ERAWATCH COUNTRY REPORTS 2010: Finland

ERAWATCH Network – Advansis Oy

Kimmo Viljamaa

Acknowledgements and further information:

This analytical country report is one of a series of annual ERAWATCH reports which are produced for EU Member and Countries Associated to the EU Seventh Research Framework Programme (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) with contributions from Directorate General for Research and Innovation and the ERAWATCH Network. The report has been produced by the ERAWATCH Network commissioned by JRC-IPTS.

In particular, it has benefited from comments and suggestions of Lena Tsipouri, who reviewed the draft report. The contributions and comments of N. Harrap from JRC-IPTS and DG-RTD are also gratefully acknowledged.

The report is only published in electronic format and available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

The opinions expressed are those of the authors only and should not be considered as representative of the European Commission's official position.

Executive Summary

Finland has a fairly open and increasingly internationalised research system. International collaboration is very active and Finnish research organisations, funding organisations as well as the private sector have been relatively networked. Especially the leading companies are highly globalised with extensive international R&D networks and R&D activities abroad. This is not surprising as the Finnish economy is very open with high share of exports and imports to GDP. According to the Confederation of Finnish Industries the Finnish manufacturing companies invested €7.5b to R&D in 2009, of which almost half (47%) was directed to activities outside Finland.

The higher education sector and public research institutes are internationally and inter-sectorally networked. Private R&D funding is an important source of funding for public R&D and international funding has also become more important. The domestic R&D programmes have been slowly opening up especially during the past ten years, but the level of international collaboration is still relatively low in these programmes.

Despite high internationalisation of key businesses and the research performers, the level of internationalisation of the Finnish research system in general is still quite low. The research system has leaned quite heavily on domestic human capital and the research system has had difficulties in attracting talented researchers and students. Both inward and outward researcher mobility has increased but is still relatively low. The higher education system has had difficulties in providing proper research careers for young researchers. At the same time, the private sector has not been able to provide proper employment for PhDs.

Education, research and innovation policies are experiencing a rapid change in Finland. Societal challenges such as globalisation, ageing, environment and public health have been recognised in the national policy. At the same time concern has been expressed about the ability of the research and innovation system to address these issues. Numerous reforms and changes are underway in the knowledge triangle policies, such as the university reform, the structural reform of the higher education system, national innovation strategy, reform of the sectoral research, the development of the national infrastructure policy and the development of the research career system. Moreover, internationalisation has also received increasing attention at the universities.

Internationalisation of research policies is also of high priority in the national policy and ERA has an important role in these plans. In practice this means particularly an increase in the support for the international networking of universities and R&D organisations.

For a long time Finland has been one of the top countries in R&D investments. Public R&D funding has increased in Finland even during the crisis and especially in 2010 public R&D funding increased substantially. This has somewhat negated the slight decrease in the private sector R&D. In relation to GDP the share of R&D expenditure has actually increased and was almost 4% (3.96%) in 2009 (Eurostat, 2010). A widely shared view in Finland is that investing in R&D is necessary for competitiveness and productivity growth and as a result a strong public commitment to increase R&D funding is expected also in the future.

Knowledge Triangle

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	• New University Act into force in 2010 extends the autonomy of universities by giving them an independent legal personality, either as public corporations or as foundations. At the same time, the universities' management and decision-making system will be reformed; • Co-ordination and steering of sectoral research to better support policy decision making; • The establishment of Strategic Centres for Science, Technology and Innovation (CSTI) addressing the facilitation of knowledge circulation between university, PRO and business sectors.	• High public and private R&D expenditure; • Funding to basic research and research infrastructures has grown more slowly than funding to applied research and innovation.
Innovation policy	• Renewal in the VTT organisation to improve management as well as R&D performance; • National innovation Strategy was published in October 2008. In October 2009 a review of key activities for the implementation of the strategy was provided together by the Ministry of Employment and the Economy (innovation) and the Ministry of Education (research and education); • Improving the management of university inventions; • Initiatives to increase demand led component in innovation policy; • Increasing role of the service sector as a target for policy.	• Strong national focus on renewing the innovation system and innovation policy instruments based on the national innovation strategy; • The major recent instrument the SHOK is connecting public and private research and innovation; • Current instruments such as the SHOK initiative are primarily targeting existing industries.
Education policy	• University reform; • Structural reform of the higher education system; • Reform of the continuing education system.	• Good performance of the education sector; • Good education levels provided by mass high education.
Other policies	• Tendency to move towards environment and energy friendly tax solutions may support research and innovation.	

European Research Area

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• New internationalisation strategy for higher education in 2009. The aim is that the higher education institutions will offer high-standard education in foreign languages and increase the share of foreign teachers, researchers and degree students; • Plans to renew the education legislation to better support both export of education and to attract international students to Finland. A strategy has been recently devised for the exportation of Finnish education.	• Strengths exist at the overall high level of basic education and large existing HRST; • Weak ability to attract talented domestic and foreign students and an unattractive research career system; • Research career not very attractive in terms of salaries.
2	Increase public support for research	• Public budget for R&D increased in nominal value from 2008 to 2009 5.7% and 8.2% from 2009 to 2010; this did not meet the recommendations from 2008. In 2010 there was a significant increase in the public R&D investment, although the share of R&D expenditure compared to all budget expenditure decreased.	• Overall high private and relatively high public R&D expenditure, private R&D slightly affected by the economic crisis; • A great part of BERD concentrated on one sector (ICT); • Increase in public R&D spending slower than planned in the national research policy guidelines.
3	Increase European coordination and integration of research funding	• Finland has active participated in European funding instruments such as ERA-NETs and Art. 185 initiatives; • Finnish programmes increasingly have an international dimension in their agenda.	• The research and R&D-programmes in Finland are open to foreign participants but this often does not include funding; • The use of European opportunities still underutilised.
4	Enhance research capacity across Europe		• A large pool of highly educated human resources (HRST)
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Recent national plan in developing research infrastructure (connected to ESFRI strategy).	• Finland does not have any significant research infrastructures; • Recently underinvestment in renewing research infrastructure; • Difficulties in finding funding for implementing the national plan may pose problems.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
6	Strengthen research institutions, including notably universities	• University reform implemented in 2010; • Public funding for universities has increased quite slowly.	• Universities have good basic level in education and research but the excellence is still concentrated on only few strong areas.
7	Improve framework conditions for private investment in R&D	• Increase in Tekes funding and the creation of the Strategic Centres of Science, Technology and Innovation; • Discussion on tax incentives has become more intense although no decisions are made yet.	• There are several instruments supporting private R&D investments; • More measures needed to increase the proportion of R&D performing firms.
8	Promote public-private cooperation and knowledge transfer	• The Strategic Centres of Science, Technology and Innovation have promoted public private partnerships; • Increasing presence of the private sector in the HEIs through participation in governance and investments.	• Promotion of public-private cooperation interaction has been a long standing priority with a significant share of public R&D funding dedicated to collaborative research and technology transfer.
9	Enhance knowledge circulation across Europe and beyond	• The Finnish participation rate in European research activities has increased during the recent years (e.g. FP, ERA-NETs); • Cooperation with other countries, especially China and India has increased.	• Mobility of researchers (both inward and outward) is well below European average, which might result in lower knowledge circulation; • Increasing participation in international initiatives may indicate that knowledge circulation is carried through other means than physical researcher mobility.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• Recommendations towards prioritisation in international co-operation through bilateral co-operation and Tekes FinNode initiative; • Internationalisation strategy of the universities in 2009.	• The need for internationalisation of the research system increasingly discussed in policy due to relatively low level of internationalisation and the need for increased researcher mobility.
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• Coordination of research, education and innovation policies between the two responsible ministries developed lately.	• Knowledge triangle co-ordination quite well developed.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
12	Develop and sustain excellence and overall quality of European research	• Policy discussion on new measures towards improving research excellence increased after the evaluation of 2009 that assessed that the relative research performance has declined; • Increased funding to the Academy of Finland to support research excellence; • New funding model of the universities has a performance based component in it.	• Based on scientific indicators such as R&D funding, publications and citations, Finnish research has performed quite well; • The excellence has concentrated to few narrow research areas.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• Policy initiatives and strategic emphasis in "broad based innovation", including new forms of innovation, demand based innovation, public procurement and service innovation.	• Finland is well established in knowledge intensive economy; • There is still underutilisation of new modes of knowledge an new technologies such as ICT in many sectors.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Emphasis in research programmes to some of the great challenges such as aging, environment and public health.	• The emphasis on societal challenges in Finland has been less developed in the past than emphasis on core technologies and industries.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• According to a recent science barometer a majority of Finns trust in science and find it important as solving problems in the society; • New demand based approach and increasing emphasis in public sector R&D may strengthen the use of scientific results in policy and practice.	• The systematic evaluation culture has been established but the evaluation results are still not used in policy making as well as they could.

TABLE OF CONTENTS

1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

Finland is a sparsely inhabited Nordic country with 5.3 million inhabitants, which represents only 1.07% of the EU population. In 2008, Finland's GDP was €184,649m. GDP per capita (PPS) was €29,400 (Eurostat, 2010), which is 17.1% above the EU27 average. In 2009, Finland's unemployment rate was 8.2% which was slightly lower than EU27 average of 8.9% (Eurostat, 2010). In 2008, the total intramural R&D expenditure (GERD) was €6,871m in Finland. GERD as a

percentage of GDP was 3.73%, which was significantly higher than the EU27 average of 1.90%. Among European and OECD countries, Finland's GERD percentage was only surpassed by Sweden in 2007 (Eurostat, 2010). During the period between 2002 and 2008, the share of GERD has increased slowly.

The growth rate of GERD in Finland between 2000 and 2008 has been average in the EU and R&D expenditures have grown quite modestly in proportion to GDP at an average annual growth rate of 4.8% (Statistics Finland, 2009).

Main actors and institutions in research governance

The highest-level governance takes place at the Parliament and at the national government. Especially, the national government – regardless of its political composition – has actively taken part in science, research and innovation policy issues for more than a decade. The government is supported by a high level advisory body, the Research and Innovation Council (RIC) (formerly Science and Technology Policy Council of Finland), which is led by the Prime Minister. The Council is responsible for the strategic development and coordination of Finnish research and innovation policies.

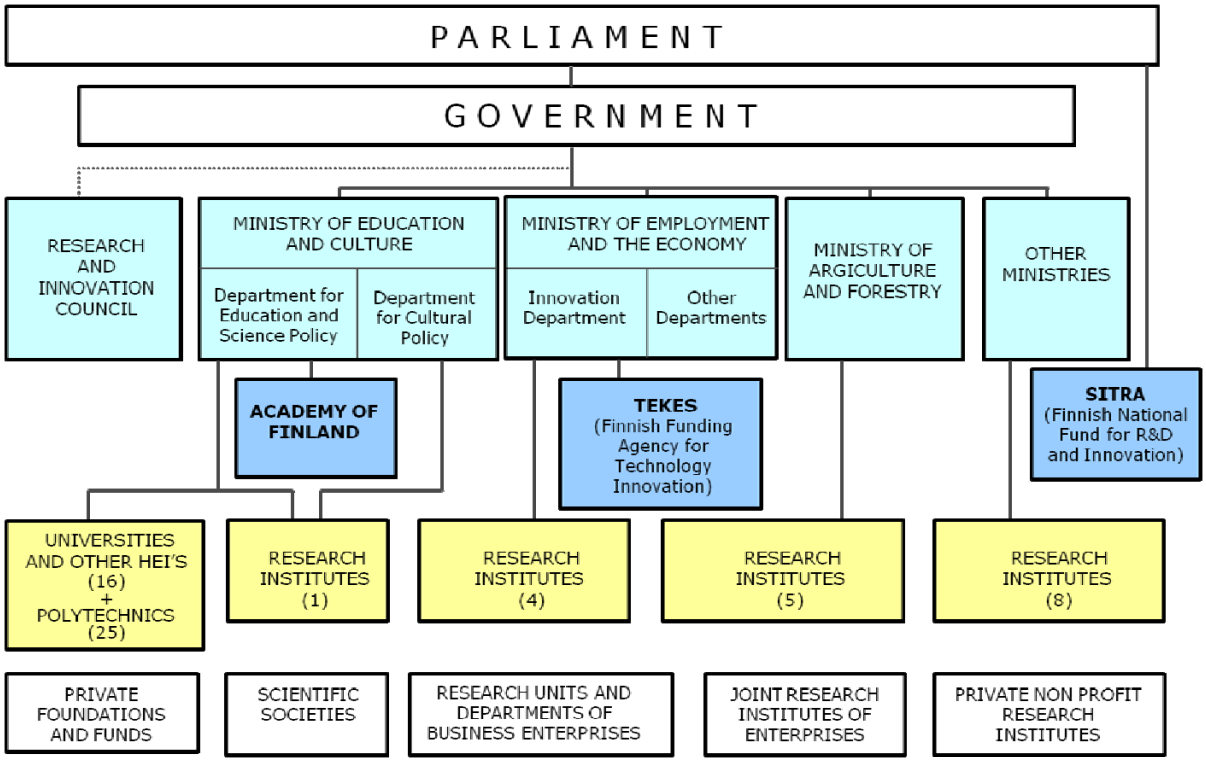
The second level consists of the ministries. The key ministries concerned with research policy are the Ministry of Education and Culture (MoE) and the Ministry of Employment and the Economy (MEE). While there is a historically developed sectoral division of labour between the two ministries concerning science and technology policy, cross-sectoral cooperation has increased in issues related to science and innovation during the past few years. This is partially due to the shared interests of the ministries to promote research funding in the government budget. As a general trend, there is a move from narrowly defined science and technology policy towards a broad-based innovation policy incorporating issues of research policy, technology policy, and elements from various other policies.

The third level consists of the R&D funding agencies, the Academy of Finland and Tekes, the Finnish Funding Agency for Technology and Innovation. The Academy of Finland funds basic research and other research related activities through competitive grants. While the majority of Tekes funds are allocated to R&D projects carried out by companies, Tekes is also a large financier of research at the universities and public research institutes. In 2010, 48.4% of the total government research funding (including direct funding of universities) was channelled through these two organisations (Statistics Finland, 2010).

At the fourth level there are the organisations conducting research: universities, public research institutes, private research organisations and business enterprises. There are 16 universities and 27 polytechnics in Finland[1]. They are owned by the state and get their basic funding from the state budget. There are also 18 state research institutes funded by the state.

[1] There are 25 polytechnics in the Ministry of Education and Culture sector. In addition there is Åland University of Applied Sciences in the Province of Åland and a Police College subordinate to the Ministry of the Interior.

Figure 1: Overview of the Finland's research system governance structure



Source: ERAWATCH Research Inventory

The institutional role of regions in research governance

Finland comprises 20 Regions all categorised at the NUTS (Nomenclature of Territorial Units for Statistics) 3 level. The institutional role of the regions in the research governance is small since research policy is mainly decided at the national level. Regional concerns have an effect on the national policy in many respects, however. For instance, the Ministry of Education and Culture reconciled the objectives of the national research policy and the regional policy in a strategy document titled Regional strategy for accomplishing education and research policies until 2013 (Ministry of Education, 2002). The municipalities in Finland are strong actors (with own financial resources) compared with many other countries and particularly the bigger cities and towns play a very active role in local economic development, often related to support in building infrastructure and support services for research and development activities.

Regional Councils are appointed by the municipalities and are therefore politically presenting the local governments. Furthermore, they also have some of their own resources. The main instruments for funding their policies so far have been the Regional Operational Programmes co-funded by Structural Funds (SF), the national government and the local governments. With the increasing focus of SF towards RDI (research, development & innovation), the role of regions has become more important.

Main research performer groups

R&D is mainly performed by business enterprises in Finland. In 2009, enterprises had 71.4% share of total R&D expenditures (Statistic Finland, 2010). A distinctive characteristic is that one company, Nokia, accounts for nearly 50% of total business sector R&D in Finland (Pajarinen & Ylä-Anttila, 2008).

The higher education sector, mainly the universities of Finland, had 18.9% share of total R&D expenditures (Statistics Finland, 2010). The higher education sector covers universities, polytechnics and university hospitals. Although R&D activity at the polytechnics has grown during the recent decade (340% from 2000 to 2009) the majority (85%) of the higher education sector R&D is performed at the universities.

The share of government departmental research (including non-profit research performers) was 9.7% in 2009 (Statistics Finland, 2010). Most of the government sector R&D is performed by state research institutes (PROs). The role of the government sector has decreased for the past decade from 11.2% of GERD (Gross Domestic Expenditure on R&D) in 2000 to 8.6% in 2008. In 2009 a relative increase was experienced through growth in public R&D expenditure and decline in the private sector R&D (Statistics Finland, 2010).

In terms of money, the total domestic expenditure on R&D was €6,925m in 2009, equalling 3.90% share of the GDP (Statistics Finland, 2010). The total amount of R&D expenditure was only €85m smaller than in the previous year. The business R&D expenditure decreased 5% (€250m) from 2008 but at the same time the expenditure on R&D went up in the public sector and in the higher education sector (Statistics Finland, 2010).

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section assesses the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

Since Finland has already been above the 3% GERD/GDP target for a long time, a new ambitious target of 4% was set in 2008. The worsening economic situation has actually helped Finland towards achieving the established R&D investment objectives since the decrease in GDP has been higher than the decrease in R&D spending. In 2009 the share of GERD as percentage of GDP was 3.96% and although it is estimated to decrease to 3.90% in 2010 (Statistics Finland, 2010), it is still fairly close to the target. In the latest review setting the guidelines for 2011-2015, RIC states that Finland's objective is to maintain the current R&D funding share of GDP (4%) in the 2010s.

The decrease of R&D expenditure during the economic downturn has affected especially the private sector. All in all, the BERD decreased 5% from 2008 to 2009 (Statistics Finland, 2010), with the biggest relative decrease in the machinery and chemical industries as well as services. Although the latest estimates predict that the

drop in BERD will be only temporary, there is a threat that some enterprises will permanently decrease R&D or move it to abroad.

What is more important than the relative share of R&D investments is the fact that public sector and higher education sector R&D expenditure has continued to increase even during the economic crisis. This has been a positive achievement although the increase in public R&D spending has been slower than the recommendations by the years 2009-2011 in the 2008 Review by the Research and Innovation Council, which was €760m, i.e. an average of €250m per year. From 2008 to 2009 public R&D spending increased €101m (5.7%). In the latest RIC 2011-2015 review, the goal for the public investment has been set to be 1.2 per cent of GDP and the council also presents a programme for increasing public research and innovation funding that supports this policy guideline.

The objectives to increase public R&D investments are closely connected to selected reforms and new measures such as the university reform, the reform of sectoral research, new research infrastructure policy (connected with ESFRI) as well as the establishment of the Strategic Centres for Science, Technology and Innovation. It seems that the biggest barrier for achieving the objectives may be political ones as the economic situation may affect the decision making processes.

The share of competitive funding is bigger in Finland than in many other EU countries. For example the share of General University Funds in the Government budget was 24.9% in Finland while it was 29.5% in EU27 and at the same time the GBAORD directed to Economic Development programmes was 38.8% in Finland compared with 21.5% in the EU27 (OECD, 2008).

The institutional funding provided for universities and public research institutes represent the largest share of the public sector R&D. However, the share (46%) is still quite low in international comparison (OECD, 2008). The main competitive public funding instruments for RDI in Finland are the Tekes programmes and other Tekes project funding, which is aimed both at the private sector R&D as well as public research. Academy of Finland research funding (including thematic research programmes) is the main source of external public research funding in Finland and the funding is mainly aimed at universities and public research institutes. Recent R&D funding instruments are the Strategic Centres for Science, Technology and Innovation, which are organisations managed together by the industry, universities and research institutes.

EU funding is also an important source. EU funding covers over 12% of the external research funding for the higher education sector (Statistics Finland, 2010). While the share of external funding for the universities has remained relatively constant from 2000 to 2007, the share of EU funding increased almost 70% at the same time.

Although the share of Structural Funds for R&D activities is relatively small compared to the funding provided by Tekes and Academy of Finland, it has an important role to play especially in developing the research environments in the less favoured regions. For the 2007-2013 period, the specific objective “Promotion of innovation and networking and strengthening of knowledge structures” will cover approximately 35% of the ERDF funding and when looking at the R&D activities under other priorities Finland will invest over 54% of all funding in activities related to RDI.

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

The growth of business enterprise R&D (BERD) in the latest 5 years has fluctuated from year to year but has generally stayed above EU level. Between 2004 and 2008 the average growth in BERD was 8.5% compared with 5.4% in the EU27 (Eurostat, 2010). However, in 2009 BERD decreased 1.6% in Finland during the economic crisis. However, the decrease in BERD was smaller than the decrease in GDP and as a result the relative share of BERD from GDP rose from 2.77% in 2008 to 2.87% in 2009. The tentative figures from 2010 estimate that BERD will turn to slight increase again. Based on these figures it seems that the business enterprise sector continues to invest in R&D despite the difficult economic situation especially in the sectors that depend on export markets. During 2009-2010 there have been some public funding support operations but these have generally supported large domestic public investments, such as road infrastructure. Some initiatives may have also indirectly affected private R&D, such as placing an emphasis of starting more ERDF funded projects in 2009. Most of this additional funding was directed to business development and innovation projects.

Innovation–oriented public procurement plays still a quite modest role in Finland. However, the development of public procurement in research and innovation policies is high in the political agenda. The national innovation strategy defines public procurement as one of the key demand driven innovation policy tools.

In 2010 the Ministry of Employment and the Economy has outlined an action plan and policy framework laying down the key elements of a demand and user-driven innovation policy. The action plan running through the years 2010-2013 covers the action points that promote policy implementation in the private and public sectors. The development of public procurement is one of the themes in the action plan. Additionally there is a programme for innovative public procurement funded by Tekes. The main aim is to encourage companies to develop new innovations, renew public services, increase productivity, and to create new markets started in 2009. The aim of the programme is to promote the use of public procurement as a tool for innovation policy as well as to develop good practices.

There have been instruments for supporting new R&D performing firms in Finland for some time. Especially Tekes R&D project funding consisting of grants and loans have had an important role in the policy-mix. This public funding requires that corresponding private funding is invested in R&D projects.

In the past decade there have been several general projects and programmes issued by the successive governments and co-ordinated by the Ministry of Trade and Industry (nowadays Ministry of Employment and the Economy, MEE), such as the Entrepreneurship project 2000-2003, entrepreneurship policy programme 2003-2007. In 2007, the government set up a new “Policy programme for employment, entrepreneurship and work life”, which is designed to ensure commitment to the jointly established strategic goals on the part of the various parties related to these issues. MEE has also set up a Growth Enterprises group within the Innovation Department, which bears responsibility for structuring, developing and implementing the growth enterprise policy, part of the broad-based innovation and industrial policy.

Tekes and the Growth Company Service of EnterpriseFinland provide funding instruments to support SMEs. Finnvera and its subsidiary VeraVenture, Finnish Industry Investment and regional ELY-Centres all have instruments that support

innovative start-ups. Most of these instruments are related to general funding support for companies but in many cases these also target (innovative) start-ups.

Public sector financing support has also focused much on seed-financing and loans. Public financing on equity terms is available from Finnvera plc, Sitra and Tekes. Seed financing is provided, amongst others by Seed Fund Vera Ltd and the Finnish Industry Investment through the Financing Programme for Early Stage Companies. In 2008 Tekes introduced a new funding instrument for young innovative companies. Innovation is one of the key criteria for funding as the firms operations have to be based on an innovative business idea based on specific expertise or new technology. Another new instrument launched by Tekes is the Funding for the purchase of innovation services that aims at promoting business development of innovative SMEs. Yet another instrument is the new business accelerator programme VIGO for fast growing young companies. The programme aims to increase significantly the quality of projects and to make young start-ups more fit for venture capital investments.

When assessing the importance of various routes in stimulating private sector R&D in Finland, stimulating greater R&D investment in R&D performing firms and increasing extramural R&D carried out in cooperation with the public sector are by far the most important routes. Promoting the establishment of new indigenous R&D performing firms has become increasingly important and increasing R&D in the public sector has also been in the agenda for a long time. Attracting R&D performing firms from abroad is also in the discussion and there is some invest-in activity both at the national and local level but investments in these activities is not as substantial as in some other countries.

Generally the research and innovation in businesses is relatively high quality and the selection criteria open and straightforward. The biggest challenge may be that as numerous new instruments have been introduced especially during the past decade by a variety of public actors, the system as a whole has become complex to access and to administer (Rouvinen & Ylä-Anttila, 2009). There seems to be a need to improve the co-ordination between various instruments that promote business R&D investment.

Other polices that affect R&D investment have not changed much recently. The administrative and legal frameworks have been relatively stable. The business environment is also quite open and competitive and e.g. public procurement has increased during recent years. New legislation related to environment and energy has recently supported innovation indirectly by introducing e.g. new tax models favouring low energy solutions and taking environmental aspects into account in public procurement when possible.

2.2.3 Providing qualified human resources

In 2009 the Human resources in science and technology (HRST) as a share of the economically active population in the age group 25-64 was 50.7% in Finland, which was clearly higher than the EU27 average of 40.1 (Eurostat, 2010). When looking at researchers in Finland, 59% of them worked in the private sector, compared with 45% in the EU27 (2007).

Education, research and innovation policies in Finland are closely tied to those affecting research and these different policies are increasingly considered as a whole in the strategic level of policy making. This is clearly evident in the 2008 review by the STPC (Science and Technology Policy Council) where a distinct acronym “ERI” is

widely used to describe the context of Education, Research and Innovation policies forming a broad based entity, also called as a “systemic approach”. In the same strategy report it is also specifically stated that “The education policy is an increasingly important part of this whole whilst research forms a major element of the overall innovation policy”.

The higher education system is well developed, offering a study place for about one third of the age class. The education policy has also been quite responsive to industry needs. The increase in the supply of science and engineering graduates has been an important factor explaining the success of the Finnish innovation system and for example with the rise of ICT industry, some specific policy response was also made in the 1990s with a special programme for increasing ICT education. The results of heavy education investments during the 1990s are also evident in the almost doubling of doctorate degrees received every year.

So far education in Finland is proving to be quite successful as Finnish students are consistently ranked near the top in the OECD Programme for International Student Assessment (PISA) in 2000, 2003, 2006 and 2009. Opportunities for on-the-job learning as well as life-long-learning are good with much education opportunities available as well as several financial instruments available.

At the same time there have been pressures to make adjustments to the education curricula to better cater for the need for new skills. For example, the education curricula in Finland have not traditionally taken into account creativity and team work.

However, creativity, critical thinking, problem solving, teamwork, and communication skills have increasingly been taken into account recently. Mixing various disciplines and new approaches to education is also visible in the institutional arrangements. The most notable example is the recently established Aalto University that tries to find new opportunities by merging a technical university, a business school and a university of industrial arts. Entrepreneurship training has been widely available in the education for a long time, partly because low academic entrepreneurship has been seen as a problem in the general economic policy.

2.3 *Knowledge demand*

This section focuses on structure of knowledge demand drivers and analysis of recent policy changes.

Foreign direct investments in Finland have increased steadily since 1990. Typical for Finland is that outward FDI are significantly bigger than inward FDI. In 2005 the FDI flows abroad were €3,739m when at the same time the FDI inflows were only €1,123m (Invest in Finland, 2010). This is a good indication that at least the bigger Finnish enterprises work actively in the global markets, a fact that needs to be taken into account in research policy.

The share of foreign R&D-investment as a share of private R&D in Finland was 6.5% in 2007 (Eurostat, 2010), which is low in international comparison. Although high level of education and infrastructure are seen as strengths, the geographical location has been a weakness in attracting FDI. However, in the R&D intensive sectors the attractiveness of Finland has remained relatively high compared to FDI as a whole. The share of foreign affiliates in total R&D expenditures by enterprises has also increased substantially during the past few years. The foreign investments for private R&D are mainly concentrated on R&D intensive enterprises and especially the software sector.

The industry needs are very well presented also in the government budget appropriations and outlays for R&D (GBAORD). When looking at the GBAORD for various socio-economic objectives in Finland, industrial production and technologies cover 26% of all budget funding compared with 12% in the EU27 (Eurostat, 2010). Also funding for the development of Agricultural production and technology is above the EU average.

Knowledge demand is facilitated through interactive joint preparation of various R&D programmes and other measures. The most important of these have been the new research calls in the recently (2007-2009) established Strategic Centres of Science, Technology and Innovation (CSTI), which have been jointly prepared by the stakeholders from the private sector, public sector and the higher education sector. Other important instruments are the planning processes of the R&D programmes by Tekes, the Academy of Finland and various ministries. E.g. Tekes has started one new programme “Built Environment 2009–2014” in 2009 and two others are in preparation (renewable energy, lean resource solutions). New programmes are prepared jointly by various stakeholders.

For the coordination of knowledge needs, some policy developments have taken place at the national level. The Ministry of Employment and the Economy (MEE) has recently published an action plan for measures to support demand-led and user-driven innovation policy. The development of public procurement in research and innovation policies is also in the agenda of MEE. Another process is the development of sectoral research to better meet the needs of the society. In autumn 2008 a committee report was completed with several proposals. One of the key proposals was that a clear national sectoral research policy be drawn up for Finland.

The Academy of Finland has also published a new strategy for research programmes. According to the strategy research programmes are an important forum for interaction between disciplines, knowledge providers, users and financiers and that the programmes should also create long term societal impact.

The establishment of CSTIs is complemented by co-ordinating other measures with them. For example in the decision of new graduate schools consideration has also been given to the need for PhDs in the disciplines represented by CSTIs in addition to normal discipline assessments.

2.4 *Knowledge production*

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section focuses on the following dimensions: quality of knowledge production, the exploitability of knowledge creation and policy measures aiming to improve knowledge creation.

2.4.1 Quality and excellence of knowledge production

The private sector is the main knowledge provider in Finland as over 70% of R&D spending is financed by the private sector (Statistics Finland, 2010). The private sector R&D (82% in 2009) is carried out mostly by large companies with over 250 employees (Confederation of Finnish Industries EK, 2008).

The main public research performers in Finland are the 16 universities and twenty government research institutes. In 2009, Finland’s HERD was €1,233m of which 84.6% was spent in universities, 9.7% in polytechnics and 5.7% in university

hospitals (Statistics Finland, 2010). The largest universities are the University of Helsinki (with the research expenditure of €256m in 2009), the Aalto University[2] (€173m), the University of Oulu (€102m) and the University of Turku (€107m). Many Finnish universities are small but there have been several recent mergers. The total research volume of twenty government research institutes was c. €540m in 2009 and the total GOVERD €656m (Statistics Finland, 2010). Among the institutes, the main research performers are the VTT Technical Research Centre of Finland, the METLA Forest Research Institute, the MTT Agrifood Research Finland, the National Institute for Health and Welfare and Finnish Institute of Occupational Health.

The level of research infrastructures is widely considered as mediocre. There has been investment in research infrastructure but the level of investments is behind the leading countries. In 2009 a new roadmap for national research infrastructures was published (Ministry of Education, 2009). The project identified 24 national-level research infrastructures and proposes 20 initiatives to be included in a list of new infrastructures or major upgrades of existing infrastructures. However, there have been difficulties to find funding for the development of research infrastructures in the national budget.

Relative to population, the Finnish number of publications was 1,600 per one million inhabitants in 2005, and, among OECD countries, Finland had the fourth highest number (Lehvo & Nuutinen, 2006). Likewise, Finland had the fourth highest publication number relative to GDP. In the early 2000s, Finnish publications received c. 6 citations per publication which was 13% higher than the OECD average and, in a comparison of the citation impacts in OECD countries, Finland ranked 8th. These figures do not necessarily imply high quality of the Finnish research. Rather, they entail that active publishing is an established practice in Finnish research system and the international visibility of Finnish publications is on a good level. In terms of scientific specialisation, Finnish research is specialized in social sciences and education, medicine disciplines, disciplines related to agriculture, environment, computer science and biology and biochemistry.

Number of patent applications per million inhabitants in 2005 was 246 while the EU27 average was 112 (DG Research, Key Figures 2009). However, between 2000 and 2005 the growth in patent applications was slightly negative (-2.1%).

In general the Finnish research system performs very well although this may be partly explained by the level of inputs. Finland ranks fourth among OECD countries in terms of scientific articles and above average in number of triadic patents per capita (OECD, 2008). However, at the same time there has been a concern that the R&D investments have not yet been converted into new innovations and jobs in the way it was expected.

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

Both Finnish universities and government research institutes have a large degree of autonomy in ensuring the quality of academic research. The Ministry of Education and Culture has performance contracts with the Universities and assesses research activity in terms of the share of competitive funding, international research funding

[2] Aalto University started in 2010 as a merger of three universities. The 2009 figures are sum of the individual university R&D performance. The same applies to University of Turku, to which the School of Economics was merged in 2010

and scientific publication. The development of these factors is followed by the Ministry.

From the point of view of assessing and ensuring academic research quality, the Academy of Finland plays the key role in Finland. The Academy is the main external financier of universities with the share of 25% of total external funding (Statistics Finland, 2010). The funding of the Academy is based on open competition and independent peer review.

The Academy also carries out evaluation of the whole research system of Finland once every three years and research programme evaluation on a regular basis. Occasionally, the Academy also evaluates separate disciplines or research fields. Concerning the quality of research, the system level assessment mainly focuses on the publication outputs of the Finnish research system. The research programme evaluations that are produced one to two years after programme completion focus on the immediate outputs of research funded. During the discipline evaluations a foreign expert panel assesses the discipline in question as well as its subfields from the point of view of the level of international research. The time span under assessment may surpass half a decade and several dozens of research units may be evaluated concurrently.

All the Academy of Finland Research Programmes as well as Tekes Programmes are evaluated. The research programmes are evaluated by an independent academic expert group (peer review). Tekes programmes are typically evaluated by external experts but they are not based on peer review.

Concerning openness to new scientific opportunities and interdisciplinary endeavours, the importance of national programmes for Finnish Centres of Excellence (CoE) in research is high. CoEs are given means to take risks and even venture into new research areas by extra funding provided by the CoE Programmes, given for a period of six years. A CoE consists of one or more research teams sharing a common set of research objectives and a joint management. The research teams may operate both at universities and research institutes, also in cooperation with business. CoEs are selected, funded and evaluated by the Academy. Additional funds are provided by Tekes, host organisations and business companies.

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Knowledge circulation within the Finnish research system is relatively strong in international comparison and the interaction between public and private research has not been identified as a major issue.

In 2008, the percentage of HERD financed by the Finnish industry was 7.2%. It was 0.9% higher than the estimated EU27 average (Eurostat, 2010). In the same year, the percentage of GOVERD financed by industry was 14.2%, which was much higher than the estimated EU27 average of 8.7%. These figures imply that university-business R&D linkages and public research institute-business linkages are above average. The high percentage of GOVERD financed by industry is largely due to the business collaboration of one research institute, VTT. In 2006, the share of external funding for VTT was 66%, which was likewise 66% of total external funding received by the Finnish research institutes. Almost half (48%) of the external funding of VTT was provided by domestic or foreign business (VTT, 2009). For the majority of other research institutes, the share of external funding is notably smaller.

Since the beginning of the 1980s, the Tekes programmes have provided important venues for knowledge circulation between the universities, research institutes and business sector in Finland. The technology programmes are established in strategically important R&D areas that Tekes has identified jointly with the business sector and researcher community. Half of the Tekes funding is channelled through these programmes. Since 1993, special programmes have been dedicated to supporting commercialisation of research and academic spin-offs. These TULI programmes aim at supporting commercialisation of publicly funded research results, developing commercialisation services in universities, polytechnics and research institutes, promoting cooperation between research organisations and companies, as well as creating viable businesses through start-ups, spin-offs and technology transfer. Projects funded by the programme are run by 45 universities, polytechnics and research institutes. In 2008-2014, the programme budget is approximately €50m.

The recently formed CSTI:s develop and apply new methods for cooperation, co-creation and interaction between the universities, PROs and enterprises, carrying out research that has been jointly defined in the strategic research agenda of each Centre. The concept has proved to be quite popular at the initial stages of operation. However, there may be a threat the main receivers of the value added and knowledge circulation are the Centres' shareholders that mostly include larger companies within existing strong industries and in this way decrease the relative amount of collaborative research funding for SMEs and emerging sectors.

According to a recent study (Kankaala et al., 2007), the research services and technology transfer organisations (TTOs) of Finnish universities - including also VTT - have a staff of two to three employees whose tasks are exclusively concerned with research commercialisation. The study notifies that many TTOs of European universities report having a similar staff of ten. International comparisons are difficult to make, however, since job descriptions of the staff and interpretation of survey results vary from country to country. However, both the work force and competence of the Finnish TTOs have increased during the recent decade. TTOs are quite capable of counselling university staff about IPR issues and helping them to find suitable partners or service providers on a regional level. Concerning national or international collaboration, the Finnish TTOs have a limited amount of collaborative relationships and some TTOs may even lack international contacts.

As mentioned earlier, the public sector employs most of the Finnish PhDs, which also sets the limits for researcher mobility between academia and industry. At the Finnish universities, academia-business collaboration is often intensified by founding professorships in close collaboration with the business sector. Private enterprises participate in defining the research area of a professorship and provide its total or partial funding. In 2005, there were 189 externally funded professorships at the

Finnish universities (Vilhula et al., 2006). The share of business sector in the external funding of professorships was one third of external funding. Many of the externally funded professorships are located outside the university cities, and therefore their importance for local business may be considerable on a regional level.

The collaboration between PROs and universities is also relatively common in research projects. Despite this there have been many discussions to extend the collaboration between the universities and PROs. The aim of the increasing collaboration is not only to increase knowledge circulation through joint research activities but also more efficient use of shared knowledge infrastructures (labs, libraries etc.) as well as better utilisation of international collaboration (Ministry of Education, 2008). It has also been argued that the division of labour between the PROs and universities has left gaps in the research and that more collaboration and joint structures in the "interfaces" are needed to better meet the needs of the society (Sektoritutkimuksen, 2006).

Finally, the university reform (and especially the recent Universities Act) aims at developing the university management and financing system to support interaction between university, firms and the society. In addition to a broader funding base the new more autonomous position enable universities to collaborate with other parties in new ways. The new legislation requires universities to have own capital. As a result 2010 the universities collected funds from the private and non profit sectors. The government has promised to put 2.5 times the collected funds to the basic capital of the universities. This process may also indirectly affect knowledge circulation as the private sector becomes more interested in capitalising academic knowledge.

2.5.2 Cross-border knowledge circulation

Improving access to knowledge has also been facilitated by increasing international collaboration in research programmes. Recent examples include the international BONUS programme which was launched at the beginning of 2009 and funded by the countries around the Baltic Sea (Academy of Finland is the Finnish partner) as well as by the EU Commission. Another example include the Academy of Finland SALVE research programme (national health), which is carried out in collaboration with Canada, the UK and Norway.

Nordic collaboration continues to facilitate access to international knowledge. Recent developments in the research cooperation in the Nordic countries include the graduate schools and Centre of Excellence Programmes. The programmes are funded by the Nordic Research Councils, the Nordic Council of Ministers and NordForsk. This Nordic support supplements the basic funding of the Nordic Centres of Excellence (NCoEs), which comes from national sources, among them the Academy of Finland. The Finnish participation has been active also in other instruments such as the ERA-NET schemes.

The Finnish researcher mobility has decreased steadily throughout the 2000s. The students' interest to undertake studies abroad has also declined. One reason behind this trend may have been the increasing competitiveness of the Finnish research system. On the other hand the forms of international research activities have changed. Short-term visits and continuous cooperation through internet have reduced longer-term researcher mobility.

In the private sector the high level of internationalisation of Finnish enterprises contributes to knowledge circulation.

2.5.3 Main societal challenges

There are not that many inter-sectoral initiatives that address the main societal challenges. Although many societal challenges are addressed in the research programmes, these tend to be inside academia. Tekes programmes and the Strategic Centres of Science, Technology and Innovation prefer inter-sectoral cooperation but these programmes are focused on the innovation in the private sector and only touch societal challenges indirectly.

Especially the research programmes by the Academy of Finland aim at addressing major societal challenges In addition various ministries have their own research programmes, which address the issues that are important to that specific section.

Many of the bilateral research programmes as well as Nordic activities tackle societal (as well as environmental) environmental challenges. The state of the Baltic Sea has been an important topic as well as health.

Many of these problems are shared challenges also addressed at the European level (aging, climate change). However, much of the research and research funding has been inspired by the national context and policy debate.

According to the Finnish Science Barometer 2010 Finns have a high level of confidence in science in general. However, at the same time, more than half of Finns think that researchers do not understand or cannot respond to the complex problems facing society today (Eurobarometer, 2010); this figure is well above the EU average and describes the attitude that although Finns are very interested in science, they are also critical in their assessments.

2.6 *Overall assessment*

Table 1: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• CSTI and University reform mobilising private sector research funding; • Strong political will to for further development of the knowledge driven economy.	• The economic situation may impact research and innovation budgets in the private sector; • University reform may have negative impact on research funding in the short term.
Knowledge demand	• Strong political pressure to increase the societal impact of R&D investments; • Focus on demand and user orientation in the policy; • Reform in the public research institute system.	• Large number of non-innovative firms; • Research programmes may be too academic and policy programmes too fragmented to be able to address societal problems.
Knowledge production	• Development of researchers' education; • Development of a researcher career system; • Development of R&D infrastructures; • Relative increase in the academic research funding.	• Creating well-resourced top-level actors may affect negatively to wider knowledge base; • Further support to collaborative and thematic research may harm the state of basic research.

Domain	Main policy opportunities	Main policy-related risks
Knowledge circulation	• Increasing mobility; • Participation in collaborative efforts may help to address main societal problems; • Increasing cross-sectoral mobility e.g., by supporting PhD employment in the private sector; • Societal challenges addressed by Nordic country collaborations.	• division of labour between the PROs and universities; • CSTIs may limit knowledge circulation to those who are not shareholders and partners.

Table 2: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Economic crisis affecting private sector R&D	The new policy initiative and support for user and customer oriented innovations may increase private sector R&D
Economic crisis may affect negatively to plans for private sector investments in university research	The university reform may provide universities new ways to attract R&D funding
Poor R&D investment capacity outside the main city regions	A substantial share of Structural Funds directed towards innovation promotion and knowledge infrastructures The support for R&D in more peripheral regions may also lead to fragmentation of R&D resources
Innovation-oriented public procurement plays still a quite small role	Recent policy initiatives for promoting demand-led innovation policy may increase the use of public procurement as a tool to facilitate R&D
The share of foreign R&D-investment as a share of private R&D is low	High level knowledge infrastructure and well educated workforce provides good opportunities for attracting R&D investments to Finland
Weak investments to basic research in comparison to applied research and development	Balancing funding for basic research, applied research and development may intensify the activities of the R&D performers

3 Interactions between national policies and the European Research Area

3.1 Towards a European labour market for researchers

The Communication Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas:

- Open recruitment and portability of grants;
- Meeting the social security and supplementary pension needs of mobile researchers;
- Providing attractive employment and working conditions;
- Enhancing the training, skills and experience of researchers

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped

under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced 'brain circulation', with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the 'brain drain' rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

In 2008, there were 40,879 researchers (FTE) in Finland (OECD, 2008). The number of researchers as % of labour force was 1.62 in 2008 (Source: Eurostat). This figure was more than twice as much as the estimated EU27 average of 0.68. Between 2004 and 2008 the number of researchers remained quite constant, but the relative share of total employment decreased slightly. In 2009 the number of doctoral students (FTE) was 20,502, which was 18% of all university students. In the period of 2000-2009, the total amount of doctoral degrees increased from 1,156 to 1,642 (42%) (KOTA database, 2010). With regard to science and engineering, the increase of doctoral degrees was 65%.

The large number of researchers and doctoral degrees is partly explained by the Finnish graduate school system. In 2007, the system comprised 119 graduate schools. Altogether over 4,000 graduate students are working full-time on their doctoral dissertations in graduate schools (Research.fi, 2010). The goal is that the students complete their doctoral dissertations in four years. All of Finland's 20 universities house one or more graduate schools, often in collaboration with other universities or research institutes.

Due to the demographic changes the amount of young people is decreasing. While the relative share of people studying at HEIs remains more or less the same, the absolute numbers drop. Thus having a sufficient number of qualified human resources will be one of the key challenges in Finland. There is an increasing need to attract foreign researchers and other experts to the country in order to maintain the high level of R&D and innovation activity.

In international comparison the inwards mobility and immigration of foreign professionals has been relatively low in Finland. In 2006, there were 1,737 foreign doctoral students in Finland with an annual increase of 5% (Eurostat, 2010). The share of foreign students was rather low in Finland, only 8% compared with 225 in the EU27.

In the same way as with researchers, the students' interest to undertake studies abroad (outflow) has declined. The visits of university teachers and researchers abroad have been in decline (except the technical fields) since the beginning of 2000s. The outflow of domestic teachers and researchers (long visits over 1 month) was 699 (741 in 2000). The inflow of foreign researchers and teachers to Finnish universities was 1,172 people (1,153 in 2000) in 2009. (Source: KOTA-database, 2010).

Several weaknesses in the Finnish research system for attracting researchers from abroad have been identified (Noki & Kovanen, 2008). The career opportunities for researchers have been limited with few permanent positions and therefore a dependence on short term funding. The remuneration level has been lower than in many other European countries. In some studies it has been also noted that often the

families and especially spouses have had difficulties in getting a job (at least partly due to language issues).

The universities have increased cooperation with the private sector and with other stakeholders and at the same time the share of competitive research funding is quite substantial. As result the number of part-time and externally funded personnel is quite big.

In the latest guidelines for 2011-2015, RIC state that the recruitment practices of higher education institutions and research institutes must be made more attractive to international students, researchers and experts. Based on these guidelines, internationalisation of the research system will be one of the key objectives for the education and research policy in the coming years.

3.1.2 Providing attractive employment and working conditions

The gross salary level of researchers (PPS) 33,084 was in the higher education sector and 37,173 in the government sector in 2006 (CARSA, 2007). Compared to most of the EU27 countries this is not particularly competitive. When looking at salaries based on experience, young researchers (0-4 years of experience, all sectors, PPS) have an average salary of 22,825 in Finland, which is above the EU25 average of 20,374. In the comparison of 30 EU and associated countries Finland ranks 14th. With experienced researchers (over 15 years of experience) the average salary was 48,992, which is below the EU average of 55,213 and Finland ranks 19th among 30 countries. Compared with the GDP and general annual earning it can be noted that researchers' salaries are not very competitive.

The administration has also proved to be a challenge. Basically there are rules and practices to help foreign researchers to work in Finland but the information is fragmented and there has not been any dedicated instruments to facilitate the immigration of foreign experts (except some short term tax deductions). The private sector has also not been very keen to recruit foreign researchers except for the few international companies. The administrative limitations at the universities have also made it more difficult to compete internationally (e.g. salaries). The administrative reform at the universities starting from 2010 may help to address these issues.

The recent university reform (2010) has given universities more autonomy to determine salary levels. The basic salary level is negotiated as part of the collective bargaining system. The individual salaries are determined by assessment of the job description and a personal share, which are added to the basic salary. This provides some flexibility in the salaries. Moreover, some specific arrangements are possible especially with foreign researchers.

The Academy of Finland and the Finnish Council of University Rectors (representing all universities) have signed the Charter for Researchers.

Generally there are not any regulations that may hinder the career progression of female researchers. The project funding typically allows researchers to take a maternal leave and continue in the project after that. It is also typical to receive an extension of the contract after the maternity leave. In practice it has been noticed that the management systems and working culture at the universities may hinder equal opportunities. In practice this is seen as slower career development and that a majority of professors are men even though almost half (46% in 2007) of researchers in the higher education sector are female. The small number of females in the

university management has also drawn the attention of the Ombudsman for Equality in Finland and in 2011 the equality in universities is under specific monitoring.

The Act on Equality necessitates all organisations with more than 30 employees to make an equality plan and promote equal rights and opportunities. As a result all universities have equality plans. Many universities have also a Committee of Equal Opportunities.

The barriers between sectors are generally quite low and it is not rare especially in the engineering sector to move from academia to industry and vice-versa. However, brain circulation from other sectors to academia is not very typical. The competition over permanent academic positions is hard and most of the researchers work with external project funding. The salaries in the university sector are also not very competitive, although top senior researchers may be given a higher salary. Nevertheless, the number of professors and researchers coming from abroad has increased lately.

3.1.3 Open recruitment and portability of grants

The academic positions are typically open. Non-nationals are eligible to apply for permanent research positions. Recruitment and competition procedures are quite open. In practice some extra commitment is still required. For example the Academy of Finland research posts are open for foreign applicants but in this case the host university must agree to provide the research infrastructure for the applicant.

One positive feature in Finland is that foreign academics (especially researchers) are not expected to be fluent in Finnish as English is widely spoken. This offers more opportunities for foreign mobile researchers to find work opportunities. In teaching this situation is often different as the permanent teaching staff (including Professors) is expected to be able to speak Finnish (and Swedish).

There is not any specific system in place for recognizing professional qualifications of foreign academic degrees and hence support international applications. These are typically assessed case by case.

Grants from Academy of Finland and Tekes are not typically portable. Grants may support temporary visits in a foreign institution but typically most of the work is expected to be carried out in the host institution.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

Finland has implemented all the relevant directives regarding cross-border provision of financial and insurance services. There are tax incentives for participating in voluntary supplementary pension schemes. Researchers' contracts are subject to subject to social and health taxes if they are paid salaries. Individual grants are exempt from taxes. There is not any specific scientific visa system in Finland. All EU and EEA researchers are free to move to Finland. Researchers from other countries need a regular work permit if they stay in Finland for more than 3 months. However, scientists are also able to get a specific work permit for a maximum of 1 year when they have an invitation from the host institution. Highly educated scientific workforce is also exempt from the regular needs assessment that normal work permit applications are subject to.

3.1.5 Enhancing the training, skills and experience of European researchers

The opening up of universities has taken place to a great extent through internationalisation of education. The 2005 degree reform gave the universities greater potential for international co-operation. Universities have launched numerous international Master's programmes and several Erasmus and Erasmus Mundus programmes, while they have also designed provision at Master's and doctoral level in particular to be more suitable for international students (Ministry of Education, 2006).

Finland has been active in the Bologna process and collaboration with other European universities has intensified through various networks that have facilitated the development of dual degrees and research collaboration. Finnish higher education institutes have been active at participating in various development schemes within ERA and there has been significant progress in this perspective. The existing of various EU instruments that support networking has had a significant role in the opening up of universities.

International experience is generally regarded very important but not necessary for the development of the research career.

3.2 *Research infrastructures*

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

Finland has a long tradition of utilising the infrastructures and experimental arrangements of other countries, since Finland has not had the funds for major investments in research infrastructures (National-level Research infrastructures, 2009). With the national infrastructure policy the situation has been less than satisfactory as Finland has not had any centralised research infrastructure policy but the establishment and development of research infrastructures has been decentralised to various organisations such as ministries, universities and research institutes.

Following the recommendation given in the Science and Technology Policy Council's report of 2006, in 2009 a national roadmap for important national research infrastructures was published with proposals for organising a national research

infrastructure policy in the future. The steering committee identified 24 projects and accepted 20 proposals for significant national research infrastructures. The European dimension is integrated in the roadmap as thirteen of the selected projects are associated with ESFRI roadmap projects.

With the expressed need for a more centralised research infrastructure policy a need for additional funding for the development of research infrastructures has also been addressed. According to estimates Finland spends approximately €130m annually of public funding for the upkeep of the national research infrastructures and around €30m for the membership fees in international research infrastructures. However, it has been a quite difficult road to increase the amount of R&D funding dedicated to research infrastructures in the scale that the plan requires.

It has been also noticed in Finland that research infrastructure policy has to be an integral part of national research and innovation policy and in this way the development of research infrastructures will probably be a more central part of the policy mix. Based on the recent developments, Finland will also seek active collaboration within the ERA in the development and use of European research infrastructures and aims to coordinate the related national activities. The planning of the development of the national research infrastructures is aimed to accommodate to the European developments.

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

For coordinating the development of research infrastructures Finland is actively participating in the operations European Strategy Forum on Research Infrastructures (ESFRI) for steering the development of research infrastructures in Europe. The Education and Research 2007-2012 plan states that Finland will also actively participate in the planning and implementation of the projects initiated by ESFRI.

In February 2009, a new roadmap for national research infrastructures was published. The project identified 24 national-level research infrastructures and proposes 20 initiatives to be included in a list of new infrastructures or major upgrades of existing infrastructures. Of these initiatives 13 are related to European level ESFRI[3] roadmap. The roadmap also makes recommendations for securing the financing of these infrastructures.

In February 2010 the Academy of Finland decided to invest €2m to two nationally significant research infrastructure projects: Greenhouse gases Observation System (ICOS, Integrated Carbon Observing System) and life sciences projects as a whole (EATRIS, BBMRI and ELIXIR). These projects are also in the ESFRI Roadmap

3.3 *Strengthening research institutions*

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The Universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system,

[3] European Strategy Forum on Research Infrastructures, a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach

assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models.

3.3.1 Quality of National Higher Education System

The Finnish higher education system comprises 16 universities and 25 polytechnics under the auspices of the Ministry of Education and Culture. Finland has an exceptionally large network of universities and polytechnics. In 2008, there were around 176,000 degree students in 20 universities and 134,000 students in 28 polytechnics (Ministry of Education, 2010). The higher education system is seen as an essential element of Finland's national and regional innovation systems. The number of universities and polytechnics has been reduced as a result of structural reforms during the past few years. Recently starting from 2010 three mergers reduced the number of universities.

The university system has been under reform recently. The key reforms have been the structural reform to reorganise higher education to be more efficient and the university reform to enlarge the autonomy of universities and make them autonomous legal entities. In this way the aim of the reform is to ensure that the universities will be better placed to make the best use of their income from capital and to better supplement their basic financing with donations and business activities. Under the new Act, the universities are independent corporations under public law or foundations under private law.

What is typical for HERD in Finland is the big share of competitive public funding. General university funds only comprise 45% of HERD, which is below the EU average. At the same time other public funding (35%) together with funding from the private sector, non profit sector and abroad is quite big. Private enterprises finance a quite significant amount of HERD compared to many other countries although the absolute share is not that big (7%). The share of foreign funding (7%) is also relatively high.

Finnish universities in general do not fare that well in international comparisons. The only Finnish university ranked in top-100 of the Shanghai ranking is the University of Helsinki. Most Finnish universities rank average in the international university rankings. This indicates that the Finnish universities have a good basic quality of research but relative few fields of international excellence.

3.3.2 Academic autonomy

Finnish universities have traditionally enjoyed a great degree of academic autonomy. The universities and research group have had a relative large autonomy in designing research activities.

The university reform has further increased autonomy for universities, which have much higher financial freedom compared to the previous situation. Governance and authority relationships have changed both between universities and the government, and within universities. The increased autonomy provided by the new legal status will grant the universities the right to decide how their assets are managed and how they use capital income and decide independently their business activities. This highlights the importance of strategic management.

Moreover the university reform may also have brought some negative effects to academic autonomy in terms of research. The new legislation requires universities to have a majority of external board members, which can have adverse affect university autonomy. Moreover universities are required to provide strategies, which may

somewhat direct the use of block funding at the universities and in this way decrease academic autonomy.

3.3.3 Academic funding

The state funding to universities follows the same principles for all universities (polytechnics follow a different funding model). Starting from 2010 the universities in Finland follow the following structure for block funding:

- Basic funding based on the breadth and impact of activities (75%)
  - Education 55% (extent of operations 85%, quality and impact 15%)
  - Research 45% (extent of operations 75%, quality and impact 25%)
- Other objectives in Education and Research policy
  - Education and discipline structure (75%)
  - Strategic development (25%)

75% of funding is allocated on the basis of calculations concerning the core elements and 25% based on the university policy and strategy considerations. The share of block funding that depends on the quality and impact assessment is mostly based on the number of degrees and number of publications.

When looking the broader situation in the funding structure of the universities it can be seen that the share of external funding is quite big. In 2009 budgetary funding encompassed 64% of the university budget. For the research activities the budgetary funding covered 52%. In research activities related to doctoral education the share of budgetary funding was 66% and in other research 44%.

The academic autonomy is somewhat challenged by the structure of research funding. The share of thematic competitive funding is relatively high in Finland compared with block funding or non-oriented research funding. Collaborative research funding (mainly through Tekes) and industry funding also forms a considerable part of external research funding. The same tendency can be seen in the growing number of external funded research professorships.

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the tran-snational dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

As in most European countries, the Finnish patent law and other intellectual property rights regulations support appropriating knowledge returns. The development of regulation is continuous. For instance, a government act on university inventions was passed by Parliament in 2006. The purpose of the new Act was to facilitate the practical application of inventions made at universities by clarifying issues of property rights and revenues.

According to a recent study (Kankaala et al., 2007), the research services and technology transfer organisations (TTOs) of Finnish universities - including also VTT - have a staff of two to three employees whose tasks are exclusively concerned with research commercialisation. The study notifies that many TTOs of European universities report having a staff of ten. International comparisons are difficult to make, however, since job descriptions of the staff and interpretation of survey results vary from country to country. For instance, the TTO of Helsinki School of Technology has a staff of 30 while only a few of them are exclusively devoted to handling research commercialisation tasks. During this decade, both the work force and competence of the Finnish TTOs have increased and in 2006 there were 19 university TTOs with the total of 107 people working in them (15 TTOs and 41-46 people in 2001) (Kansallinen yliopistojen, 2007). Moreover, several polytechnics have also recently established their own TTOs. The more recent numbers collected during the ERAWATCH Observatory of Universities project in 2009 gave the impression of further slight growth in the TTO resources. According to this study only two universities (TTK, now part of the Aalto University, and University of Helsinki) had a mid-sized staff of over 30.

TTOs are quite capable of counselling university staff about IPR issues and helping them to find suitable partners or service providers on a regional level. Concerning national or international collaboration, the Finnish TTOs have a limited amount of collaborative relationships and some TTOs may even lack international contacts.

According to the study mentioned above, Finnish TTOs received 40 invention announcements from university staff on average in 2005. At the same time, 7 university inventions received a patent granted, 5 spin-out companies were founded, and the license revenue of the universities was €236,000 on average per university. In comparison with British TTOs, the Finnish figures were similar with the exception of the license revenue that was twice as large in the UK than in Finland. Even though spin-out companies are actively founded in Finland, their economic performance has proven somewhat disappointing. Among 171 spin-out companies founded in 2000-2005, only one company had an annual turnover over €2m and only 15 companies had succeeded in increasing turnover over €400,000 by 2005.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Involvement of private sectors in the governance bodies of HEIs and PROs

The private sector is increasingly involved in the governance of HEIs. According to the new Universities Act, external stakeholders will be afforded a much greater role in the university governance and a great minority of board members come from the private sector.

The private sector has a substantial representation of the PROs. In the biggest PRO in Finland, VTT, a majority of the board members are from the private sector. In other

PROs the role of the private sector is smaller but nevertheless a notable one. Typical for the boards is that representatives of various stakeholders are present. These include universities, the responsible ministry, companies and key interest groups or associations relevant to the field.

Inter-sectoral mobility

Inter-sectoral mobility faces relatively few formal constraints between business and academia. In practice it has been noticed in the past that the industry does not always appreciate researchers' education as much as expected and PhDs are mostly employed by the public and HEI sectors. In 2006, the Academy of Finland founded a programme supporting PhD mobility between the academia and private sector. A researcher could apply for a project that is accomplished outside home organisation by moving from academia to a firm or vice versa. When the programme was launched, it did not attract researchers' attention and half of the funding remained unused. This was an abnormal situation in the Finnish research funding system in which hard competition among applicants is a general rule. The instrument is not used anymore. However, some other projects to facilitate the employment of PhDs to the private sector have since been initiated, such as "Tohtoreita yrityksiin (Doctors to Enterprises)", a project initiated by the Culminatum Innovation in the Helsinki region in 2008.

Nevertheless, inter-sectoral mobility is increasingly typical in Finland.

Promoting research institutions - SME interactions

There are various incubators activities in Finland. These incubators have been mainly maintained by various local and regional Science parks and Technology Centres. As opposed to some other countries the incubators have gathered their financing from various sources on project basis and there has not been a centralised funding model for the incubators although the regional ELY-centres are a key supporter of incubator activities. Some incubators are also co-financed by the European Social Fund.

In the regional ERDF-programmes one key policy line is to support for cooperation and networking of innovation actors and SMEs, the improvement of the availability and efficiency of innovation services, the development of business incubators, the development of special knowledge in areas, the development of activities that support R&D, the development of electronic advisory and customer service systems and the utilisation of applied research.

The main support for R&D activities in Finnish SMEs is provided via Tekes funding. In 2000-2007, more than 50% of Tekes funding was allocated to SMEs (Tekes, 2008). In 2007, Tekes funding covered one third of R&D expenditures of Finnish firms with less than 50 employees. Although much of the support goes directly to the support of in-house R&D it is also typical that the support goes for collaborative projects between universities and SMEs or that an SME buys research services from HEIs or PROs.

EU cohesion policy

The second main line of ERDF is dedicated for promoting innovation and networking, and strengthening competence structures. According to the Finnish NRP 2008-2010 more ERDF action plan appropriations than in the past are allocated to supporting key business activity and clusters of expertise in terms of regional development and competitiveness as well as to projects promoting regionally more comprehensive

expertise, innovation and networking. The key aim of the plans is to promote business and enterprise as well as innovation, networking and expertise structures. A preliminary estimate indicates that at least 80 per cent of the available ERDF funding will be directed to measures in accordance with these priorities.

Spin-offs

Tekes and the Finnish Technology Park Association have had a dedicated TULI-programme for supporting the commercialisation of research since 1993. These TULI programmes aim at supporting commercialisation of publicly funded research results, developing commercialisation services in universities, polytechnics and research institutes, promoting cooperation between research organisations and companies, as well as creating viable businesses through start-ups, spin-offs and technology transfer. Projects funded by the programme are run by 40 universities, polytechnics and research institutes. In the 2008-2013 period, the programme budget is approximately €50m. In 2009 a total of 1600 project ideas were evaluated and 748 were granted funding for further development. A total of 80 licensing and technology sales were reported with the revenue of €2m to the universities and research institutes.

The programme has also been quite successful in creating spin-offs. In the previous four year term from 2002-2005 TULI contributed to the creation of 112 spin-off companies. There is no information on their later success rate available.

3.5 *Cooperation, coordination and opening up national research programmes within ERA*

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of coordination, synergies, efficiency and simplification. The policy fragmentation at EU and national level and between EU and national policies can hinder the build of critical masses of research excellence, leads to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

Much of the joint R&D activity in Finland is carried out through EU joint initiatives and participation in the activities of the European research organisations. Finland participates actively in many European research organisations such as the European Space Agency (ESA), the European Organisation for Astronomical Research in the Southern Hemisphere (ESO), European Organisation for Nuclear Research (CERN), European Molecular Biology Laboratory (EMBL), and the European Molecular Biology Conference (EMBC).

Finland has been relatively active in participating in the Framework programmes. In the FP6, Finland was the 5th most active country at received funding in proportion to population, and on the number of participations/population Finland was 8th.

The Finnish participation for FP7 has also been active. According to the FP7 Finnish annual report 2009, until October 2009 there have been a total of 4,118 Finnish

participants in FP7 calls, of which 960 was among the accepted. The tentative amount of funding for the Finnish participants was €365m. These numbers indicate that the Finnish participation has further increased from FP6.

Finland has actively participated in the EUREKA and COST initiatives. The importance of EUREKA as a framework for international R&D is particularly great in the ICT sector. However, the relative importance of EUREKA and COST has decreased during the recent years, as R&D cooperation is increasingly carried out globally.

3.5.2 Bi- and multilateral agreements with other ERA countries

Outside the large European multilateral initiatives a broad international cooperation schemes, Finland is especially active in the Nordic research co-operation. Research cooperation with areas adjacent to Finland includes Nordic cooperation, which is expanding to the Baltic States, arctic research and cooperation with Russia.

Finland as well as other Nordic countries has been very active in promoting bilateral cooperation involving Nordic research institutions. There is also a specific organisation NordForsk, established in 2005. It is a Nordic research board operating under the Nordic Council of Ministers for Education and Research and responsible for Nordic collaboration in research and research training. The objective of NordForsk is to support co-operation in the fields of scientific research and science policy. Nordic co-operation covers several different instruments.

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

Finland is very active in both participating and coordinating European ERA-Net projects. This has been especially the responsibility of the Academy of Finland. At the end of 2009 the Academy was a coordinator for two ERA-Net projects and involved as a partner in 17 others. Also Tekes has been involved actively in ERA-Nets (11 in 2009).

Currently there is not information available of the involvement of MS in Joint Programming (JP) Initiatives. However, the need to be active in this regard has been noticed in the Academy of Finland.

In addition, other cooperative frameworks for implementing cooperation at the European level (e.g. Joint Technology Initiatives, bilateral and multilateral research programmes) are being initiated, which is likely to have an impact on the importance of EUREKA and COST for the internationalisation of the Finnish research system. Finnish companies are also active in European initiatives such as European Technology Platforms (ETP's).

Finland is also involved in some of the Art. 185 projects (mainly through Tekes). Some of the key activities are EUROSTARS, AAL (Ambient assisted living) and BONUS (Joint Baltic Sea Research Programme)

3.5.4 Opening up of national R&D programmes

In 2009, six out of the ten Academy of Finland Research Programmes were open to foreign participation and all recent programmes that do not exclusively target national dimension will have international dimension. The international dimension typically covers bilateral agreements with foreign research funding organisations or co-ordination with ERA-NETs.

Finland has also participated in some of the Art. 185 programmes such as BONUS and EUROSTARS.

The Centre of Excellence Programmes (CoE), which finance top level research units in their respective fields, also have an international dimension embedded in the operations. Top level research is seen as an exercise of international collaboration that "requires both national and international funding" Under these agreements, funding can be provided to support cooperation among CoEs for purposes of research cooperation, researcher mobility and training, and the organisation of joint seminars and scientific meetings.

Tekes supports international co-operation but only finances the Finnish counterparts. However, to promote co-operation, Tekes has established cooperation agreements with international funding agencies all over the world to exchange information and launch joint calls for proposals or joint R&D programmes.

3.6 *International science and technology cooperation*

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Cooperation to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

The national approach for cooperation with third countries mainly takes place in the form of bilateral co-operation and agreements that are used with countries outside ERA.

In addition to European and Nordic collaborative activities there are also many smaller joint R&D activities based on bilateral collaboration agreements. The Academy of Finland has bilateral agreements with 16 countries. Although most of the agreements deal with mobility, there is also joint research activity. In the international strategy of the Academy it has also been stated that the Academy will create strategic partnerships with foreign funding organisations in order to create opportunities for researchers to engage in joint projects as well as enhance the impact of international activities in general.

Tekes has also collaborative partnerships with several countries, such as the USA, Japan, China and European countries. Recently Tekes has built up partnerships with Canada, Israel, Singapore and Korea. In 2006, Tekes launched cooperation with Canadian Institutes of Health Research (CIHR). The cooperation concerns the cardiac and circulatory effects of diabetes. During the same year Tekes and the Korea Institute of Industrial Technology Evaluation and Planning (ITEP) signed an agreement to increase research and technology cooperation between Finland and Korea. Tekes is also involved in FIT (Finnish Israeli Technology), a joint programme between Finland and Israel for market-oriented R&D, supporting development of technologies and applications in different technology areas.

3.6.2 Mobility schemes for researchers from third countries

The Academy of Finland supports mobility through various instruments such as bilateral agreements as well as through project and programme funding as well as through funding supporting researcher training. Some of the main instruments to support the international mobility of researchers are the grants based on bilateral agreements with international organisations. The national bilateral agreements and other national instruments concentrate more on mobility activities with non-EU countries although bilateral agreements with many EU countries also exist. Mobility is typically only one dimension of the bilateral agreements

4 Conclusions

4.1 *Effectiveness of the knowledge triangle*

The approach to knowledge triangle policy approach is well established in Finland. The latest 2008 report by the Science and Technology Policy Council regularly talks about the "education, research and innovation (ERI) policy" as one entity, consisting of various interconnected factors and activities.

The following table gives a short assessment of the effectiveness of policies in the knowledge triangle:

Table 3: Effectiveness of knowledge triangle policies

	Recent policy changes	**Assessment of strengths and weaknesses**
Research policy	• New University Act into force in 2010 extends the autonomy of universities by giving them an independent legal personality, either as public corporations or as foundations. At the same time, the universities' management and decision-making system will be reformed; • Co-ordination and steering of sectoral research to better support policy decision making; • The establishment of Strategic Centres for Science, Technology and Innovation (CSTI) addressing facilitating knowledge circulation between university, PRO and business sectors.	• High public and private R&D expenditure; • Funding to basic research and research infrastructures has grown more slowly than funding to applied research and innovation.
Innovation policy	• Renewal in the VTT organisation to improve management as well as R&D performance; • National innovation Strategy was published in October 2008. In October 2009 a review of key activities for the implementation of the strategy was provided together by the Ministry of Employment and the Economy (innovation) and the Ministry of Education (research and education); • Improving the management of university inventions; • Initiatives to increase demand led component in innovation policy; • Increasing role of the service sector.	• Strong national focus on renewing the innovation system and innovation policy instruments based on the national innovation strategy; • The major recent instrument the SHOK is connecting public and private research and innovation; • Current instruments such as the SHOK initiative are primarily targeting existing industries.

	Recent policy changes	Assessment of strengths and weaknesses
Education policy	• University reform; • Structural reform of the higher education system; • Reform of the continuing education system.	• Good performance of the education sector; • Good education levels provided by mass high education.
Other policies	• Tendency to move towards environment and energy friendly tax solutions may support research and innovation.	

4.2 *ERA 2020 objectives - a summary*

The following table gives a short assessment of the effectiveness of policies in the knowledge triangle:

Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• New internationalisation strategy for higher education in 2009. The aim is that the higher education institutions will offer high-standard education in foreign languages and increase the share of foreign teachers, researchers and degree students; • Plans to renew the education legislation to better support both export of education and to attract international students in Finland. A strategy has been recently devised for the exportation of Finnish education.	• Strengths exist at the overall high level of basic education and large existing HRST; • Weak ability to attract talented domestic and foreign students and an unattractive research career system; • Research career not very attractive in terms of salaries.
2	Increase public support for research	• Public budget for R&D increased in nominal value from 2008 to 2009 5.7% and 8.2% from 2009 to 2010; this did not meet the recommendations from 2008. In 2010 there was a significant increase in the public R&D investment, although the share of R&D expenditure from all budget expenditure decreased.	• Overall high private and relatively high public R&D expenditure, private R&D slightly affected by the economic crisis; • A great part of BERD concentrated on one sector (ICT); • Increase in public R&D spending slower than planned in the research policy guidelines.
3	Increase European coordination and integration of research funding	• Finland has actively participation in European funding instruments such as ERA-NETs; • Finnish programmes increasingly have an international dimension in their agenda,	• The research and R&D-programmes in Finland are open to foreign participants but this often does not include funding; • The use of European opportunities still underutilised.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
4	Enhance research capacity across Europe		• A large pool of highly educated human resources (HRST).
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Recent national plan in developing research infrastructures.	• Finland does not have any significant research infrastructures; • Recently underinvestment in renewing research infrastructure; • Difficulties in finding funding for implementing the national plan may pose problems.
6	Strengthen research institutions, including notably universities	• University reform implemented in 2010; • Public funding for universities has increased quite slowly.	• Universities have good basic level in education and research but the excellence is still concentrated on only few strong areas.
7	Improve framework conditions for private investment in R&D	• Increase in Tekes funding and the creation of the Strategic Centres of Science, Technology and Innovation; • Discussion on tax incentives has become more intense although not any decisions made yet.	• There are several instruments supporting private R&D investments; • More measures needed to increase the share of R&D performing firms.
8	Promote public-private cooperation and knowledge transfer	• The Strategic Centres of Science, Technology and Innovation have promoted public private partnerships; • Increasing presence of the private sector in the HEIs through participation in governance and investments.	• Promotion of public-private cooperation interaction has been a long standing priority with a significant share of public R&D funding dedicated to collaborative research and technology transfer
9	Enhance knowledge circulation across Europe and beyond	• According to the latest monitoring report 2007-2009, the Finnish participation rate has increased from 2.07% in FP6 to 2.69% in FP7.	• Mobility of researchers (both inward and outward) is well below European average, which might result in lower knowledge circulation; • Increasing participation in international initiatives enhances knowledge circulation.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• Recommendations towards prioritisation in international co-operation through bilateral co-operation and Tekes FinNode initiative; • Internationalisation strategy of the universities in 2009.	• Despite a policy focus on the development of international cooperation and attractiveness of the Finnish STI-system, Finland is still rather weak in these areas.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• Coordination of research, education and innovation policies between the two responsible ministries developed lately.	• Knowledge triangle co-ordination quite well developed.
12	Develop and sustain excellence and overall quality of European research	• Policy discussion on new measures towards improving research excellence increased after the evaluation of 2009 that assessed that the relative research performance has declined; • Increased funding to the Academy of Finland to support research excellence; • New funding model of the universities has a performance based component in it.	• Based on scientific indicators such as R&D funding, publications and citations, Finnish research has performed quite well; • The top excellence has concentrated to few narrow research areas.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• Policy initiatives and strategic emphasis in "broad based innovation", including new forms of innovation, demand based innovation, public procurement and service innovation.	• Finland is well established in the knowledge intensive economy; • There is still underutilisation of new modes of knowledge and new technologies such as ICT in many sectors.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Emphasis in research programmes to some of the great challenges such as aging, environment and public health.	• The emphasis on societal challenges in Finland has been less developed than the emphasis on core technologies and industries.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• According to a recent science barometer a majority of Finns trust in science and find it important as solving problems in the society; • New demand based approach and increasing emphasis in public sector R&D may strengthen the use of scientific results in policy and practice.	• The systematic evaluation culture has been established but the evaluation results are still not used in policy making as well as they could.

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List of Abbreviations

BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
CoE	Centres of Excellence
COST	European Cooperation in the field of Scientific and Technical Research
CSTI	Strategic Centres for Science, Technology and Innovation (also the Finnish abbreviation SHOK is often used in the reports)
EEA	European Economic Area
ERA	European Research Area
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ERI	Education, Research and Innovation policies
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ETP	European Technology Platforms
EU	European Union
EU-27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP6	Sixth Research Framework Programme (European Commission)
FP7	Seventh Research Framework Programme (European Commission)
FTE	Full-time employee
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HRST	Human Resources in Science & Technology
ICT	Information and Communication Technology
IP	Intellectual Property
IPR	Intellectual property rights

MEE	Ministry of Employment and the Economy
MoE	Ministry of Education
MS	Member State
NCoE	Nordic Centres of Excellence
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RDI	Research, Development & Innovation
RIC	Research and Innovation Council
STPC	Science and Technology Policy Council
Tekes	Finnish Funding Agency for Technology and Innovation
TTO	Technology Transfer Organisations
VTT	Technical Research Centre of Finland