor Environment (2011 – 2014), Energi-zing Urban Ecosystems (EUE) (2012 – 2015)	Intelligent Monitoring for Health and Well-being; Mind and Body	Future Internet; Devices and Interope-rability 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.

SHOK shareholders make the decisions on research programs, their implementation and sources of funding. Key public funding providers are Tekes and the Academy of Finland. Tekes funds the SHOKs' research programmes and projects initiated by companies. The Academy of Finland funds research carried out in the areas of the SHOKs. On average about 40% of research conducted by the SHOKs is co-funded by companies, 50% by Tekes and 10% by the Academy of Finland.

Between 2008 and 2013, Tekes funded the SHOK research programmes by a total of €450 million. In 2014, Tekes funding was €88 million, allocated to the six Centres as follows:

- CLEEN – 13%
- FIMECC – 28%
- RYM – 6%
- SalWe- 7%
- DIGILE – 30%
- FIBIC – 4%

A detailed evaluation was made of the SHOK program in 2013. While generally positive, and noting that the SHOK Centres have become "one of the main instruments of Finnish innovation policy ', the evaluation identified some significant tensions in the operations of the SHOK Centres, as described in the abstract below:

Tiivistelmä | Referat | Abstract

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.

The findings of this evaluation may well have had significant consequences. There was a call for new SHOK programs for September 2015. However, on 30 June the call was withdrawn, as a result of the new Strategic Government Programme issued in June 2015.[27]

Appendix

Guidelines for Preparation of a Proposal for a Strategic Research Opening Project

1 Vision (and characteristics of the project as a strategic research opening) (length, 1 page)

- Glimpse to the future. How would this opening and its outcomes be described in 2025 in a New York Times article about a success story receiving global attention? Suppose the starting points of this story are in the new expertise created in this strategic research opening.
  - What were the key elements behind the success story?
  - What new expertise was developed to enable the great change?
  - In which way this new expertise influenced the emergence of development paths leading to breakthroughs?
  - What were the game changers (i.e. key events, actors or factors)?
  - Describe the concrete means by which business operators could utilize the expertise in these breakthroughs for the development paths? What new opportunities did the new expertise make possible for companies in global value networks? In which way did the expertise affect the competitiveness of those involved? What new business did the new expertise create and in what scale?
  - As an example, the article could have an imaginary quote citing a person behind a breakthrough.

Note: It is impossible to predict the final breakthrough solutions; the most important thing is to understand the roles of various actors and parties in the realization of the vision and the potential of the expertise being developed.

A key point in a strategic opening is to have a challenging and ambitious vision, which, when realized, will create wide-ranging opportunities for business and for its global renewal.

To become realized, the vision needs creation of new expertise with the help of long-term and high-quality research. To carry out the vision requires multidisciplinary cooperation. The vision must be concrete enough so that the roadmap for its implementation can be believable.

It is required that 1) the research does not apply current expertise on new targets, rather wholly new expertise is created, 2) businesses are not yet focusing on the utilization paths described in the opening and 3) patent protection has not yet been sought for the solutions related to the utilization of the results.

The length of the answers for items 2–6 should be 3 pages at most.

2 Need

What is the important need to be met by the development of this expertise? Describe this from the viewpoint of:

- possible end-users
- direct exploiters of the research results
- societies

Who are the most important beneficiaries of the project results? Whom is this research serving?

3 Expertise to be developed and solutions

- Describe the new expertise this opening wants to achieve?
- In which ways does this opening attempt to solve the needs described in item 2?
- How unique, globally, is the expertise development concerned?
- Briefly describe the project stages – how is the expertise needed sought in this project?

A clear perception of the new expertise needed for the realization of the vision is needed. The project plan presented for this purpose must be consistent and credible. An ability to clearly describe the role of the project in extensive international context is necessary.

4 Feasibility and alternative solutions

- Describe the competitive situation and alternative solutions now and in the future.
- What kinds of obstacles can we expect in the realization of the vision?
- What are the most important risks? How can one prepare for them?
- Will all the key actors in the realization of the vision be made active participants in the project?
- What other parties do you need to convince to be able to implement the vision?

The project plan must describe the competitive solutions and possible challenges in the operating environment (for example, legislative amendments and obstacles in development paths) which must be solved for feasible implementation the project.

The team must be networked with national and international advisory boards that are needed for the implementation of the vision that is required in the development of expertise. Possible shortcomings must be identified and to correct them there must be a clear action proposal. The team must have the ability to identify changes in the operating environment and to adapt to them.

5 Business impacts and benefits

- How will the new expertise to be developed change the world? Describe the impacts especially from the viewpoints of a) business life b) consumers and c) societies.
- What kinds of development paths will this strategic research opening start up?
- What is the significance of the new expertise developed by the expertise?
    - Describe possible commercial solutions enabled by the new expertise.
    - Estimate the potential market size and market areas related to the research results.
    - Estimate, globally, the potential share of the new business by the current and soon-to-be established Finnish businesses. Justify your estimate.
    - What is the realistic schedule for the start of commercialization?

The expertise developing under the umbrella of the vision will enable creation of entirely new growth sectors where the international value networks will provide its Finnish participants with a significant role. The impact goals of the opening have been set on a nationally significant level (business and employment). Thus, when a vision is actualized, its impact on the renewal of Finland's business must be significant and extensive. The opening can create several development paths. It also can enable the development of completely new types of commercial solutions, even of the kinds that might seem inconceivable. The roadmap for the utilization of expertise must be credible and clear.

6 Resources as the key for success

- What are the team's key competences in the context of key research

questions and the vision?

- What is the level of these competence resources in the global context?
- Capacities and motivation of the team in the implementation?
- What kinds of contacts does the consortium have to the world's top research teams?
- How do the parties of the research consortium stand in international competition in general?
- The level of the commitment by the organizations behind the applicants in relation to the goals of the projects?
- Describe the funding plan for utilizing international funding sources for the further implementation of the vision?

In the opening, the leading national and international experts must be involved to realize the vision. The consortium will be led by a team which needs to have the ability to lead high-quality research and set new paths of development for commercial utilization. Allocation of work and the roles in the consortium must be clearly defined. The team must have a credible champion with the competence required for the realization of the vision.

Organizations seeking to participate must be strongly committed to the targets of the project. The organizations underpinning the consortium must have the willingness and capability for extensive and long-term utilization of the research results.

From the viewpoint of the implementation of the vision, the research and the utilization of the results require a concrete plan from other important international funding sources, such as the European Commission's Horizon 2020 fund.

Contacts

1. kirjaamo@tekes.fi
2. Totti Konnola, Managing Director, Insight Foresight institute (IFI), formerly with VTT, totti.konnola@if-institute.org
3. Tuomo Suortti, Senior Adviser , Strategic support for programs, Innovation Research, tuomo.suortti@tekes.fi

References

[1] http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/fi/country
[2] CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/fi.html
[3] https://www.globalinnovationindex.org/content.aspx?page=data-analysis
[4] file:///H:/SAF09/Finland/Finland%20_%20Innovation%20Policy%20Platform.htm
[5] OECD, Science, Technology and Industry Outlook, 2014, Paris, p.317.
[6] Research and Innovation Policy Council, 'Reformative Finland: Research and Innovation Policy Review 2015–2020', http://www.minedu.fi/export/sites/default/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/julkaisut/liitteet/Review2015_2020.pdf
[7] Ibid, pp 6-7
[8] Ibid, p 11.
[9] Ibid, pp 18-19.
[10] http://www.tekes.fi/en/tekes/strategy/
[11] http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/fi/country?section=ResearchFunders&subsection=GovernmentAndRegionalAuthorities
[12] TEKES Facts from 2014 (pdf), http://www.tekes.fi/en/tekes/results-and-impact/
[13] Evaluation of Tekes, Final Report, Ministry of Employment and the Economy, 2012, pp28-29.
[14] http://www.tekes.fi/en/whats-going-on/news-from-tekes/funding-cuts-to-affect-tekes/
[15] http://www.tekes.fi/en/funding/research_organisations/public-research-networked-with-companies/, Terms and Conditions for Public Funding (pdf)
[16] Strategic Research Openings Funded by Tekes (26.6.2014),
[17] www.tekes.fi/globalassets/global/rahoitus/tutkimusorganisaatiot/strategic_research_openings_-_summary_template_august2014.pdf
[18] http://www.tekes.fi/en/funding/yic/funding/
[19] http://www.tekes.fi/en/funding/yic/companies/
[20] 'Licence to SHOK? External Evaluation of the Strategic Centres for Science, Technology and Innovation', Ministry of Employment and the Economy 2013, p. 51.
[21] http://www.shok.fi/en/activities/background-and-objectives/
[22] http://www.cleen.fi/en/
[23] http://fibic.fi/
[24] http://www.fimecc.com/
[25] http://rym.fi/
[26] http://www.digile.fi/
[27] 'Finland: A Land of Solutions', Strategic Programme of Prime Minister Juha Sipila's Government, May 2015.