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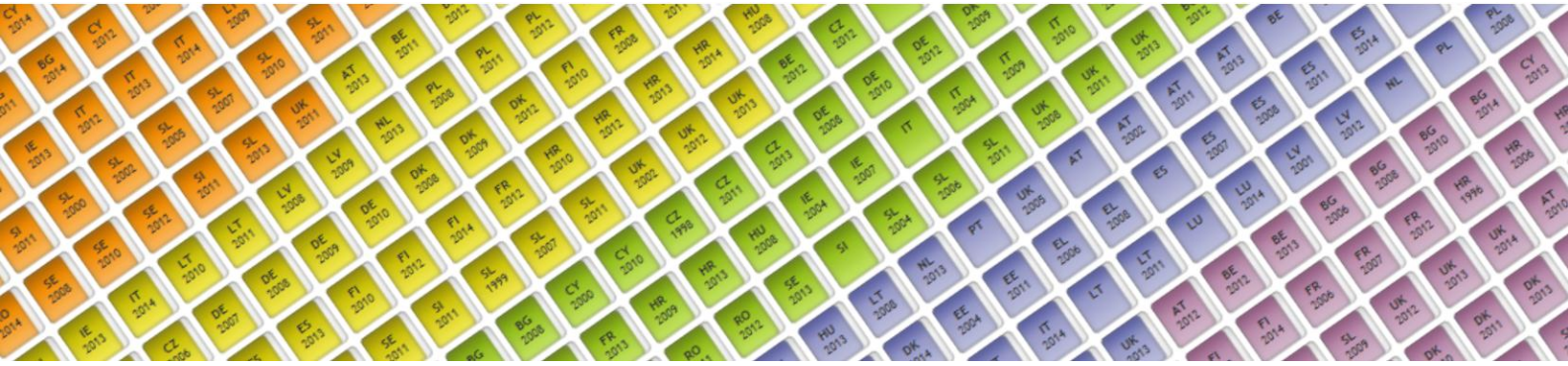

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Abstract

The report offers an analysis of the R&I system in the Finland for 2014, including relevant policies and funding, with particular focus on topics critical for two EU policies: the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The report identifies the structural challenges of the Finnish research and innovation system and assesses the match between the national priorities and those challenges, highlighting the latest policy developments, their dynamics and impact in the overall national context.

Acknowledgments

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Executive summary

This 2014 Research and Innovation Country Report for Finland provides an up to date overview of the R&I system and funding for R&I in Finland. It also examines developments connected with two EU policies – the European Research Area and the Innovation Union. This report was prepared according to set guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites, etc. The quantitative and qualitative data is, whenever possible, comparable across all the other EU Member State reports.

The combined impact of the economic recession and Nokia's fall have caused a remarkable decline in private and public R&D investments. Gross Domestic Expenditures for Research and Development (GERD as a % of GDP) has declined since 2009 when it was 3.75 %. The estimate for the year 2014 is 3.13%, being far less than the 4 % target set by the Government. Governmental R&D funding increased during 2006-2010 by 15% but declined during 2010-2014 by 13% in real terms. Nonetheless, Finland ranks among the world's best in the R&D intensity. Moreover, the country performs well in terms of scientific and technological excellence. The Finnish economy is knowledge-intensive, and has achieved the state of continuous change towards a high and medium-high-tech specialisation. The country has several hot-spot clusters in key technologies, in particular in the ICT, environment, materials, energy, security, and the food and agriculture sectors. The Innovation Union Scoreboard 2014 positions Finland among other innovation leaders including Sweden, Germany and Denmark, which show a performance well above the EU average. Finland outperforms its peers in terms of highly skilled human resources, public and business investments in R&D and patent applications. The main weakness in the Finnish innovation system lies in its low level of internationalisation, both in the public and the private sector. In the Scoreboard, the metrics which have improved significantly include community trademarks, non-EU doctoral students, international scientific co-publications, knowledge-intensive services exports and license and patent revenues from abroad. In contrast, there is a relatively small decline in new doctoral graduates. Finally, the country has improved its performance in the categories of intellectual assets and innovators. In firm investments and linkages & entrepreneurship categories the values are a bit below the EU average.

The structure of the national research and innovation system and its governance has remained quite stable. The main changes in 2013 - 2014, in response also to the Council Country Specific Recommendations, include a new university funding model, a reform of research institutes and research funding (including mergers of PROs, establishment of a new body - the Council for Strategic Research, and the change of VTT's legal status), open data initiatives, a reform of polytechnic, a new program for structural funds including Innovative Cities (INKA) programme and growth agreement with 12 cities, a tax incentive for Business Angels, an extension of the capital investments in universities, a capitalisation of the Finnish Industrial Investment, a Team Finland strategy update (a team of public organizations helping companies go global), streamlining public services for companies, enlargement of the Finnvera mandate, establishment of Tekes Venture Capital Ltd, reorganizing Finpro, and new policy recommendations of the Research and Innovation Policy Council (RIC).

The ratio between institutional and project funding for R&D has remained at about the same level. After a minor last year's decrease in the share of project funding the share will increase in coming years due to the reform of the research institutes and funding, and also due to the recommendations of the RIC if the recommendations will be followed. The new funding model for universities increases competitive elements in institutional funding, too.

Finland has a long tradition of organizing Research and Innovation funding as a cooperative service provided by the funding organisations and as public-private partnerships. This has been strengthened by the new funding concepts of Tekes, by allocation of Tekes funding to start-ups, by the enlargement of the Vigo-accelerator program, and by the enlargement of Finnvera mandate. The new generation of students have created a strong ecosystem of start-ups and VC investors. As a consequence the share of private VC investments in GDP was second to none in the EU in 2013. There is a strong culture for evaluation in Finland: all major actors of the system have indeed been evaluated and 80% of the recommendations given in the evaluations have proceeded to an operational execution phase. European dimension is seen as a natural extension of the national policy for a small country with limited resources. This is also why Finland is strongly committed to the ERA and IU priorities. Progress regarding these two has been achieved but boost in further progress would not hurt. Especially participation in the EU FP program should be increased, and demand based policy measures like innovative public procurement need stronger incentives.

In this report the main challenges of the Finnish R&I system have been defined: weak internationalisation, the quality of scientific research, a fragmented university and research institute system with dispersed resources, and an undiversified business structure and poor productivity development. The Government has initiated major structural and instrument specific changes to address these challenges. The Finnish National Reform Programme (updated 2014) identified the most important reforms of the research and innovation policy to be the creation and introduction of new means and models to strengthen innovation activity, the establishment of attractive hubs of expertise, internationalisation, structural development of higher education, reform of research institutes and research funding, renewing the infrastructure policy, and setting up the tenure track system. Overall, the number and the scale of the strategies and reforms taking place signal the continuous commitment to a broad and ambitious R&I policy. It emphasizes on one hand the role of education and competences, and on the other hand integrates innovation and industrial policies. It also recognizes the significance of interaction with other policies and sectors. The Government has guaranteed an adequate level of research, development and innovation funding and clarified the roles and responsibilities of actors that distribute public financing. However, GERD (as a % of GDP) declined between 2009 and 2013 from 3.75% to 3.32%, and public R&D funding has been cut. In particular, government R&D funding for boosting the knowledge base and the renewal of industries has declined in real terms by 35% during 2011-2014. Incentives for private R&D investments have been weak and they weakened further in 2009 - 2014.

In addition to the efforts in improving the internationalisation, quality of research and fragmented university and research institute system, policy reforms are targeted at increasing the number of high growth innovative firms which are considered to be the major source of employment growth. The funding for innovative companies is also considered as a means to diversify the Finnish economic structure. Other policy initiatives are needed, too. Indeed, the Government has made important policy initiatives focusing on structural reforms. The reforms have been desperately needed but the weak trend in the

economy, however, mean that the undertaken reforms are not enough to increase multifactor productivity. Major decisions are needed to reduce production costs relative to Finland's trading partners. There is also a need for removing regulatory controls that limit competition. What has been discussed here is not generally considered as innovation policy. However, it is necessary to consider a wider policy mix to see the big picture, as the success of innovation policy is in the end dependent on the cost competitiveness. In Finland, means are especially needed to increase the multifactor and the labour productivity of the whole economy by hastening the introduction of the planned R&I measures which aim at broadening the innovation base, and increasing the incentives for R&I and risk taking of businesses and capital.

TABLE OF CONTENTS

1. Overview of the R&I system

1.1 Finland in the European RDI landscape

Finland is a sparsely inhabited country in the Northern Europe with 5.5 million inhabitants, accounting for 1.07% of the EU population. By land mass Finland is the 8th largest country in Europe. The Gross Domestic Product (GDP) was €201bn in 2013 and GDP per capita €37,018, 12% above the EU-28 average (Eurostat, 2013). GDP increased in 2011 by 2.6 % but decreased in 2012 by 1.5 % and in 2013 by 1.2 % (Statistics Finland, Annual national accounts, 2014).

R&D investments have declined in Finland since 2011, and GERD (as a % of GDP) has declined since 2009 when it was 3.75 % as follows: 2011: 3.64 %, 2012: 3.43 %, and 2013: 3.32 %. The estimate for the year 2014 is 3.13 %. (Statistics Finland 2014, Research and development 2013). The combined impact of the economic recession and Nokia's fall caused a remarkable decline both in public and private R&D investments. In 2014 Finland's GERD (as a % of GDP) is far below the target set by the Government (4 %). governmental R&D funding increased during 2006-2010 by 15% in real terms but declined during 2010-2014 by 13%. As identified by the Research and Innovation Policy Council (RIC), the Government funding for R&D for boosting the knowledge base and the renewal of industries declined by 35% in real terms during 2011-2014.

Nonetheless, Finland still ranks among the World's best in the R&D intensity. The country also performs well in terms of scientific and technological excellence. The Finnish economy is knowledge-intensive, and has achieved a state of a continuous change towards a high and medium-high-tech specialisation. The country has several hot-spot clusters which compare well internationally, in particular in the ICT, forestry, metal products and machinery, environment, materials, energy, wellbeing, and food and agriculture sectors. Finland is among the "*Innovation Leaders*" in the Innovation Union Scoreboard 2014 and is ranked fourth in the Global Competitiveness Index (WEF Global Competitiveness Report 2014-2015).

1.2. Main features of the R&I system

The role of private sector in the Finnish R&I system is strong. The share of the private sector of R&D expenditures was 68.9% of GERD in 2013 despite the recent decrease of the share (Statistic Finland 2014). Regarding the Finnish governance system, it is centralised in terms of national guidelines, strategies and funding but a mix of national and local administration allows regions to have a relatively high degree of autonomy in the design and implementation of regional policies. Innovation policies and strategies are led by the Finnish government, which decides on national development goals and sets the general guidelines. On the other hand funding agencies, universities and research institutes have a substantial freedom of creating their strategies and implement them. Finally, it has been a long term trend to increase competition in the research system (see Chapter 2.5.2).

1.3. Structure of the national research and innovation system and its governance

The Finnish research and innovation system is divided into four operational levels as illustrated in Figure 1. The Finnish Parliament and the national Government rule the highest level. In matters related to research, technology and innovation policy, the latter is supported by a high-level advisory body, the Research and Innovation Policy Council (RIC). The RIC gives recommendations for the strategic development and coordination of Finnish research and innovation policies and is led by the Prime Minister.

The second level consists of the ministries, of which the Ministry of Education and Culture (MEC) and the Ministry of Employment and the Economy (MEE) play the main role in research and innovation policy. MEE was reorganised in September 2011 and is responsible for planning and budgeting innovation policy. MEC is responsible for the matters related to higher education and science policy. Together these ministries account for 83% of the governmental research and innovation funding. In 2014, the share of MEC of governmental R&D was 51% while that of MEE was 33%. The share of MEC has increased during recent years mainly due to additional funding to universities and cuts in funding of VTT and Tekes (Statistics Finland; R&D funding in state budget 2014).

On the third level of the Finnish Innovation system we find the competitive R&I funding and the R&D funding agencies, Academy of Finland, Tekes - the Finnish Funding Agency for Innovation, Sitra - the Finnish Innovation Fund and state owned financing companies Finnvera and TESI, Finnish Industry Investment Ltd (FII).

Academy of Finland provides funding for scientific research and training researcher, and aims at improving research capacities. Academy's funding decisions are budgeted to amount to €323m in 2014 (a 2.0% decrease from 2013). The traditional funding pillar of the Academy is formed by the four Research Councils. The Research Councils allocate funding for scientific research in the areas of Biosciences and Environment, Culture and Society, Natural Sciences and Engineering, and Health.

All of the funding of the Academy is competitive based on peer review, mostly international.

As a part of the reform of the research institute and funding system, a new funding pillar was established in 2014 in the Academy: The Council for Strategic Research (CSR). Finally, the Academy is responsible for drafting the research infrastructure policy in the Finnish Research Infrastructure Committee (FIRI Committee).

Tekes - the Finnish Funding Agency for Innovation funds for applied research in universities, research institutes and large companies, provides competitive grants and loans for development and innovation in SME's, grants and loans for YIC's (Young Innovative Companies). Tekes also funds start-ups, and through Tekes Venture Capital Ltd, a fund of funds, contributes to seed phase VC-investments. A special target of Tekes funding is to build incentives for cooperation and knowledge interaction. Funding decisions of Tekes are budgeted to amount to €513m in 2014 (a 5.3% decrease from 2013, Statistics Finland; R&D funding in state budget 2014). All Tekes funding is competitive. Tekes also is responsible for the Finnish coordination of several international initiatives like Eureka, COST, Eurostars, ESA and Horizon 2020.What is more, Centres for Economic Development, Transport and the Environment (ELY Centres) are responsible for the regional

implementation and development tasks of the central government. Their innovation staffs provide Tekes services to regions.

Sitra, the Finnish Innovation Fund operates directly under the parliament having high autonomy. Sitra's mission involves foresight of societal change, studying megatrends and promoting evidence based decision making, trying out new operating models and accelerating business activities by pilots and VC-funding. Sitra operates with the profit it earns from the investments of its own capital. In 2013 Sitra's total long term assets were €665m and total expenses €33m (Sitra, 2014).

TESI, Finnish Industry Investment Ltd (FII) is a Government owned special purpose investment company. FII makes private equity (PE) investments directly and through funds. Its mission is to correct market failure where there is a perceived lack of private funding contributing to the Finnish innovation, entrepreneurship and growth. FII invests in companies seeking rapid growth, internationalisation, and in spin-offs. FII does major industrial investments, as well as sectorial, corporate and ownership restructurings. The value of assets under the management of FII is €900m.

Finnvera Ltd is a specialised financing company owned by the State and it is the official Export Credit Agency (ECA) of Finland. It offers loans, domestic guarantees, venture capital investments and export credit guarantees. The State covers some of Finnvera's credit and guarantee losses. This enables Finnvera to take more risk in its lending operations than commercial banks would generally accept. Finnvera's commitments (30 September 2014) were

- SME Financing €2.6bn

- Export Financing €12,5bn.

In 2013 Finnvera's offered SME financing was €757m and Export credit guarantees and special guarantees €3.4bn. The role of funding by Finnvera is not focused specially on supporting innovations but its role is crucial in the commercialization phase of the innovation processes. Even though the share of Tekes customers among Finnvera customers is only 10%, the share of Finnvera customers among Tekes customers is 60% in a longer time span. Finnvera's mandate, including a better ability for higher risks, was enlarged 2014.

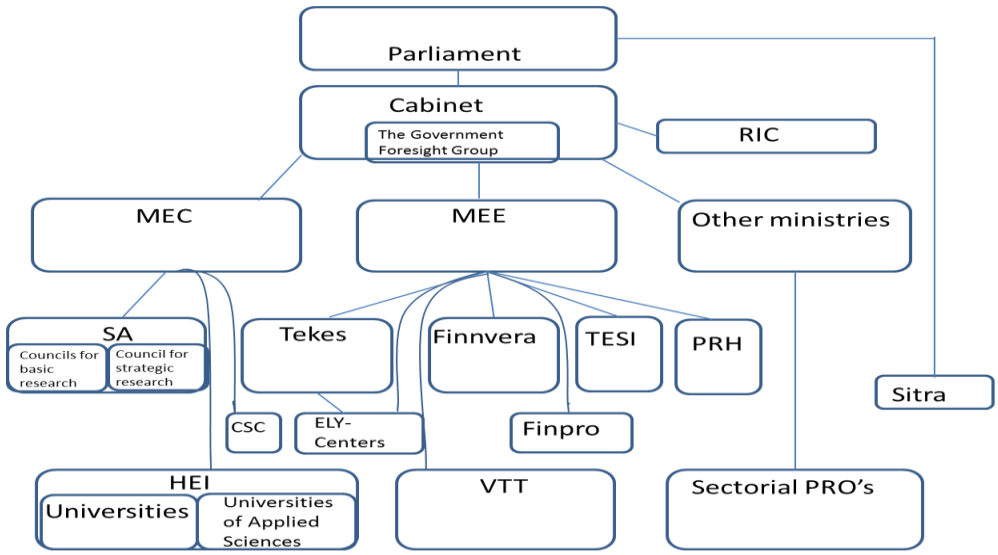
CSC - IT Center for Science Ltd is a non-profit, state-owned company administered by the Ministry of Education and Culture. CSC maintains and develops the state-owned centralised IT infrastructure and uses it to provide nationwide IT services for research, culture, libraries, archives, museums as well as information, education and research management.

Finpro helps Finnish SMEs go international, encourages foreign direct investment in Finland and promotes tourism having a role in many innovation processes of enterprises including supporting export activities and market foresight.

Moving to the next level of the Finnish innovation system, the fourth level is comprised of the public organisations that conduct research: universities (14), public research organisations (12) and Polytechnics, also known as Universities of Applied Sciences (26). The reform of the central government's sectorial research institutes has proceeded so that the number of the institutes has declined from 18 (2012) to 12 (2015). Still, due to the high number of universities, polytechnics and public research institutes the Finnish research system is rather fragmented. The biggest state research organisation is Technical Research Centre (VTT).

Considering universities and public research organizations, the division between institutional and project funding in 2013 is shown below (Statistics Finland 2014, Research and development 2013), where also the share of the international project funding is shown:

	Institutional	***Project***	***Total***	
For HEIs	€603m	€835m	(intl. €144m)	€1438m
For PROs	€315m	€329m	(intl. €89m)	€644m



- RIC, Research and Innovation Policy Council
- MEC , Ministry of Education and Culture
- MEE, Ministry of Employment and the Economy
- SA, Academy of Finland
- Tekes, Finnish funding agency for innovation
- Sitra, the Finnish Innovation Fund
- Finnvera Ltd, a specialised financing company owned by the State of Finland and it is the official Export Credit Agency (ECA) of Finland.
- TESI, FII, Finnish Industry Investment Ltd, a government-owned investment company
- CSC - IT Center for Science
- ELY Centres, Centres for Economic Development, Transport and the Environment are responsible for the regional implementation and development tasks of the central government.
- Finpro helps Finnish SMEs go international, encourages foreign direct investment in Finland and promotes tourism
- VTT, Technical Research Centre of Finland
- PRH, Finnish Patent and Registration Office
- HEI, Higher Education Institutions
- PRO, Public Research Organisations

Figure 1. Overview of the Finnish research and innovation governance

Higher Education Institutions (HEI) includes Universities, Polytechnics and Universities' Central Hospitals. In 2013, Universities' share of the R&D expenditures was €1216m,

Polytechnic's share €169m and Universities' Central Hospitals' €54m. The share of international funding was €144m, most of which is EU funding. Regarding the project funding received by the HEIs, almost half comes from the Academy of Finland and Tekes, and €72m from private companies, (Statistics Finland 2014, R&D funding in state budget 2014). Concerning the institutional funding, two thirds of university budgets is allocated to education and one third to research (Research in higher education institutions). At polytechnics, according to the Statistics Finland, only 8% of the budget has been allocated to research but the new funding model will allocate 15% of the budget to research (Finnish National Board of Education, MEC Funding 2014, in Finnish).

Looking at the share of project funding at different Public Reseach Organisations (PROs) we see that it varies a lot. The share is highest for VTT (68% of funding is project based), Finnish Environment Institute (SYKE) (70%) and MIKES, Metrology Finland (52%; MIKES was merged to VTT in 2015). In the case of other PROs the share varies between 11% and 40% (Statistics Finland 2014, R&D funding in state budget 2014). Doing this comparison, it is noted that also the balance between research and other activities varies depending on the institute, which affects the ratio between project funding and institutional funding.

VTT, Technical Research Centre of Finland is the biggest multi technological applied research organisation in Northern Europe. VTT's turnover was €279m in 2013, external revenue €190m (68% of turnover), block funding €89m (32% of turnover) and revenue from abroad €53m (19% of turnover). VTT has four subsidiary corporations: VTT Expert Services Ltd, VTT Ventures Ltd, VTT International Ltd and VTT Memsfab Ltd. Turnover of the whole VTT Group was €308m. VTT's role in driving Finnish participation in EU-programmes is very important, as VTT ranks first in Finland in raising funding from the EU Framework programmes (22.5 % of all funding).

There are 350,000 companies in Finland of which 315,000 have less than 4 employees, and 19,200 have more than 10 employees. The number of large companies is 590 of which 112 have more than 1000 employees. The number of medium sized companies is low (Statistics Finland, Structural business and financial statement statistics 2013). A bit more than half of the companies (with more than 10 employees) reported innovation activity in 2010 - 2012 (Statistics Finland, Innovation activity 2012). Private sector R&D expenditure in 2013 was €4.6bn. The contribution of manufacturing was 71% and other sectors (mainly services) 29%. The share of the ICT sector (as a % of BERD) was 45%, the metal and machinery sector 13%, chemical sector 7%, wood and paper sector 2% and the other manufacturing sectors 4%. Segmenting the figure based on the company size, 78% of the R&D was executed by large companies, 4% by micro companies and 20% by other SMEs (Statistics Finland 2014, Research and development 2013).

Finishing off with the structure and the governance of the national research and innovation system, main changes during 2009-2014 are listed below:

Main Changes in 2010
The University Reform (the new University Act 2010) including: Autonomous legal entities, Capital investments (private and public), Merges, Tenure track system
Main changes in 2011
The polytechnic reform (a Government programme)
Main changes in 2012
The reform of research institutes and research funding (a Committee recommendation) *New openings of Tekes programs (continuing yearly)* *Capitalisation of the Finnish Industrial Investment (2012, 2014-2017)*
Main Changes in 2013
The new university funding model *Open public data initiative (continuing yearly)* *European Regional Development Fund and European Social Fund measures combined and prepared for the programme period 2014–2020, launching the INKA program,* *Growth agreements with 12 cities* *The R&D tax incentive for labour costs* *Tax incentive for business angels* *Streamlining public services for companies*
Main Changes in 2014
Research and Innovation Policy recommendation (RIC) 2015 - 2020 *The polytechnic reform (the new Polytechnic Act took force)* *The reform of research institutes and research funding implemented 2014-2017, including: Council of strategic research, Merging of PROs, Change of VTT's legal status (starting 2015)* *The R&D tax incentive for labour costs was terminated* *Capital investments in universities continued (with one private € three public €)* *Open science and research roadmap 2014-2017* *Strategy and Roadmap for Research Infrastructure 2014-2020* *Updated strategy for Team Finland* *Enlargement of the Finnvera mandate* *Establishment of Tekes Venture Capital Ltd* *Reorganizing Finpro (privatizing the export consultancy and market entry unit)* *Launching the Smart Procurement program and INKA Innovative cities program*

2. Recent Developments in Research and Innovation Policy and systems

2.1 National economic and political context

Regarding the development of national economy, Finland is facing the effects of the global and European recession by restructuring the economy towards new growth areas. Moreover, the Finnish economy will also be strongly affected by the ageing population. Productivity and living standards still rank high among the developed countries, but previously strong industries such as electronics and forestry are now in experiencing difficulties and, in general, the share of manufacturing in GDP is declining. Although Finnish labour productivity has traditionally been high in manufacturing, this is less the case in the services sector.

Finland's GDP has been declining continuously since the second half of 2012. The performance of the Finnish economy is lagging well behind most countries in the euro area. Finland's real GDP is still a good 5% smaller than immediately before the onset of the international financial crisis in 2008. Since the onset of the international financial crisis, Finnish exports have declined by approximately one fifth, which is more than in any other advanced economy. Production costs in Finland have increased due to an approximately 10% rise in average wages relative to the euro area average since 1999, when the common currency was adopted. Most of the difference in average wages has come since 2007. Unit labour costs have also risen by approximately the same amount across the economy as a whole relative to the euro area average.

The turnover of the electronics sector has collapsed 2009-2013 by 48% (at current prices) led by Nokia's tumble in the mobile phone market and its acquisition by Microsoft in 2014. The erosion of wood and paper production has been more gradual, but remarkable: 9% at current prices. The chemical and metal sectors have been more resilient, but have been unable to make up for losses in electronics and forestry. Services have not compensated for losses in output and exports in manufacturing (OECD 2014, Economic survey). Trade with Russia has declined as a result of the recent conflict in Ukraine. Due to the collapse of the electronics sector, R&D expenses of the sector also decreased 2019 - 2013 but more moderately, by 27%. However, R&D expenditure of the wood and paper sector remained about at the same level. Although other companies in other sectors increased their R&D expenditures, BERD decreased by 5%.

Finland's general government deficit was 2.4% of GDP in 2014. Tightening fiscal policy will probably improve the position of central government finances in 2015, but less than estimated in June 2014. General government's share of the gross value added that describes the size of the public economy was 21.2% (Bank of Finland, Economic Outlook 5/2014). Finland's long-term debt rating was downgraded from AAA to AA plus on 10 October 2014 by one of the major rating agencies (Standard & Poor's) due to poor growth prospects for the Finnish economy. The outlook for the rating is stable.

Finland's GDP growth will continue to be lacklustre through 2014–2016. The Bank of Finland estimates that there will be a decrease of 0.2% in 2014, and, although the figure will slightly grow during the course of the next year, real GDP in 2015 will still be 0.1% down from the previous year. After four years of unbroken decline, the economy will return to growth in 2016, but only of 1.0%. The general government deficit will still be around

2.5% of GDP in 2014. The period of low inflation will continue (Bank of Finland, Economic Outlook 5/2014).

In terms of the political context, the Government has made important policy initiatives on structural reforms to improve the sustainability of the public finances, the most significant of these being the pension reform. There have also been essential decisions taken in order to achieve fiscal consolidation. The Government's priorities are reducing poverty, inequality and social exclusion, consolidating public finances and promoting sustainable economic growth, employment and competitiveness. The weak trend in the economy and the bleakness of the long-term outlook do, however, mean that the next parliaments will still have much to do to bring the Finnish economy onto a sustainable growth trajectory. One area in which crucial decision-making is needed relates to a reduction in production costs relative to Finland's trading partners. There is also a need for implementing broad range of structural reforms e.g. by removing regulatory controls that limit competition, particularly in private service sectors, and using a range of means to increase labour supply. The major reforms of the R&I policies are described in the chapter 2.2. The impacts of the reforms and political initiatives on the R&I will be seen in a longer run.

2.2 National R&I strategies and policies

The challenging economic situation of the Finnish economy has had impact also on the R&D system in the country. In particular we note the decline of Nokia and its subcontractors, the downturns of the paper and pulp industry, and the cuts in public resources for R&I. This has resulted in a decrease in budget allocation for VTT and PROs, for instance. While the research and innovation system is facing major structural pressures, the expectations on its potential to revive the economy remain high.

However, measures and recommendations have been put forth to improve the quality and impact of Finnish R&I activities, thus increasing welfare and competitiveness in the long run. Luckily, an adequate and stable R&I structure is already in place to meet the challenges. The RIC is coordinating science and innovation policies whereas the implementation of the policies has been spread under two different ministries. Ministers, industries, funding agencies and the research community are represented in the Council headed by the Prime Minister. The network of all relevant stakeholders is present, visible and well connected at the operational level, too. PPP (public-private-partnership) is a common practice especially in Tekes programmes, SHOK programmes (see Chapter 2.5.3) and in start-up funding.

National R&I strategies during the years 2013 and 2014, described in the following, are based on the RIC recommendations 2010. National innovation policy guidelines are based on the RIC recommendations. However they are also based on the decisions of the Government and on strategies and guidelines of ministries. The Programme of the Prime Minister Alexander Stubb's Government 6.4.2014 builds on the previous Government Programme, the Structural Policy Programme and to the necessity of fiscal adjustment. The Government program states that "industrial renewal, bio economy, cleantech and digital business will be the Government's priority sectors" and that as agreed "The Government will strengthen universities' capabilities to attract funding and will also aim at ensuring opportunities for development of the quality of research through changes made to the funding system. The Government will agree in the budget session on a one-off increase in the basic funding of universities within the framework of the 2015 unallocated

reserve". Sector wise, the Government is also increasing emphasis on the service and creative sectors, including marketing, design, branding and other consumer focused value creating activities. Business models as sources for economic growth are also focused on. The IPR (Intellectual Property Rights) strategy will be revised. Budget will be allocated to stimulating growth in the creative economy. The Act on Public Contracts will be changed to stimulate innovative public procurement. Moreover the Government is examining the introduction of a tax incentive related to the utilisation of patents. Furthermore, in a spirit of open data, a decision has been taken to open up non sensitive public data resources systematically. Finally, there will be a shift in the focus of public funding to small and medium-sized, growth-oriented enterprises aiming at international markets (Ministry of Employment and the Economy 2014, National innovation policy guidelines).

In 2014 the RIC gave new recommendations for the Finnish R&I strategy: Reformative Finland: Research and Innovation Policy Review 2015-2020. The recommendations focus on the *most important development themes that are* the radical renewing of the HEI system; boosting the utilisation and impact of the results of R&I activities; and strengthening new growth sources, intangible assets and entrepreneurship. *Other major themes are:* Extensive improvement of knowledge base, selective support to cutting edge knowledge creation, reform of the public research system and enhancement of horizontal cooperation, and sufficient and focused R&D funding.

The recommendations emphasise performance, quality and impacts, interaction and cooperation between different stakeholders, and internationalisation. The recommendations define that "internationalisation must be integrated in all R&D activities and decision making - it is not a separate task ... Finland will be proactive in the EU R&D policy. The target is that funding which will be received from the Horizon 2020 is 50% higher than the funding received from 7th Framework program." RIC points out knowledge areas and sectors, which are important for Finnish economy and wellbeing, including: ICT, especially mobile and software knowhow; clean solutions in energy, environment and material efficient technologies (cleantech), bio- and nanotechnologies, health and wellbeing, and arctic knowhow. The RIC recommendation, related to the radical renewing of the HEI system, refers to the need of rising the quality and internationalization, reducing fragmentation, making strategic choices, focusing, building stronger and fewer units, and developing the HEI and PRO system as an entirety.

Concerning public funding the recommendation states that "real governmental R&D funding grew by 15% during 2006-2010 but declined by 13% during 2010-2014. Especially institutional funding for VTT and the funding mandate of Tekes have declined: real governmental R&D investments to build knowledge base and for the renewal of industries have dropped in four years by 35%. At the same time governmental R&D funding for health care has decreased by 20% and the funding for research in university hospitals has declined by 28%".

The RIC recommends increasing governmental funding in R&D during 2015-2020 by 2% yearly in real value. By 2020 this means a €210m increase in real value compared to funding in 2015 level. 65% of the increase should be allocated through competitive funding (Tekes €85m and the Academy of Finland €50m). Implementation of the recommendations for 2015-2020 starts in 2015 but the changes compared to the previous recommendations from 2010 are not that radical. The RIC recommendations are taken seriously - indeed most of the previous recommendations (in 2010) have already been implemented.

The major R&D programmes in Finland are thematic, organised by the Academy of Finland, Tekes and the SHOKs. More than 60 programmes are underway. (Programmes of the Academy of Finland, Tekes programmes, SHOK programmes)

The R&I structure and strategy is relevant in the sense that the targets of the policy initiatives are in line with the national challenges. Priorities in science, research, innovation and economy are similarly relevant for Finland and reflect also the EU priorities. Strategies and policies encompass research, innovation and education aspects. It remains to be seen how well the strategy will be implemented and will the recommendations lead to the much needed actions and new instruments.

2.3 National Reform Programmes 2013 and 2014

The Government has initiated major structural and instrument specific changes to address the challenges facing the Finnish economy. The Finnish National Reform Programme (NRP) is based on the Europe 2020 Strategy (Ministry of Finance 2012). The programme has recently been updated (Europe 2010 Strategy, Finland's National Programme, spring 2014). It defines that Finland's national targets are raising the employment rate of the population aged 20–64 to 78%, maintaining R&D expenditure at a minimum of 4% of GDP, reaching the climate and energy targets agreed in the EU, keeping the proportion of people aged 30–34 having completed tertiary-level education at 42%, decreasing the proportion of 18–24 year-old early school leavers below 8%, and reducing the number of people living at the risk of poverty and social exclusion.

Even though investments in research, development and innovation continue to be high, they are declining, and a critical issue of innovation efficiency remains. That is, how research is translated into innovations and new high-growth companies, and how the growth companies can penetrate fast growing export markets and strengthen international competitiveness. In the short term, Finland should increase its cost competitiveness, and in the long term, implement the new RIC recommendations, and propose further reforms, where relevant, based upon existing evaluations and foresight work.

In 2012, an ICT 2015 working group was appointed to prepare a strategy to mitigate the effects of the sudden structural change in the ICT sector as well as to reform the information and communications technology sector and to increase its competitiveness. The strategy proposed by the working group is not an official governmental strategy but its implementation is followed by the Government. The strategy is still valid.

The Government approved the decrees related to the revision of university funding model (MEC, 2014). Government appropriations will be directed especially on the basis of performance and quality. The new Universities Act (558/2009) and the use of the new funding model came into effect in 2013. Further development of the funding model is focused on measuring societal and economic impacts of universities.

The polytechnic (Universities of applied sciences) reform (MEC 2014) started as a part of the Government Programme in September 2011. A new Polytechnics Act came into effect in the beginning of 2014. The responsibility for polytechnic funding as a whole was transferred to the Government, and polytechnics were made independent legal entities. The license to provide polytechnic education will be revised, with new emphasis on quality and impact. The new funding model allocates 85 % of resources to education and 15 % to

R&D. About 70% of funding is allocated based on the number of examines awarded, and 30% based on performance indicators related to the quality, internationalization, regional impacts and cooperation with working life.

In September 2013 the Finnish Government approved a Resolution on comprehensive reform of research institutes and research funding (Finnish Government, 2013). The resolution specifies three packages of measures for the reform of research institutes and research funding. These three sets of measures comprise structural reforms, research funding reforms, and the implementation and follow-up of the reforms. All reforms will be implemented in 2014–2017. The Council for Strategic Research and the Committee for Research Infrastructures were established 1.7.2014 and are a part of the Academy of Finland. A new Finland's strategy and roadmap for research infrastructures 2014–2020 was also released (MEC, 2014).

Furthermore, Innovative cities (INKA) program began in 2014, replacing the previous centre of excellence programme (OSKE) (see Chapter 2.6). Team Finland strategy was updated in 2014 (Prime Minister's Office 2014). The MEE reorganised Finpro in 2014. Tekes Venture Capital Ltd was established in July 2014. Activities under Tekes Venture Capital were in effect moved from Finnvera to Tekes.

The mandate of Finnvera (Finnvera news 2015, in Finnish) was enlarged. As a result, Finnvera can increase risk in its funding. The new mandate improves funding especially for start-ups and growth companies entering international markets and medium or large companies which have turnover up to €300m. Export guarantees are now available at domestic markets, too.

2.4 Policy developments related to Council Country Specific Recommendations

The Council Country Specific Recommendations support Member States and the Commission in coordinating their economic and budgetary policies. In relation to research and innovation policy in Finland, the Council stated in 2014 that some measures have been taken and/or progress made on policy initiatives to promote growth and innovation. However, there still are remaining challenges. The Council recommends continuing to boost Finland's capacity to deliver innovative products, services and high-growth companies in a rapidly changing environment, and continue the diversification of industry, in particular by improving the business environment to strengthen investment in Finland and further facilitating smaller firms' entry into export markets.

The Government of Finland has ensured an adequate level of research, development and innovation funding and clarified the division of responsibilities of actors that distribute public financing. In particular, the following measures have been taken forward during 2013-2014 in response to the commitment to the Reform Program: reallocation of public research funding, a reform of public research institute structure, reform of university funding model, a polytechnic reform, reform of public services for internationalisation, reform of structural fund allocation system, renewing recommendations of the Research and Innovation Policy Council and National innovation policy guidelines, reform of seed phase VC funding, boosting the start-up ecosystem development, improving the financing tools for growth, internationalising and export, new Tekes programs, increasing YIC and start-up funding, and enhancing public procurement practices for innovative procurement.

However, GERD (as a % of GDP) declined between 2009 and 2013 from 3.75% to 3.32%, and it is concerning that incentives for private companies' R&D have been cut. OECD STI 2014 Outlook (page 69), indicates a minor decrease in total public support for business R&D in Finland in 2007-2012. The mandate of Tekes to assign grants has been cut by €128m and to assign loans has been increased by €64m from 2009 to 2015 which will be visible in funding flows and public support level in 2014 and later on (Tekes budge 2006-2015, in Finnish).

2.5 Funding trends

2.5.1 Funding flows

The Europe 2020 target for Finland is to have 4 % expenditure to R&D as a proportion of GDP by 2020. However, GERD declined between 2009 and 2013 from 3.75% to 3.32% of GDP and is estimated to drop further to 3.13% in 2014. There are no specific targets for BERD/GERD or BERD/GDP but an overall target is to keep the share of private funding on a high level. The private sector share of GERD decreased from 70% to 69% and BERD/GDP degreased from 2.33% to 2.28% during 2011-2013 (Eurostat, 2014). The share of the governmental funding increased from 27% to 29% of GERD, respectively. The share of funding from abroad increased from 9% to 12% of GERD.

Thus in 2013 the Government funded around 29% of all R&D activity. From this amount 63% was directed to the higher education sector, around 25% went to the public research organisations (mainly sectorial research institutes) and approximately 12% to the private sector. The public funding is about 3% of private sector's expenses on R&D. This is very low compared to the 8% OECD country average.

R&D expenditures of the Universities are still quite high (0.72% of GDP in 2013) (Statistics Finland, 2014, Research and development 2013 and Statistics Finland, Annual national accounts, 2014) but because of the dispersed university structure the use of resources is not as effective as it could be (RIC, 2014).

In 2013, most of the university funding came from various government sources (81%), especially from the MEC but also from the funding agencies, the Academy of Finland and Tekes. The share of private sector in university funding was 5%, and from abroad universities collected 10%.

Although the private sector participates in the funding of the research carried out by the higher education and public sector, most of their funding naturally goes to private R&D. Public research organisations perform about 10 % and the higher education institutions around 22 % of all R&D activities in the country. In 2013 70% of R&D funding from abroad was directed to the private sector. Around 19% of the foreign funding went to universities and 11% to the public research organisations.

The share of basic research and research infrastructures funding is difficult to estimate because the definition is unclear (e.g. the Academy of Finland refers to scientific research, as do many universities, though it can be either basic or applied research). Most of universities' block funding goes to basic research. Moreover most of the funding from the Academy of Finland goes to basic research. The Academy is the largest research funder outside the block funding. . Looking at the long term trend it can be however estimated that the share of applied research has declined. Major cuts in public funding were made in

2014 in terms of government budget appropriations or outlays for R&D (GBAORD), as presented below.

Table 1. Government budget appropriation or outlays for R&D in 2014 and 2015

	R&D funding € million 2014	**Share of R&D funding, % 2014**	**Real change from 2013, %**	**R&D funding € million 2015**	**Share of R&D funding, % 2015**	**Real change from 2014, %**
R&D funding total	1955.1	100	-3.6	2002.5	100	0.6
Universities	578,9	29.6	-0,7	578.0	28.9	-1.9
Tekes	513,3	26.3	-6,8	488.2	24.4	-6.6
Academy of Finland	322,7	16.5	-3,6	415.6	20.8	26.5
Government research institutes	282,2	14.4	-7,2	256.2	12.8	-9.4
Other R&D funding	226,7	11.6	1,0	242.8	12.1	3.0
University central hospitals	31,3	1.6	-0,6	21.7	1.1	-31.9

Statistics Finland 2015, Government R&D funding in the state budget 2015

In Finland governmental support to research and innovation has mainly been channelled through direct funding and this seems to continue. Indirect funding measures have been used three decades ago and again in 2013-2014. The Government budget for 2013 included two tax incentives aimed at growth seeking businesses. The Tax Incentive for Private Investors targets business angels investing equity in SMEs. The incentive provides a possibility to postpone paying capital gains taxes as long as those gains are re-invested in qualifying businesses. The R&D Tax Incentive was a deduction from corporate income taxes tied to the wage costs of R&D personnel in Finland. In 2014 the Government decided to terminate it due to the lowering of corporate tax (State budget 2014), and because the R&D tax incentive presumably doesn't have any impact on adding R&D investments of enterprises when direct funding has been measured to have an additionality of 2 (Ali-Yrkkö J. 2008 and Einiö E. 2009). This will be re-evaluated in the evaluation of the tax incentive scheme.

Table 2. Basic indicators for R&D investments

	2009	2010	2011	2012	2013	EU28 (2013)
GDP growth rate	-8.5	3.4	2.8	-1.0	-1.4	0.1
GERD (% of GDP)	3.75	3.73	3.64	3.43	3.32	2.07 (2012)
GERD (euro per capita)	1,274.1	1,302.7	1,332.7	1,264.9	1,231.7	530.1 (2012)
GBAORD - Total R&D appropriations (€ million)	1,928.4	2,068.9	2,071.7	2,064.1	1,996.7	90 505.6
R&D funded by Business Enterprise Sector (% of GDP)	2.55	2.46	2.44	2.16	2.02	1.12% (2011)
R&D funded by Private non-profit (% of GDP)	0.04	0.04	0.05	0.04	0.05	0.03%[e] (2011)
R&D funded from abroad (% of GDP)	0.25	0.26	0.24	0.30	0.38	0.19% (2011)
R&D performed by HEIs (% of GERD)	19	20	20	21.6	21.5	23.6.% (2012)
R&D performed by Government Sector (% of GERD)	9	9	9	9.0	8.9	12.2% (2012)
R&D performed by Business Enterprise Sector (% of GERD)	71	70	70	68.7	68.9	63.3% (2012)
Share of competitive vs. institutional public funding for R&D	56/44[E]				54/46[E]	N/A
Venture Capital as % of GDP (Eurostat table code tin00141)[VC]	0.05	0.055	0.041	0.042	0.052	N/A
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	5.5	5.7	5.2	5.2	5.2	5.6% (2011)
Employment in knowledge-intensive service sectors as share of total employment	43.0	42.2	43.2	45.0	44.6	38.9% (2011)
Turnover from Innovation as % of total turnover *(Eurostat table code tsdec340)*		15.3				13.4% (EU-27, 2010)

E= Estimate; Institutional funding also includes competitive elements
VC figures are not Venture Capital figures but VC investment figures

International funding dropped in 2010 but has grown since 2011. EU funding has been growing steadily but slowly. Figures for the years 2009-2013 are (€ million):

	2009	*2010*	*2011*	*2012*	*2013*
All funding from abroad	648	479	469	600	771
EU funding	141	163	182	183	185

R&D related FDI is difficult to define and measure. Intramural R&D expenditures of multinational corporations and international VC investments may however indicate it. The intramural R&D expenditures of multinational corporations were €562m in 2011 (11% of BERD), (OECD: AMNE Database – Activity of Multinational Enterprises). This data does not match well with the national statistics according to which foreign R&D funding of enterprises was €251m in 2011. The mismatch reflects the challenges in collecting this kind of data. On the other hand foreign R&D funding of enterprises according to the national statistics, was €539m in 2013 which is close to the AMNE Database data. The intramural R&D expenditures of multinational corporations indicate mainly the foreign affiliates' share of overall entrepreneurial activity in a country. In Finland the share (of turnover) has been quite low varying between 17% and 22% and being 18% in 2013 (Statistics Finland 2014, Foreign affiliates in Finland).

International VC investments (institutional, private) can be estimated from the data of the EVCA (European Private Equity and Venture Capital Association). Based on two ways of defining the investments, the VC/PE Investments (as % of GDP) in Finland were 0.067% (based on PE market statistics[1]) or 0.052% (based on PE industry statistics[2]). The foreign VC/PE investments were 0.022% of GDP.

In Finland the national FDI strategies and objectives are not well defined. International VC investments - especially in start-ups - are desired. So are the green field investments but the foreign ownership nonetheless concerns politicians and citizens (Kotiranta A, 2008). According to the past evidence, foreign ownership has mainly had a positive impact in market shares, turnover and export of the acquired companies. However, there are case examples of negative impacts, too, and the foreign affiliates' share of overall private business in Finland is low. In short, clear national objectives are missing especially related to foreign acquisitions.

The total EU funding that Finland received in the 6th Framework program (FP6) was €327m and in the 7th Framework program (FP7) €887m. The latter is 1.18 times the money Finland paid as the effective membership fee to the FP7 (Tekes 2014, Finland as a net receiver in the EU 7th Framework program and EC statistics).

The structural funds (SF) programme 2007–2013, allocated under the Regional Competitiveness and Employment objective for Mainland Finland, distributed a total of

[1] Market statistics are based on the location of the company receiving the investment. So, this figure includes investments in Finnish companies regardless of the location of the private equity firm.

[2] Industry statistics are based on the country of the private equity firm's office in charge of the investment. So, this figure includes investments made by Finnish private equity firms regardless of the location of the target company.

€1,589m, of which the share of the European Regional Development Fund (ERDF) was €974m, while the European Social Fund (ESF) contributed €615m (Ministry of Employment and the Economy 2012, Structural Fund Programmes of the EU 2007–2013).The share of structural funds initially allocated under RTDI priorities in 2007-2013 was €468m (29.3% of the total). The absorption of the allocated SF funding (under RTDI priorities) was 75-100% in all regions (IU Progress Report).

Comparing the FP participation in Finland to other member states, the role of the FP programs internationalising research has been and will be very important. Finland ranks fairly high in the number of program participations per capita or funding received per capita. However, when measured against to the national R&D effort, Finland ranks low. Indeed, the RIC recommends increasing participation in the FP programs by 50%.As the private investments in R&D in Finland have been high, the relative role of the Structural funds has not been very significant for RTDI on the national level. Anyhow, the SFs have boosted regional activities in RTDI. The main challenge in the use of SFs has been the allocation of resources. Resources have been split into too many small projects and therefore the focus has not been strong on renewing structures and the economy. Specialisation, strategic choices, and focusing on forerunners have not been as clear as in the case of national funding.

To summarize this chapter, the governmental strategies and national innovation policy are well in line with the Finnish challenges with one exception: the 4% target for GERD (as a % of GDP) will not be reached without stronger incentives for private companies' R&D. The RIC expressed the concern at the cuts of governmental R&D investments building knowledge base for and boosting renewing of industries, and gave a recommendation to add grants for business R&D (Reformative Finland: Research and Innovation Policy Review 2015-2020). The economics explaining the market failures related to R&D investments is not fully understood and accepted in Finland. This leads to confusion, and traditional subsidies (targeted to preserve existing businesses) are mixed up with R&I subsidies (targeted to renew existing businesses and to boost creative destruction) in the political debate.

2.5.2 Project vs. institutional allocation of public funding

The legal framework for the allocation of R&D project and institutional funds has been stable for many years in Finland. Within the framework, the share of competitive funding increased until 2009 and then decreased until 2013, the decrease in 2009 - 2013 being 2 %. Starting in 2013 changes have been made to the framework itself, including the reform of research institutes and research funding, and new funding models for universities and polytechnics.

There are no overall statistics on project vs. institutional[3] allocation of public funding in Finland but an estimate can be made. In Table1 Government budget appropriation or

[3] Institutional funding is defined as the total of national budgets in a given country, attributed to an institution, with no direct selection of R&D project or programmes and for which money the organisation has more or less freedom to define the research activities to be performed." Institutional funding can be in the form of non-competitively allocated Block funding. Institutional funding may also be allocated in a variable/competitive manner tied to institutional assessments. "project funding is defined as the total of national budgets in a given country, attributed to a group or an individual to perform an R&D activity limited in scope, budget and time, normally on the basis of the submission of a project proposal describing the

outlays for R&D in 2014 are shown. It is seen that 43% of funding is allocated through Tekes and the Academy of Finland, which both fully operate within a competitive project funding framework. In 2013 50% of Tekes funding was allocated to business sector, 33% to HEIs, and 17% to PROs. The Academy of Finland allocated 91% to HEIs, and 9% to PROs.

Looking at Table 1, the category of other public funding includes governmental funds allocated by ministries and structural funds allocated by ELY-centres and regional councils. These are mainly competitive project funds.

When estimating the share of institutional and project funding of GBAORD (Table 3) it is assumed that "Other public funding" is mostly project funding (as it probably is). Now, the share of institutional funding is 46% and project funding 54%. The share of project funding of GBAORD has decreased from 56% (2009) to 54% (2014). But at the same time competitive elements have been increased in institutional funding. The new recommendation by the RIC proposes a €210m increase in GBAORD by 2020, and 65% of this increase would be competitive funding.

Institutional funding

The share of institutional and project funding varies in HEI's and PRO's. Based on their budgets and action the share of institutional funding (for research) in HEI's was 42% and in PRO's 49% in 2013. According to the new performance and quality based funding model of universities (Ministry of Education and Culture 2014; Universities Core Funding) the Government appropriations for universities (90 % of HEI institutional funding) will be allocated on the basis of completed qualifications and credits as well as scientific publications and attracted competitive project funding. Moreover, institutional funding for universities of applied sciences (10% of HEI institutional funding) (Ministry of Education and Culture; Polytechnic reform 2011-2014) is revised to better support improvement in the quality of teaching and research. The governmental funding for polytechnics will be allocated in the ratio of 70:30 considering the number of degrees awarded and performance indicators. So, institutional funding includes a strong competitive element for universities and a reasonable competitive element for polytechnics. Institutional funding for PROs is mainly pure block funding.

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research activities to be done". Steen, J. v. (2012), "Modes of Public Funding of Research and Development: Towards Internationally Comparable Indicators", *OECD Science, Technology and Industry Working Papers*, 2012/04, OECD Publishing. http://dx.doi.org/10.1787/5k98ssns1gzs-en.

Table 3. Institutional and project funding (€ million) for HEIs and PROs 2013 (Statistics Finland 2014, Research and development 3013)

Sector	Total funding	Institutional funding	Project funding		Project funding source
HEI	1438	603	835	270	Academy of Finland
				188	Tekes
				144	From abroad
				70	Domestic enterprise
				56	Domestic funds
				139	Other public funding
				5	Own capital
PRO	644	315	329	147	Government
				61	Enterprise
				89	From abroad
				32	Other public/Funds

Project funding

The share of funding in 2013 (for research) from outside sources was 58% in HEI's and 51% in PRO's in 2013. Almost all of it was project funding, including Tekes and Academy of Finland funding, other governmental sources, international project based funding (especially FP and SF funding), funding from domestic enterprises and from other governmental sources.

As a result of the already briefly discussed reform of research institutes and research funding 19 % of institutional funding for research institutes (€52.5m) will be subjected to competition. The objective is to make €70m available for project funding (strategic research) by 2017. The budget will be reallocated from several sources in 2015–2017, including the state research institutes' institutional funding (€52.5m), the Academy of Finland's project funding (€7.5m) and Tekes' project funding (€10m). The Strategic Research Council, which will manage these funds, is based at the Academy of Finland. The funding of newly formed council is competitive and funding decisions are based on not only the scientific quality but also on the societal impact. Secondly, the reform creates another new opening: a funding pool for evidence based decision making. The pool has a funding of €12.5m until 2016 and is under the disposal of the Government (led by the Prime Minister's Office). The pool provides project funding to enhance evidence based decision making.

In Finland there are two main agencies who allocate most of the project funding for R&D: the Academy of Finland and Tekes. In 2013, the Academy decided to fund €334m worth of projects. The Academy's funding is focused on scientific research and the funding decisions are based on international standards for peer review. The experts are mostly international. The funding criteria of the Academy of Finland are:

- Scientific quality and innovativeness of the research plan
- Competence of the applicant/research team
- Feasibility of the research plan
- Cooperation contacts for the research

- Significance of the research project for the promotion of professional careers in research and researcher training.

In 2013 the Academy's funding was allocated to research projects (53%), including thematic programmes (7%) and the Centres of Excellence program (15%), to researchers (29%), to research environments (7%) and on international cooperation (9%).

All of Tekes funding is competitive based on funding instruments. These instruments are used in different funding concepts. In turns, strategic choices are made by using the concepts. About 60% of the funding is allocated to the concepts (strategic choices) and 40% of the funding is reactively based on demand. The major concepts are Tekes programmes, Tekes campaigns, SHOK (Strategic Centres for Science, Technology and Innovation) programmes and start-up funding. The funding criteria of Tekes varies depending on the nature of the project but *in general the criteria include the scientific or technological excellence, relevance to the economy and society, business and internationalisation targets and opportunities, cooperation, international cooperation, resources, economic status of a company and commitment of private financers, risks, and business and project plans*. The evaluation is made in-house by Tekes experts who have experience in both research and business. External experts can't be used because if the best experts on a certain industrial sector are used, they are competitors of the company who is applying for funding - and this causes a conflict of interest. An exception is the start-up funding - external experts from VC funds and business angel communities are used to evaluate pitches of start-up CEOs.

Tekes provides funding for applied research in universities, research institutes and large companies, provides competitive grants and loans for development and innovation in SME's, grants with a special instrument dedicated for YICs (young innovative companies). Tekes also funds start-ups and through Tekes Venture Capital Ltd, a fund of funds, contributes to seed phase VC-investments. A typical target fund of Tekes Venture Capital Ltd is a Finnish fund organised as a limited partnership company with a management company. Funding agreements follow the market practices, taking into account the additions described in the state subsidy programme of Tekes Venture Capital Ltd. These additions are connected with, among other things, restrictions in (or lack thereof) possible asymmetric distribution of profits of target companies, and demands associated with the fund's investment process and reporting.

Finally, a special target of Tekes funding is to build incentives for cooperation and knowledge interaction. Funding budget of Tekes is €513m in 2014 (5.3% decrease from 2013), (Statistics Finland, R&D funding in state budget 2014).

Other allocation mechanism

Ministries' and Tekes' activities include minor amount of contract research.

Assessment

In Finland there has been a strong trust in the power of competition. That's why the long term trend until 2009 has been clear: increase competition by increasing the share of project funding. In 2009 - 2013 the share of project funding decreased a bit. The new reforms and the recommendations of the RIC will again increase the share of project

funding and competition in institutional funding. Finland might not be in the position to change the existing balance radically. Institutional funding is needed - but it should include competitive elements, too. A major challenge for Finland is that government funding in R&D to boosting the knowledge base and the renewing of industries has declined by 35% during 2011-2014, even though it's well known that total productivity based on intangible investments and innovations has been a more important factor for GDP growth than other factors (contributions from capital input and labour increase) (Maliranta M, Rouvinen P, Ylä-Anttila P, 2010 and Statistics Finland, Development of productivity in the whole national economy 1976-2013).

2.5.3 R&I funding

The public innovation ecosystem, i.e. the funding streams to cover the entire R&D&I process from fundamental research to market innovation are in Finland organized as cooperative services of funding organisations and as public private partnerships. The concepts are based on the experience that innovation process is not a linear chain from basic research to commercialisation but an interactive process where activities are concurrent and parallel. All Tekes resources are targeted to innovation. Public-private-partnerships are typical in cases when Tekes is funding universities, research institutes or large companies. Indeed, the partnerships are prerequisites for funding. Tekes programmes and SHOK programs include projects which are led by, and involve, public and private sector participants, and there is also cooperation between the projects. Tekes programs are always thematic and by nature *Innovation programs*. In later phases of the innovation process there are many cooperative funding concepts like Vigo, Growth Track and Team Finland. These concepts will be discussed later in more detail. A tax incentive for R&D was in use in 2013-2014. The tax credit was a deduction from corporate income taxes tied to the wage costs of R&D personnel. The total sum of deduction in costs was €65m in 2013 causing €15m loss in tax revenues. Starting 2015 the only special tax incentive for R&I is targeted to Business Angels.

Tekes funding for universities and research institutes includes concepts like *Public research networked with companies* and *new knowledge and business from research ideas* where companies are involved in research projects. Most of the cooperation between universities, research institutes and companies in Finland is partly funded by Tekes. The major types of innovation funding and funding streams improving access to finance for innovative companies are described below.

The total funding of Tekes is channelled through different concepts, which are:

- *around 40% for customer initiatives based on demand;*
- *around 20% for research programmes of the Strategic Centres for Science, Technology and Innovation (SHOK);*
- *around 25% to focus areas through Tekes programmes;*
- *around 15% to other strategic choices*

Project funding for businesses, according to the Tekes strategy is targeted in the following ways:

- more than one third for young SMEs

- roughly one third for established, growth and internationalisation oriented businesses with less than 500 employees

- less than one third for businesses with more than 500 employees if external impacts on other actors are significant, or if the company is essentially reinventing its business operations.

In particular, Tekes programs and the programs of the Strategic Centres for Science, Technology and Innovation (SHOK) integrate public and private resources and are relevant initiatives of innovation funding, creating cooperation platforms for innovative companies and world class research. The SHOKs are private companies including public-private networks of a new type that engage in intensive and long-term work to achieve shared goals. The introduction of the SHOK concept has created important structural changes in Tekes funding to selected strategic areas. In total, six SHOKs have been established:

Energy and the environment CLEEN Ltd www.cleen.fi

Finnish Bioeconomy Cluster FIBIC Ltd www.fibic.fi

Metal products and mechanical engineering FIMECC Ltd www.fimecc.com

Built environment innovations RYM Ltd www.rym.fi/en

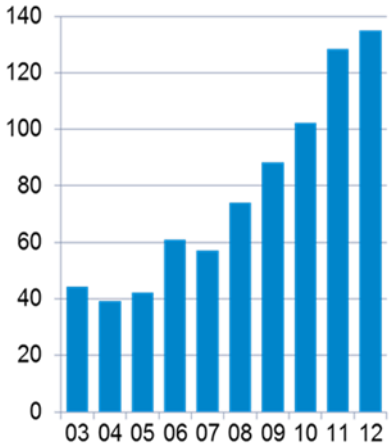
Health and wellbeing SalWe Ltd www.salwe.fi

Information and communication industry and services DIGILE www.digile.fi

Tekes is the main funder of SHOK programs. In addition, the Academy of Finland has allocated a small amount of funding and a special application process on fields with SHOK research. An international evaluation of SHOKs was published in February 2013. According to the evaluation, the objectives of SHOK activities determined by the Research and Innovation Policy Council in 2006 are still valid. Despite the achieved major advances SHOKs also face challenges that include 1) multiple and often internally contradictory objectives, 2) tensions between short and long-term perspectives and 3) lack of international activities. After the evaluation, the new SHOK management team put forward development proposals in spring 2013 that aim at solving these challenges. A working group was established to develop key performance indicators and impact assessment for SHOK's (Development of key performance indicators and impact assessment for SHOK's). It defines the measurement framework and a set of key performance indicators (KPIs) to measure the performance and impacts of the SHOK's. Based on the recommendations of the evaluation, Tekes increased competition between SHOKs (starting in 2014), the criteria for internationalisation were tightened, and cooperative programs of two or more SHOKs are under preparation.

Start-ups and young innovative companies (YIC) need a different kind of financial ecosystem. The funding for start-ups and YICs is a good example of concurrent initiatives (private and public, top down and bottom up). In 2006, based on Tekes' own impact evaluation, it was decided that Tekes should have stronger impact on generating new start-ups, growth companies and new business lines in existing companies. Thus the US

SBIR (Small Business Innovation and Research) program was benchmarked and some of its ideas were implemented. The implementation however required changes in the EU rules. EC General Block Exemption Regulation was changed in a good cooperation with Tekes, Taftie (The European Network of Innovation Agencies) and the Commission (EC No 800/2008). Based on the new regulation YIC funding instrument was launched and private VC investors were invited to participate in the project evaluation process. At the same time the MEE and Tekes benchmarked Israel's VC funding program. Some ideas were implemented and VIGO business accelerators (private companies in a cooperation agreement with Tekes) were established. Even though the Government had a target to develop VC markets, attract foreign investors and create an ecosystem for start-ups and venture capitalists, the means of the Government to do it were not effective enough. But what happened is that the students especially at Aalto University started to develop the ecosystem based on their own ideas, Aalto University gave premises and Tekes funded students' activities. The result of the students' activities can be seen for example as yearly Start-up Sauna tours and SLUSH event attracting more than 10.000 attendees (start-ups, international investors, executives and media). After these three parallel initiatives(YIC funding, VIGOs, ecosystem development by students) the number of good business ideas and the amount of private investments, also required to be eligible for Tekes funding, grew so much that Tekes yearly funding for young growth companies has almost doubled in 5 years.



Tekes funding to young growth enterprises (€ million)

Additionally Finnvera, TESI and ELY-Centres all have instruments related to innovation. Most of these instruments are related to general funding or financing for businesses but in many cases these also target development and (innovative) start-ups.

Growth Track provides integrated services of several service providers (Tekes, ELY Centres, Finnvera, Finpro, TESI and the Finnish Patent and Registration Office) for SMEs that pursue rapid growth and internationalization.

Especially Finnvera's role is crucial in the commercialization phase of innovation processes, although it is not focused on innovations. Even though the share of Tekes customers among Finnvera customers is only 10%, the share of Finnvera customers among Tekes customers is 60% in a longer time span. Seed phase VC-activities were moved from Finnvera to Tekes in 2014 by founding of Tekes Venture Capital Ltd.

Services for internationalization were integrated to operate as the Team Finland concept aiming at helping companies go global. It is a cooperation team of 16 organisations including the international office networks of Finpro, Tekes and the Ministry for Foreign Affairs.

Early stage VC funding seems to be developing (see Chapter 4.6), and Finnvera's enlarged mandate offers better opportunities for financing commercialisation, growth and internationalisation of R&D results. Public-private partnerships are enhanced especially by

Tekes funding concepts. However, the incentives for private sector investments are weakening. Challenges still remain related to producing new good business ideas and collecting private equity for later stage growth.

2.6 Smart Specialisation (RIS3)

In a small economy like Finland Smart specialisation has to be solved at the level of the whole economy not only at the regional level. The principles of Smart Specialisation have traditionally been applied in Finland both on national and regional level, and a process is going on to further strengthen the specialisation. For multi-scientific, cross-technological, knowledge-integrated, problem-oriented research in a small economy, intensified cooperation between the actors is required. Although the need for specialisation is obvious, the processes to implement it have to combine both top down and bottom up approaches in order to avoid the risks involved in making wrong choices in the top down policy. Smart specialisation in Finland is especially focused on the creating of knowledge base, lead markets initiatives and ecosystems development. Anyhow, business R&I funding has to be flexible allowing risks in order to pursue good business ideas. This should not depend on the predominant field of strategic agendas.

The goal in the big picture in the Finnish research policy is to increase specialisation of universities and PROs, which means doing stronger strategic choices. The UNIFI (Universities Finland) is negotiating to agree priorities and focus areas among universities and the MEC supports the process - by funding incentives, too. The already discussed reform of research institutes and research funding aims at creating the critical mass, reducing fragmentation, building knowledge hubs, and strengthening evidence based policy. Smart specialisation is also supported by competitive funding: about 60% of Tekes funding and about 7% of the Academy of Finland funding are focused on strategic choices.

The next period of the EU Structural Funds (SF) 2014-2020 includes a range of innovative actions through smart specialisation. The Finnish Government, to attain the targets of regional development in Finland, has drawn up special programmes, of which the Centre of Expertise Programme (OSKE) has now been terminated and replaced by the INKA (Innovative Cities) programme. The INKA Programme (2014 - 2020) encourages major urban areas in Finland to choose strategic focus areas and generate competence-driven business with the help of new kinds of development environments and lead markets. The growth agreement, also coordinated by the MEE, requires 12 largest cities making choices in accordance with the Smart Specialisation Strategies of the EU. The MEE has decided to choose five themes for the start of the INKA Programme: *the future of health (Oulu), a bio-based economy (Joensuu), sustainable energy solutions (Vaasa), smart city and reforming the industry (Tampere), and the cyber security (Jyväskylä)*. The Programme is under the management of Tekes.

To intensify cooperation and to ensure knowledge building on regions, the regional actors together with the national Government and HEIs have jointly contributed to the establishment of six regional university centres in several non-university towns. The university centres gather the operations of several universities in one location in these towns. Cooperation between universities, polytechnics and research institutes is aimed to build stronger but fewer regional knowledge hubs to boost European SF interventions in RDI.

The Regional Innovation Scoreboard 2014 covers five regions in Finland: Itä-Suomi (FI13), Etelä-Suomi (FI18), Länsi-Suomi (FI19), Pohjois-Suomi (FI1A) and Åland (FI2). According to the scoreboard, Finland belongs to the performance group innovation leaders, with 3 regions (FI18, FI19, FI1A) being among the leaders and 2 (FI13, FI2) being among the followers. Åland (FI2) is quite a special case because it has a strong independent status in Finland. The state of Finland is not allowed by law to get involved in Åland's policy (such as public R&D funding). According to RIS 2014 innovation growth performance is 2.5-15% in Pohjois-Suomi (FI1A) and 0-2.5% in other regions. According to the EU Funding typology, Etelä-Suomi (FI18) is the only FP leading absorber, whereas Itä-Suomi (FI13) and Pohjois-Suomi (FI1A) are SF leading users and Länsi-Suomi (FI19) SF low user. In early 2014, thirteen regions took part in the S3 Platform of the European Commission.

The RIS3 monitoring and evaluation system is quite theoretical and challenging. Smart specialisation is not a separate, independent activity - it is an objective and a means to reach to the impacts of research and innovation policy. Again in a small country this is not only a regional matter but rather a national one. Thus in the Finnish perspective it would be very useful to see the measurement and assessing of the smart specialisation as an integrated part of larger impact assessment used to evaluate the big picture performance of R&I policy.

2.7 Evaluations, consultations, foresight exercises

Governmental reviews, studies, evaluations and guidelines act as the instruments that guide and inform the science policy makers at the national level. Starting in 2015, the Prime Minister's Office is playing an active role in national foresight cooperation. In this, it is tasked with supporting foresight activities and networking. The Prime Minister's Office and Sitra coordinate the national foresight network and support foresight activities and networking in Finland. The Government Foresight Group appointed by the Prime Minister's Office on 21 January 2015 is responsible for leading and coordinating national foresight efforts and for making this operation visible (http://vnk.fi/en/foresight). Once during each electoral period, the Government submits to the Parliament a foresight report on long term perspectives. The foresight report gives the Government's view on the chosen issues and associated policies. In 2013, the Government Report on the Future 2013: Well-being through sustainable growth was issued by the Government. The report explores new directions for Finland. For the first time, a separate foresight phase was included in its preparation.

The foresight phase was implemented in collaboration between the Prime Minister's Office, Sitra, the Academy of Finland and Tekes, alongside a host of independent specialists and experts from research institutions, enterprises and NGOs. In addition, several different types of foresight activities have been carried out for instance by the Parliamentary Committee for the Future, by the ministries, Tekes, the Academy of Finland, research institutes and universities. Foresight studies have often been done in association with research programs of the Academy of Finland or Tekes programs. During the last decade the foresight process has been done nationally together. Starting in 2014 the national foresight process integrates strategy work of several organisations: the Academy of Finland, Tekes, Sitra, VTT, Finnvera and Finpro.

Regarding evaluations, they are used extensively to assess the operation of individual organisations. Finland was ranked 1st in the World in the terms of evaluation culture by evaluation experts (Jacob S et al., 2015).

The Finnish National Innovation System was evaluated in 2009. In the evaluation, several recommendations were made. Four of the recommendations have strongly guided the development of innovation policy in Finland:

- Improve productivity: Focus on forerunners who are (seeking to) be at the global frontier, emphasise pioneering. *This has been the guideline in developing the strategy of Tekes*

- Increase the quality of research by providing autonomous universities incentives thru funding rules. *The universities were indeed given autonomy and the funding model was renewed.*

- Increase internationalisation. There has been slowish s*tep by step development.*

- Perform evaluation of all the actors. *The recommendation has indeed guided the MEE and MEC. Many evaluations of the organisations involved have been made during 2010-2014:*

- The evaluation of VTT 2010
- The evaluation of Tekes 2012
- The evaluation of Finnvera 2012
- The evaluation of the Academy of Finland 2013
- The evaluation of the FII (TESI) 2013
- The evaluation of the Strategic centres for science, technology and innovation 2013
- Regions in global ecosystems - Final evaluation of the Finnish Centre of expertise program (OSKE) 2013
- The evaluation of the Research and Innovation Policy Council 2014

In 2013, the MEE ordered a Study on the Impacts of the Evaluations Made in 2009-2014 (in Finnish). In these evaluations a total of 157 recommendations were made. According to the study, 80% of the recommendations have exceeded to an operational execution phase (42% completed, 41% in progress), 7% were assessed to be irrelevant, and 10% were not put into practice for a reason or another. So it seems that the culture of evaluations supporting evidence based decision making is really working. However, the Government has not yet decided if the role of the RIC will be changed according to the evaluation.

The funding agencies Academy of Finland and Tekes have a long history in doing foresight and evaluation. The Academy of Finland evaluates the state of the science in Finland every second year. The state of the scientific research in Finland 2014 reviews the state and the position of the Finnish research system, comparing it internationally. In the report the relative strengths of different scientific disciplines are discussed and areas in the need of further development identified. According to the 2014 report Finland's position in the global scientific community has remained quite unchanged throughout the 2000s. At the same time, however, many other countries have picked up speed and are now making strides. Finnish science is in danger of falling further behind other countries. The report goes on to note that Finnish universities and research organisations will have to make an increasing number of strategic choices, focus on their strengths, step up collaboration, and invest in the new initiatives that might emerge therefrom.

Tekes evaluates all of its programs and instruments (including mid-term and ex post evaluations) and has integrated impact assessment into yearly strategy and management process (Saarnivaara V-P, Uusikylä P, 2014, Impact Evaluation - Finnish Experience). A couple of examples of impact evaluations are: Tekes 2014, Results and Impact and Technopolis Group et all, The Impact of Tekes Activities on Wellbeing and Environment.

Considering the bigger picture, there is no reliable macroeconomic model to measure the impact of R&I on economic growth. The modelling is difficult due to the challenges in measuring indirect and spill over effects, taking into account time delays, and in defining valid reference groups in counter factual analyses. Tekes does have an impact (logical framework) model but it is simplification of the complex path dependencies. Moving on, there are also challenges with some actors in Finland whose expertise, knowledge and methods in impact evaluation and assessment are not up to date, which may lead to misleading conclusions, recommendations and decisions. When, for example, the National Audit Office enters the area of impact assessment, it is necessary that assessments are reliable, valid and credible as the role of the Audit Office is very important indeed.

3. National progress towards realisation of ERA

Information on ERA Priority 1 is provided in Chapter 2, and Information on knowledge transfer and open innovation (part of ERA Priority 5) is provided in chapter 4.

The Finnish R&I system has a long track-record in addressing the ERA priorities as discussed earlier in connection with the national challenges. However, there also is a clear need for further development. Finland has generally taken an active role in participating in the ERA. For a small country with limited resources, the European dimension is seen as a natural extension of the national policy. In its recommendations for 2015-2020, the Research and Innovation Policy Council stated that Finland is a proactive partner in the European research and innovation policy.

3.1 ERA priority 2: Optimal transnational co-operation and competition

There is no overarching legislation governing Finland's participation in European research. However, the strategies of the main actors (funding organisations, HEI's, PRO's) support selectively joint projects with partners in the other Member States. Given that Finland is a relatively small country, participating in cross-border joint initiatives has typically ranked high on the R&I agenda. Finland participated in 45 ERA-NET networks as of 2013.

The research agendas of EC and those of the other countries are taken into account when new programs are prepared in Finland. In the case of Tekes and SHOK programs also global market studies are made. Typically, Tekes programs have a direct connection to European programs and they prepare and support the programme participants to take part also in European programs. Ex-post evaluation procedures are implemented in major programmes. Tekes implements both mid-term and ex-post evaluation processes in all of its programs, funding instruments and funding concepts. The funding agencies have cooperation agreements with corresponding organisations in other countries: Tekes with Sweden, China, India, Russia and the US; the Academy of Finland with 13 countries. Moreover the funding agencies have launched focused initiatives to boost international cooperation. The funding criteria of Tekes and the Academy as well as HEI's institutional funding reward international cooperation. The Academy has earmarked funding for international projects whereas Tekes has not. The principle of Tekes has been that all the project applications compete against each other, and international projects have to succeed in this competition. However the funding criteria still reward for cooperative international projects. Furthermore, R&I cooperation is intensive between Nordic countries. As an example Tekes co-funds innovation research with its Swedish sister organization VINNOVA.

The new recommendation by the RIC recognises that Finland has not utilised the opportunities offered by European and other international research funding to a sufficient degree. It recommends increasing the participation in the EU Framework Program by 50% and creating a special funding instrument for planning international projects and preparing for FP projects.

The share of joint initiatives in Finland is below the EU average**.** The latest available Eurostat data for Finland, however, show an increase in the share of the public funding invested in transnational activities between 2010 and 2011: the amount of coordinated

funding (which includes ESA contribution) more than doubled (EU, JRC 2013, ERA Communication Synthesis report).

The mandate for activating HEIs, PROs and enterprises to participate in international initiatives has been given to the funding agencies. Top down joint calls and programs are more common in scientific research but usually cooperative innovation is a bottom up process that should not be dictated by external limitations.

Finland is well represented in the European cooperative research landscape, being a member of all major pan-European research organisations and infrastructures (like European Organisation for Nuclear Research CERN, European Molecular Biology Laboratory EMBL, European Space Agency ESA, European Organisation for Astronomical Research in the Southern Hemisphere, European Synchrotron Radiation Facility ESRF, ITER – International Thermonuclear Experimental Reactor, European Southern Observatory ESO, and GSI/FAIR – Facility for Antiproton and Ion Research).

3.2 ERA priority 3: An open labour market for researchers. Facilitating mobility, supporting training and ensuring attractive careers

3.2.1 Introduction

The main trend in this ERA priority in Finland is that institutional autonomy is common but funding incentives are used for facilitating researcher mobility. Universities have launched a new tenure track system and increased the recruitment of foreign researchers and professors recently.

Considering the statistics, in 2011 the number of researchers per 1000 active labour force was 21.5 (EU average 10.6) and new doctoral graduates per thousand population aged 25-34 was 2.71 in 2012 (EU average 1.81). The shares of non-EU doctorate students as a % of all doctorate students was 6.8% in 2011 (EU average 24.2%), which is alarmingly low (EC 2014, Research and Innovation performance in Finland; Country Profile 2014 and ERA Progress Report 2014, Country snapshots).

Recent economic downturns and the structural reforms in HEIs have led to a growing number of highly educated people being unemployed. Considering different educational backgrounds, the proportion of the unemployment of the labour force aged 18 to 64 decreased in all categories until 2008. Unfortunately since 2012, the proportion of the unemployment has grown in all categories. The biggest hit, however, has been taken by the highly educated (taking into account both higher and lower university degrees). Many universities and PRO's have been forced to lay off staff due to the decreased public and private funding. Some unemployed academics establish companies of their own; others re-educate themselves if the perspectives in the job market seem hopeless for their educational background. Despite of the situation, there is a need to attract more qualified researchers and labour in order to support and sustain the relatively high level of the Finnish research and innovation system. While the amount of researchers has decreased since 2008, the decrease has not been reflected neither in the share of foreign researchers or in the mobility of students and staff at Finnish HEIs. Both of the latter values have actually increased (Finnish National Board of Education (FNBE), Statistical services, in Finnish). Speaking of employment and labour force, in 2010 - 2013 altogether 1219 new professors were recruited to Finnish universities and research institutes. 166 (14%) of

them were foreigners (Academy of Finland, The State of Scientific Research 2014, in Finnish). The share of foreigners among young researchers is higher than in other groups. Overall statistics is not available but for example at the biggest Finnish university (Helsinki University) the share of foreigners among young researchers is about 30% while the average is about 8%. This is a promising sign considering the low numbers otherwise.

3.2.2 Open, transparent and merit-based recruitment of researchers

Carrying on from the above discussion, high institutional autonomy affects recruitment and awarding positions of trust in Finland. The Strategy for the Internationalisation of Higher Education Institutions in Finland (2009-2015) calls for the principles of open, transparent and merit-based recruitment as laid down in the Charter and Code. UNIFI (the Rectors' Council of the Finnish universities) and the Academy of Finland have signed up to the Charter and Code. The principles are being promoted through national higher education and research policy. Moreover, the funding model of HEIs, the 2012 agreement between national authorities and HEIs, and the new tenure track system adopted by the universities since 2010 support the principles of prioritising and focusing on improving research careers. A governmental programme to ensure that recruitment policies are developed in a way that makes research careers, both studying and working in Finnish universities and research institutes, more attractive, was launched in 2007. Moreover, measures such as RIC recommendations 2015-2020 and the FiDiPro programme further contribute to the opening up of the recruitment system and attracting foreign researchers.

The Finnish universities are fully autonomous under the Act on Universities (2010) and thus MEC cannot directly affect recruiting or the nature of the contracts of the academic personnel. However, Strategy for the Internationalisation of Higher Education Institutions in Finland 2009–2015 is a guideline for the recruitment processes in higher education institutions.

Moreover, National research code was set already in 2002. The code consists of guidelines in good scientific practices and dealing with instances of misconduct. A National Advisory Board on Research Ethics amends and imposes the guidelines and offers a point of call for business research that might be in breach of them. Furthermore, publicly-funded fellowships, bursaries, grants or equivalent provide sickness, unemployment and old-age benefits for researchers.

All Finnish universities post their open vacancies on-line. Platforms may however vary between universities. Most institutions have a policy of publishing job vacancies also on relevant Europe-wide online platforms, including EURAXESS. Although, as discussed before, the institutions are highly independent, the practices in recruiting are quite similar. There are only some variations in details between individual institutions but the main principles are the same. This is elaborated on below, considering the case of the biggest Finnish university, University of Helsinki. An open vacancy announcement is in use everywhere, but there might be exceptions for special reasons. Teaching and research positions are normally opened for international applications, too.

Let us now consider the recruiting practices of University of Helsinki. The vacancy announcement always includes the job profile, skills and competences required, the eligibility criteria and the information about the selection process. The criteria used in evaluating the candidates are available for the candidates. The time period between publishing the open vacancy and deadline for application is defined but not included in the

announcement - the information can be obtained by asking. Those applicants who have been selected on the short list of best applicants are able to get feedback from the assessors. Some special reasons - like gender equality - give a right to appeal against the decision. Considering professorship, an appointment committee is established to prepare for the appointment process of a professorship, and information on the composition of the appointment committee is available for candidates. Selection committees are indeed the general rule here, although there may be exceptions and variations. Universities have instructions and guidelines for the composition of selection committees especially for tenure track recruitment. However, some guidelines are more generally valid for all academic recruitment. The composition of the selection committee is public information. The members of the selection committee are professionals from Finland (internal and/or external) but the assessors are international. The procedure varies depending on the level of the title (a four-level hierarchy for teaching and research staff is commonly used). In 2012, 56% of university-based researchers were satisfied with the extent to which research job vacancies are publicly advertised and made known by their institution (EC, MORE2, 2013).

The share of researchers (post PhD) having spent a period of at least 3 months as researchers in another country was 57% (EU average 48%, 2012), the share of non-EU doctoral students was 6.8% (EU average 24.2% in 2011), doctoral candidates with a citizenship of another EU member state was 7% (EU average 8% in 2011), work or internship in the non-academic sector during PhD was 26% (EU average 23% in 2012), and post PhD researchers with inter-sectorial mobility was 12% (EU average 12%). As a summary it can be stated that the outward flow of researchers is a bit above the EU average, the inward flow is clearly below the EU average. Most of the foreign researchers come from the EU countries, and the inter-sectorial mobility is about at the average level of the EU countries, (EC, The Researchers' Report 2014). The international mobility of the Finnish education and research labour increased by 19% in 2010 - 2013, (FNBE, Statistical services).

It has been noted that a particular challenge for Finland in its efforts to attract foreign talents relates to the research and innovation environments and the non-competitive salary in the public and higher education sectors (Viljamaa et al., 2010). The situation might however have changed since 2010. Today there are no legal limits for researcher salary. The salary however must be in a reasonable balance with salaries paid for Finnish researchers. According to an interview among university managers, there have been very few cases when the salary has been a deal breaker for recruitment. A researcher career is still quite attractive in Finland although the salaries are not high - they are a bit above the EU average - and the researcher labour market is strongly competitive. About one third of the contracts are permanent. The labour market has been quite unstable for the younger generations but the tenure track system adopted by the universities in 2010 now provides better opportunities for career development.

International evaluations and audits of staffing policies have been done in many universities but they have been for internal use only. Higher education and research institutes are autonomous to organise their activities in the areas of education, research and innovation, and no alternative sources of funding are needed. There are no national accreditation mechanisms, institutional processes or informal barriers that hinder foreign researchers' access to the scientific labour market. Be that as it may, in some cases Finnish language is essential which may discourage the access.

3.2.3 Access to and portability of grants

Grants are by and large open to foreign researchers and portable to other EU countries (e.g. Academy of Finland grants and fellowships), and the Academy of Finland has signed up to the Money Follows Researcher (MFR) agreement, the initiative of the European Heads of Research Councils (EUROHORCs). The Academy of Finland has a commitment to promote the internationalisation of Finnish science and research by establishing bilateral agreements with countries and regions. For instance, the Academy of Finland provides funding for the Finnish Centres for Excellences (CoE) in order to support international cooperation in research. Financing to support the outflow of researchers is provided especially by the Academy of Finland and Tekes. Publicly funded grants or fellowships by the Academy of Finland are portable to other EU countries. However, administrative processes involved remain problematic, thus discouraging researchers from going abroad.

In case of Tekes, international researcher mobility involves performing part of the research work for the project in Finland and part of it abroad. Alternatively, a researcher can come from abroad to work in a research project carried out in Finland. Researcher mobility funded by Tekes involves research that genuinely adds value to the project. Tekes covers costs incurred by the recipient from researcher mobility. Tekes only provides funding for researcher mobility to the results for which the recipient receives at least access and utilisation rights for research and education purposes free of charge and globally (Tekes, General terms and conditions 2012, Funding for Public Research).

Moving on, the FiDiPro programme of the Academy of Finland and Tekes is one of the tools established in Finland to tackle the issue of attracting talent from abroad. Additionally Joint Degree Programmes have been initiated in Finnish universities to target foreign students aiming at Master's Degree level. Moreover, especially Tekes and the Academy of Finland promote the use of EU mobility schemes. So far the actions taken have improved the situation very slowly. To summarize, other policies or measures could perhaps be developed, as Finland is not considered a hotspot of scientific research and fails to attract foreign researchers on a larger scale.

3.2.4 EURAXESS

The Academy of Finland acts as the national EURAXESS bridgehead organisation and host the EURAXESS Finland Portal. The portal provides basic information for foreign researchers planning to come to Finland or those already staying there, as well as for outgoing researchers. Five Finnish universities have organised services for incoming researchers. These can be found through the links on the EURAXESS Finland Portal:

- *Helsinki university*
- *Aalto university*
- *University of Tampere*
- *University of Turku*
- *University of Eastern Finland*

International Staff Services of the University of Helsinki has the most useful portal for their incoming international researchers, teachers and other staff. They have an office of 3 experts to give tailored services. Moreover, they also use outsourced tailored services to help incoming researchers and their families. In addition, the websites of the Social Insurance Institution of Finland (Kela: InTo Finland) and the Finnish Tax Administration are service points for employees moving to and from Finland. They help the self-employed,

students and companies hiring and recruiting foreign labour. The portal's multi-lingual officials provide information on social security and on taxation matters in Finland, and direct users to the authorities connected with immigration. Finally, The Finnish Immigration Service provides relevant information for incoming foreign researchers.

3.2.5 Doctoral training

The 'National Guidelines for the Development of Doctoral Training' (2011) outlines the principles for doctoral training in universities. Until 2010 the Academy of Finland was running and funding Graduate Schools for doctoral training. These responsibilities and funds were transferred to the universities. Since 2011, all Finnish universities have started the reform of the doctoral training system in line with the principles of innovative doctoral training. The Strategy for the Internationalisation of Higher Education Institutions in Finland (2009-2015) aims at improving the entry of foreign researchers and their access to research positions in Finland.

Tekes do not fund individuals such as researcher. It instead funds research projects, although in the evaluation of the project applications also the skills and expertise of the applying researcher are considered. A significant number of academic degrees achieved as a result of projects funded by Tekes. In such projects that ended in 2013, 840 students have graduated, 1030 patents or patent applications have been filed, and 1270 new products, services or processes have been launched. So, at least some elements of IDT (Innovative Doctoral Training) are indeed fulfilled in projects funded by Tekes.

3.2.6 HR strategy for researchers incorporating the Charter and Code

Twelve Finnish organisations are actively engaged in the Commission's Human Resources Strategy for Researchers (HRS4R) of which at least six have received the 'HR Excellence in Research' logo for their progress in implementing the Charter and Code although according to the HR managers of some universities special added value from the audits is not clear.

Persistent weaknesses in the Finnish research system for attracting researchers from abroad include limited career opportunities for researchers (affected by the small size of the economy): the remuneration level has been a bit above the EU average. Families and especially spouses have had difficulties in getting a job, and the administration issues have also been seen as a challenge. Information regarding immigration bureaucracy is fragmented and there has not been a dedicated programme to facilitate the immigration of foreign experts. Another issue has been the reluctance of the private sector to recruit foreign researchers although few international companies are an exception. There are rules and practices to help foreign researchers to work in Finland. There is no clear policy and strategy to facilitate the immigration of foreign experts. Partly due to the above challenges, the private sector has recruited relatively low numbers of foreign researchers except the few global companies.

3.2.7 Education and training systems

Tertiary educational attainment in 2012 was 39.7% (EU28 average 27.6; Eurostat 2013). Finland used to be top ranked on educational attainment which is no longer the case. In 2014 there still are strengths in the knowledge base of the Finnish society but the

corresponding development has been faster in many other countries (Ministry of Education and Culture, 2014, Educational structure of Finns in international comparison, in Finnish).

Compared to other European countries, Finland has the highest number of R&D personnel as a proportion of the total employment. Finland has strong innovation performance overall and outperforms its reference group in terms of highly skilled human resources (Innovation Union Progress Report 2014). In Finland there were 2.7 new doctorate graduates (ISCED6) per 1000 population aged 25-34 in 2011 (EU average 1.81, IU Progress Report). Related to education, Finland performs below the EU average in share of foreign students and foreign doctoral students. The number of foreign students has doubled in 7 years but it still is very low; (Finnish National Board of Education (FNBE), Statistical services).

The Katainen-Stubb Government Programme, the main action plan agreed on by the parties represented in the Government in 2011, sets out the main functions of the Government. Education policy priorities are outlined in the Government's five-year Development Plan for Education and Research. It directs the implementation of the education and research policy goals stated in the Government Programme. The current Development Plan for the period 2011–2016 was adopted at the end of 2011. The key objectives of the Development Plan include:

- promoting equality in education,
- enhancing the quality of education at all levels
- supporting lifelong learning

As an upcoming development, together with higher education institutions the MEE will agree upon a reform of student admissions and study structures by the end of 2015 to facilitate improved access to higher education. Understanding the needs of the future society and economy requires cooperation with many stakeholders including the private sector. The societal and corporate needs interplay with numbers of students taken in in all fields of. Indeed, the applicant volumes outweigh the number of places available.

Entrepreneurial activities in many universities have been enhanced, both in the curriculum as well as in the structures and methods that boost entrepreneurship, create start-ups and utilize IPR and research results. As a result of decades of cooperative project funding by Tekes, there is a culture of open innovation in Finland. There is deep cooperation with other organizations in the private and the public sectors, and the universities.

In Finland education is evaluated locally, regionally and nationally. Finland also takes part in international reviews. In higher education the polytechnics and universities are responsible for the evaluation of their own operations and outcomes. In this they also receive support from the Higher Education Evaluation Council. The MEE is preparing an evaluation plan for third-party evaluations and new evaluations for monitoring learning outcomes. The plan is being drawn up in cooperation with the Finnish Education Evaluation Council, the Finnish Higher Education Evaluation Council and the National Board of Education. From the 2014 evaluation activity concerning education has been concentrated into a single Education Evaluation Centre.

Employees' opportunities attending training in Finland is slightly above the EU average (36%) and the amount of training received per employee measured by the number of hours is a little below the EU average (10 hours).

3.3 ERA priority 5: Optimal circulation and access to scientific knowledge

Led by the Ministry of Finance, the Open Data Programme 2013 - 2015 has been put forward, aiming at eliminating obstacles in the re-use of public data and creating the preconditions for making public administration data open. Ministries, government agencies, municipalities, enterprises, NGO's, various organisations developing the sector and citizen bodies are collaborating in the implementation of the programme.

The MEC launched 2014 an Open science and research roadmap 2014–2017. It is based on the work of the Open Science and Research Initiative (ATT), a cross-administrative initiative established by the Ministry of Education and Culture, with the goal of promoting open science and the availability of information. Open science means the promotion of an open operating model in scientific research. The key objective is, subject to the restrictions of research ethics and the juridical environment, to publish research results, research data and the methods used, so that they can be examined and used by any interested party. Open science includes practices such as promoting open access publishing, openly publishing research materials, harnessing open-source software and open standards, and the public documentation of the research process through 'memoing'.

3.3.1 e-Infrastructures and researchers electronic identity

No overarching policy on electronic identity for researchers in Finland has been identified, although electronic identity is being implemented. Finland is participating in the following initiatives related to e-identity: GEANT and EduROAM (through Nordunet gathering Nordic regions), REFEDS (Research and Education Federations) and EDUGAIN through Haka. It is the identity federation for the Finnish higher-education and research institutions serving as a route to more than 160 services. It has 298,000 end users which also is the total number of university and polytechnic students in Finland. Users log into Haka services over 11 million times per year. Haka is connected to the other identity federations of the Nordic higher-education institutions, giving users access to services throughout the Nordic region. FUNET is the Finnish National Research and Education Network (NREN), a specialised internet service provider dedicated to supporting the needs of the research and education communities within the country. HAKA and FUNET are hosted by CSC. It provides a computing environment and virtual computation services for R&D. Researchers can access the services through the FUNET network. Examples of the services that are available to researchers are:

Funet Network Services

Eduroam Roaming Access Service

Funet Boksi Cloud Storage Service

Funet FileSender File Sharing Service

Funet Tiimi Web Conferencing System

Identity and Access Management

Haka Identity Federation

Resource Entitlement Management System (REMS)

Consultation and Tailored Solutions

Training Services

Education Management and Student Administration Services

Eduuni - e-Work and Collaboration Service Environment
Scientific Computing and Software

Research Information Management

AVAA - Open-access publishing platform

Etsin - research data finder

IDA Storage Service

Research Information Management

3.3.2. Open Access to publications and data

Although Open Access-related measures have been adopted as early as 2005, there is no overall legislation supporting Open Access to research publications and data. A national policy for the long term storage of data is a broader initiative in Finland. The Government Program specifies that "opening the non-sensitive public databases will boost open science and create opportunities for new entrepreneurship and service innovations". Government's objectives are implemented by the National Research Data Project (TTA). The first institute to open public databases was the National Land Survey of Finland (NLS). Open spatial data sets and interface services are available in Finland now free of charge. Coming back to the TTA project, it also includes measures like the Open Data Programme and the Working group on Open Access to publications and research data. Finland has adopted two overarching policy measures supporting the development of digital research services (i.e. 'Putting data into use' and 'Roadmap for the utilisation of electronic data in research').

Open Access is not a mandatory funding criterion within the Academy of Finland funding programs but the Academy recommends that Academy-funded researchers and research projects deposit their research data in open-access repositories, and that Academy-funded

researchers investigate the possibility of long-term storage of their data. Recommendation is that research data is stored and made available through major national or international repositories, such as:

- Finnish Social Science Data Archive (FSD)
- FIN-CLARIN consortium
- CSC's IDA Storage Service and its Kata metadata catalogue and AVAA open-access publishing platform
- CERN's Zenodo service

The data should be delivered and deposited as soon as possible after Academy funding has ended. As for publishing, the Academy advises that researchers deposit their articles and other publications (as well as parallel copies) in high-quality open-access publication repositories, either provided or recommended by the host organisation. The Academy does not recommend so-called hybrid forms of open-access publishing.

The proportion of OA articles in Finland 2008-2013 was 55% (adjusted 63%), (Green 8.9%, Gold 9.3%, other 38%); the total EU proportion was 51%, (Proportion of Open Access Papers, Science Metrix 2014).

4. Innovation Union

4.1 Framework conditions

The framework conditions conducive to business investments in research and innovation are well in place in Finland. The Finnish policy is balanced between scientific research and innovation activities. The major public incentive for business R&I is Tekes funding. Tekes funding is guided by the national as well as the European state-aid legislation. Finnvera and TESI and the related legislation have also impacts in business R&I behaviour. The latest changes in legislation related to business R&I deal with the establishment of Vigo accelerators, the tax incentive for business angels investing equity in SMEs, the establishment of Tekes Venture Ltd, the implementation of changes of EU state aid rules, the enlargement of the Finnvera mandate, and the changing of VTT from a public institution to a limited liability company. Beyond legislation, other important frameworks are the RIC recommendations, the Government Program and guidelines, the MEE guidelines, strategies and roadmaps which all emphasize the idea of broad innovation policy including growth entrepreneurship, the start-up and VC ecosystem, lead market initiative, demand and user driven innovations, innovative environments, and innovative public procurement (MEE, Innovations).

In the national innovation strategy by MEE, lead markets are viewed as a prime means of overcoming the modest size of the home market, which is cited as one of Finland's main weaknesses. Lead market initiative is a part of demand and user driven innovation policy. In the autumn of 2009, MEE and Tekes launched a joint study aimed at producing information on the role of lead markets. The study targeted the six sectors identified in the EU's lead market initiative (LMI), analysing them from the Finnish perspective, as from the national perspective, the sectors defined in the LMI are too broad.

Therefore, within various sectors and at the interfaces between them, more precise definition of subsectors was needed. The potential of such subsectors was assessed from the viewpoints of growth and their lead market potential, the structural competitiveness of the sector, the ability to innovate and their strategic significance in society. Several sub-sectors that are justified choices from Finland's perspective can be identified within each extensive LMI sector. However, the number of potential sub-sectors is relatively high, and more precise selection requires the prioritisation of assessment criteria and/or political decision-making. This has not been done but on a general level the action plan of the lead market strategy include, for example, developing and using public procurement processes and practices, mobilizing citizens involvement in public sector service innovations, opening up public data sources, and enhancing the use of design in service and product development.

4.2 Science-based entrepreneurship

Regarding science based entrepreneurship, the funding schemes targeted at young innovative companies are described in Chapter 2.5.3 and 4.6, and knowledge transfer schemes in Chapter 4.4. Moreover, Tekes ran a temporary (2002-2011) TULI program to develop structures, expertise, innovation services and methods for research organisations to manage IPR, create start-ups and enhance the commercialisation of research results. It was replaced in 2012 by a new concept called TUTL (New knowledge and business from

research ideas). The new focus is on commercialisation of the results parallel with top-notch research. What is more, Innovation Mill was launched in 2009. It is a concept for commercializing "non-core" corporate IPR from large companies by spinning off start-ups and new business lines in SME's. It is coordinated by a private service provider and funded by Tekes. Total funding of Innovation Mill in 2009-2014 has been €84m of which €42m has been public (Tekes) funding. Innovation Mill was launched with the only participating large company being Nokia, as the other big companies were not willing to share their IPR. A couple of years ago the other large companies changed their attitude. Today, the innovation mill concept has been thus expanded and combines well the benefit to participating large companies and boosting the birth of start-ups.

Structural Funds in the previous period allocated funds also to Business parks activities. The new SF period however doesn't continue this type of funding. In any case, organisations in Finland like Technology and Business parks, business offices of municipalities, and business or start-up hubs of universities have a mandate to build PPP networks and collaboration. University hubs are funded by universities' own resources. The others can be subsidised by municipalities.

Services for internationalization were integrated to operate as the Team Finland concept which_aims at helping companies go global. It is a service team consisting of several organisations: Tekes, the ELY Centres, Finnvera, Finpro, TESI and the Finnish Patent and Registration Office (PRH). Team Finland includes the international office networks of Finpro, Tekes and the Ministry for Foreign Affairs. TeamFinland members are also members of the Enterprise Finland service network coordinated by the Ministry of Employment and the Economy.

Internationalisation of SMEs is promoted also by several other concepts. Growth Track provides integrated services of several service providers for SMEs that pursue rapid growth and internationalization. Each company selected to Growth Track is given an account manager, a Growth Pilot, who finds the best suited public expertise and financing services for the company and coordinates the cooperation between the various parties. Growth Track is not intended for SMEs that are already involved in Vigo accelerators or receive funding for young innovative companies (YIC) from Tekes.

A Tekes loan for demos, piloting and commercialisation enables companies to notably speed up their development work and enter new markets. Focus areas for product, service and process development have been identified here, and also nationally, to be digital industries and bio-economy, and the clean technology sectors. However, the demonstration, piloting and commercialization funding is not restricted to any areas of industry in particular. Tekes loans are without collaterals, have low interest rates, and can be partially received in advance. Funding is available to all business sizes.

Tekes campaigns, which are organized in cooperation with partners such as Finpro and Finnvera are directed especially to small and medium-sized enterprises. They can target to certain sectors or themes that are important and topical from the viewpoint of the emerging or renewing industry. The campaigns differ in their contexts. They can offer, for example, funding calls and networking and matchmaking events. Below, examples of ongoing campaigns are listed:

Health India; Tekes promotes health and diagnostics companies facilitating market entry in India and networking with Indian operators in the field.

Growth Track; offers SMEs the best suited public financing and expert services for international growth via own Growth Pilot.

Nanotech Finland China – Partnering with China; Tekes together with Team Finland network promote nanotechnology innovators, developers and utilizers to collaborate with Chinese counterparts. The China-Finland Nano-Innovation Center in Suzhou offers services, subsidised by the government and local partners, to ease market entry to China, introduction to potential business partners and aims at opening new opportunities.

Team Finland Explorer; with the help of the Team Finland Explorer funding, companies can consult external experts in internationalisation matters when preparing to enter a new market.

Team Finland LetsGrow is a combined financing program for SMEs seeking international growth. Companies can receive loans from Finnvera to be used in investments and as working capital, grants from Tekes for purchasing innovation services, and advisory services from Finpro to support international growth.

In Tekes' Market Access Program, Finnish SMEs get a tailor-made Market Entry plan from MBA students of the world's top universities. The MBA team has years of working experience and local knowledge of the market. The plan consists of strategy, marketing and management analysis and a tailored analysis of opportunities and challenges involved in expansion to foreign markets. Market Access Programs include Global Access Program GAP (USA), Fudan iLab Program and Tsinghua SEM (China) and UCLA NUS Management Practicum (Southeast Asia).

Finnish start-ups and growth companies participate in many Venture Cups. Examples include (Impacts of innovation activities and Tekes 2014, in Finnish): Deloitte Technology Fast 50 Finland, 10 fastest growing companies in Finland, Deloitte rising stars (2013), Wired Magazine, European hottest start-up cities and top ten start-up companies of each city 2014, Red Herring Global Top 250. Ninety percent of the companies which have reached top positions in the lists have been funded by Tekes.

4.3 Knowledge markets

Firstly, Finnish Patent and Registration Office (PRH) is the organization responsible for **s**ervices connected with protecting IPR in Finland. PRH services (on line services, consulting services, local services) are respected in Finland. Centres for Economic Development, Transport and the Environment (ELY centres) are the regional providers of IPR related services. PRH and ELY centres promote innovation and the technical and commercial exploitation of inventions related to IPRs. They assist inventors in questions related to patenting and other industrial property issues, product development and funding applications. PRH and ELY centres participate in conferences, seminars, trade shows and fairs introducing their services and providing IPR related information. The ELY innovation advisors are contact persons for the Product Track service. Nationally, the applications for first stage development aid for inventions can be submitted to the Product Track service at the ELY Centre in Helsinki. The funding is primarily intended for microenterprises that want to develop their innovative ideas and inventions into business. The grant paid to companies for these invention development projects accounts for maximum of 50% of the approved costs. The aid granted is subject to de Minimis conditions.

Secondly, Tekes funding for enterprises allows the services purchased externally for the acquisition of IPR to be included on the eligible costs for SMEs. In Tekes funding for research organisation (Tekes, General Terms and Conditions for Public Research Funding) the public availability of project results and the rights to the commercial use of project results are defined. This practice normally leads to companies and research organizations agreeing separately how the IPR is shared before project starts. A model agreement of Tekes can be used. Support for the commercial exploitation is related to the internationalization (see Chapter 4.2). The statistics of the public funding to support IPR and commercial exploitation is not collected in Finland.

The ratio of PCT patent applications per billion GDP (in current PPS, 2010) was 10.4, (EU average 3.9). PCT patent applications by researcher (2010) was 0.027 (EU average 0.02). License and patent revenues from abroad as a % of GDP (2012) was 1.34, (EU average 0.59). Community trademark (CTM) applications per million populations (2012) was 196, (EU average 152). Community design (CD) applications per million populations (2012) was 52, (EU average 29).

4.4 Knowledge transfer and open innovation

The innovation environment in Finland has been built especially on the idea that knowledge transfer is the most effective when it occurs during the execution of cooperative innovation. The knowledge transfer starts already in the invention phase and continues concurrently during all phases of the innovation process. Because of the system failure involved in cooperation and knowledge interaction, these have been incentivised. The public-private partnerships (PPP) are mainly facilitated through Tekes and SHOK programs. The idea that knowledge transfer works best in cooperative innovation is been based on experience. Tekes funding, especially thematic program funding, is meant for and has in fact boosted cooperation and knowledge interaction between research organisations and private companies. Recent scientific evidence also hints in this direction (Heli Koukkari 2014). Moreover, the work by Koukkari also shows that the innovation process is not a chain from basic research to commercialisation but rather an interactive process in which different phases are concurrent. When innovation is based on research, the phases in the innovation process can be considered to be the fuzzy front end, invention, research and development, commercialisation and diffusion. All of the phases are iterative and often partly parallel. Importantly, the diffusion phase or knowledge transfer phase does not happen at the end of the innovation process but concurrently with the whole process.

Tekes programs continue incentivis cooperation, and in SHOK programs the fuzzy front end includes even more intensive interaction between research organisations and enterprises. Stakeholders are involved in planning the strategic research agenda for the research programs coordinated by the SHOKs and partners are deeply involved in operational planning and execution of the programs.

The principles of establishing and enabling PPPs are integrated in the whole system from the top (Research and Innovation Policy Council and the strategy processes of main actors) to the grassroot operational level. Open innovation is also on the agenda but how the concept is applied depends on the sector and the occasions. Semi open innovation is more common.

Regarding research in universities, there is an indirect incentive for cooperation as the funding model of universities reward for outside funding, such as Tekes project funding.

Cooperation can also be incentivised with concepts like the Innovation Mill. As discussed earlier, the Innovation Mill commercialize "non-core" corporate IPR by spinning off start-ups and new business lines in SMEs, putting the IPR into use. In this case the research has already been executed - often by big companies and research organisations together - and patented, with Innovation Mill commercialising the results.

PPP is used also in evaluation of project and business ideas for funding. VC experts (investors) are evaluating the pitches of start-ups together with Tekes experts.

Many organisations in Finland such as Technology and Business parks, business offices of municipalities, and start-up hubs have a mandate to build PPP networks and initiate collaboration. Moreover, Tekes' TULI program developed structures, expertise, innovation services and methods of research organisations to manage IPR, created start-ups and aimed at commercialising research results. It was replaced in 2012 by a new concept called TUTL (New knowledge and business from research ideas). The new focus is on commercialisation of the results parallel with top-notch research.

The cooperation between research organisations and companies can be and has been measured by the amount of money: i.e. how much companies fund research in universities and research institutes. Finland used to perform well by this measure. However, the forms of intensive cooperation have changed. Companies and research organisations plan and execute cooperative projects with common goals and shared disciplines. Both give their resources, knowledge and efforts to the project without any money flows from an organisation to another. This can't be seen in the statistics.

4.5 Innovation framework for SMEs

Looking at the size distribution of Finnish companies large and micro companies dominate. Accordingly there is a bottleneck in the low number of medium sized companies. Moreover, the medium sized companies grow poorly or moderately on average. Finland's SMEs have been slow to recover from the 2008 crisis, particularly in the case of employment. Micro-sized companies were hit hard and they struggled the most to recover from the initial shock. What is more, large companies fared even worse than the micro-firms. Policy-wise, Finland´s Small Business Act (SBA) profile continues to be one of the strongest of all the EU-28 Member States. In seven out of ten SBA areas, Finland performs above the EU average, the areas being: responsive administration, second change, internationalisation, entrepreneurship, access to finance, and skills and finance. Secondly, Finland performs averagely in two areas: state aid and public procurement, and environment. Thirdly, Finland performs below the EU average in the area of Single market. Finally, over the past six years, most SBA areas have not improved, the exception being responsive administration and skills, and innovation. The areas that improved the most in 2013 were access to finance and internationalisation, (EC, 2014: SBA Fact Sheet Finland).

Finland generally lacks a dedicated SME strategy. One of the objectives of the Government's 2011-2015 programme is to support entrepreneurship, although SMEs are generally not singled out in the objectives. Entrepreneurship and SMEs are also mentioned in the latest guidelines of MEE concerning future growth opportunities. However, the strategies lack a comprehensive SME dimension and mainly focus on promoting entrepreneurship, supporting growth oriented SMEs and internationalisation (see Chapters 2.5.3, 4.2 and 4.6). The reason is clear as was stated in the evaluation of the Finnish

innovation system: public intervention should be focused on reallocation of national resources, especially on forerunners, pioneering, excellence and internationalisation.

Overall, government policies and measures are considered to be in line with the expectations of the SME sector and SBA principles. New initiatives have been implemented to support the financing, growth and internationalisation of SMEs. Nonetheless, the focus on the business environment of SMEs concerning for example regulatory changes and tax policies is lacking. The reform of the procurement legislation aims also at improving conditions for SMEs in public procurement. Growth and internationalisation - the two key focus areas of policies targeting SMEs - remain difficult. There is insufficient number of growth SMEs as well as internationalised SMEs. In Finland, although larger companies are well internationalised, the SME sector still mostly operates in the domestic market. Do, these two issues will continue to be in the spotlight, as SMEs are expected to produce a bigger share of growth than previously. There is little bureaucracy involved in entrepreneurship in Finland compared to many other countries. However, there still is a pressure to further develop the business environment in Finland, (EC, 2014: SBA Fact Sheet Finland).

Although the basic environment for SMEs and entrepreneurship is good, the low birth rate of start-ups and the large number of businesses that stay small remain a challenge (Commission Staff Working Document COM(2015) 85 final). The challenges concern mainly indirectly R&I policy related aspects. The challenges are related especially to attitudes, cost competitiveness, tax rates and regulations, restrictive labour regulations and access to finance (WEF Global Competitiveness Report 2014-15).

4.6 Venture capital markets

Start-ups and young growth companies are crucial for renewing the structure of the national economy and increasing productivity through reallocation of resources (creative destruction). Priorities of the Finnish innovation policy have changed more towards start-ups, growth companies and commercialisation of research. VC investments play an important role in these priorities. Finnish Private Equity (PE) industry VC investments (as % of GDP) were 0.052% in 2013 as shown in the Table 1 (Eurostat 2014). However, these numbers are problematic and may be misleading for several reasons:

1. They are PE industry specific - the international VC investments are excluded although they are of special interest and indeed an objective of Finnish innovation policy; market specific figures would be more interesting
2. They include only institutional PE/VC investments - BA (Business Angels) and public early stage investments are excluded
3. VC investments only do not describe very well the allocation of national resources for young innovative growth enterprises.

According to the IU statistics (IUS 2014 database) VC investments in Finland were 0.096% in 2012. However the definition (early stage, expansion, replacement) is not transparent.

Looking at the FVCA's (Finnish Private Equity and Venture Capital Association) VC market statistics of the PE industry, VC investments in Finland were 0.067% (as a % of GDP, 2013) which is the highest value among European countries (FVCA, VC/PE Industry in

Finland 2013). It includes international PE/VC investments to Finland (€44m) and excludes Finnish PE industry's international investments (€16m). FVCA estimates that its share of all VC investments in Finland is a bit more than 60%. BA investments in Finland are estimated to be €40-50m (FIBAN, Finnish Business Angels Activity 2013). Public VC investments are difficult to estimate because they are mainly allocated indirectly through private funds.

VC investments are often syndicated or they are depending on other risk taking funds. FVCA listed all early stage investments and Tekes' funding for Finnish young growth

companies in 2013:

PE (seed, start-up, later stage venture), includes international investments	€135m
BA (members of FIBAN who answered the survey)	€11m
Other VC (BA and public; estimate)	€20m
Tekes YIC funding	€26m
Tekes YIC funding through VIGO companies	€6m
Tekes R&D grants for young (less than 6-years old) enterprises	€45m
Tekes R&D loans for young (less than 6-years old) enterprises	€59m
Total	€**302m**

Total VC investments (as a % of GDP) in the Table 4 (0.083%) are estimated as follows:

PE/VC (including international investments)	€135m
Other VC (BA and public)	€30m
Total	€**165m**

A Tax Incentive for Private Investors is in use 2013-2015 targeting business angels investing equity in SMEs. The incentive provides a possibility to postpone paying capital gains taxes as long as the gains are re-invested in qualifying businesses

According to the IU progress report at country level (key indicators) in 2012 total invested venture capital in Finland was 0.24% (as a % GDP), whereas the EU average was 0.29%. Thus, it seems that venture capital under management in Finland is below the EU average but yearly VC investments are comparatively high. In connection with VC investments, it is beneficial to consider the functionality of start-up ecosystem as a whole. Speaking of the start-up ecosystem, it seems to work well thanks to a good cooperation between all actors in the ecosystem (see Chapter 2.5.3). However, it is difficult to say if the situation is a longer term trend or just a momentary improvement. Anyhow, the consensus in Finland at the moment seems to be that the major challenges are more related to the later stage PE investments.

4.7 Innovative public procurement

Prior to 2009 the role of innovation oriented public procurement was quite modest in Finland but the development of public procurement in research and innovation policies is underway and high on the political agenda. For instance the Research and Innovation Policy Guidelines for 2011–2015 (2010) placed emphasis on public procurement by referring to it as one of the key tools of demand driven innovation policy. The development of public procurement is also one of the key themes in the action plan and policy framework for demand and user-driven innovation. The main barriers in implementing demand-side

policies in Finland are the small domestic markets and to some extent the dispersed local government sector. As a result active participation of Finnish organisations to the EU Lead Market is seen as a very important approach in the action plan by the MEE. On the other hand the small markets can possibly work as an efficient pilot market for global innovations.

The share of public procurement in Finland is 19.4% of GDP i.e. €35bn (2010, Government's statement to the Parliament U 14/2012, in Finnish)The Action plan of the MEE states that since procurement decisions play a significant economic role, a consistent and professional procurement policy can create the conditions for increased supply and competition, leading to better-functioning markets. Innovation can be promoted through public procurements, especially in young, growing sectors. In addition, costs can be lowered and the quality and efficiency of public services enhanced by procuring innovative products and services. Innovative public procurement can include acquiring innovative products and services, pre-commercial acquisitions promoting research, development and innovation activity, and measures for encouraging innovation-friendly private procurement. Finland's national innovation strategy defines public procurement as a demand driven innovation policy tool. The intention is to develop public procurement practices, in order to create opportunities for and encourage innovative procurements. The action plan also refers to the reform of the Act on Public Procurement. The reform is based on the revision of the public procurement Directives announced in 2013. Expertise in procurement is enhanced by strengthening and developing comprehensive support and advisory services in matters of public procurement related to innovation.

Tekes had a program for piloting public procurement of innovation. 70 projects were funded 2008-2013 with the main focus areas of construction and real estate, social and health care, energy and environment, and water supply. The aim of the new Smart Procurement program (2013 - 2016) is to create smart demand, which will provide the prerequisites for new market creation and growth. The main focus areas for the program are those areas in which the public (or private) procurement has a major impact on the market: *energy and environment, ICT, health care, built environment, security and safety and private strategic procurement.* Furthermore, smart procurement is integrated as a theme in some other programs, too. Moreover, the INKA programme includes objectives related to innovative and precompetitive public procurement, and the Growth agreement between the state and the 12 largest cities include commitments of these cities to implementing innovative and precompetitive procurement. In Finland 8% of companies have been involved in the public procurement of innovative solutions (EU average 6 %), (EC 2014, Flash Eurobarometer 394).

5. Performance of the National Research and Innovation System

5.1 Performance of the National Research and Innovation system

Innovation Union progress report at country level 2014 and Innovation Union Scoreboard 2014 rank Finland among innovation leaders, including Sweden, Germany and Denmark, the countries' innovation performance being well above the EU average. Finland performs very well in terms of scientific and technological excellence, with a strong positive evolution. The Finnish economy is knowledge-intensive, and has achieved a state of continuous change towards a high and medium-high-tech specialisation. The country has several hot-spot clusters in key technologies at European and world scale, in particular in ICT, environment, materials, energy, security, and food and agriculture. Forestry and machinery are strong clusters in Finland, too. Finland has one of the world's highest private and public R&D intensities (GERD per capita). Moreover, Finland outperforms its reference group in highly-skilled human resources and patent applications. The share of new doctoral graduates was somewhat lower in Finland than in the reference group with a declining trend but it is still clearly above the EU average. In summary, Finland performs above the EU average in most indicators. Relative strengths are, in particular, international scientific co-publications, R&D expenditures in the business sector, new doctorate graduates, patent revenues from abroad and trademarks. In contrast, the weaknesses lie in the areas of non-EU doctorate students, knowledge-intensive service exports, non-R&D innovations, and SMEs with marketing/organisational innovations. High growth is observed for community trademarks, non-EU doctorate students, license and patent revenues from abroad, international scientific co-publications and knowledge intensive service exports. Clear growth is observed also for SMEs with marketing or organisational innovations, SMEs with product or process innovations, and community designs. Moreover, on average in 2012 Finland produced 28.7 publications per 10,000 inhabitants, which is well above the EU-28 average (13.8). There is significant international orientation with 51.96% of publications having international co-authors. In 2012, Finland had 1415 international scientific co-publications per million populations (being in the top five among the EU Member States). In the period 2002-2012, 13.6% of the Finnish scientific publications were in the top 10% most cited publications worldwide in comparison with 11% of top scientific publications produced in the EU28 (Science Metrix, 2014)[4]. The share of public-private co-publications in Finland was 2.8% in the period 2008-2013, the same as the EU28 average.[5]

While statistics on applications to the national patent office are not always comparable across different countries, they can provide some indication of technological development activities that are not captured by EPO/PCT data. In Finland approximately 14 thousand patent applications were made at the EPO in the period 2000-2010. Approximately 16000 patent applicants took the PCT route. The National Patent Office received over 38 thousand applications in this period (these three figures are based on fractional counting) (KU

[4] These publication data are based on Elsevier's Scopus database.
ScienceMetrix, 2014, Analysis and Regular Update of Bibliometric Indicators, study conducted for DG RTD, see also http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies

[5] Scival 2014, Scopus based publication indicators derived from Elsevier's SciVal platform, www.scival.com last accessed December 2014

Leuven, Bocconi University, Patents and Licensing study for DG RTD – data release Summer 2014).

The number of national patent applications has been decreasing for several years but the number of international applications has increased until 2008 and after that remained about at the same level. This indicates the importance of global markets for a small economy such as Finland. The overview of figures regarding patent applications submitted by the Finns is presented in Table 5, (PRH, Statistics over patent applications and patents and WIPO, Statistical Country Profile).

Table 4. Assessment of the Performance of the National Research and Innovation System.

1. ENABLERS	Year	FI	EU
Human resources			
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2011	2.70	1.70
Percentage population aged 30-34 having completed tertiary education	2012	45.80	35.80
Open, excellent and attractive research systems			
International scientific co-publications per million population	2012	1,415.41	343.15
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2009	11.40	10.95
Finance and support			
R&D expenditure in the public sector as % of GDP	2012	1.09	0.75
Venture capital as % of GDP	2012	0.10	0.08
2. FIRM ACTIVITIES			
R&D expenditure in the business sector as % of GDP	2012	2.44	1.31
Linkages and entrepreneurship			
Public-private co-publications per million population	2011	97.88	52.84
Intellectual assets			
PCT patent applications per billion GDP (in PPS€)	2010	10.36	3.92
PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	2010	1.19	0.85
3. OUTPUTS			
Economic effects			
Contribution of medium and high-tech product exports to trade balance	2012	1.24	1.27
Knowledge-intensive services exports as % total service exports	2011	34.87	45.26
License and patent revenues from abroad as % of GDP	2012	1.46	0.59

Source: European Commission, IUS Database (2014).

Table 5. International patent applications submitted by the Finns (PRH, Statistics over patent applications and patents)

Patent applications submitted by the Finns to	2007	2008	2009	2010	2011	2012	2013
PCT	2009	2214	2123	2138	2079	2326	2103
EPO	2039	1793	1444	1639	1571	1900	1895
USPTO	2444	2621	2610	2772	2551	2760	2869
JPO	585	575	340	413	319	367	362
SIPO	973	979	897	1089	964	1069	1039
KIPO	536	575	393	387	334	273	312
UKIPO	80	67	73	50	52	72	173
Total	**8666**	**8829**	**7880**	**8488**	**7870**	**8767**	**8717**

Comparing the performance of the national science and innovation systems, OECD, Science, Technology and Industry Outlook 2014 ranks Finland's in the top 5 OECD countries in public R&D expenditure (per GPD), top 500 universities (per GDP), business R&D expenditure (per GDP), triadic patent families (per GDP), young patenting firms (per GDP), wireless broadband subscribers (per population), industry financed public R&D expenditure (per GDP), tertiary education expenditure (per GDP), top adult performance in technology problem solving (%), top 15 year old performers in science (%) and doctoral graduate rate in science and engineering (%). Furthermore, the outlook ranks Finland to be on par or above the OECD median in publications in the top-quartile journals (per GDP), trademarks (per GDP), easy of entrepreneurship index, fixed broadband subscribers (per population), e-government readiness index, patents filed by universities and public labs (per GDP), international co-authorship (%) and adult population at tertiary education level (%). Finally, Finland is ranked to be in the middle range below the OECD median in ICT investment (per GDP) and international co-invention.

5.2 Structural challenges of the national R&I system

Finnish strategic objectives for research and innovation policies have undergone gradual changes during the last years. Some of the key points identified in the 2009 international evaluation of the R&I system was that despite having a good trend in labour productivity and high levels of R&D, the main weaknesses are the lack of growth entrepreneurship and difficulties in internationalisation. Moreover, there are structural challenges in universities and public research organisations. Based on the international evaluation and other policy documents (see Chapter 2) the key challenges are discussed more in detail below.

Before turning to the main challenges, let us consider the strengths of the system. Firstly, the private sector in general has a high investment rate in innovation activities and it is significantly involved in the financing of domestic R&D activities. Furthermore, the number of joint publications between private and public actors is relatively high. Not only the electronics industry, but also several manufacturing and services industries have increased their R&D intensity (BERD as a % of GDP) during the last decade. Secondly, Finland has a growing entrepreneurship culture, a relatively robust VC market and relatively a very high

number of young patenting firms (OECD, 2012). However the situation regarding internationalisation has pros and cons. Finland does not perform well, compared to its peers on inward BERD, the share of non-EU doctoral students, international co-invention and participation in EU Framework programmes. The share of foreign researchers is low. On the other hand Finland's performance is above the EU average in international scientific co-publications, patent revenues from abroad, and triadic patent families. Be that as it is, it can be concluded that the major challenges in the Finnish innovation are 1) Weak internationalisation, 2) Quality of scientific research, 3) A fragmented university and research institute system with dispersed resources, and especially 4-5) An undiversified business structure and poor productivity development.

1) Weak internationalisation of the research and innovation system

Internationalisation of science has been a policy objective in Finland for quite long, but so far the results of the policy measures have been modest. In five years (2007 - 2012) the share of foreign students in universities increased by 75% from 3.3% to 5.8% but the level is still very low. In 2012 the share of new foreign student was 12% and the share of foreigners among doctorate graduates 18%, (Finnish National Board of Education (FNBE), Statistical services). According to the report on the State of scientific research in Finland 2012 only 13% of the researchers in Finnish universities were foreigners. In 2010 - 2013 foreigners' share of all recruited professors was 14%, (The Academy of Finland, The State of Scientific Research 2014). Co-publishing with foreign researchers has increased considerably since 1990; between 2006 and 2009 49% of scientific publications were co-published with foreign researchers. The share of foreign R&D investments as a share of private R&D in Finland was 14% in 2013 (Statistics Finland 2014, Research and development 2013) which is low in international comparison but is mainly explained by the low share of foreign affiliates of total entrepreneurial activities in Finland. The structural weakness of internationalisation also applies to human resources more broadly. The international evaluation of the research and innovation system (MEE & MEC, 2009) concluded that the "lack of global insight and foreign expertise", i.e. difficulties in utilizing or attracting foreign immigrant human capital, foreign R&D and venture capital investments is the major challenge. Moreover, the level of foreign direct investments (in 2012the FDI inflow €2.76bn, 1.73% of GDP) is low compared to other leading countries. Considering commercialisation, the share of patent applications with foreign co-inventors was on the average EU level (19%, patent applications filed under the PCT), (OECD.StatExtract). Finland is developing in internationalisation but the development is slow. The challenge of internationalisation doesn't concern only the R&I environment but the whole economy and the society. It is obvious that the results of internationalising the R&I environment will be modest until a political consensus has been reached and a proactive strategy created for both the immigration and FDI.

2) The quality of scientific research

The report of The Academy of Finland, The State of Scientific Research 2014 evaluates that Finland's position in the scientific world community has remained fairly unchanged throughout the 2000's. At the same time, however, many other countries have picked up speed and are now making strides. Finland ranks just above the mid-table but is behind the other Nordic countries, and the gap to the top performers seems to be growing. According

to the 2014 report, Finnish science is in danger of falling further behind. The report goes on to note that Finnish universities and research organisations will have to make an increasing number of strategic choices, focus on their strengths and step up collaboration, and invest in the new initiatives that might emerge therefrom. The disciplines hosted by the Finnish universities are often quite small, and the same disciplines may be represented at several universities at the same time. The number of publications in Finland has been growing steadily in the 2000's. During the years 2009 - 2012 the number of publications has grown up to 28000 (publications by researchers working in Finland). The Web of Science (WoS) top 10 index is 1.04. The number of researchers at the very top of their field remains low in Finland. Finland needs more high-quality, leading edge research. Regarding the importance of internationalising research, it is important to note that according to the bibliometric results of the Academy' report international cooperation increased the impact of the research significantly.

Finnish universities in general do not fare that well in international comparisons. The only Finnish university ranked in the top-100 of the Shanghai ranking in 2014 is the University of Helsinki (73rd). Also in the Times Higher Education World University Rankings in 2013, the University of Helsinki is the only Finnish university among the best 200 universities in the world. On the other hand the OECD STI Outlook ranks Finland among the top 5 based on the top 500 universities (per GDP). Most Finnish universities reach a mid-table ranking in the international university rankings partly due to international excellence being focused on few fields, and also due to the small size of universities. The regional policies of Finland may have also affected the level of science in several Finnish universities: several of them have been established in remote locations based more on equal regional policy than actual demand. Student–teacher ratios are lower in Finland than in the top universities of the world. Finally, Finnish universities used to offer only few regular postdoc vacancies but the new tenure track system will probably change this.

3) The fragmentation of the higher education and the public research sector

The quality of research and its efficient use in the society is linked with the structure of the research system. According to the international evaluation of the Finnish research and innovation system (MEE & MEC, 2009) the Finnish higher education and public research system is fragmented, which makes it more difficult to focus resources and to provide high-level research. According to the evaluation the system can be seen as fragmented in three dimensions. Firstly, resources are scattered in three different types of organisations with overlapping tasks – universities, polytechnics and public research organisations (PROs). Secondly, these institutions are scattered around the country with several rather small units. Thirdly, the universities have been internally fragmented in several rather small units.

There are 14 universities doing research in total in 54 fields of science divided in 297 units in s in Finland. From the 54 fields 27 are represented in six or more universities. No research in any of these 27 fields was clearly above the world average level (top 10 index > 1.15). Therefore, there is a clear need to prioritise and make strong strategic choices to decrease fragmentation and aim at increasing the critical mass. There are 26 polytechnics (also known as universities of applied research), and 12 public research institutes which also have several regional extent.

4-5) Undiversified business structure and poor productivity development

Finland faces the combined effects of the global and European recession and the challenges related to the structure of the economy and ageing population. Productivity and living standards rank high among the developed countries, but especially the positive development of productivity has stopped. Finland's GDP has been continuously decreasing since the second half of 2012. The performance of the Finnish economy is lagging well behind most countries in the euro area. Finland's real GDP is still a good 5% smaller than immediately before the onset of the international financial crisis in 2008. Since the onset of the international financial crisis, Finnish exports have declined by approximately one fifth, which is more than in any other advanced economy.

Finland has lost its cost competitiveness. Production costs in Finland have risen due to an approximately 10% rise in average wages relative to the euro area average since 1999, when the common currency was adopted. Most of the difference in the average has come since 2007. The reasons are related to the high cost level and losses in multifactor and labour productivity. (Maliranta M, 2014, in Finnish). Finnish multinationals have been increasing activities and manpower in foreign countries and decreasing them in Finland. The market shares of these companies in global markets have declined. In the recession companies have been first waiting for better times causing productivity losses, and then adopting their costs and manpower to the decreased demand which caused a slow productivity increase but did not increase value added. To put it simply, the national economy is suffering. There is a remarkable challenge in increasing the multifactor productivity and reallocating national resources. These challenges call for the renewal of the existing businesses as well as boosting creative destruction of the economy (Maliranta M, Rouvinen P, Ylä-Anttila P, 2010) and diversifying the economic structure. The challenges are more complex today than before the recession. National clusters are not dominating anymore; companies are a part of global value chains. Competitive advantage is not related to the location of clusters nor companies but to the location of different functions of companies. All economies are targeting at boosting high added value functions of the businesses (Ali-Yrkkö J, 2013, in Finnish). In Finland, the extent to which the business and the public sectors will be capable of absorbing new innovations from the ICT sector – and more concretely the available highly-skilled human resources – will determine the country's growth or decline.

5.3 Meeting structural challenges

Finland's innovation policy and national measures are geared towards speeding up the development, commercialisation and take–up of new technologies and businesses. The Finnish National Reform Programme (2012) and the new recommendations of the RIC (2014) identified the important reforms needed in the research and innovation policy to be the creation and introduction of new means and models to strengthen innovation activity, the establishment of attractive hubs of expertise, internationalisation, structural development of higher education, the reform of research institutes and research funding, and setting up the infrastructure policy and the tenure track system. Overall, the number and scale of reforms taking place signal the continuous commitment to a broad and ambitious R&I policy. In addition to the efforts in enhancing the efficiency and improving the internationalisation of the innovation system, the policy reforms are targeted at increasing the number of high growth innovative companies as they are considered to be

major contributors to employment of tomorrow. The innovative high growth companies are also considered as a means to diversify the Finnish economic structure. Connected with the growth companies, a tax incentive for private investment in start-ups has been introduced, and Vigo accelerators have been set up and expanded to increase the volume of the domestic venture capital market. The newly founded Tekes Venture Capital Ltd adopts asymmetric profit distribution mechanisms functioning as fund of funds. Moreover, Tekes funding has been focused on start-ups. In total, these actions are expected to support especially knowledge- and innovation-based young growth enterprises. What is more, the Finnish Government has recently encouraged innovation and the country's transformation into a digital service economy by releasing non-sensitive public data as open data.

The university funding model (2013) is a good step forward in rewarding for quality and internationalisation, but incentives for creating societal-economic impacts are still not in place. Nonetheless, the Government has made important policy initiatives focusing on structural reforms to improve the sustainability of the public finances, the most significant of the reforms being pension and health care reforms. These aim at fiscal consolidation, and increasing the labour supply. The reforms have been indeed needed but the weak trend in the economy and no brighter view in the future, however, mean that the reforms are not enough to raise multifactor productivity. Major decisions in many areas of policy are needed both now and in the years ahead. One crucial area in which decision-making is desperately needed is the reduction in production costs relative to Finland's trading partners. Moreover, there is also a need for removing regulatory controls that limit competition. What have been discussed here is not generally considered as innovation policy. However, it is necessary to consider a wider policy mix to see the big picture, as the success of innovation policy is in the end dependent on the cost competitiveness. In Finland, means are especially needed to increase the multifactor and the labour productivity of the whole economy by hastening the introduction of the planned R&I measures which aim at broadening the innovation base, and increasing the incentives for R&I and risk taking of businesses and capital.

Considering Finland's high level of R&D inputs, the country has a relatively low contribution of high-tech and medium-high-tech exports. The comparison is however misleading. The reason for high level business R&D has been primarily due to the remarkable R&D investments by Nokia. Actually, the R&D investments by other companies in Finland have been quite moderate. So the average business investments in R&D are similar to the average investments in competing economies. Although the public research investments in Finland are high, a quite modest share of the public research investments aimed at contributing to the economy and especially to the competitiveness of enterprises. This became even more evident when RIC 2014 report pointed out that the governmental funding for R&D for boosting the knowledge base and the renewal of industries has declined by 35% during 2011-2014. Unfortunately the evidence based understanding of the market failures involved in R&I as a reason for public funding for R&D is not widely spread in Finland. That's why incentives for business R&I investments are very week compared to other economies (RIC: Reformative Finland: Research and Innovation Policy Review 2015-2020 and OECD 2014, Science, Technology and Industry Outlook 2014, p 69).

Table 6. Challenges, policy measures and respective assessment Challenges

Challenges	Policy measures/actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness
1. Weak internationalisation of the research and innovation system	Foreign companies eligible for the Tekes funding Attracting international students and researchers by universities. Strategy for the Internationalisation of universities in Finland 2009–2015 Funding criteria of the funding agencies giving rewards for internationalisation The new university funding model Finnish Centres for Excellences by the Academy of Finland Financing to support the outflow of researchers The FiDiPro –programme attracting talent TeamFinland cooperative network, Growth Track service for internationalising SMEs New Tekes campaigns, Market Access Program of Tekes Nordforsk and Baltic research alliances	Internationalisation and participating in cross-border joint initiatives are typically ranked high on the R&I agenda. Increased collaboration and coordination of public agencies streamlining of instruments to provide more comprehensive support for internationalisation Agencies have established their own practices and programmes that increasingly allow cross-border access to R&I. There are rules and practices to help foreign researchers and their families in Finland but efforts have not been sufficient. The results of internationalising R&I environment will probably be modest until a political consensus has been reached and a proactive strategy created for immigration and FDI.
2. The quality of scientific research and 3. The fragmentation of the higher education and the public research sector	The new University Act 2010, reforms of doctoral education and tenure track systems University funding model (2013) The structural development scheme for polytechnics implemented in 2014 The reform of research institutes and research funding (starting 2014) including the establishment of Strategic Research Council (2014) R&I recommendations for 2015 2020 by the RIC The Finnish Research Infrastructure Committee, updated Finland's national roadmap for infrastructures 2013 Evaluations of major actors Strategic Centres for Science, Technology and Innovation (SHOKs) - evaluation (2013), implementation of the recommendations of the previous evaluations (2014) Broader role for the Academy of Finland - evaluation (2013) The evaluation of the effectiveness of the Research and Innovation Policy Council 2014	Structural reforms of funding agencies, research institutes and universities have advanced, there have been mergers more, excellence driven funding models, increase in the quality of scientific research. The means for coordinating and strengthening universities' strategic choices are soft and results have been achieved quite slowly. Stronger incentives are needed.

4 and 5. Limited business structure and losses in productivity development	RIC, Tekes and MEE addressing supply side measures R&I recommendations for 2015 - 2020 by the RIC (2014) The action plan and policy framework for demand and user-driven innovation by MEE. The reform of the Act on Public Procurement, so that public procurements pay greater attention to innovation (2015) A joint–service 'Growth Track' intended for enterprises aiming at rapid growth and internationalisation Tekes funding concept for young, innovative enterprises VC - start-up ecosystem The enlargement of Finnvera's mandate The expansion of the Vigo Accelerator Programme The Tax Incentive for Private Investors ICT 2015 working group's (2012) strategy to mitigate the effects of the sudden structural change The new strategy of Tekes with emphasis on growth companies, establishment of Tekes Venture Capital Ltd fund of funds with the possible of asymmetric distribution of profits Governmental decision on central government spending limits for 2014 – 2017 in April 2013	Important steps have been taken forward in the Government and its key agencies to address the current excessive emphasis on supply side measures. The focus of public R&D&I funding has been effectively shifted to SMEs which are growth–oriented, job creating and successfully establishing international connections. Coordination and cooperation between funding agencies aim at more streamlined services for companies, and new co-funding models, increasing diversification and supporting growth businesses. University funding model increases the quality and internationalisation of research but incentives for socio-economic impacts are missing Incentives and allocation of public funding to research boosting the growth of the economy and the competitiveness of companies will remain modest. Incentives for business R&D&I will remain on a low level compared to competing economies. This caused of challenges in the renewal of industry and hinders growth in productivity. New measures to boost FDI, private equity for growth stages of SMEs, IPR creation and measures that ensure that the added value stays in Finland could be considered.

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Annex 2 - Abbreviations

AAI	Authentication and Authorisation Infrastructures
AVAA	Open-access Publishing System
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BERD	Business Expenditures for Research and Development
BoD	Board of Directors
CD	Community Design
CERN	European Organisation for Nuclear Research
CESSDA	Consortium of European Social Science Data Archives
CLARIN	Common Language Resources and Technology Infrastructure
CLEEN	a SHOK for Energy and the environment
CoE	Centre of Excellence
COST	European Cooperation in Science and Technology
CSR	Council for strategic research in the Academy Finland
CSC	IT Centre for Science
CTM	Community Trademark
DIGILE	a SHOK for Information and communication industry and services
EATRIS	European Infrastructure for Translational Medicine
EC	European Commission
ECA	Export Credit Agency
EDUGAIN	a federated AAI service between the GÉANT Partners
EduROAM	Education Roaming, an international roaming access service
EK	Confederation of Finnish Industries
ELIXIR	European Life Science Infrastructure for Biological Information
ELY	Centres for Economic Development, Transport and the Environment
EMBL	European Molecular Biology Laboratory
EPO	European Patent Office
ERA	European Research Area
ERA-NET	a funding instrument within the EU Framework Programme
ERDF	European Regional Development Fund
ESF	European Social Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
ESRF	European Synchrotron Radiation Facility
ESS	European Social Survey
EU	European Union
EURACCESS	Researchers in Motion, a pan-European initiative for researchers
EURODOC	European Council of Doctoral Candidates and Junior Researchers
EUROHORCS	European Heads of Research Councils
EU-28	European Union including 28 Member States
Eurostars	a joint programme between EUREKA and the European Commission
EVCA	European Private Equity and Venture Capital Association
FDI	Foreign Direct Investments
FIBIC	a SHOK for Finnish Bioeconomy Cluster
FII	Finnish Industry Investment Ltd, TESI
FIMECC	a SHOK for Metal products and mechanical engineering
FIN-CLARIN	a Finnish part of the European CLARIN collaboration
FIRI	Finnish Research Infrastructure Committee in the Academy Finland
FNBE	Finnish National Board of Education
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
FSD	Finnish Social Science Data Achive
FTE	Full Time Equivalent
FUNET	Finnish University and Research Network, a Finnish NREN
FVCA	Finnish Private Equity and Venture Capital Association

GAP	Global Access Program is a MAP (USA) of Tekes
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GEANT	a pan-European research and education network interconnecting Europe's NRENs
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GSI/FAIR	Facility for Antiproton and Ion Research
HAKA	an identity federation for the Finnish higher-education and research institutions
HEI	Higher Education Institutions
HPC	High Performance Computing
HR	Human Resources
ICOS	Integrated Carbon Observation System
ICT	Information and Communication Technology
IDA	a research data storage system
IDT	Innovative Doctoral Training
INKA	Innovative Cities Program
INSTRUCT	Integrating Structural Biology
InTo	Coming to work in Finland Portal
IP	Intellectual Property
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
IT	Information Technology
ITER	International Thermonuclear Experimental Reactor
IU	Innovation Union
JRC	Joint Research Centre
Kela	Social Insurance Institution of Finland
KIPO	Korean Patent Office
KPI	Key Performance Indicator
LMI	Lean Market Initiative
MAP	Market Access Program of Tekes
MEC	Ministry of Education and Culture
MEE	Ministry of Employment and the Economy
MFR	Money Follows Researcher
MIKES	Research institute for measurement science and technology (metrology)
MS	Member State
NGO	Non-Governmental Organisations
NLS	National Land Survey of Finland
NORDUnet	a Nordic Infrastructure for Research & Education, a Nordic representative towards GÉANT
NREN	National Research and Education Network
NRP	National Reform Programme
NUS	National University of Singapore
OA	Open Access
OECD	Organisation for Economic Cooperation and Development
OSKE	Centre of Expertise Programme
PCT	Patent Cooperation Treaty
PE	Private Equity
PPP	Public-private-partnership
PRH	Finnish Patent and Registration Office
PRO	Public Research Organisation
REFEDS	Research and Education Federations
REMS	Resource Entitlement Management System
RIC	Research and Innovation Policy Council
RIS3	Research and Innovation Strategies on Smart Specialisation
RTDI	Research, Technological Development and Innovation
RYM	a SHOK for Built environment innovations
R&D	Research and Development
R&I	Research and Innovation
SA	Academy of Finland
SalWe	a SHOK for Health and wellbeing

SBA	Small Business Act
SBIR	Small Business Innovation and Research
SEM	School of Economics and Management (Tsinghua University)
SF	Structural Funds
SHOK	Strategic Centre for Science, Technology and Innovation
SIPO	China Patent Office
SITRA	Finnish Innovation Fund
SLUSH	An event for Eurasian start-ups to meet with international investors, executives and media.
SME	Small and medium sized enterprise
SRC	Strategic Research Council
SYKE	Finnish Environment Institute
Tekes	Finnish funding agency for innovation
VC	Venture Capital
TESI	Finnish Industry Investment Ltd, FII
TTA	National Research Data Project
TULI	Business from Research, a Tekes Program
TUTL	New knowledge and business from research ideas, a Tekes funding concept
VIGO	Business accelerator
VTT	Technical Research Centre of Finland
UC	University of California
UCLA	University of California in Los Angeles
UK	United Kingdom
UKIPO	UK Patent Office
UNIFI	Universities Finland, a co-operational organisation for Finnish universities
UPSTO	US Patent Office
US	United States
WEF	World Economic Forum
Wos	Web of Science
YIE	Young Innovative Company

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