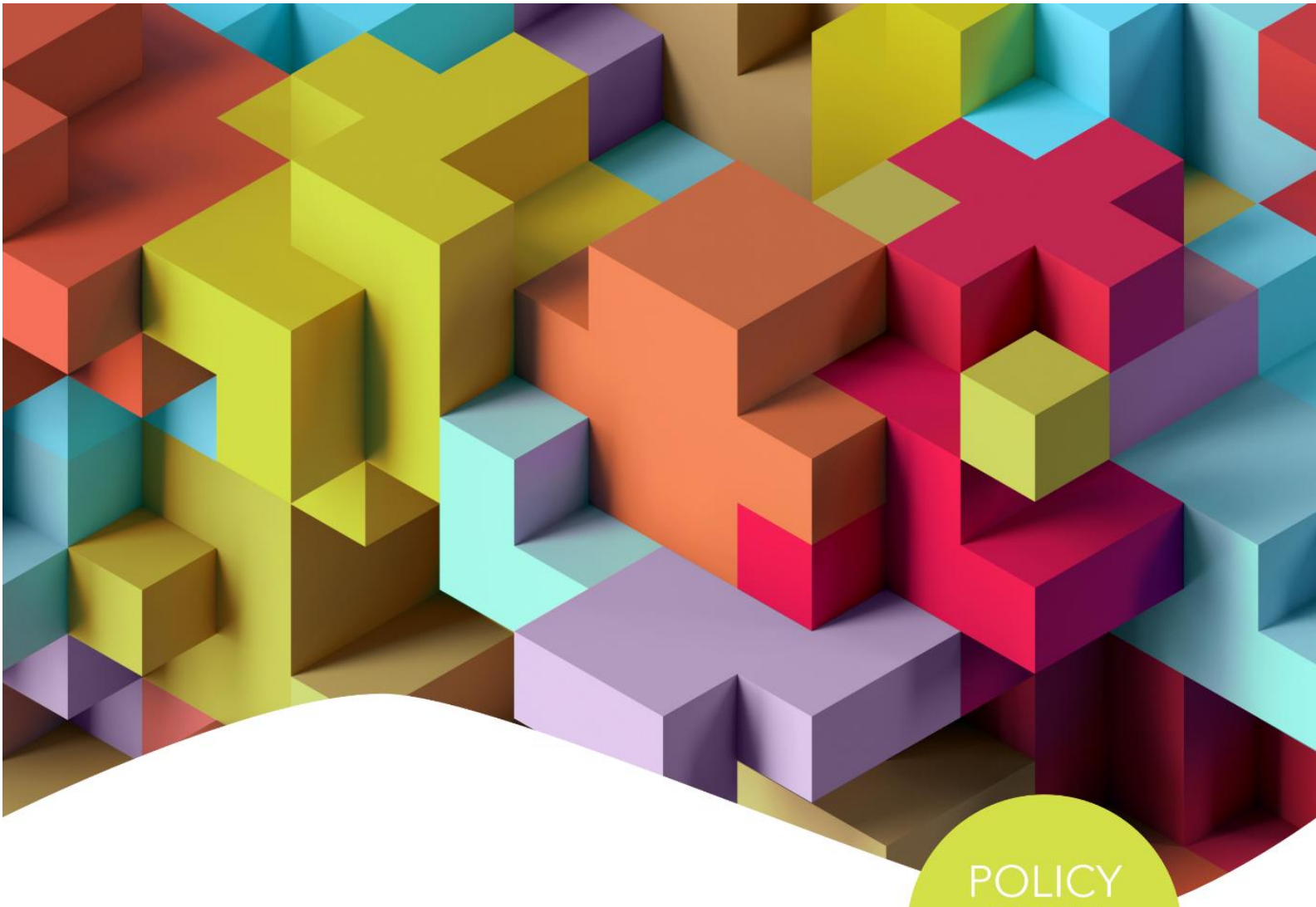

POLICY CASE STUDY

Case study on TUTL – New Business from Research Ideas, Finland

Contribution to the OECD TIP Knowledge Transfer and Policies project

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Case study on TUTL - New Business from Research Ideas, Finland: Contribution to the OECD TIP Knowledge Transfer and Policies project

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Executive Summary

This study describes the main results of the Finnish innovation and research policy tools related to the commercialization of research ideas. The main tool for helping research institutes and universities to commercialize is the Tekes-based instrument called TUTL (New Business from Research Ideas).

The TUTL instrument was launched in 2012 with the aim of funding projects by research organizations involving preparation for the commercialization of an idea, such as innovation searches and the determination of customer value or other analyses, as well as projects involving applied research. The broader goal of TUTL is to support the creation of new, internationally competitive growth companies.

TUTL fulfils a clear gap in the commercialization process of research results. However, it does not solve and is not intended to solve, for example, the "big" challenges of the Finnish innovation system raised by the OECD Evaluation Report (2017).

TUTL was evaluated in 2017-2018. Main finding was that the additionality of TUTL funding is high and the "leakage effect" is low. Most of the projects implemented under TUTL funding would not have been implemented without the funding of Tekes. Other key results in short were as follows:

- TUTL is the only financial instrument aimed at research organizations for research result commercialization. Its relevance and value added to research organizations are undeniable. The "leakage effect" of funding is small, and many of the results obtained would not have been generated without it.
- Financing has successfully created commercialization structures and processes and benefited the strategic position of commercialization in research organizations.
- Tekes funding has increased IPR and commercialization awareness and capabilities in research organizations.
- Tekes funding provides the mandate and resources to focus on the commercialization of research and directs the use of the organization's own resources to this end.
- Tekes funding has strengthened cooperation with companies and opened up new contacts with sponsors and external research infrastructure.
- The commercialization of research results in research organizations has clearly improved over the past 3 years.
- TUTL has been an important and functional instrument for research institutions, and similar financial services are also needed in the future.
- According to Tekes data, approximately 60 new companies emerged between 2013 and 2017, of which some 20 were international growth companies.

In general, the TUTL instrument has been effective form of funding. Compared, for example, with Tekes' previous TULI funding, TUTL has been a more efficient and straightforward instrument for commercialization. TULI was launched in 1993, was converted to a programme in 2002, was further renewed in 2007 and ended in 2012.

However, the TULI programme aimed to generate the development of competences and structures within recipient organizations and was a central instrument Tekes used to improve the effectiveness of research commercialization.

TUTL has found to be extremely important to research organizations, and its benefit is large. TUTL has also significant effects on creating cultural change in research organizations. Moreover, the TUTL evaluation showed that individual funding instruments can have significant impacts on contextual factors. Thus, it is important in developing individual policy instruments to take into account these contextual factors and ensure that the different parts of the policy mix complement each other in a comprehensive manner.

Introduction

The goal of this case study is to describe the main features of the Finnish innovation and research policy tools related to the commercialization of research ideas. Currently, the main tool for helping research institutes and universities bring their research findings to the market is the Tekes-based instrument called TUTL (New Business from Research Ideas).

Tekes (the Finnish Funding Agency for Innovation) has used various funding instruments to support the development of new businesses from public research. The TULI programme (Creating Business from Research) was Tekes' targeted long-term effort aimed at creating business from public research. TULI was launched in 1993, was converted to a programme in 2002, was further renewed in 2007 and ended in 2012. Importantly, the programme aimed to generate the development of competences and structures within recipient organizations and was a central instrument Tekes used to improve the effectiveness of research commercialization.

Currently the funding instrument supporting the development of research results into new businesses is TUTL, which is targeted at researchers and research teams in state research institutes, universities, universities of applied sciences, non-market-based state-owned companies and cities/municipalities. The broader goal of TUTL is to support the creation of new internationally competitive growth companies. The TUTL instrument was launched in 2012. By the end of 2017, Tekes has made 430 funding decisions granting 138 million euros for 380 separate projects (TUTL Evaluation 2018).

The structure of this case study is as follows. Section 2 describes the main institutions involved in research commercialization in Finland and the characteristics of TUTL. Section 3 explains why the TULI programme was ended and the TUTL instrument was launched as a new policy instrument. In section 4, we present evidence from other policy tools. Section 5 describes the results of the TUTL impact analysis, and Section 6 concludes the case study by presenting key implications.

1. Main features of the policy

1.1. Institutional setup in Finland

Finland is a small open economy dependent on its competitiveness in the global market. Even if Finland still excels on a number of welfare and economic indicators, the ability of Finnish RDI environments to commercialize R&D products and services has faced a number of challenges in the last years. The global recession in 2008 – 2009 hit Finland very hard, and the economy has not recovered at the same pace as in many other European countries. During this economic recession, many businesses chose not to invest heavily in innovation, and the Finnish innovation environment has thus not generated enough new commercialized products and services in the global market. Public RDI funding, especially for Tekes (now **Business Finland**), has been reduced, and Tekes has aimed more funding at startup and fast-growing companies. Tekes has also changed funding for cooperation between research organizations and business so that less funding is available, especially for research cooperation between large companies and research organizations and SMEs.

At the same time, a whole new type of startup scene has emerged. While Finland used to lag behind many other economies in terms of indicators measuring entrepreneurship and startup activities, today it offers a good setting for startups and growth-oriented businesses. Universities and research organizations, and startup communities around them, have had an important role in this development. In addition, the funding prospects for startups and growth businesses have improved considerably. As a result, today the backbone of the Finnish industry is shifting more towards SMEs (e.g., in terms of employment). However, it has been argued that the scene is too domestic and there are currently not enough globally operating medium-sized Finnish companies.

The key to improving innovation capacity is generally considered to be the acquisition of new information and competences, the utilization of R&D networks and the combination of competences from multiple disciplines and sources. Therefore, it is vital that research results be utilized in business. Traditionally, large companies have carried out a significant proportion of Finland's R&D; they have led the development of RDI networks with SMEs and research organizations and have been the main commercialization unit for innovations. Recent developments include, however, a major shift in R&D activities from large companies to universities. This change is one among many major structural changes that universities and research organizations have undergone during the recent years.

The University Reform Act 2010 and the Universities of Applied Sciences Reform in 2014 changed the legal status of universities into private entities.

This has given them more independence in terms of attracting private funding, targeting their own funding and making investment decisions. Naturally, independence has also meant more freedom to design and organize their commercialization activities and industry cooperation.

The Comprehensive Reform of State Research Institutes and Research Funding in 2013 changed both the organizational and financial structure of research in Finland, e.g., by imposing mergers and by turning the legal status of the VTT Technical Research Centre of Finland (a major player in Finland in R&D commercialization and in business cooperation) into a limited liability company. At the same time, the reform created new financial incentives for research partnerships on issues of high societal relevance. In addition to these reforms, a change in the Higher Education Institution Inventions Act 2007 gave universities

the rights to inventions conceived within their domain and provided incentives for R&D commercialization.

Partly due to these reforms, the number of universities and research organizations decreased through mergers; at the same time, these organizations strengthened their strategies.

However, another characteristic of the Finnish R&D system is the importance of activities at the regional and local city level, where different public or public-private development organizations have played a significant role in facilitating the creation of innovation environments, providing commercialization services and operating as innovation and experimentation platforms for companies and researchers. This has led to a fragmented innovation support scene with various national, regional and local players.

This fragmentation together with the focus of the university (i.e., technical vs. humanistic) also impacts the strategic choices related to commercialization within research organizations. Some organizations have positioned themselves more towards commercialization and company cooperation, while others have chosen to concentrate less on these aspects. Some are already advanced with well-functioning processes, while others are only starting to build their competencies. The lack of incentives for commercialization within the basic funding of universities remains a challenge. Many universities also lack commercialization experts, and researchers are reluctant to invest in commercialization activities, as there is much less funding available for commercialization than for basic research and there are less clear career opportunities in commercialization. The tools and processes used in commercialization activities also vary considerably among universities.

1.2. Main challenges of research commercialization in Finland

The reforms and development in recent years have also generated some criticism concerning the lack of a national vision for the development of innovation capabilities. According to these views, there is a lack of alignment of priorities regarding research commercialization among the university budget funding of the Ministry of Education and Culture, the sectoral ministries' coordination of sectoral research organizations, and the innovation funding distributed through Tekes under the Ministry of Economic Affairs and Employment.

Another concern raised is that, while Finland is an open economy, its research and innovation system remains quite domestic and lacks strategic leadership and systematic structure and processes to reach global networks and investors. This is reflected, for example, in international indicators measuring the quality of research, where Finland performs well in many areas of science, but Finnish universities are ranked relatively low. However, the domestic markets are limited, and both the clients and the investors are often international. Finding these contacts can be extremely challenging for individual universities.

The key challenge for the commercialization of research has been the global economic downturn, from which the Finnish economy has recovered more slowly than many other countries. At the same time, the cuts in RDI funding have been considerable. In the world more broadly, business and industrial environments are evolving around the digitalization and globalization of value networks, which both require stronger, more agile and more open innovation networks, open and available information, and new co-creation models. For example, in Finland, this has challenged the practices and structures of traditional industrial

sectors and has affected the commercialization of research and research results (especially licensing) in these areas.

The challenges faced by our national system for the commercialization of research results are as follows:

- The lack of a common national vision and policy for the commercialization of research results and capacity building among the ministries, universities, the sectoral research institutes, the Academy of Finland's research funding and Business Finland's innovation funding.
- While the research environment is of a high standard and high quality, Finland lacks a systematic structure and functioning processes to connect university research with private equity investors and international networks.
- The national research and innovation system is too limited to domestic forces and resources. There is no systematic structure and processes for reaching global networks and investors.
- Funding to overcome the death valley of the commercialization of research results is far too limited compared to the extent to which, for example, basic research is supported.
- Universities do not have a strong drive or significant incentives to commercialize, as success does not affect core funding.

1.3. Main characteristics of TUTL funding

- The TUTL instrument was launched in 2012 with the aim of funding projects by research organizations involving preparation for the commercialization of an idea, such as innovation searches and the determination of customer value or other analyses, as well as projects involving applied research. TUTL funding can be applied for in cases when:
- A researcher or research team in the research organization is seeking to progress towards the commercial exploitation of research results.
- The applicant has the rights to use the background material and the resulting research results in order to commercialize the information and expertise in question.
- After the project, the research organization will be able to hand over the rights to the research results to the party in charge of commercialization.
- The new business activity being created is significant in scope. The application must include an assessment of the planned business's scope.
- The project involves the examination of various commercialization options – the beneficiary of commercialization must not be evident during the project.
- Tekes' experts evaluate the research project as a whole. The evaluation also takes into account other, competing funding applications. Important evaluation factors include the following:
- The novelty value and challenging nature of the technology or competence to be developed by the research project.

- The project's impacts on the development of a major international business and on society.
- The role of business in the realization and steering of the project and the utilization of its results.
- The project's resources, competence level and international cooperation; the team's commercialization skills tend to present the greatest challenge.
- The application must describe the expertise and previous references of the persons responsible for commercialization.

Tekes funds up to 70% of the total cost of each project. A TUTL project consists of two parts: commercialization and research. At least 40% of the project funding must be used for activities that promote commercialization. In addition, the research portion of the project should produce knowledge and expertise relevant to the utilization of the research idea.

Two calls for applications for TUTL funding were arranged in 2013-2017. Tekes evaluated the applications by examining the novelty value and challenging nature of the technology or competence to be developed by the research project, the project's impacts on the development of a major international business and on society and the role of business in the realization and steering of the project and the utilization of its results. Furthermore, Tekes evaluated project resources, competence level and international cooperation. The applications had to describe the expertise and previous references of the persons responsible for commercialization, as usually the project team's commercialization skills tend to present the greatest challenge.

In TUTL-funded projects, several pre-commercialization opportunities and promising paths must be explored. Funds can be used to a) review the research idea from a commercialization point of view and obtain proof of relevance; b) obtain experimental confirmation of the idea and proof of concept; c) conduct innovation searches; d) determine customer value; e) perform competitor analyses; f) perform intellectual property rights analyses; g) investigate funding and business models; h) undergo commercialization and entrepreneurship training; and i) conduct applied research targeted at predefined market potential.

2. Development of the initiative

2.1. TUTL tailored application

Tekes has used various funding instruments to support the development of new business from public research. The TULI programme (Creating Business from Research) was Tekes' long-term effort aimed at creating business from public research. TULI was launched in 1993, was converted to a programme in 2002, was further renewed in 2007 and ended in 2012. Importantly, the programme aimed to generate the development of competences and structures within recipient organizations and was a central instrument Tekes used to improve the effectiveness of research commercialization.

The TULI programme was evaluated in 2013 when the TUTL instrument was already launched. Thus, the evaluation did not affect the launch of TUTL, but it provided insights

for the development of TUTL. The TULI evaluation also covered the analysis of international trends and good practice benchmarks related to themes such as 1) the integration of references to commercialization in research funding, 2) how commercialization structures can be consolidated in different ways, and 3) policy makers' understanding of the need for long-term commitment to support structures.

The TUTL instrument is aimed at researchers and research teams in state research institutes, universities, universities of applied sciences, non-market-based state-owned companies and cities/municipalities. TUTL funding is granted for the preparation of an idea for commercialization and to promote the development of the idea into a new business.

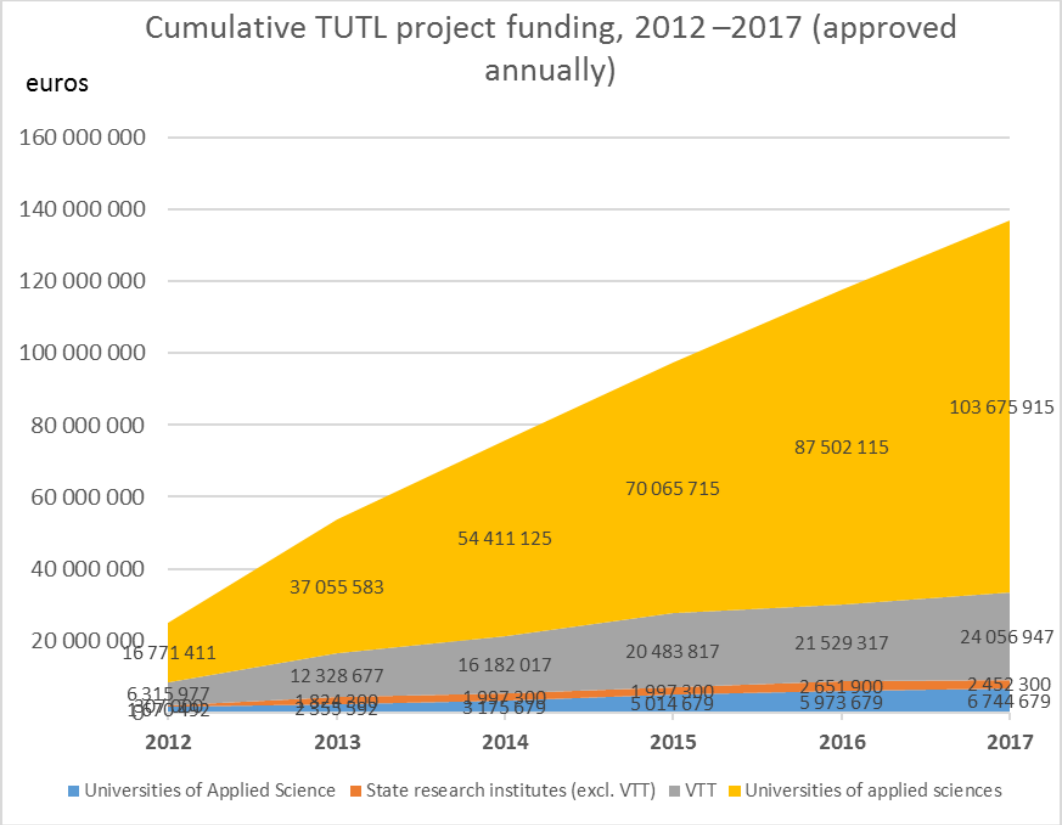
The broader goal of TUTL is to support the creation of new, internationally competitive growth companies. Further to that and separately from TUTL, Tekes places a strong emphasis on funding established startup companies through its other funding services, such as Tempo funding, as Finland has seen an emergence of active entrepreneurship in the form of startups during recent years.

Over the years, Tekes has funded 334 separate TUTL projects through 454 funding decisions. TUTL can be summarized via the following figures (Source: Tekes):

- Total number of applications: 1,020
- Funding applied for: €360.4 million
- Number (%) of accepted applications: 454 (45%)
- Total funding granted: €129.4 million (2013 – 2017/6)
  - To universities: €97.2 million
  - To VTT: €23 million
  - To universities of applied sciences: €6.5 million
  - To public research institutions (excluding VTT): €2.5 million
- Number of applicant organizations: 51
- Number (%) of funded organizations: 31 (61%)

VTT and major universities in particular have been most successful in applying for and obtaining TUTL funding (see Figure 1). For example, more than 50% of VTT's applications and requested funding have gone through. On the other hand, many universities of applied sciences have applied for TUTL funding but have not been successful. In the universities of applied sciences, the processes of commercialization are not as well established as in universities and some research institutions. One exception among universities of applied sciences is Saimaa AMK, which has cooperated with Lappeenranta University of Technology and used ERDF (European Regional Development Fund) funding in its commercialization activities.

Figure 1 Cumulative TUTL project funding, 2012-2017



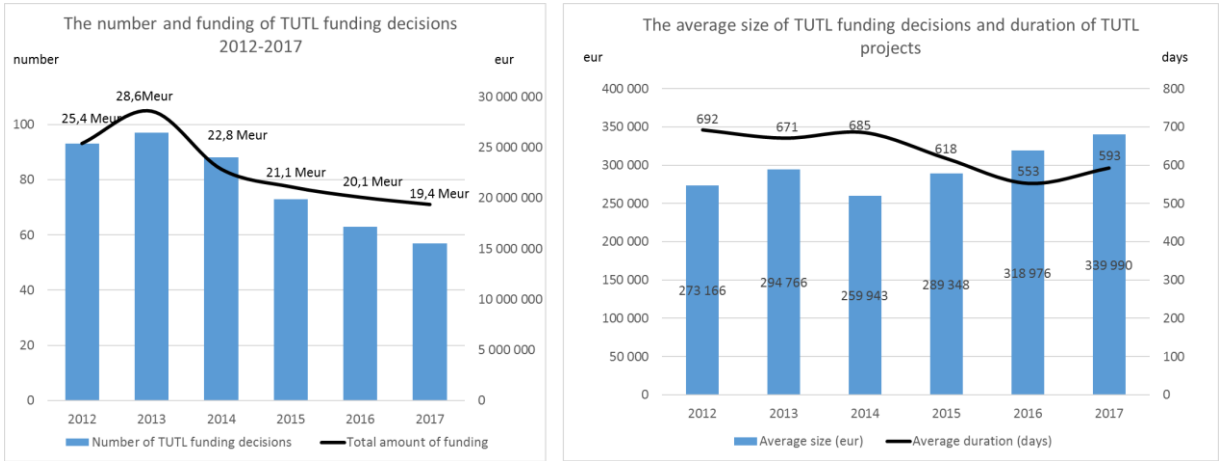
Source: TUTL Evaluation 2018 and Tekes

Annual TUTL funding has fallen since 2013. The decrease in the amount of funding (60% of the 2012 level in 2016) is a significant change (see Figure 2). The annual number of projects funded has also decreased, while at the same time the average size of TUTL projects (in euro terms) has increased slightly.

The duration of the projects has decreased slightly in the same period. As the amount of funds available has fallen, the number of applications has also fallen.

The decline in the number of applications by VTT explains a large portion of the drop in the overall number of applications. This decline supposedly stems from the increased pressure VTT placed on commercialization projects when TUTL was introduced.

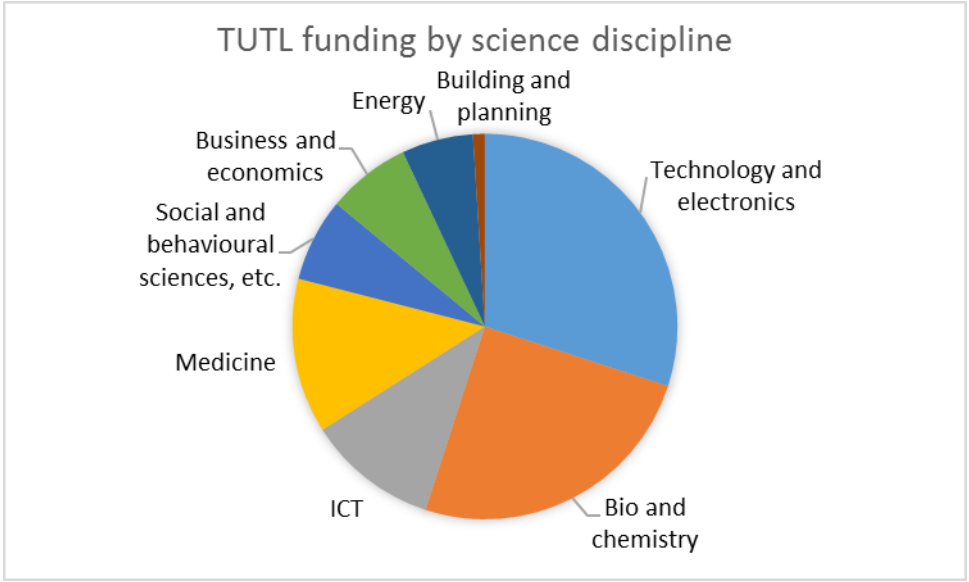
Figure 2 The number and funding of TUTL projects; average size and duration of TUTL projects.



Source: TUTL Evaluation 2018 and Tekes

With regard to different disciplines of science, funding has focused most heavily on the technical sciences and on electronic engineering, the biosciences and chemistry (see Figure 3). More than 50% of TUTL funding has been allocated to these disciplines. A significant amount of TUTL funding has also been targeted at the fields of medicine and ICT.

Figure 3 TUTL funding by science discipline.



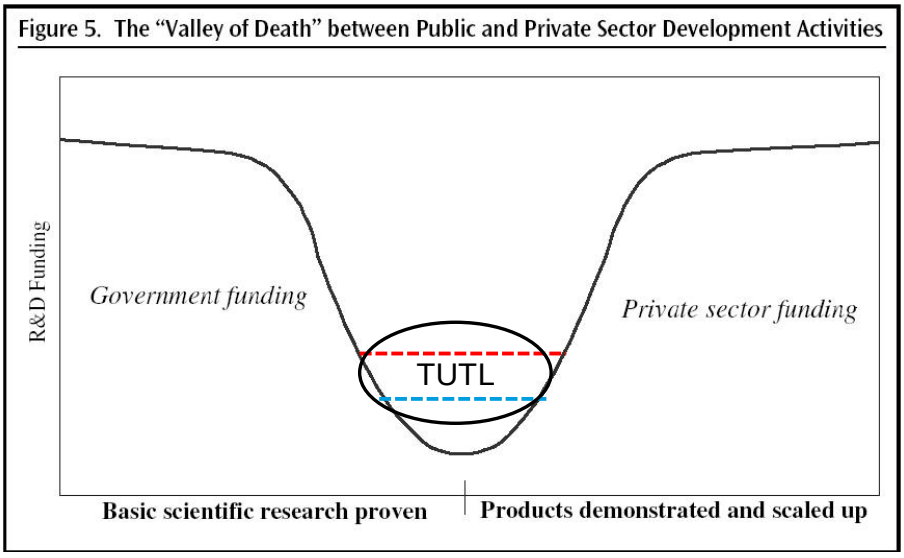
Source: TUTL Evaluation 2018 and Tekes

3. Interactions with policy mix

3.1. Policy instruments in line with TUTL

TULI aimed at building competencies related to research commercialization at HEIs and public research institutions. It provided funding for small studies (such as market studies or feasibility studies) but did not consider the commercialization process comprehensively. The TUTL instrument has contributed to a very critical point in terms of the need to stimulate and support the commercialization of research in research organizations. For a significant number of TUTL projects there is no other funding available for commercialization activities. More broadly, there is a clear demand and social need for TUTL. Funding is justified in a market situation where business or research institutes / universities underestimate the commercialization of research in relation to its societal impacts. No other public or private commercialization actions similar to TUTL are available to develop ideas and to help bridge the valley of death (see Figure 4). In addition, TUTL has pushed research organizations to boost their research result utilization as well as build new tools and incentives for commercialization.

Figure 4. TUTL's position in creating a bridge across the valley of death. Source: TUTL Evaluation 2018



3.2. Previous policy mix gaps

TUTL fulfils a clear gap in the commercialization process of research results. However, it does not solve and is not intended to solve, for example, the "big" challenges of the Finnish innovation system raised by the OECD Evaluation Report (2017). These challenges are related to improving governance and effectiveness, developing strategic partnerships in the private and public sectors, developing cooperation between SMEs and larger businesses in R&D, increasing funding for research and innovation, promoting internationalization, and prioritizing the development of radical innovations in order to develop high value added products and services. These challenges call for measures that are broader than one specific funding tool.

Other Tekes startup funding and TUTL

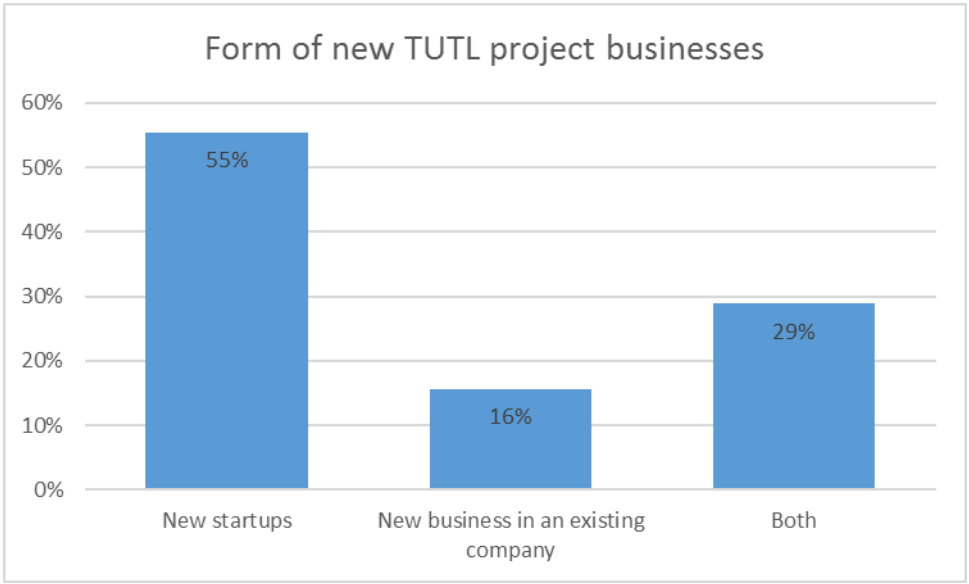
Other funding instruments that Tekes provides for startup companies were built to form a support path from research ideas to growth companies. In practice, the funding mechanisms that Tekes provides to startup companies are not suitable for companies in the very early stages. In addition, many of the funding tools emphasize growth and expanding to international markets. The most important tools for startups offered by Tekes include the following:

- ”Planning for global growth” grant (max. €50,000) for small companies with a new business idea with genuine international market potential.
- ”Companies’ research projects” grant (max. €100,000) to create new knowledge and competences.
- ”Development and piloting” loan (max. €100,000) to demonstrate the functionality of a solution.
- “Young Innovative Companies” grant and loan (max. €1.25 million) to expand internationally if a company is young and has exceptional potential (customers, venture capital investments, turnover).

Tekes also invests in venture capital funds that then invest in seed and startup funding.

It has to be noted that 1) the result of the TUTL process can be a startup, a new business in an existing company or both of these and 2) Tekes startup funding is targeted at all types of startups, not only those originating from the TUTL instrument. A majority of the new business originating from TUTL projects takes the form of new companies, as shown in Figure 5.

Figure 5 The different ways new businesses are born from TUTL projects. Source: TUTL Evaluation 2018



From the point of view of the wider societal impact of TUTL, it is essential to understand how the various instruments and various combinations of economic and innovation policies can fully support the process of commercialization of research results (identification of an

idea → demonstration of the commercialization pathway → maturity testing and growth → evaluation by financers and other partners → connect to global networks and business). Particularly important and challenging is how to succeed at the end of the chain and who is supporting the project and by what means. With TUTL, the maturity of accepted projects can be increased; in addition, a post-instrument and after-support for TUTL projects can be added to the instrument toolbox.

A recent evaluation of TUTL (2018) showed that its base structure is suitable for different industry sectors, but more flexibility is needed, for example, in regard to application and funding periods. Commercialization and investment time spans are different in different industry sectors. For example, the development and commercialization processes in the ICT sector are often very short and fast-paced, whereas in the pharmaceutical sector, for example, the process from product development and testing to commercialization takes years.

In the higher education sector, there are large differences among universities in terms of their capacity and ability to execute activities related to the commercialization of research results.'

The more traditional universities, which focus more on the humanities and social sciences, lack a culture and tradition of commercialization, while the universities that focus more on technology and medicine have more advanced practices. TUTL as a funding tool was not targeted at capacity building, and Tekes decided to support universities in their development of commercialization-related activities, tools and processes via KINO and Innovation Scout funding.

Basic university funding and TUTL

The basic funding that the Ministry of Education and Culture provides to universities has been criticized for not taking into account the utilization of research results. The current funding model rewards universities for education (41%) and research (34%); 25% of funding is allocated based on education and science policy objectives, of which 10% goes to "strategic funding". The funding model targets universities' research-related activities, especially in the field of scientific publishing, whose share of funding is 13%. The financing model in this respect is relatively successful. It has proven that funding has a strong guiding effect on organizations' activities.

The societal impact of universities is indirectly realized in many different ways, and research and training are undoubtedly of the utmost important from the point of view of universities' so-called "third mission". The grounds for the current funding model are that, as the Ministry of Education and Culture states, "the societal impact is generated from the two basic functions of universities, education and research, and it is taken into account in the funding model as a cross-cutting function" (OKM 2011). However, this is not enough for society to be able to change rapidly and face increasingly more complex challenges. A special emphasis should be placed on supporting the business sector's innovativeness and renewal, which calls for measures and support structures that enhance direct interaction. Many experts in the field consider that it is essential to renew the funding model in order to strengthen the societal impact of Finnish universities. There has been much debate about how to measure societal impact in a manner that takes into account universities' different profiles. Various indicators from different countries have also been identified (Ramboll 2014).

As incentives to commercialize research results are not included in universities' general funding model, the importance of TUTL as a funding tool is even more crucial. As shown

above, the benefits of TUTL funding have been significant because most of the results would not have been achieved without it. It has played a particularly important role in terms of encouraging and stimulating universities and research organizations to pay attention and direct resources to the commercialization of research results. TUTL has also played an important role in the development of practices and tools related to the commercialization process (project preparation and implementation, identification of potential ideas, improvement of commercialization skills). TUTL has not yet had the same significance in terms of enhancing the ability of organizations to commercialize and leverage commercialization tools, broadly involving donors and partners in TUTL projects, and transferring research results from projects to business and IPR issues.

Innovation Scout

To strengthen the knowledge, expertise and capabilities of HEIs related to research commercialization, Tekes launched Innovation Scout funding in 2016. It was preceded by KINO funding in 2015-2016. Innovation Scout funding is granted to research organizations to build the capacity to create research-driven business activities. Funding is directed to organizations, not to individual research teams. Funding is used for the economic activities of research organizations to disseminate new knowledge and expertise created in research to society and to the business world.

Tekes evaluates Innovation Scout projects on the basis of how clearly they will help the applicant's ability to promote the dissemination of research results and knowledge to business. Tekes funds are used to build capacity and tools to increase innovation and growth entrepreneurship at the international level in higher education institutions and research institutes. This includes, for example, 1) creating contract models for the effective and flexible transfer of IPR from research organizations to companies; 2) developing new operating models and working methods in cooperation with international partners; 3) creating tools to find and evaluate new research ideas for commercialization; 4) creating tools for project evaluation models; 5) building a culture of disseminating research results and knowhow to society and the business world; and 6) strengthening the networks between research organizations and businesses to enhance innovation activity. Funds are also used to develop international and national cooperation models among actors to enhance economic activity, raise awareness and clarify the roles of different actors.

The long-term objective of Innovation Scout is to increase the commercialization and innovation capacity of research organizations at the organizational level. Tekes funding typically amounts to 40% of a project's total eligible costs.

Spark Finland

The Ministry of Economic Affairs and Employment together with two universities from the Helsinki area (University of Helsinki and Aalto University), two universities from the Tampere area (University of Tampere and Tampere University of Technology) and university hospitals from these areas started a pilot for the commercialization of research results in the fields of life sciences and biomedical engineering. The pilot is called Spark Finland, and it is part of the global Spark network (see Figure 6) originating from Stanford University. See more about Spark here: http://med.stanford.edu/sparkmed/about.html.

Figure 6 The global Spark network

The operations of Spark Finland are based on the following cornerstones of the Spark philosophy:

- A non-profit programme that links to the SPARK Global network.
- The programme may not claim a share of intellectual property or other commercial interest.
- Freedom to operate must be sufficient within the home environment.
- The programme has a Stanford-accredited manager and is audited by the community.

Spark gathers a global network of experts that take part in the sparring process with regard to the selected cases on a voluntary basis. The aim of the programme is to enhance health and wellbeing by growing ideas into new products, services and business. The teams can consist of researchers, students and clinicians. The pilot was launched at the beginning of 2017 and will continue until 2020.

The Spark pilot has already proved that support structures can be similar in various science or industry fields, but the expertise used in supporting the cases must be relevant to the field and case in question. The global network ensures that there is top expertise available for each of the selected cases.

4. Impact

4.1. TUTL impact evaluation

TUTL was evaluated in 2017-2018, and this section is based on the results shown in the TUTL Evaluation 2018 report. The evaluation focused on the impacts of the TUTL instrument, and contextual factors such as other knowledge transfer policies (with the exception of Innovation Scout) were not taken into account.

The significance and value of TUTL for research organizations are clear (see also the case studies summarized in Appendix 1, which are useful to illustrate the impact of TUTL projects). As a financial instrument for boosting research, TUTL has successfully bridged the gap in the national innovation system between the funding for applied research and the growth funding for companies. TUTL funding has in practice been the only instrument to prioritize research-intensive, IPR-intensive, innovation-driven commercialization. In this respect, there is a clear demand and social need for TUTL. By financing the commercialization of research results, Tekes has also supported the objectives of the government programme to improve the effectiveness of research and innovation activities, as it has been shown that companies and research institutes as well as universities underestimate the commercialization of research relative to its societal impacts and returns.

It is found that the additionality of TUTL funding is high and the "leakage effect" is low. Most of the projects implemented under TUTL funding would not have been implemented without the funding of Tekes. At the same time, most of the results obtained would not have been generated without TUTL. Funding does not replace other sources of funding for research institutions/HEIs or funding targeted at commercialization activities. Moreover, it does not appear to have superseding effects in funded organizations or, more broadly, in the operating environment of the commercialization of research.

The TUTL instrument has been a very effective form of funding. Compared, for example, with Tekes' previous TULI funding, TUTL has been a more efficient and straightforward instrument for commercialization. Although TUTL has been in use for only a short time and its final results and impacts are just emerging, preliminary results indicate that it has been more cost-effective than TULI with regard to commercial results, for example, in the form of new startups and new commercial solutions.

The key results in short:

- TUTL is the only financial instrument aimed at research organizations for research result commercialization. Its relevance and value added to research organizations are undeniable. The "leakage effect" of funding is small, and many of the results obtained would not have been generated without it.
- Financing has successfully created commercialization structures and processes and benefited the strategic position of commercialization in research organizations.
- Tekes funding has increased IPR and commercialization awareness and capabilities in research organizations.
- Tekes funding provides the mandate and resources to focus on the commercialization of research and directs the use of the organization's own resources to this end.

- Tekes funding has strengthened cooperation with companies and opened up new contacts with sponsors and external research infrastructure.
- The commercialization of research results in research organizations has clearly improved over the past 3 years.
- TUTL has been an important and functional instrument for research institutions, and similar financial services are also needed in the future.
- According to Tekes data, approximately 60 new companies emerged between 2013 and 2017, of which some 20 were international growth companies.
- TUTL has already "exhausted" a large part of the "prime" organizations' top ideas. It is not clear whether demand for the instrument will lessen or the quality of applications weaken in the future or whether the research system will continue to produce ideas that require a TUTL-type financial concept.

5. Implications

5.1. TUTL broader implications

In the recent TUTL evaluation, questions arose regarding the national research and innovation environment, but it was not within the scope of the evaluation to delve further into these questions. However, the observations in the TUTL evaluation support the conclusions of the OECD Evaluation of Finland (2017) regarding, among others, the challenges faced by the national innovation environment in terms of bringing research results and new ideas to global markets, the lack of a target-oriented approach and an overall vision and the development needs of knowledge-based growth. The OECD and, in part, the national Research and Innovation Council (RIC) have proposed ideas regarding the importance of the development of the national research and innovation system as a whole, the need to increase interaction between research and business, the necessity of internationalizing the innovation system and R&D operations and the necessity of a research and innovation vision, which are important factors in the operational environment and for the success of the commercialization of research.

Types of funding such as TUTL are extremely important to research organizations, and their added value is large. The funding is important not only from the point of view of the commercialization of individual research results, but it has had significant effects on creating cultural change in research organizations. In this respect, further investments are needed in order to make the culture and strategic management in universities more positive towards research result commercialization.

The TUTL evaluation showed that individual funding instruments can have significant impacts on contextual factors. Thus, it is important in developing individual policy instruments to take into account these contextual factors and ensure that the different parts of the policy mix complement each other in a comprehensive manner.

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Appendix 1. TUTL-funded cases. Source: TUTL Evaluation 2018

Case 1: PeptiCrad as a successful project example from Helsinki Innovation Services (HIS)

PeptiCrad was a TUTL project at the University of Helsinki that aimed to develop and commercialize the idea of using immunogenic viruses as active carriers of tumour-specific peptides to direct the immune system to specifically target and kill cancer cells. The idea was to combine the best features of two clinically proven cancer immunotherapy approaches: an oncolytic adenovirus and a peptide vaccine. The ultimate mission was to provide cancer patients with less toxic and longer-lasting therapeutic options, which have a very large market potential.

HIS supported the commercialization process by using its networks abroad and in Finland to find a suitable management team for the commercialization. A suitable leader from the UK was found for the company, which was to be established as a spin-off. The leader had a background as an investor and in the field of medicine. The person in question also made a substantial investment to further develop the idea for the next stages in clinical testing.

A new company, Valo Therapeutics Oy, was created from the PeptiCrad project. Since then, the company has collected seed-stage funding worth 7 million euros. Tekes granted Valo Therapeutics a 3-million-euro non-dilutive loan for the preparation of a phase 1 trial, and approximately 3 million euros have been received from private markets.

Case 2: Saimia University of Applied Sciences DRIVE! project as an example of successful cooperation with a university and of the use of other funding instruments with TUTL

A strength of Saimia has been its collaboration with Lappeenranta University of Technology (LUT) in the commercialization of RDI. LUT concentrates on scientific research and Saimia on applied RDI activities. All of Tekes' TUTL projects have been joint projects with Saimia and LUT. Saimia has had nine TUTL projects, one Innovation Scout project and one KINO project funded by Tekes.

The DRIVE! project shows that continuous long-term funding is necessary for the commercialization of RDI. The project has succeeded in creating a startup company. The Tekes TUTL funding (2014-2016) was preceded by funding from the EU (2012) and Technology Industries of Finland (2013). The inventions were created while funded by both Technology Industries of Finland and Tekes. After the DRIVE! project, a startup company was established. Tekes is funding the startup company to scale up the business.

Case 3: Collaboration in Tampere led to the development of an award-winning Ventica device

The Ventica device measures the expiratory flow of breathing of a child at night. These measurements detect changes in respiration typical to asthma, helping physicians to diagnose the condition and determine the optimal medication. Ventica was developed in cooperation with TUTL, Tampere University Hospital and Helsinki University Centre Hospital. The project received TUTL funding in 2013 and won the Health Challenge innovation competition organized by GSK, Mehiläinen and the British UK Trade and Investment organization in August 2015. As part of the award, opportunities emerged for cooperation in the form of a pilot or research project with the organizers and/or with their assistance. The asthma product was named Ventica in 2016 and received CE marking in early 2017.

Case 4: TUTL project resulted in a new company with a bright outlook

Spectral Engines (www.spectralengines.com) produces ground-breaking smart sensor technology, which determines the very make-up of materials. The spin-off was based on TUTL-funded research at VTT and represents a generic technology platform, which is applicable to a wide range of industries and has considerable growth potential. The company was established in 2014 and received seed financing from VTT Ventures, Inventure and Finnvera. The company has been growing fast and has received international recognition. In 2017, the company won the main prize of €1 million in the EU's Horizon Prize for food scanners.