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Building long term strategies and public-private alliances for export development: the Finnish case

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Abstract

The Finish case of industrial renewal from essentially natural-resource-based industries toward machinery, engineering, electronics, and ICT is of particular relevance for Latin-American countries. The study explains the crucial role of the finish innovation system and the long-term public-private partnership in the industrial transformation towards a higher knowledge intensity and value added economy. The report recognizes the importance of innovation investments, but estimates as equal essential consistent long term strategies on facilitating conditions to build up, cooperative, confidential and dynamic innovation environment. Long term public-private partnership and broad cooperation within the industry as well as with other industries and the research sector, as exemplified by the "Triple Helix" alliance has been a key factor for economic success in Finland.

I. Overview of successful economic performance

While smaller than many European markets, Finland is one of the most competitive and technologically advanced countries in the world. Promising growth forecasts, low inflation outlook, superior technological and scientific expertise, and a leading innovation system count among the elements ensuring Finland a strong position in the science and technology sector. However, how has Finland managed to reach this prominent position, when the country up until less than 100 years ago was one of the poorest in Western Europe?

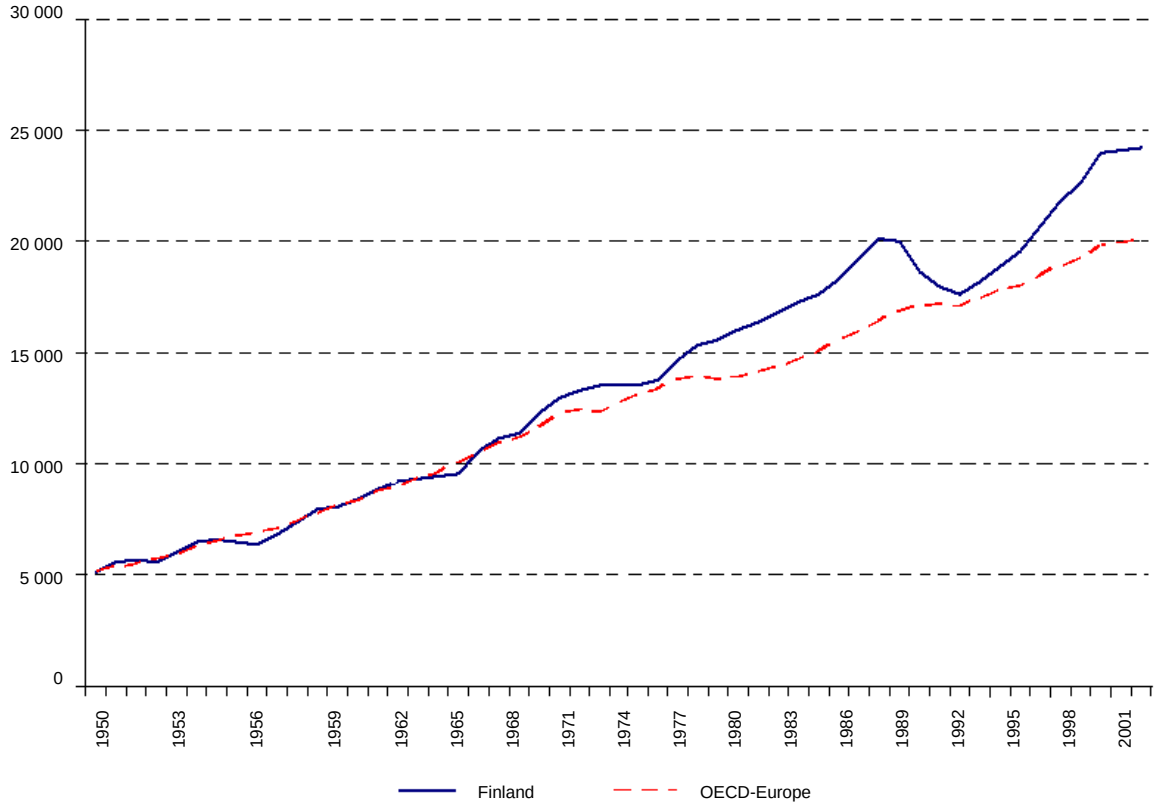
A. Some general characteristics

With a population of 5.3 million people, Finland is one of the most sparsely populated countries in Europe. Finland has experienced a GDP growth of 3.6 per cent between 1993-2003 which is a higher average GDP growth than the EU-15 (2.1%) and OECD region (2.6%) (Statistics Finland).

Finland joined the European Union in 1995. However, when Finland applied for EU membership in 1992, the country was in the middle of its worst peacetime recession of the 20th century. The national debt and unemployment were high and this placed pressure on the Finnish currency. Following the accession, there was an increase in commerce and investment. Unlike the other Scandinavian countries, Finland adopted the Euro from the start. The decision to join the Economic Monetary Union (EMU) showed immediate benefits, as this

stabilized the country's money market, which provided needed credibility in the international business community (Kiander, Kröger & Romppanen, 2006).

FIGURE 1
GDP VOLUME IN FINLAND AND OECD-EUROPE
(In 1995 prices and PPP-adjusted)



Source: Organization for Economic Development (OECD) [online] <www.oecd.org>, Penn World Tables.

Over the last decade, the structure of the Finnish industry has changed tremendously. After relying on the forest industry for centuries, Finland suddenly found electronics, particularly information and communication technologies, as the most important sectors both in terms of value added and exports.

Often regarded as a test laboratory for the global ICT industry, the Finnish market is characterized by large multinationals on the one hand, and small start-ups companies developing cutting edge technology on the other. Consequently, SMEs dominate the Finnish economy which is found to be the contrary to the prevailing situation in neighbouring Sweden (Virtual Finland).

Finland is one of the world's leading countries in terms of innovation. Currently, Finland ranks as number six in the World Economic Forum's (WEF) Global Competitiveness Index from 2007/2008 (Table 1).[1]

[1] WEF aims to evaluate countries' competitiveness with emphasis on future development, and includes indicators such as macro-economic environment, public institutions and technology. The WEF Lisbon review uses different indicators, such as IT, innovation, and R&D, and compares European performance in competitiveness, in which Finland ranked first in most categories.

TABLE 1
GLOBAL COMPETITIVENESS INDEX
(2006-2007 and 2007-2008 comparisons)

	GCI	GCI		=
Country/economy	2007-2008 rank	2006-2007 rank	Changes	
United States	1	1	→	0
Switzerland	2	4	↑	2
Denmark	3	3	→	0
Sweden	4	9	↑	5
Germany	5	7	↑	2
Finland	**6**	**6**	→	0
Singapore	7	8	↑	1
Japan	8	5	↓	-3
United Kingdom	9	2	↓	-7
Netherlands	10	11	↑	1
Korea	11	23	↑	12
Hong Kong SAR	12	10	↓	-2

Source: J WEF, The Global Competitiveness Report 2007-2008.

Likewise, in the European Innovation Scoreboard (EIS) indicators, Finland's performance in innovation remains sharp even in comparison with 2005's excellent results (Oksanen, 2006). Along with Sweden and Switzerland, Finland was a global leader in innovation both in 2005-2006, scoring much better than EU-25 average. In particular, Finland is one of the best performers concerning innovation drivers, knowledge creation and intellectual property (Hollanders, H. & Arundel, A, 2006).

In international comparison Finland's exports in communication technology devices, and many other high tech fields, in relationship to the size of the country, performs remarkably well (Ahlbäck, 2005). Furthermore, in terms of overall innovation capacity Finland is also among the top countries, as can be seen from Table 2.

TABLE 2
FINNISH INNOVATIVE CAPACITY INDEX, 2004

Rank	Scientists and engineers	Innovation policy	Cluster environment	Linkages	Operations and strategy
1	**Finland**	Singapore	Japan	USA	Germany
2	Iceland	Luxembourg	USA	**Finland**	Japan
3	Japan	Taiwan	Taiwan	Sweden	Denmark
4	Sweden	**Finland**	**Finland**	Taiwan	Israel
5	USA	Canada	Hong Kong	Japan	**Finland**
6	Norway	UK	UK	Israel	Switzerland
7	Singapore	USA	Korea	Singapore	Sweden
8	Switzerland	Malaysia	Singapore	Germany	USA
9	Russia	Australia	Denmark	Switzerland	Netherlands
10	Denmark	Ireland	Canada	Denmark	Belgium

Source: Steinbock, 2006.

An extremely well managed economy, the quality of Finnish public institutions, the low level of corruption, a culture of innovation, and good government finances are all contributing factors to Finland's top position.

B. Economic development

During the 20th century, Finnish GDP per capita grew at an annual rate of close to 3 per cent, that is, faster than in any other European country. Initially however, the real industrial revolution came about later than in other Western Countries, such as Sweden. One explanation for the slow start was that Finland gained its independence from Russia only in 1917.

Finland's proximity to Russia, and formerly to the Soviet Union (USSR), powerfully affected Finnish economic development even after the independence. In the early years of the USSR, political tensions prevented much trade outside the Eastern block. Yet Western European demand, especially for lumber, pulp, and paper, supported the forestry industry at that time. During World War II, Finland joined the Axis powers, partly in order to prevent partial annexation by the Soviet Union. After the war, Finland had to pay reparations to the Soviet Union, which demanded mainly industrial products. This requirement forced Finland to develop a substantial metal and engineering industry. After reparations were completed in 1952, trade with the USSR continued through a barter system, characterized by an exchange of goods for energy since Finland lacked natural fuel resources. Finland was the only free-market member of the Council of Mutual and Economic Assistance (COMECON), an economic and development cooperative association formed in 1949, which was otherwise composed of socialist states. Finland was able to use its good relations with socialist states as an economic buffer against downturns in the Western market. However, Finland did not hesitate to link itself to Western markets as well, which helped its position as a trade gateway to the USSR. Finland joined the Organization for Economic Cooperation and Development (OECD) in 1969 and the European Free Trade Agreement (EFTA), a predecessor to the European Union (EU), in 1986. However, the USSR, as Finland's closest neighbour, remained a large and influential market and its collapse in the early 1990s aggravated Finland's already severe recession at that time (Fellman & Lindholm, 1996).

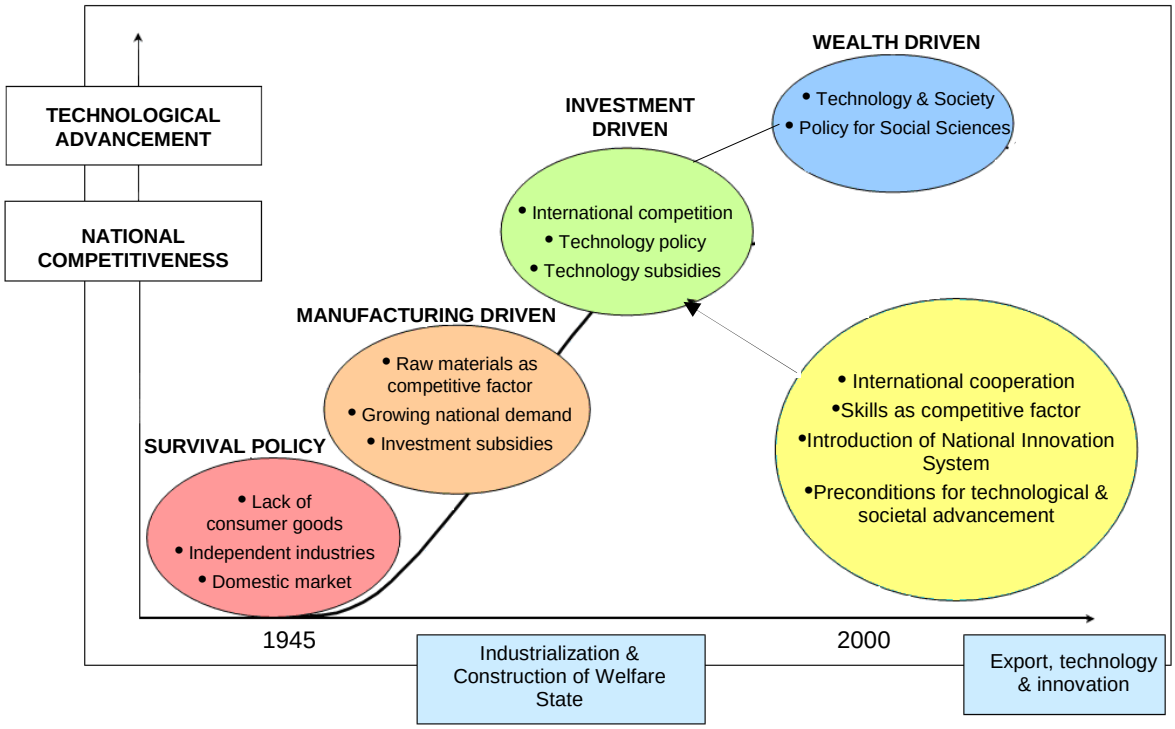
Even though Finland's industrialization started later than elsewhere, many of the basic preconditions for growth were nevertheless in place already before the independence. Institutions such as well-functioning educational and banking systems, as well as a good transportation infrastructure, were important in the take-off phase. Similarly, national identity and culture were strong. Furthermore, when Finland liberalized both internal and external trade in the 1870's, it opened up more paths for domestic industrial growth.

The role of institutions was important, not only in the take-off phase of industrial growth, but also later when the economy moved from factor to investment, and later, to innovation-driven stages of industrial development. Finland's most important, and basically only, endowment of natural resources, forests, proved to be the decisive factor in the take-off phase. Quick advancement in prosperity towards the end of the 1800s and in the early 20th century was based on rapidly growing exports of forest-related products - first timber and later, pulp and paper. Additionally, Finland used its connection with Russia to enter this market with its commodity goods. From the late 1950s to the late 1970s, the Finnish forest industry carried out massive investments and transformed itself gradually into a global technology leader. (Hjerppe, 1989) By the late 1980s, the forest sector had developed into a competitive industrial cluster that today provides high value-added paper grades, as well as exports of forestry technologies and consulting services (Dahlman, Routti, Ylä-Antilla, 2005).

In Finland, the specialization of production, trade, and R&D in to more knowledge-intensive goods and services coincided with the gradual opening of the economy and deregulation of capital flows. A peculiarity of the Finnish case is the atypical pattern of industrial renewal from essentially natural-resource-based industries toward machinery, engineering, electronics, and ICT. There are few, if any,

other examples of natural-resource-abundant countries that have managed to transform their industrial structures toward higher knowledge intensity and value added so rapidly and successfully as Finland (Fellman & Lindholm, 1996).

FIGURE 2
FINLAND'S STAGES OF INDUSTRIAL AND ECONOMIC DEVELOPMENT



Source: Author's elaboration.

The origins of the Finnish knowledge economy can be traced back to user-producer linkages between the forest-based industries as early users of high technology, and the emerging engineering, electronics and ICT industries in the 1960s and 1970s (see Figure 2) (Dahlman, et. al, 2005).

C. Education

The country recognized the connection between an educated population and economic growth early on. Educating the common people also served as tool in nation-building prior to Finnish independence in 1917 (Fellman & Lindholm, 1996). Hence, Finns have willingly participated in education and training, including higher education.

Education that would enhance technological change was a high priority in the policies of the 1960s and 1970s. However, it is not only graduate level science and technology education that matters; a high general level of education is equally important for adopting and utilizing new technologies. Thus, basic education continues to be the focal point of the Finnish educational system. Also internationalization of the educational system has been an integrated target of educational policy, especially since the end of 1980's (Ministry of Education, 2006).

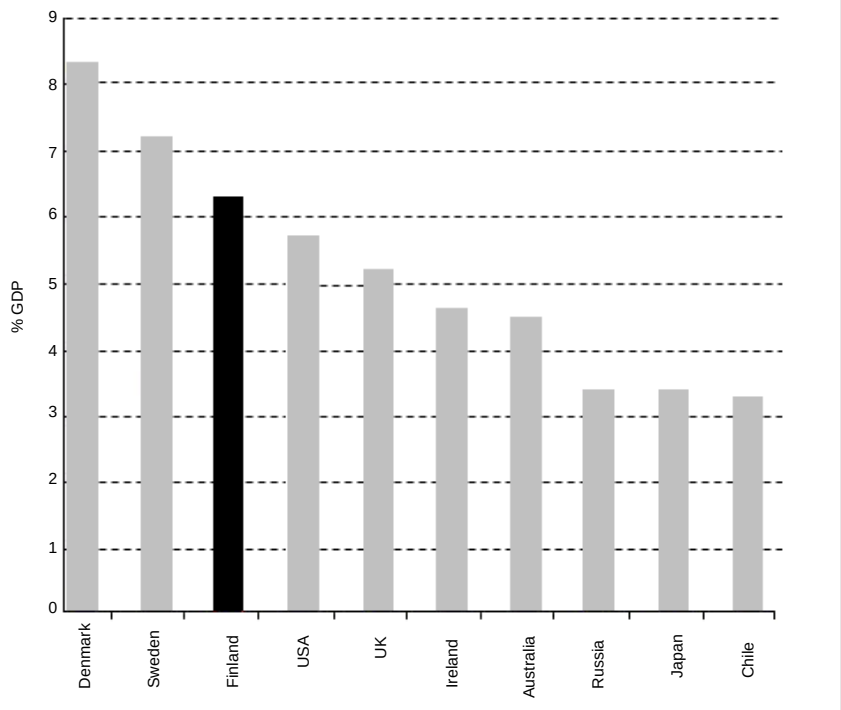
In the Finnish education system, the local authorities are largely responsible for organizing basic education and schooling. Equality by gender, religion, and socioeconomic background are fundamental

principles of the Finnish education policy. Everyone receives the same basic education and, furthermore, it is the goal of the educational system that no one relies on basic education alone. Previously, equality was considered quantitatively, and the distribution of schools and access to them were measures of equality. Nowadays, equal quality of education for everyone is the goal, and individual learning results are the measure of success. The social welfare system in Finland also provides a strong incentive for young people to continue educating themselves after the lower secondary school, which is normally completed in the age of 15-16. One example of this is the requirement that a person must be 18 or over to qualify for unemployment benefits. Hence, there is an incentive to continue to go to school (free for everyone) after completing the lower secondary education. Also, subsidies from the government promote university studies, and student loans are granted to everyone (Ministry of Education, 2006).

BOX 1
EDUCATIONAL EXPENDITURE AND PERFORMANCE

The expenditure on education (both in terms of elementary, secondary and tertiary) is by no means higher than in the other Nordic Countries. The successful ranking in the Program for International Student Assessment (PISA) can therefore be explained by a good utilization of resources. The public expenditure on education is 6.5 per cent of GDP according to 2004 data presented by UNESCO (see figure 3).

FIGURE 3
EDUCATIONAL EXPENDITURE, 2004



Source: UNESCO database.

The high level of population know-how was also underlined by the OECD PISA Survey of 2003. This study looked at student performance in problem-solving, science and reading and at students' approaches and attitudes to school in 41 countries. In the study, Finland once again came out top with high performances in mathematics and science, matching those of top-ranking Asian school systems in China, Japan and Korea. This top performance in mathematics and science adds to Finland's previous leading position in the PISA 2000 reading assessment. Additionally, unlike in many countries, research careers attract young people. The aggregate intake in institutions of higher education, i.e. the universities and polytechnics, corresponds to 70 per cent of the youth age group.

Source: Author.

D. Macroeconomic and labour policy

Finland's high growth rate has been accompanied by large cyclical fluctuations. Hence, the Finnish economy has proven to be highly shock sensitive. Yet the Keynesian model has not been used to dampen the market fluctuations despite the public sectors central role in the economy. Rigidities in economic and political systems and corporatist structures are some of the underlying causes (Fellman & Lindholm, 1996).

The deregulation of Finnish financial markets in the 1980s led to a domestic credit boom, which collapsed in the early 1990s, leading to stock and real estate market speculation and crashes. The recession lasted until 1993, when Finland devalued its currency. This action allowed the nation to improve its export sector, especially through growth in manufacturing high-tech electronics and expansion of its export market for paper goods into the newly-booming Asian economies.

Greater emphasis was put on long-term microeconomic as opposed to short-term macroeconomic policies, acknowledging that the foundations of sustained national competitiveness are largely created at the micro level, in firms financial institutions, and various innovative policy agencies. The European integration process also fuelled the shift in policy. Since joining the European Monetary Union (EMU) in 1999, Finland has been required to reduce its debt. Even before its membership, partial privatization of many state-owned businesses, such as the telecommunications provider Sonera, helped to create revenue from the sale of shares. However, public debt is still high and has been increasing, posing a continued economic challenge into the 21st century (Kalela, Kianden, Kivikuru, Loikkanen & Simpura, 2001).

For most of the post-war period, Finland had very low unemployment. The emergence of unemployment as a serious problem more or less coincided with the collapse of the USSR and the 1990s recession. Recent growth has not been able to solve the problem, especially as many of the fastest-growing businesses are in the high-technology sector and do not require as many employees as jobs of earlier eras.

Finland is also one of the most unionised countries in the world with over 80 per cent of labour being organized. Likewise, 80 per cent of employers belong to an employers' association. (Progressive Policy Institute, 2007) The prevailing labour market policy is problematic for SMEs. The employees are highly protected in terms of different employment security benefits, which bring about high indirect wage cost. Additionally, extensive regulations and problematic job terminations is seen has disadvantageous for smaller firms.

E. Infrastructure

Although the relatively small size of the Finnish innovation system has certain disadvantages, it has also important benefits. Finnish infrastructure is known to be uncomplicated and smooth, and easy to navigate. Firms operate in a structured, centralized and effective system, in which there is widespread respect for contracts and the rule of law.

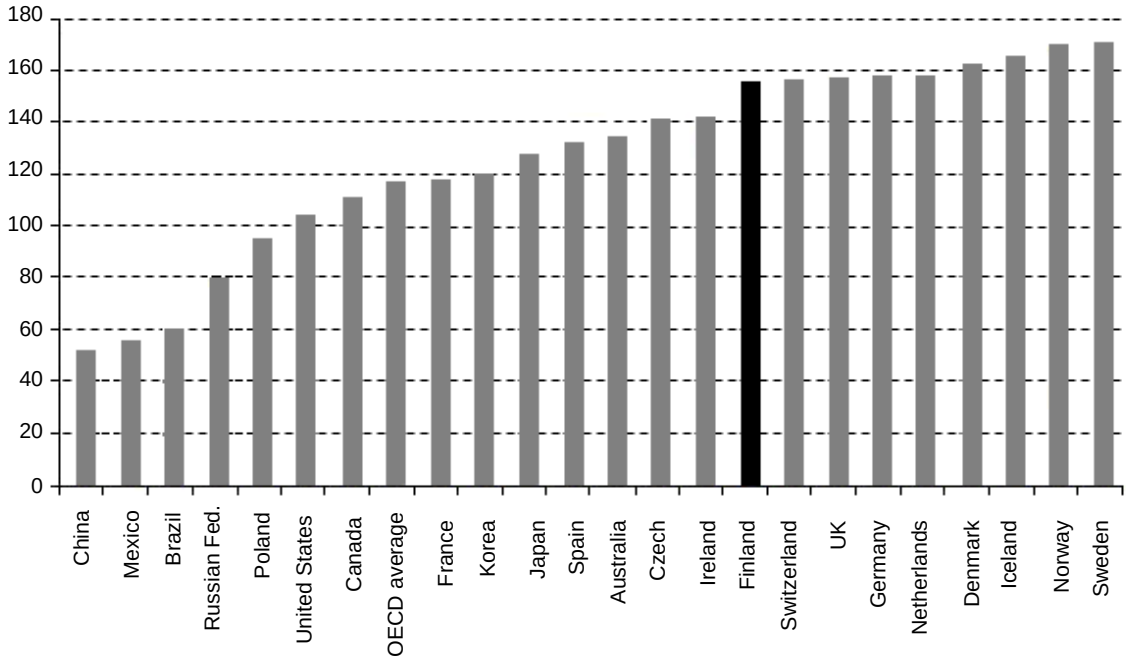
From the point of view of initial industrialization and the building-up of the basis for technological advance, networks of physical communication were crucial. Basic networks of roads, railroads and canals which were especially important for the transportation of raw materials for the forest industry were constructed early in the 19th century. Other basic infrastructure issues include the building-up of the energy supply system, power plants and electricity transfer networks. This was an important arena for transferring foreign technology in the country and for learning by doing (Hjerppe, 1989).

The creation of telecommunication networks also started early; Finland stands internationally very high; e.g. in the comparison of telephones per capita – and the modernization of the network has taken place quite rapidly. See figure 4 for telecommunication access in relation to inhabitants.

Finland ranks lower than in telecommunications; especially compared to the other Nordic countries regarding to access to a home computer. Nonetheless, the country still ranks as one of the top countries in the world.

The Finnish inhabitants have hence become willing users of technology. This might partly explain why the Finnish market is often described as a test laboratory, and why Finland represents one of the most technologically advanced markets in the world. Similarly, Finland records the highest per capita use of electronic commerce as a form of payment (use of credit, debit and smart cards), while having the lowest ratio of cash-in-circulation to GDP of any developed country (The Information Society Council, 2005).

FIGURE 4
TELECOMMUNICATION ACCESS PATHS
(Per 100 inhabitants)



Source: OECD Factbook, 2007.

The top performance within this field is reflected in the Network Readiness Index, where Finland is placed in fourth position. See Table 3.

TABLE 3
FINNISH INNOVATIVE CAPACITY INDEX, 2004

Countries	Store 2006	Rank 2006-2007	Rank 2005-2006	
Denmark	5.71	1	3	+2
Sweden	5.66	2	8	+6
Singapore	5.6	3	2	-1
Finland	**5.59**	**4**	**5**	**+1**
Switzerland	5.58	5	9	+4
Netherlands	5.54	6	12	+6
United States	5.54	7	1	-6
Iceland	5.5	8	4	-4
United Kingdom	5.45	9	10	+1

(continues)

TABLE 3 (concluded)

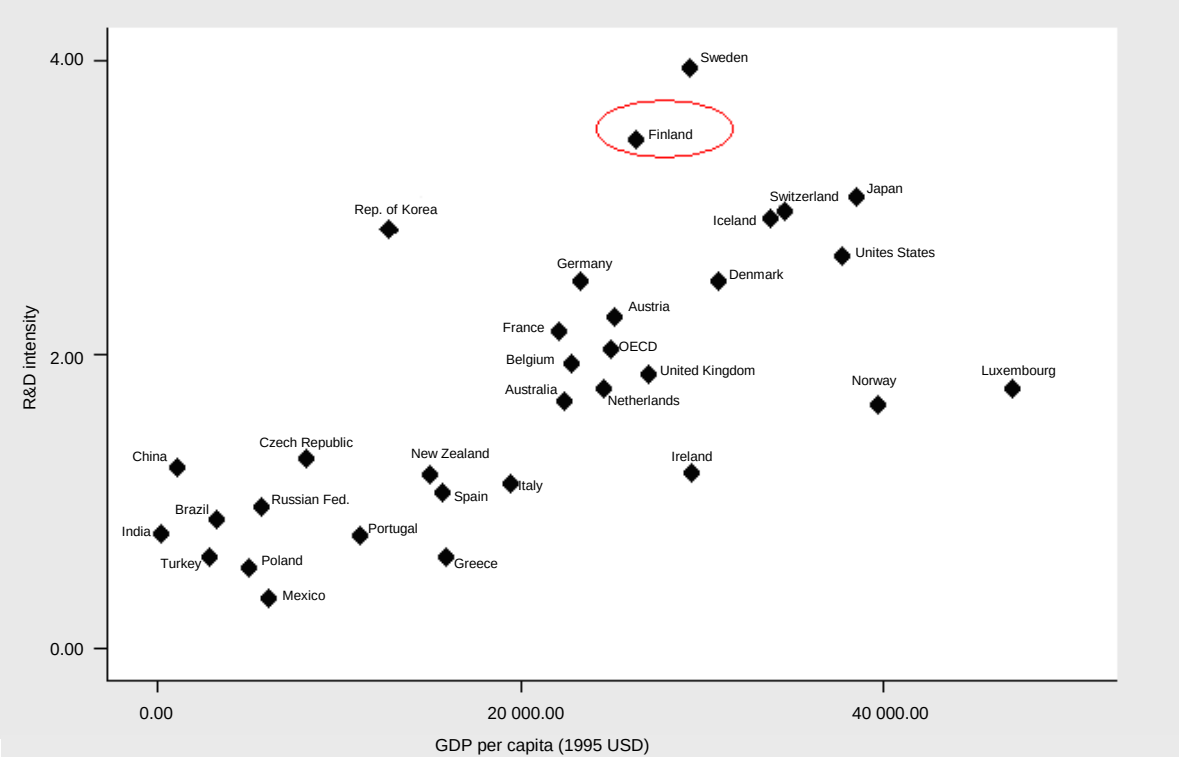
Norway	5.42	10	13	+3
Canada	5.35	11	6	-5
Hong Kong SAR	5.35	12	11	-1
Taiwan, China	5.28	13	7	-6
Japan	5.27	14	16	+2
Australia	5.24	15	15	0

Source: ECLAC data indicators, 2007.

F. R&D investment

It was the recession of the 1990s that became the turning point between the investment- and innovation-driven stages of national development. The country's R&D intensity grew rapidly as the business sector increased expenditures on innovative activity, and as a result Finland presently has one of the highest intensity levels in the world (See Figure 5).

FIGURE 5
R&D INTENSITY, 2004



Source: Organization for Economic Development (OECD), 2006.

Public R&D funding rose at a time when virtually all other public expenditures were cut in the midst of the recession. However, the transition to innovation-driven growth was considerably aided by widespread telecommunications deregulation in Europe and elsewhere, as well as by technological developments in the ICT sector. Both of these developments have contributed to the booming demand since the early 1990s (Paija, 2001).

The total funding of R&D in the 2007 Government Budget is €1.73 billion. That corresponds to an increase of 1.2 per cent in real terms from the previous year. (Statistics Finland) However, even though public funding of R&D has increased substantially during the past decades, its relative share of total R&D expenditures has decreased. Increasingly, investments in R&D have been privately funded. Presently, private funds account for some 70 per cent of the total.

The increase in private R&D is attributable, above all, to Nokia. Although there are also other firms, Nokia was the industrial engine for developments in the ICT industries in Finland during the last decade. Nokia has thereby influenced to a significant extent the rapid industrial restructuring in the 1990s toward electronics and electrical engineering. By 2003 Nokia accounted for 25 per cent of Finland's total R&D expenditures, 3.3 per cent of GDP, and 20 per cent of total exports (Gergils, 2006). Nokia has benefited from the public innovation system, particularly through the public support programs executed by the agencies Tekes and VTT.

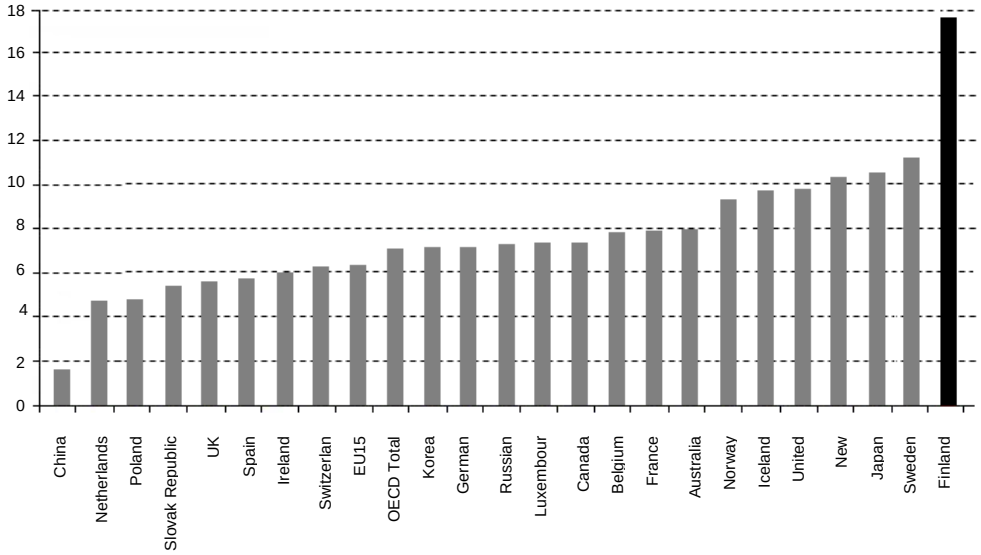
Their exchange seems however to reflect mutual dependence and there is nothing to suggest from published studies that Nokia has drawn inappropriately large benefits from public funding, despite being Finland's "flagship" enterprise (Ali-Yrkkö & Hermans, 2002).

Through the public funding made to Nokia, not only has this large MNC benefited, but also smaller businesses. SMEs and industrial research institutes have participated in 50 and 75 per cent, respectively, of the Nokia projects financed by TEKES. This has helped develop an extensive network of high-quality subcontractors to Nokia (Ali-Yrkkö & Hermans, 2002).

As a result Finland, unlike other countries, has an important proportion of its business R&D in the high-tech sector. Indeed, 70 per cent of business sector R&D is dedicated to high-tech the highest share of the EU countries (Gergils, 2006).

During the last ten years, the number of people involved in R&D in Finland has steadily risen from 46,000 to nearly 70,000, while the number of doctorates more than doubled. According to OECD 2007 Fact Book, Finland has the most researchers per inhabitant (see figure 6). Counted in person years, the relative share of the labour force in R&D is clearly the highest figure in the OECD, over two per cent according to the 2006 Science, Technology and Innovation Outlook.

FIGURE 6
NUMBER OF RESEARCHERS
(Per 1000 employed)

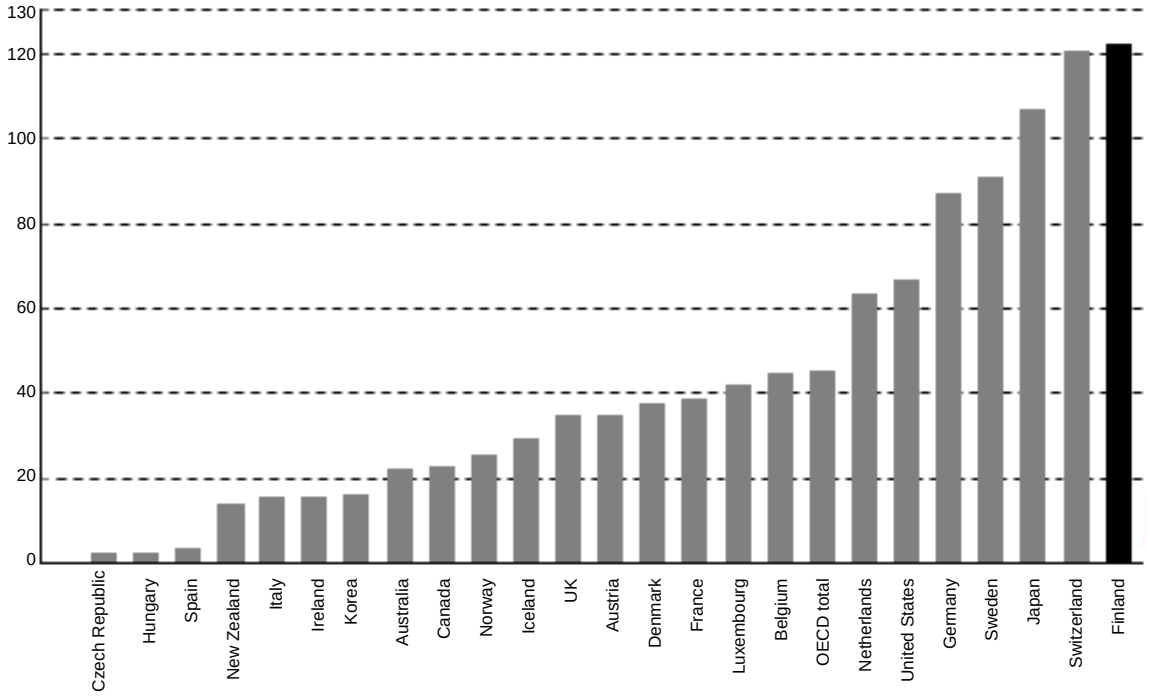


Source: OECD Factbook, 2007.

Still, the Finnish government is making a determined effort to develop researcher training even further. In 1995, a special graduate school system was established to supplement traditional postgraduate education. (See the Section (3.4.1) about the Academy). The aim is high-quality postgraduate education and dynamic researcher communities which have close international contacts and work in interaction with Finnish society and business (Finnish Science & Technology Information Service, 2007).

Furthermore, the ratio of triadic patent families (i.e., registered simultaneously in Japan, U.S. and the E.U.) to population identifies Finland, Switzerland, Japan, Sweden and Germany as the five most innovative countries in 2003. Finland had the highest propensity to patent, with 122 patent families per million of inhabitants and Switzerland had 121 (see figure 7). Finland also shows a significant specialization in ICT patenting.

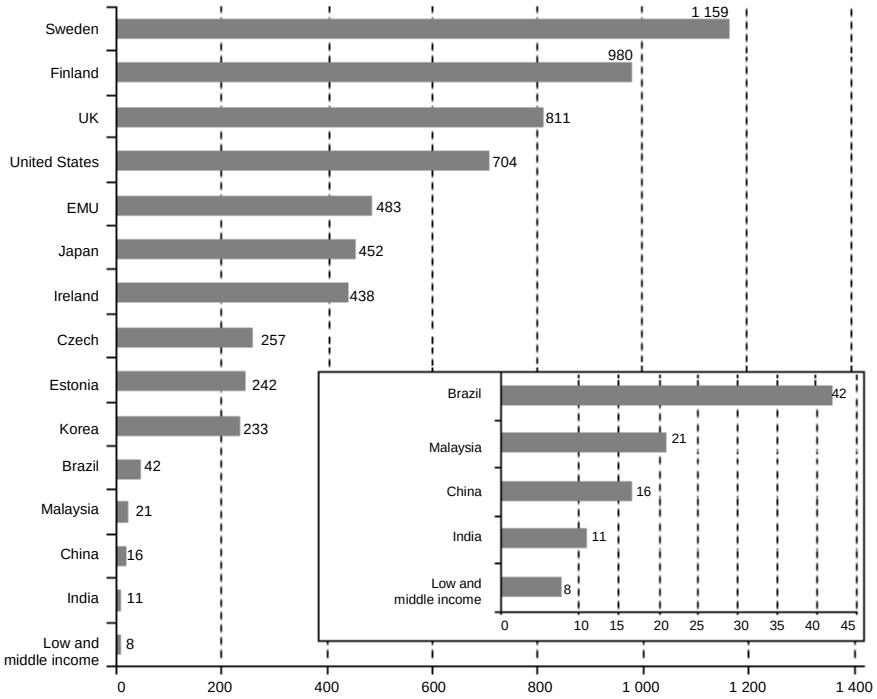
FIGURE 7
NUMBER OF TRIADIC PATENT FAMILIES
(Per million of population, 2003)



Source: OECD Factbook, 2007.

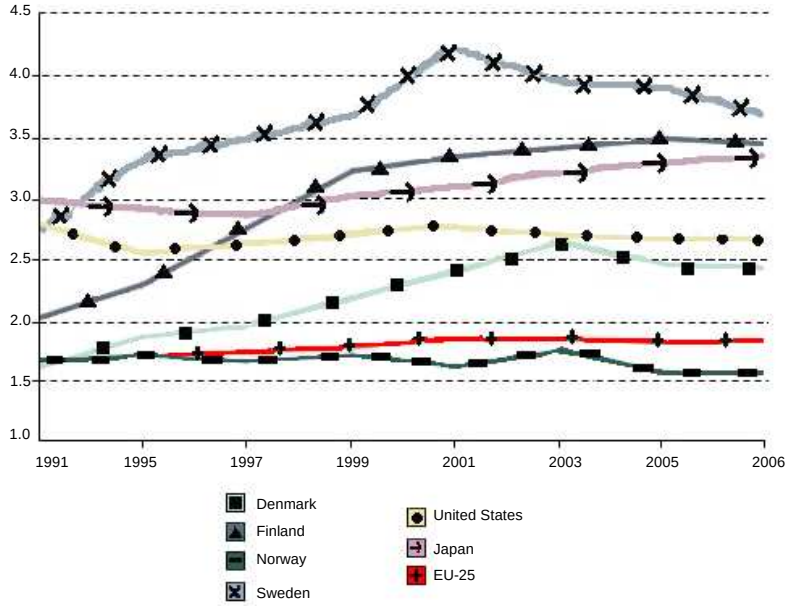
Additionally, it can be observed from Figure 8 that Finland ranks second in terms of number of scientific publications per million of inhabitants. Meanwhile, Finland's relative R&D intensity (the share of the gross domestic research and development expenditure of GDP) is the second highest in the world, with only Sweden exceeding it. This can be observed in Figure 5. Finally, the largest expenditure of R&D in relation to GDP is the private sector, followed by the universities and the different government organisations (see figure 10).

FIGURE 8
NUMBER OF SCIENTIFIC PUBLICATIONS ,2001
(Per million people)



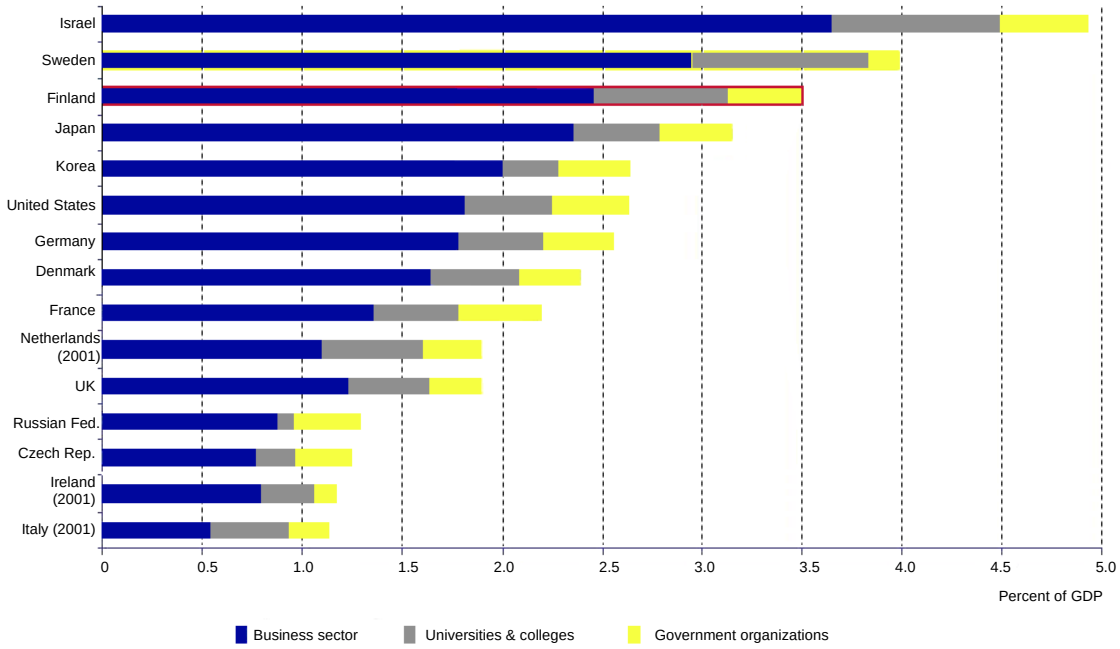
Source: OECD (2006).

FIGURE 9
HISTORICAL OVERVIEW OF R&D EXPENDITURE
(As a percentage)



Source: Statistics Finland.

FIGURE 10
R&D EXPENDITURE IN RELATION TO GDP AND SECTOR, 2003
(As percent of GDP)



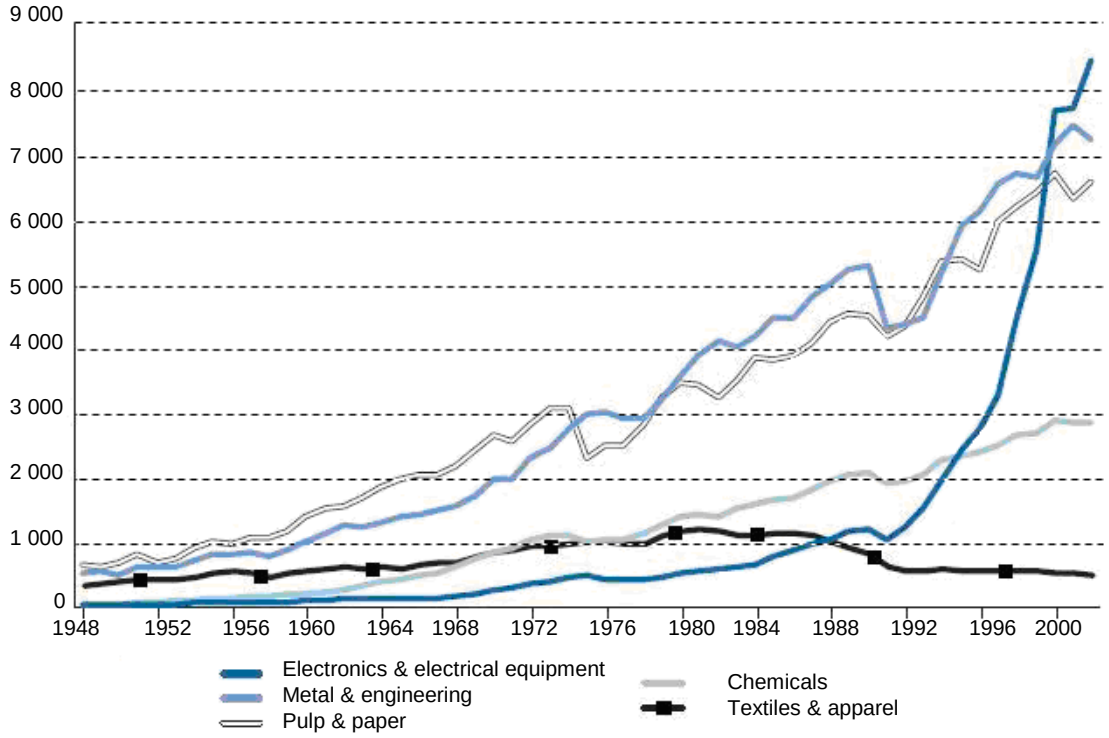
Source: OECD MSTI, 2005.

It should be noted that the Finnish Government is thus fully committed to R&D and the fostering of innovation, with a particular emphasis for the period 2003-2007. Both university core funding and science and technology financing have increased. The investments in R&D will be continued and even increased to 4%/GDP in 2010. However, it will not only concentrate on technology or science development. The aim is to commercialize the utilization of research findings and technology for the good of the economy, employment and societal development. The whole value chain from pure science to innovation will be more systematically covered. The results will be seen in few years. However, the industrial cooperation will be kept essential.

G. Growth of the ICT industry

The change in the 1990s in Finnish industrial structure and exports was unique both nationally and internationally. In less than a decade, electronics became the most important single branch in production and exports. As already mentioned, the Finnish industrial structure that was previously raw material-, capital-, energy-, and scale-intensive, is now primarily knowledge-intensive. Hence, Finland has become a world leader in high-tech trade surplus (high-tech exports/imports ratio) among indigenous high-tech producers (Paija, 2001). See figure 11 for development of different manufacturing products.

FIGURE 11
GROWTH IN ELECTRONICS SINCE THE EARLY 1990S: FINNISH MANUFACTURING PRODUCTION VOLUME BY INDUSTRY
(Billions of Euros in year 2000 prices)



Source: ETLA database, Hjerppe et al. (1976), National Industrial Statistics by Statistics Finland.

This successful transformation is to a large extent built on the basis of an extensive cluster system. In Finland successful clusters have especially been formed in the areas of telecommunications equipment manufacturing, electronics, forest and service provision. The universities and research institutes have been successful in producing competent human resources and world-class R&D to support the cluster development (Hirvonen, 2004).

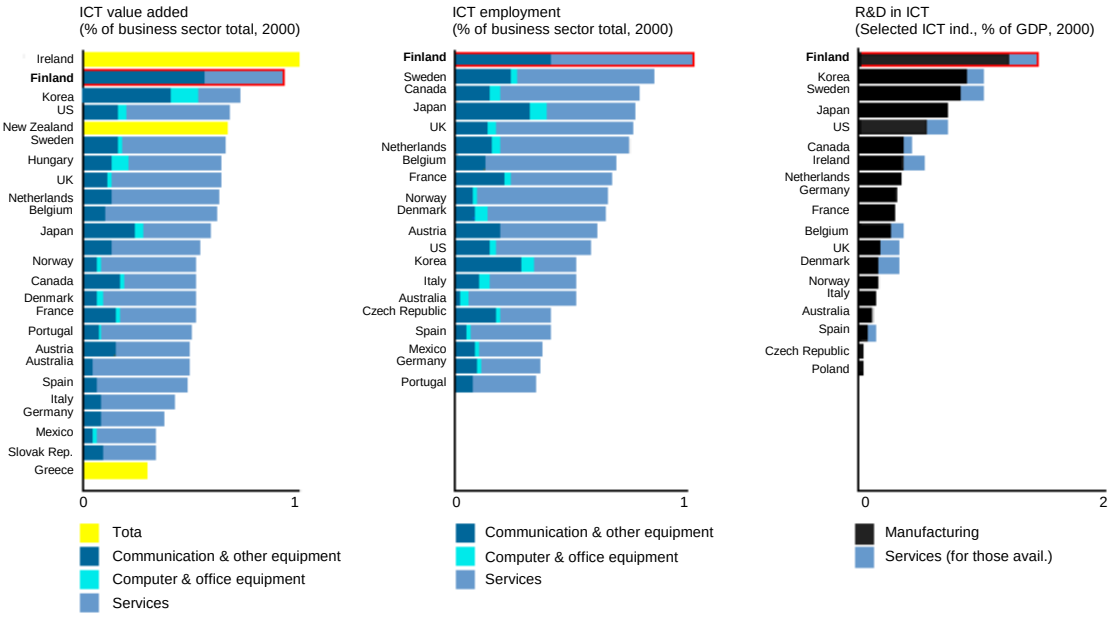
As presented in earlier sections, high-tech foreign trade is clearly in surplus and the R&D input in relation to GNP is one of the highest in the world. On this basis Finland has become an export-driven location for leading international ICT sector companies (figure 12). Finland is often viewed as a pioneering adapter and an important research centre of new technology. International companies (e.g., ICL, IBM, Siemens, Hewlett Packard, Ericsson and Lotus) have all set up research units in Finland, increased their co-operation with Finnish firms or acquired small companies in the sector (Hirvonen, 2004).

Thus, Finland has come full circle in regard to foreign capital. In the 1800s, foreign entrepreneurs brought their know-how to the country. But until recently there had been certain ambivalence about FDI in the country. Now, however, the importance of foreign companies is again on the rise; this time as part of Finland's well-developed ICT cluster (Paija, 2001).

There are many reasons for Finland's rise to become a leading ICT country. The strength of the telecommunications field is largely based on the rapid deregulation of competition in the 1990s as well as previously created markets that included more competition than in many other countries (Paija, 2001). The operators forced the equipment suppliers to compete with each other, leading to rapid technological development. Nokia succeeded in domestic competition before doing so globally (Hirvonen, 2004).

In addition to the deregulation of telecommunications competition and the liberalization of the market, the research and educational system encouraged the emergence and growth of a strong ICT cluster. This cluster is a central element of the Finnish innovation system, which includes networks of large and small companies as well as research, training and corporate co-operation.

FIGURE 12
ICT DATA



Source: Organization for Economic Development (OECD), 2004.

BOX 2
SUMMARY OF FINNISH INNOVATION POLICY

- Education, science, technology and know-how have been a conscious focus of the industrial policy and the foundation of the Finnish economy and society for a very long time.
- The results of the policy can be seen today: the transformation from a low-tech country to a knowledge based society.
- Investments in innovations are important, but as important is a consistent long term focus on national facilitating conditions, as well as operational measures to build up a well-committed, co-operative, well balanced, confidential and dynamic innovation environment.
- Regional development is a special challenge, because the birth of innovations is in Finland is very centralized.
- Small countries, like Finland too, have a lot of challenges in the future.

Source: Author's elaboration.

H. The Finnish model

BOX 3
FEATURES OF THE FINNISH MODEL

According to Ojala, et.al (2006) there are especially six ingredients that can be associated with the "Finnish Model" of economic success over a long period of time.

1. Solid institutional legacies, including a centuries-long continuity in government structures and policies, ethnic homogeneity, and a strong government role in regulating the economy.
2. The long-term utilization of the key natural resources, namely the abundant forests, as a source of energy and raw material in industrialization.
3. The ability to adapt quickly to structural changes (from an agricultural orientation to an industrial and service-orientated production) and to external crises (such as political changes and economic recessions). In this context, the importance of competitive and institutional forces as well as long-term co-operation within and between companies in different industrial sectors has to be emphasised.
4. The strong emphasis on the creation of human capital, going back to the educational reforms of the 19th century, which aided economic growth.
5. The development of an egalitarian society with an extensive welfare system, created to improve the social discontent of the industrial era, which has included pro-growth policies, highly regressive taxation and gender equality.
6. Innovation, manifested especially in the country's recent success in ICT and its ability to create many key inventions such as GSM technologies and the Linux operating system. Part of this success has been the joint effort of private and public spending.

Source: Author's elaboration.

Long-term Public-Private Partnership - intense and broad interorganizational co-operation both within the industry as well as with other industries and the research sector - is seen as a key for economic success in Finland. Part of this is top research erected around strong clusters of expertise and high-quality infrastructures. In addition, the Strategic Centres for Science, Technology and Innovation brings forward a crucial new form of cooperation between the business sector and academia. They are placed in parts crucial to the future prosperity of the Finish industry sector and society (www.tekes.fi).

II. The public strategies underpinning economic transformation and export development

A. Trade and external capital liberalization

1) FDI liberalization

In the past, the Finnish economic nationalism was partly expressed as a critical view of foreign direct investment. Foreign ownership was limited both directly and indirectly through regulation of capital movement, as in many small countries at that time. However, as mentioned, foreign companies and entrepreneurs played a crucial role in the early industrialization of several sectors. Russians, and later Norwegians, helped develop the sawmill industry. Later on the country relied on Swedish technology in particular (Hjerppe, 1989).

In 1910-20 foreign-owned companies produced one quarter of sawmill industry output, with 40 per cent of the sawmill companies' forest area held by foreign firms. After independence and during the Second World War, most foreign companies were sold to Finns (Hjerppe, 1989). A suspicious attitude toward foreigners was typical, particularly in the early years of independence. Suspicions about foreign ownership of the country's forest and ore resources led to a restrictive 1939 law. The legislation allowed limitations on foreign companies' entry as well as monitoring of those operating in the country. Hence, in the immediate post-war years, economic nationalism mobilized extra resources

to develop domestic industry. However, the negative attitude toward foreigners continued for a surprisingly long time, perhaps too long from the structural standpoint (Fellman & Lindholm, 1996). Arguably, the lack of diversity of Finnish industry was partly due to the scarcity of foreign investment. This channel which perhaps most effectively brings in technology and know-how was kept very narrow. The restrictive policy remained in force until the early 1990s. Permit procedures were liberal, particularly in later years, but a legal and bureaucratic jungle dampened foreigners' interest in Finland, as was the intent. The law changed in early 1993 because of Finnish membership of the European Economic Area (EEA). That membership required, among other things, deregulation of the external capital movements (Piepponen, 2001).

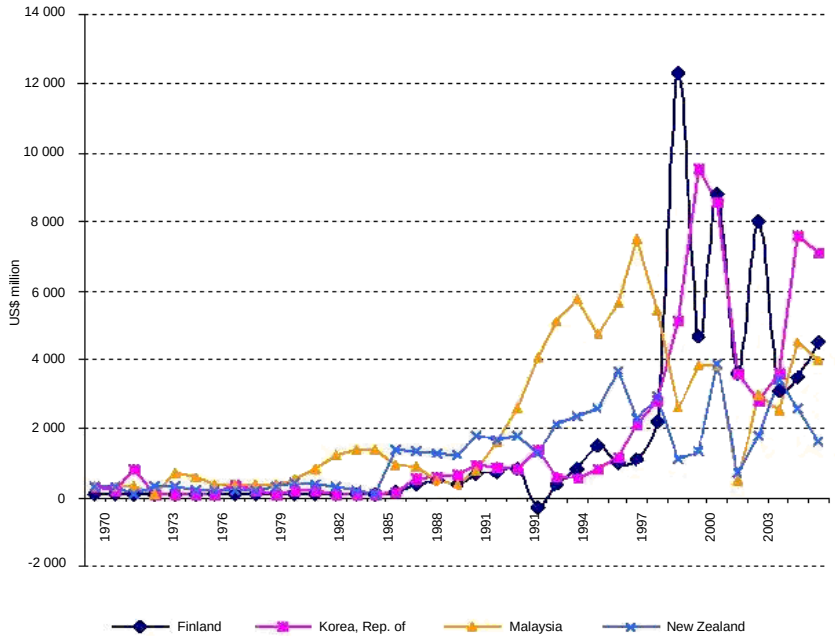
In 1979, the number of Finnish companies abroad exceeded the number of foreign-owned firms at home. Today there are estimated to be twice as many Finnish-owned companies overseas as foreign companies in Finland. However, at the same time there was an increase in the number of foreign-controlled Finnish firms.

In 1990 about 70 of the 500 largest Finnish companies were foreign-owned. By 1999 the number had exceeded 150. In the early 1990s, service firms in particular, such as advertising agencies, cleaning companies, accounting firms etc, have changed to foreign ownership, as have some small high-tech companies. A clear motive for these buyouts by foreign companies in recent years has been a desire to acquire specialized Finnish know-how (Oinas, 2005).

As a result of the nationalistic policies the role of FDI in technology transfer was for a long time minimal in Finland. Nevertheless, in the 1980's the country became very open to FDI, but the investments remained at a low level. Due to the taxation system, high wages and costs, Finland was not very attractive for FDI. Other reasons were the small market and remote location. Internal technology transfer was arranged directly within the national technology programs, which to a large extent are industry-research consortiums. A separate and inefficient technology transfer process was therefore largely avoided.

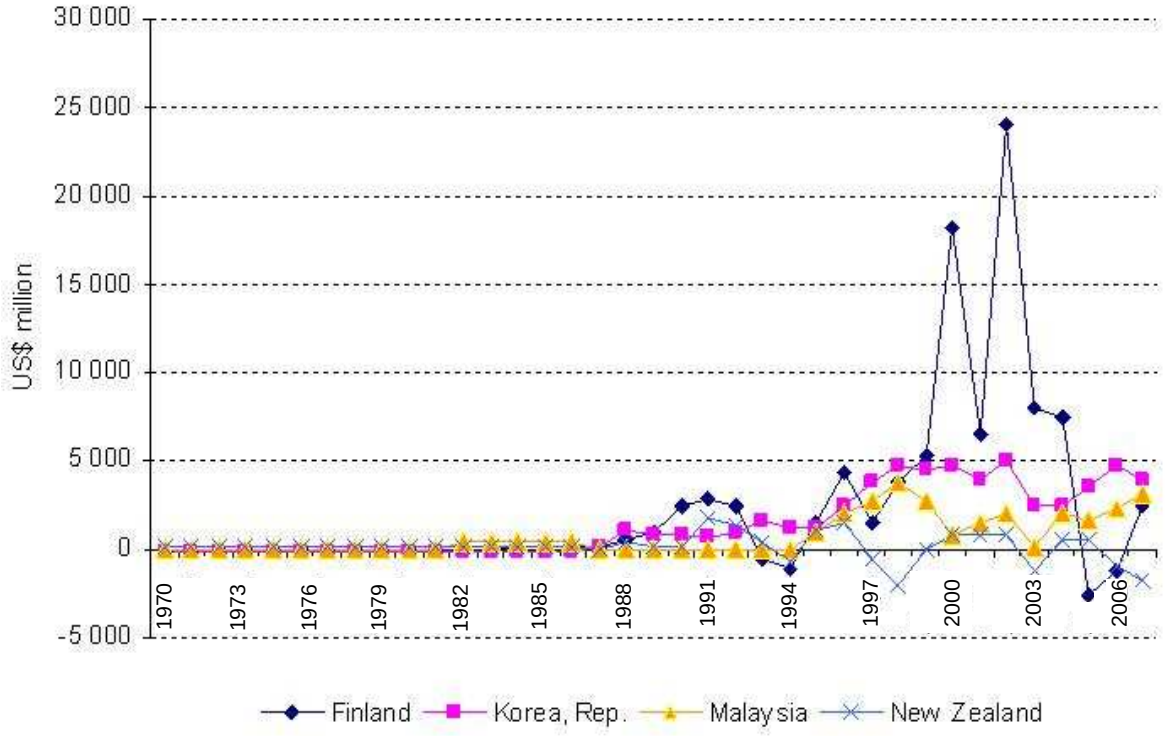
However, the general trend towards internationalization has over the last decade distinctly increased the growth of both inward and outward direct investment in Finland as a result of corporate restructuring on both a domestic and a global level (see figures 13 and 14) (Oinas, 2005).

FIGURE 13
FDI INFLOW, 1970-2005



Source: ECLAC database, 2005.

FIGURE 14
FDI OUTFLOW, 1970-2005



Source: ECLAC database, 2005.

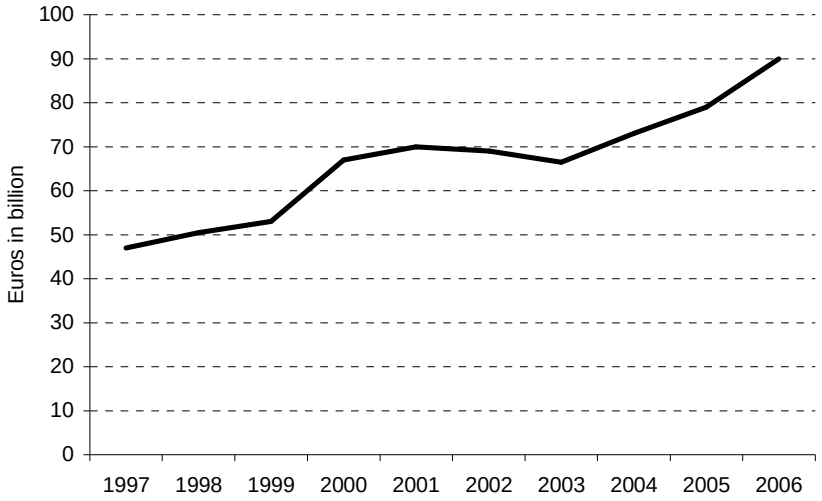
2) Trade liberalization

Finland's industrial renewal has benefited from the government's liberalizing trade and the lifting of the remaining restrictions on capital flows in the 1990s, which promoted investment in general and the inflow of foreign capital in particular. It is important to note that these developments in industry were essential to the Finnish ICT-driven path toward the knowledge economy. These developments resulted from the increased investments in R&D (Luukkonen & Palmberg, 2006).

Trade statistics also reveals the transformation of the Finnish economy into an export nation. According to the annual statistics presented by Statistics Finland, the current account surplus amounted to about 10 billion Euros, which represents just fewer than 6 per cent of GDP. The current account surplus is still to a large degree generated by goods exports, but in recent years the services account has also recorded a surplus. Nearly 70 per cent of the receipts and expenditure on the current account continues to be derived from trade in goods.

In current account terms, Germany and Sweden have traditionally been Finland's main trading partners. In recent years, Russia has become Finland's third important trading partner. However, the fastest increase in 2006 was seen in the trade with China. Where financial assets are concerned, the European Union accounts for almost 80 per cent of the investment stock, while the shares of individual countries vary by type of goods (Statistics Finland).

FIGURE 15
CURRENT ACCOUNT DEVELOPMENT
(In billions of Euros)



Source: Statistics Finland.

As mentioned, Finnish manufacturing has gone through a relatively large structural change over the past couple of decades. The volume of electronics industry exports, in particular, grew very rapidly during the 1990s, and the industry is now Finland's largest exporter, surpassing the country's traditional number-one export, forest products (see figure 17).

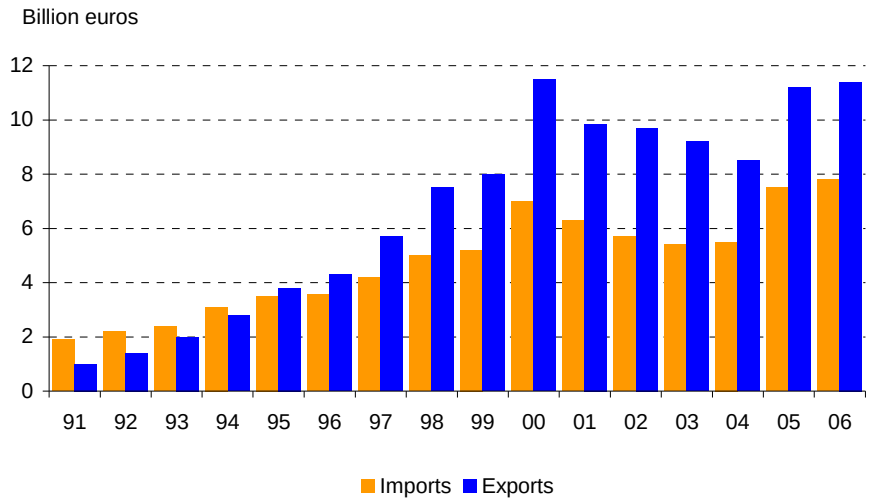
This structural change has also been reflected in export prices. Export prices usually fluctuate in raw material commodity manufacturing according to the state of the business cycle. When international demand is high, export prices go up, and vice versa. In the rapidly growing electronics industry, however, export prices tend to fall steadily per quantity and quality unit, as R&D activities enhance the quality of new products.

The international cost-competitiveness of the electronics industry has developed well, despite falling export prices. One of the reasons for this has been that the growth of labour productivity in the industry has been the fastest of any sector in Finnish industry. The cost-competitiveness of the paper industry has also developed more rapidly than the industrial average (Ministry of Trade & Industry).

Finnish exports of high technology products remained on level with the previous year in 2006 when their value was almost EUR 11.2 billion (see figure 16). Asia's importance grew as Finland's trading partner in high technology in 2006. However, Russia remains the main export partner in terms of high technology products (Statistics Finland).

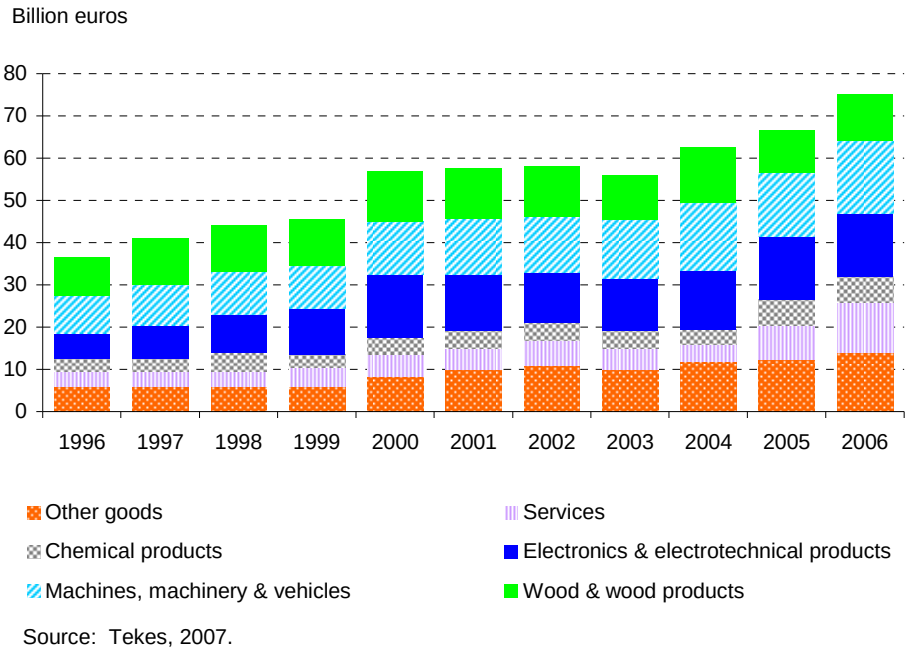
A comparison between Sweden and Finland in the area of high technology foreign trade (both exports and imports) between 1981 and 2000 reveal that Sweden increased its high technology share by 40 per cent over the stated time period compared to an increase of 250 per cent in Finland (Gergils, 2006). In other words, 20 years ago Sweden was by far the more successful of the two, while Finland now is slightly ahead.

FIGURE 16
TRADE IN HIGH-TECH PRODUCTS
(In billions of Euros)



Source: Tekes, 2007.

FIGURE 17
EXPORTS BY INDUSTRY
(in billions of Euros)



Source: Tekes, 2007.

B. Industrial and business strategies

In the 1990s Finland managed to change its industrial structure from being raw material-, energy-, capital-, and scale-intensive to knowledge-intensive based. This transformation took less than a decade and illustrates one of the few cases of how knowledge can become the main incentive for economic growth. During this period, Finland also became the most ICT-driven economy in the world.

However, there was no underlying master plan aiming at achieving the extensive structural change and growth of the ICT sector. Instead, the following emphasis shift occurred during this period:

- From separate science and technology policies to an integrated approach,
- from macro-oriented structural policies towards long-term micro policies,
- from selective and target-oriented policies to ones targeting the business environment.

The emphasis on a systemic view towards policymaking since the 1990s, placing education, R&D, and innovation at the centre of industrial policy and viewing the concepts of a national innovation system and industrial clusters as fundamental policy outlines, has greatly contributed to the successful Finnish transformation.

Early approval of a systems view of industrial policy was a crucial factor of the Finnish "model". An important characteristic of this view is that it acknowledges the significance of the interdependencies existing between research organisations, universities, companies and industries as a consequence of using knowledge as a competitive advantage. In particular, this was the case for small, open economies with a well-developed welfare system. Nevertheless, the systems view is far from a "master plan" where the government plays a leading role. Instead, the systems view has been used for stressing responsive, longer-term policies aimed at improving the general framework conditions for companies and industries. This especially applies to knowledge development and diffusion, innovation, and industrial clusters which have been formulated through public-private partnerships involving economic research organisations, industry federations, and companies, and based on a wide-ranging economic policy framework. From the late 1990s, practical policymaking focused on facilitating better coordination between the actors involved in the innovation system in order to correct system failures.

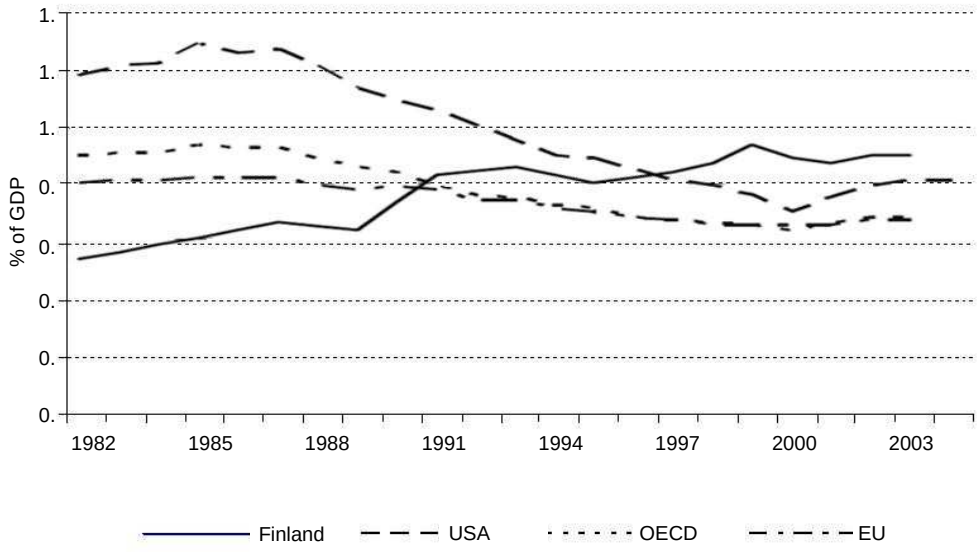
In this context, the Science and Technology Policy Council and the Economic Council played a vital part in defining broader guidelines. Moreover, the more specific content of new industrial policy is the responsibility of the Ministry of Trade and Industry (MTI). The white paper *National Industrial Strategy for Finland* published in 1993, was very important since it reshaped industrial policy towards "industrial clusters".

Cluster thinking was largely compatible with new growth theory in highlighting the significance of human capital and knowledge spillovers. It represents a broad framework that emphasises the establishment of complex production factors, which is well synchronised with the concept of the national innovation system (NIS). Indeed, the early implementation of the NIS concept as a general framework for S&T policy enabled the fast diffusion of cluster and cluster analysis in industrial policy.

The new policy recognized the potential of ICT although the breakthrough of Nokia and other Finnish ICT companies occurred a few years later in the mid-1990s. In the Science and Technology Policy Council triennial review in 1996, this was further expanded through the use of knowledge-economy concepts. The breakthrough of Nokia further strengthened the importance of R&D funding in a knowledge economy.

An example of the shift from macroeconomic to microeconomic policies with a long-term perspective can be seen in the absolute increase in public R&D expenditure throughout the 1990s. Additionally, it also assisted industry's increasing R&D expenditure, and displayed the swift development of ICT as the third pillar of the Finnish economy by the late 1990s. As illustrated in figure 18, the Finnish government, and the Science and Technology Policy Council as a policy creator, kept their commitment to continue to increase R&D funding despite the recession in the early 1990s, and the fact that most other public expenses were reduced.

FIGURE 18
GOVERNMENT-FINANCED INTRAMURAL EXPENDITURE ON R&D (GERD)



Source: OECD Main Science and Technology Indicators.

From the 1990s, shifts have taken place in the Finnish industrial policy which contributed to the successful transformation to a knowledge-intensive ICT-driven economy. It is possible to identify three main reasons for this:

- The close integration of science, technology, and innovation policies,
- the early adoption of a systemic view to industrial policy,
- the Finnish approach to implementing cluster policies, not by picking the winners or creating and planning clusters, but rather by following a broad-based type of cluster thinking in devising national industrial policies.

An important lesson from the Finnish case is that industrial policy must have a long-term strategic outlook. In addition, policies must be consistent over the long-term and not governed by short-term political considerations. The Finnish Government acted forcefully during market failures in R&D and education for instance, and communicated a shared vision of future emphasis without disturbing a well-functioning market. The government assumed the role of a facilitator and coordinator in its attempt to raise the innovation and economic growth (Ylä-Antilla & Palmberg, 2007).

1) Business structure

The lifespan of large Finnish companies indicate how corporate activities have adapted to social and economic changes, while firms have participated in changing society at large. Most of today's large industrial corporations were established in the late 19th or 20th century. Finland's 30 biggest industrial companies are on average over a century old (Fellman & Lindholm, 1996). Hence, this is in line with the Swedish corporate structure; however, this is where the resemblance more or less stops.

Many industrial companies were originally established by trading houses. Finland's industrialization was financed by capital generated through domestic and foreign trade. In the late nineteenth century, a company operating in a small town had to set up its own shop, mill, and brewery, sawmill and brick works to order to operate and expand. This is the root of the branching out into many sectors that was so typical of Finnish industrial companies until the 1980s and early 1990s (Fellman & Lindholm, 1996).

Another reason for this diversification was acquisition of forests. Wood processing companies bought iron works that owned large areas of forest, and which were developing or developed into machine shops. Forest companies also set up manufacturing facilities to make use of their by-products or to ensure their supply of chemicals for paper manufacture. This gave birth to both the multi-branch conglomerates and the entire national forest industry complex (Fellman & Lindholm, 1996).

The 1980s ended the growth of these giant multi-sector corporations. Along with a wave of mergers, companies shifted from broad diversification to concentrated core operations. As a consequence few major corporations have remained in their original business sectors or locations. All have changed significantly as the result of acquisitions, entering new fields or exiting from old ones (Haukes & Smith, 2003). Thus, the Finnish corporate structure experienced a basic turmoil, which continues in the new millennium. The forest industry, for instance, is controlled by three large corporations (UPM-Kymmene, StoraEnso and Metsäliitto) which all have grown into multinationals. While the forest products companies have become bigger and fewer, the textile and apparel companies have disappeared from the list of major corporations. In the early industrialization and post-war years, they played a significant role in Finland's industrial structure (Haukes & Smith, 2003).

Also the number of banks rose rapidly in the late nineteenth century and during the period between the wars. Furthermore the banking sector has undergone bigger upheavals than others (Fellman & Lindholm, 1996). Recent developments have led to strong concentration, with the merger of the nation's two biggest banks and the birth of a Nordic bank, Nordea.

In Finland, 3 of the 10 largest companies were majority state-owned as late as in 1998; however state ownership has decreased over the last decade. State ownership still occurs, but then mainly in metals and mining, chemicals, and utilities as well as Finland Post and the Finnish State Railways. These companies do not receive subsidies or special treatment, and private companies are not excluded from these sectors (with the exception of Alko, the state's monopoly on liquor (sales) (Ojala, Eloranta & Jauala, 2006). Sonera, a telecommunications company, was the largest state-owned company in 1999; however the company has now become privatized and merged with formerly Swedish state-owned telecommunication company Telia. Hence, total state ownership has become rare.

Compared to Sweden, both Finland, Denmark and Norway exhibit fewer large enterprises (Schröter, 1997). At the same time there is a lack of innovative small and medium-sized firms. This has been identified by the European Trend Chart (2003) as a weak point in the Finnish innovation system. Furthermore, Finland remains relatively averse to risk-taking, and needs to do more to provide a supportive climate for entrepreneurship. According to the Global Entrepreneurship Monitor (GEM) 2001 report, the Finnish public attitude towards entrepreneurship is positive: people think there are many opportunities to start new businesses and believe they have the required skills and competence. However, the motivation to start new businesses is low.

2) The Finnish tax system

Taxes are the Finnish government's main source of revenue. However, both the OECD and the International Monetary Fund (IMF) have urged Finland to cut its income tax to encourage employment. Corporate taxation is on the other hand only 26 per cent, giving Finland one of the lowest rates among OECD countries, along with Sweden. The tax rate was conversely lowered from 29 per cent on the 1st of January 2005 (KPMG, 2005).

One of the reasons for the lowering of corporate tax levels was that Finland faced tax competition especially from its close neighbours Sweden and Estonia. Lower corporate tax rates abroad, combined with lower labour costs, have driven companies to reconsider their residence. The Finnish Government therefore was under pressure to adjust the taxation system to keep the best professionals and companies in Finland (Kiesi & Vilppula, 2003).

Although, according to the GEM (2001), even after the corporate tax reduction the Finnish taxation system still does not provide effective incentives for entrepreneurship. The main problem is the big gap between corporate and personal tax rates. Changes such as family firm succession situations and

other changes in the status of ownership of the business might create problematic situations for entrepreneurs if they fall into this gap between corporate and personal income tax.

Moreover, during the growth period of a new business, practically all income from the company is treated as the entrepreneur's personal income, which is taxed at a lower rate than the corporation tax at relatively low levels of income. This practice eases the tax burden of the very smallest firms were firm incomes normally are low. The situation is rapidly reversed if the firm grows and the tax changes into the higher capital gains corporate tax rate. This causes a disincentive to expand businesses.

Like Sweden, Finland presently does not apply preferential tax treatment to R&D. It is believed that tax-based R&D support does not give the opportunity to direct business R&D into areas with potentially high social returns. In the late 1980s Finland allowed a deduction of tax for R&D expenditure, but after a couple of years of experimentation the tax scheme was abandoned. However, an interest in tax incentives has increased in Finland in recent years. The topic is now under reconsideration, and a special study on advantages and disadvantages of tax incentives for R&D has been started. Finland has a tax regime for foreign experts, not exclusively for foreign researchers. A foreigner working in Finland may qualify for a special tax at a flat rate of 35% during a period of 24 months if he receives any Finnish-source income for duties requiring special expertise and earns a cash salary of EUR 5,800 or more per month. This law applies provided that the expert has not been resident in Finland any time during the five preceding years. This system is advantageous to employees with high salary. It has been mainly applied to a small group of foreign experts employed by firms, much less if at all to researchers employed by universities and government research institutes (National Board of Taxes, 2006).

Notwithstanding the above, GEM (2001) views that the overall legal and fiscal environment in Finland is relatively favourable to private equity and venture capital companies.

3) Seed capital

The level of investment in terms of seed capital in Finland is approximately 40 million euros yearly. Target groups for seed fund management companies are primarily firms in their very early stages, spin offs, research-based companies, inventions, entrepreneur teams and other innovative and know-how intensive start-ups. The means of funding varies from equity investments, loans, grants and a combination of the three, however no tax incitements.

The Finnish private equity and venture capital market has experienced considerable growth in terms of both investors and operations. Despite a downturn in international economics, the Finnish private equity industry has remained vital. Government agencies have pioneered the Finnish private equity investing. At the end of the 1990s many private management firms had become prominent players. Today, the private sector accounts for most of the market. The public sector is focusing mainly on seed financing and in rescue or turnaround.

In Finland, lots of work has been done in order to improve the seed capital market. The market has been actively built up and several support services and systems have been developed in order to stimulate the start-ups and their networks so that venture capitalists become interested. One system for this is the development of business incubators; in addition there is the government agency Sitra's Intro program which has been able to increase the number of business angels, which now have significant amount of investments.

The seed capital market is divided between different actors, public and private. The role of the public sector in seed capital market is nonetheless the most significant. In 2004, the role of the public sector was once again quite significant in the seed stage companies where public actors invested 85 per cent of the total 12.7 million euros. In 2004, public sector investments made up approximately 9 per cent of the total amount invested and were quite evenly divided between initial and follow-on investments.

The main seed phase financing sources in Finland are four government organizations: SITRA, which has different kinds of support programs; TEKES, which offers own capital, loan and R&D subsidies; and TESI and Avera, which have own capital instruments. Meanwhile, Innofinance, a private

organisation, acts as a fund manager and there are the aforementioned business angels, which have approximately one-third of the market.

4) SME policy

SMEs in Finland are enterprises with fewer than 250 employees. In 2002, 99.7 per cent of all Finnish enterprises were SMEs. On this basis, SMEs accounted for 62 per cent of the employment and contributed to 52 per cent of the total turnover in the business sector.

A significant majority of Finnish SMEs in the small category and it is therefore claimed that a more growth-oriented focus is necessary for start-ups. Moreover, international studies illustrate that there exist few barriers for entrepreneurship, and it is rather the success of large enterprises which might explain the current enterprise structure in Finland.

Finland altered its policy in 2000 from a specific SME policy to an enterprise policy with the launch of the Entrepreneurship Project, initiated by the Ministry of Industry (MIT) and Trade (MIT). It consisted of 130 measurements which aspired to boost start-ups, growth and the competitiveness of enterprises.

The former government in Finland carried out four new horizontal and inter-ministerial policy programs. One of the programs was the Entrepreneurship Policy Program (2004-2007), which was a fundamental element of the government's economic and industrial policy. The Entrepreneurship Policy Program was administered and coordinated by (MIT), under the supervision of a ministerial group. Additionally, eight ministries, business organisations and other stakeholders contributed to monitoring and identifying necessary reforms and improvements of the program. The motivation of the government was to safeguard the performance of the market economy and enhance the society's understanding of enterprises and entrepreneurs role as facilitators of growth and employment.

In order to meet these aims, further improvement and of conditions to promote entrepreneurship are required (OECD, 2005).

In Finland, recent reports has emphasised the need to direct R&D funding to growth-oriented enterprises as well as the significance of internationalisation of enterprises. The government's recent Entrepreneurship Policy Program (2005), has failed to place the internationalisation of SMEs very high on the agenda. In addition, the policy aims of attracting external capital and skilled labour, has not been emphasised in the political agenda. See Appendix 5.

5) Public procurement

As described in the introduction to this section public procurement, unlike Sweden, does not have a strong profile in the Finnish economy. According to Edquist, Hommen and Tsipouri (2000) this is perhaps related to the lack of a significant defence sector. Nevertheless, the main policy rationale for the public procurement, including public procurement of new technologies, has been to increase the domestic content of procurement orders as substitutes to imports, and thus contribute to job creation and the protection of infant industries (Edquist, et al., 2000). An interesting feature of Finnish procurement has been the establishment of a set informal institutions and monitoring committees with the purpose of assuring that bigger orders are given to domestic producers. However, at the same time as there has existed this infant-industry argument, Finland has been a keen advocate of free trade agreements. Moreover, with the entry in the EU in 1995, the final arguments in favour of protecting domestic industry were removed (Edquist, et al., 2000).

Public technology procurement does have a presence in industrial development. The best example is the cooperation between Nokia and the Finnish PTT telecommunications firm (today part of Telia-Sonera). The important role of the PTT originates from the fact that this publicly-owned company has been an important producer and network operator in Finland's telecommunications sector. Additionally, the company was a key client for Nokia's products. Consequently, government bodies played the role of a demanding customer for goods that ultimately served as prototypes of exportables (Paija, 2001).

III. How contemporary innovation strategies developed

Entering a phase of innovation-driven development presumes interaction between several factors. High social cohesion, a consistent and predictable policy environment, sound basic infrastructure, networking, as well as an efficient legislative and juridical environment are all necessary preconditions. While these were all in place in Finland before the boom, the key factors were raising investments in R&D and a strong commitment to education.

The decision to establish innovation promoting policies was especially important for the private sector where R&D had been found to be low in international comparisons. Gradually, the emphasis shifted from more science and university-based policy, to technical applied research, technical faculties, research institutes and firms (Oinas, 2005). The Finns themselves consider that their innovation system has been "imported" from other countries which have acted as role models, while at the same time there has been adaptation to the conditions prevailing in the country itself (Gergils, 2006). Hence, by absorbing impulses from abroad Finland has developed its own, unique innovation system.

The emphasis on improving the country's technological base had been already initiated in the 1980s by the government, with the creation of the National Technology Agency and the Technology Policy Council, coupled with the founding of technology centres and science parks located around Finland's universities. During this period, Finland became the first European country to state knowledge intensity and technological dominance as its main strategic policy aim. This push towards a technology-orientated economy was enabled by a strong private-public consensus.

As mentioned, only a little more than a decade after the deep economic crisis of the 1990's, Finland is now one of the most competitive countries in the world. We have already seen that the Finnish innovation system was developed through cooperation between government actors with emphasis on policies to stimulate the collaboration between the business sector, universities, and research centres in R&D performance. Today's Finnish research, technology and innovation policies are characterised by efforts to strengthen international competitiveness, business and technology-driven approaches, continuous growth of research and development inputs, and a proactive position towards internationalisation.

Presently, Finnish policymakers' main concern is to find out how to make more out of long-standing investments in innovation, research and technological advancement, in order to face the challenges of the competitive international climate. Thus far, extensive investments in R&D has not transformed into the expected new innovations, firms, jobs or boosted exports. One of the reasons for why the outcomes are lower than expected despite of the high R&D investment is the low productivity and innovation in the service sector. The improvement of the performance of service sector is now one of the central policy priorities in the coming years.

Notwithstanding these rather somewhat disappointing results, the government has emphasised the importance of further investment in research, technology, education and innovation. The strategies being pursued are reflecting a new focus on a broader approach to innovation, particularly on successful exploitation of capabilities and knowledge (Ahlbäck, 2005).

A. The Finnish innovation system

The Finnish innovation system was developed during the mid-1960s and the mid-1970s into what is currently called the National Innovation System (NIS). It began with the formulation of the science and technology policies which intended to enhance national R&D. The policies are written in the Science and Technology Policy Council's (STPC) semi-annual reports and guided by the 3-year strategies the Council regularly prepares. The strategy is then executed by public institutions such as Tekes and the Academy (Saarinen, 2005).

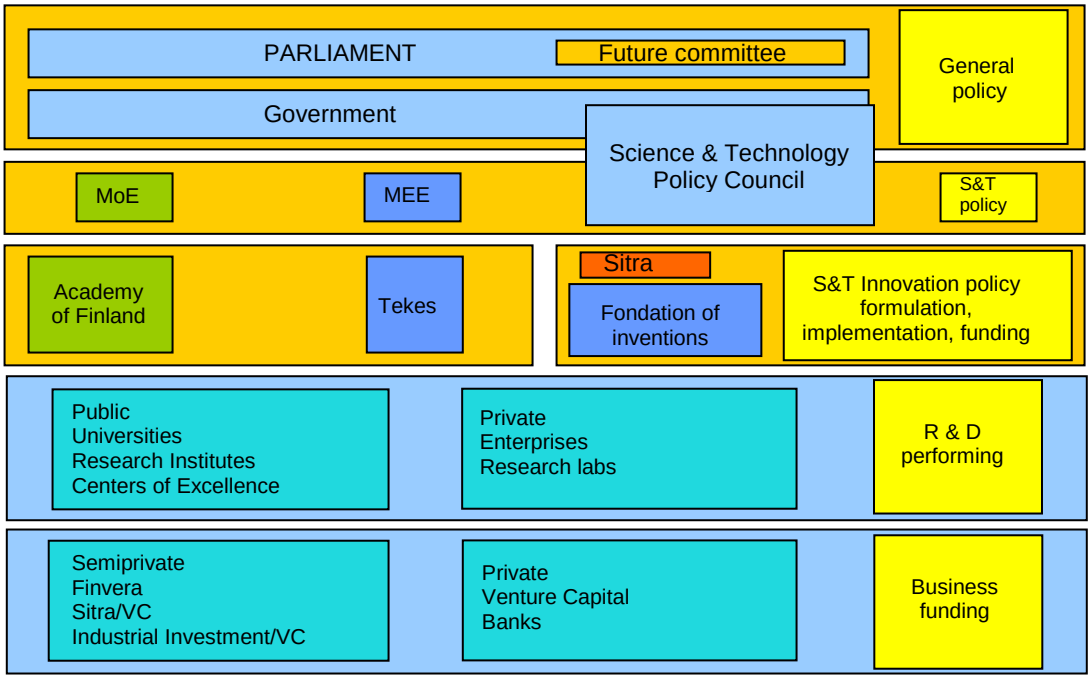
The organizational structure of the Finnish innovation and research system consists of four operational levels (See Figure 18). The highest-level governance takes place at the Parliament and at the National Government. As the general awareness of the importance of research and innovation to the economic growth and national well-being has increased, in the same way the Finnish parliament's interest and involvement in these issues is been growing.

For more than a decade now, regardless of its political composition, the Finnish national government has been active and interested in taking part in science, research and innovation policy issues, and lately even more so. The key document to this end is the Government's Program, approved after the nomination of each government and updated annually via the Government Strategy Document. The Government is supported in matters related to research, technology and innovation policy by the aforementioned high level advisory body, the Science and Technology Policy Council of Finland. The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. As mentioned, the Council prepares 3-year strategies; these moreover give indicative figures for resource allocation.

The second level consists of the ministries. The key ministries with respect to research policy are the Ministry of Education and the Ministry of Trade and Industry. While there is a sectoral division of labor between science and technology policy, over the past years the cooperation has increased significantly between these two ministries in issues related to science and innovation. This is partially due to their similar and joint objectives to promote research funding in government budget, for which their close participation in Science and Technology Policy Council has provided a good platform. The third level consists of the R&D funding agencies, Academy of Finland and Tekes, the Finnish Funding Agency for Technology and Innovation. The Academy of Finland funds basic research 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 university research. This is the level, where research

priorities are factually set, funding decisions (except for the allocations between different ministries) are made and cooperation facilitated. At the fourth level there are the organizations that conduct research: universities, public research institutes, private research organizations and business enterprises. The Finnish research system is rather decentralized, as there are 20 universities 31 polytechnics and 20 government research institutes in Finland (Erawatch, 2007).

FIGURE 19
ACTORS AND TASK OVERVIEW IN THE FINNISH INNOVATION SYSTEM



Source: Author's elaboration.

B. The Science and Technology Policy Council of Finland and the innovation policy

The Science and Technology Policy Council of Finland, chaired by the Prime Minister, advise the Council of State and its Ministries on important matters concerning research, and technology and their utilization and evaluation. The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. It was established in 1987 and continues, with a slightly different emphasis than the objectives and tasks performed by its predecessor, the Science Policy Council, which was established in 1963.

The key tasks of the Science and Technology Policy Council are:

- To direct S&T policy and make it nationally compatible and to prepare relevant 3-year Plans and proposals for the Council of State;
- to deal with the overall development of scientific research and education, to prepare relevant plans and reviews for the Council of State, and to monitor the needs and development of research in the various fields;

- follow up and assess measures taken to develop and apply technology, and to prevent or solve eventual problems involved in this;
- to deal with important issues relating to Finland's participation in international scientific and technological co-operation;
- to issue guidelines on the allocation of public science and technology funds to the various ministries, and on the allocation of these funds to the various fields and Programs;
- to handle the most important legislative matters pertaining to the organization and prerequisites for research and the promotion and implementation of technology and
- to take initiative for making proposals in matters related to its competence for consideration of the Council of State and its ministries.

BOX 4
STRUCTURE OF STPC AND OPERATION

The Chair is the Prime Minister. The other membership consists of the Minister of Education and Science, the Minister of Trade and Industry, the Minister of Finance, and 0-4 other ministers appointed by the Council of State plus 5 permanent government experts. In addition, the membership includes 10 other members well versed in science and technology. These members must include representatives of the Academy of Finland, the Agency for Technology and Innovation of Finland, universities and industry as well as employers' and employees' organisations.

The Council of State appoints the members for the term of the Parliament:

- *Subcommittees: t*he Council has a science policy subcommittee and a technology policy subcommittee with preparatory tasks. These are chaired by the Minister of Education and Science and by the Minister of Trade and Industry, respectively.
- *Secretariat:* The Council's Secretariat consists of one full-time Secretary General and two full-time Chief Planning Officers. They are appointed for four-year terms. Clerical tasks are taken care of at the Ministry of Education.

The full Council has meetings two to four times a year and the subcommittees meet on average ten times a year. The Council also holds joint meetings on an ad hoc basis with other Finnish high-level policy groups and councils, such as the Economics Council or the Higher Education Evaluation Council.

Source: IKED, 2008.

One of the main tasks of the Council is to publish a science and technology policy reviews every third year, which amounts to a national strategy and vision for the development of the national innovation system. The reviews analyze past developments, draw conclusions, make policy proposals for the future and prioritize public expenditure. Most of the strategic recommendations are adhered to by the ministries concerned.

The Science and Technology Policy Council, has also been an important institution for building consensus. Even though the Council has meager resources and is basically an advisory body, it still plays a critical role in the formulation and promotion of basic guidelines for the Government. In addition, it has ensured adequate continuity for science and technology policy from one government to the next. Taking care of framework conditions has been the essence of the Council's contribution. It has provided general support for active science and technology policy across the entire economy. Alongside its main tasks, growing importance has been given to collaborative relations with other societal sectors, such as economic, industrial, labor, environmental and regional policies and social and health care. The Council has also commissioned or otherwise initiated a large number of evaluations from the very beginning of 1990's and is carefully following the operational and structural development of public research. In this respect, the Council works as a supervisory body to the functioning of the Finnish research and innovation system and ensures the quality of its assessments.

C. The major implementing agencies

A big advantage of the Finnish system is to have only two major players, the Academy and Tekes. The cooperation between these two actors is very tight and joint programs are common.

1) The Academy of Finland

According to the Act regarding the Academy of Finland, the Academy is a central agency for science administration and operates within the administrative sector of the Ministry of Education. In 2005, the Academy's funding for research amounted to 257 million euros. The Academy accounted for 14 per cent of government R&D spending. The Academy of Finland in its present form was founded in 1970. The roots of the Academy go further back though. The first state science policy board was founded in 1918, and the first Act regarding the Academy of Finland was issued in January 1939, although enforcement had to be postponed because of the outbreak of war.

a) The tasks of the Academy of Finland are:

- To foster scientific research and its application,
- to promote international scientific cooperation,
- to act as a science policy expert, and
- to award grants for scientific research and other fostering of science.

The President of the Republic may, on proposal by the Board of the Academy of Finland, bestow the honorary title of Academician on a highly distinguished Finnish or foreign scientist or scholar.

FIGURE 20
THE ORGANIZATION OF THE ACADEMY OF FINLAND

Board
▪ President ▪ Chairs of Research Councils ▪ Two members appointed by the Council of State

Research Council *Chair. 10 members*	Administration Office *President*	
	Vice President (research)	Vice President (Administration)
▪ Research Council for Biosciences & Environment ▪ Research Council for Culture & Society ▪ Research Council for Natural Science & Engineering ▪ Research Council for Health	▪ Bioscience & Environment Research Unit ▪ Culture & Society Research Unit ▪ Natural Sciences & Engineering Research Unit ▪ Health Research Unit ▪ International Relation Unit	▪ Administration Unit ▪ Service Unit ▪ Communications Unit ▪ Information Management Unit ▪ Finance Unit

Source: Author's elaboration.

The organization of the Academy consists of internal staff and scientific committees which are nominated periodically and which have duration of 4 years. Outside experts work in the committees to assist the decision making.

The main instruments available for project funding are research grants, research programs, centre of excellence programs and Academy Professor and Academy Research Fellow posts. Virtually all research projects included international cooperation, researcher training and research work abroad.

b) The research support instruments of the Academy are:

- Research grants,
- Research programs,
- Centre of excellence programs,
- Research posts of Academy Professor,
- Academy Research Fellow,
- Grants to postdoctoral researchers,
- Researcher training,
- Other support.

2) The Finnish Funding Agency for Technology and Innovation (Tekes)

Tekes is responsible for the research and development, linking the efforts of universities and industry. Selective project funding is the basis of Tekes operations. Funding and expert services are channelled to business R&D projects run by companies, research institutes, and universities. Tekes encourages cooperation between firms, as well as between differing fields of technology.

Tekes assists companies in their search for ideas, the finalisation of business plans, and their quest to conduct meaningful and valuable research. Tekes adopts an open and proactive approach towards companies' technology planning. Companies are encouraged to contact Tekes' experts in the initial planning stages to formulate their research proposals with the aid of a dedicated Tekes expert. Tekes does not derive any financial profit from its endeavours, nor does it claim any intellectual proprietary rights, these stay strictly with the enterprise that Tekes is working with at that point in time.

Completed project proposals are then evaluated internally by Tekes business and technology experts and then each project is designated a Tekes expert to assist with the project and monitor progress.

Tekes has both application and technology related research priorities. The application focus areas are: renewing products and business models; environment and energy; health and well-being; services; security and safety; and work and leisure. The technology focus areas are selected strategic areas within ICT, biotechnology, materials technology and nanotechnology. Business competence is becoming equal in importance to technology competence (Tekes Annual Report 2005).

BOX 5
STRUCTURE OF TEKES AND ITS MAIN ACTIVITIES

The Board is the principal governing body. The Chair is Ministry of Employment and the Economy. The other 9 members include 2 representatives of Tekes and 7 from each of the major stakeholders in the research and innovation system (business, labour, and academia). The role of the board is to formulate strategy and develop plans and to decide the budget proposal. Tekes prepares annually a plan guided by the requirements for execution of the 3-year strategy prepared by the STPC. There is also a strategic management group led by the Director General (see figure 21) for overview of structure.

Tekes organisation matrix consists of separate branches for different support areas: activation, technology programs and project funding. On the other side there are several dedicate branches for different activities: Technology and Research Areas, Regional Network, International Networks and Finance and Administration. Moreover, there is a cross-cutting office for Industrial Branches and Support for Core Processes. Tekes constantly strives to investigate promising areas where extended effort could ultimately lead to greater success. In these cases Tekes implements a technology program specifically designed to gather the best players in the field to work together with the intention of

achieving a common goal. Tekes' way of working has its strong foundations in the carefully defined annual strategy that executes the strategic guidelines laid out by the STPC. The core activities (programs) of Tekes are given in figure 22.

FIGURE 21
STRUCTURE OF TEKES

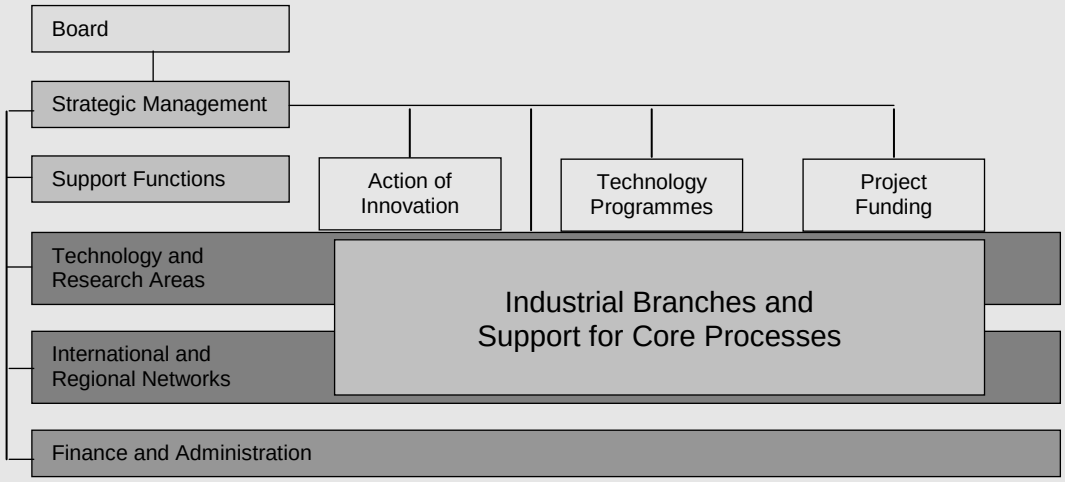
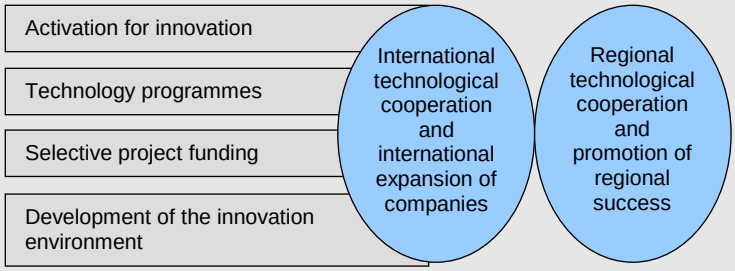


FIGURE 22
CORE ACTIVITIES FOR TEKES



Source: Tekes, 2007.

3) The Finnish National Fund for Research and Development (Sitra)

The Finnish National Fund for Research and Development (Sitra) is an independent funding body directly subordinated to Parliament, which provides venture capital for high-tech business, thus contributing to the development of the new economy in Finland. Sitra was set up in conjunction with the Bank of Finland in 1967 in honour of the 50th anniversary of Finnish independence. The Fund was transferred to the Finnish Parliament in 1991. Sitra's operations are funded with endowment capital and returns from capital investments. The value of this capital is more than 500 million Euros. The organization fills the need on the public side to have an instrument by which to experiment and start new activities without the budgetary delays and political commitments of government to carry them out immediately on a broad front. To do this requires sufficient economic means, preferably an endowment and flexibility in decision making. Sitra's annual budget therefore comes to about EUR 40 million. Sitra has program directors, who are usually experienced industrial managers. It is their responsibility to decide how the programs work, what are the targets and the level of investment.

The fund allocation is managed through the Sitra Matching Service. The Matching Service provides a channel for communication between investors and entrepreneurs. This program helps

companies find a private individual, i.e. a business angel, interested in investing in the company and willing to offer management involvement to develop the business.

4) The Technical Research Centre of Finland (VTT)

VTT was established in 1942 and is presently entirely state-owned. It has become the biggest polytechnic applied research organization in Northern Europe and is integral to Finland's innovation system. The VTT concern is in itself divided into six relatively independent industrial research institutes. Nevertheless the whole organisation has a strong central function with an executive Board appointed by the government. The 7 person Board includes 4 representatives from the private sector, 3 businesses and one from a national engineering association.

By developing new technological solutions and applied technologies, VTT helps its clients to improve their competitiveness. VTT also promotes technology transfer by participating in national and international research Programs and collaborative networks. Nearly 80 per cent of government research funding is channelled through VTT together with Tekes (Cogan & McDevitt, 2003). Total amount of resources for 2007 was 217 million Euros (VTT webpage).

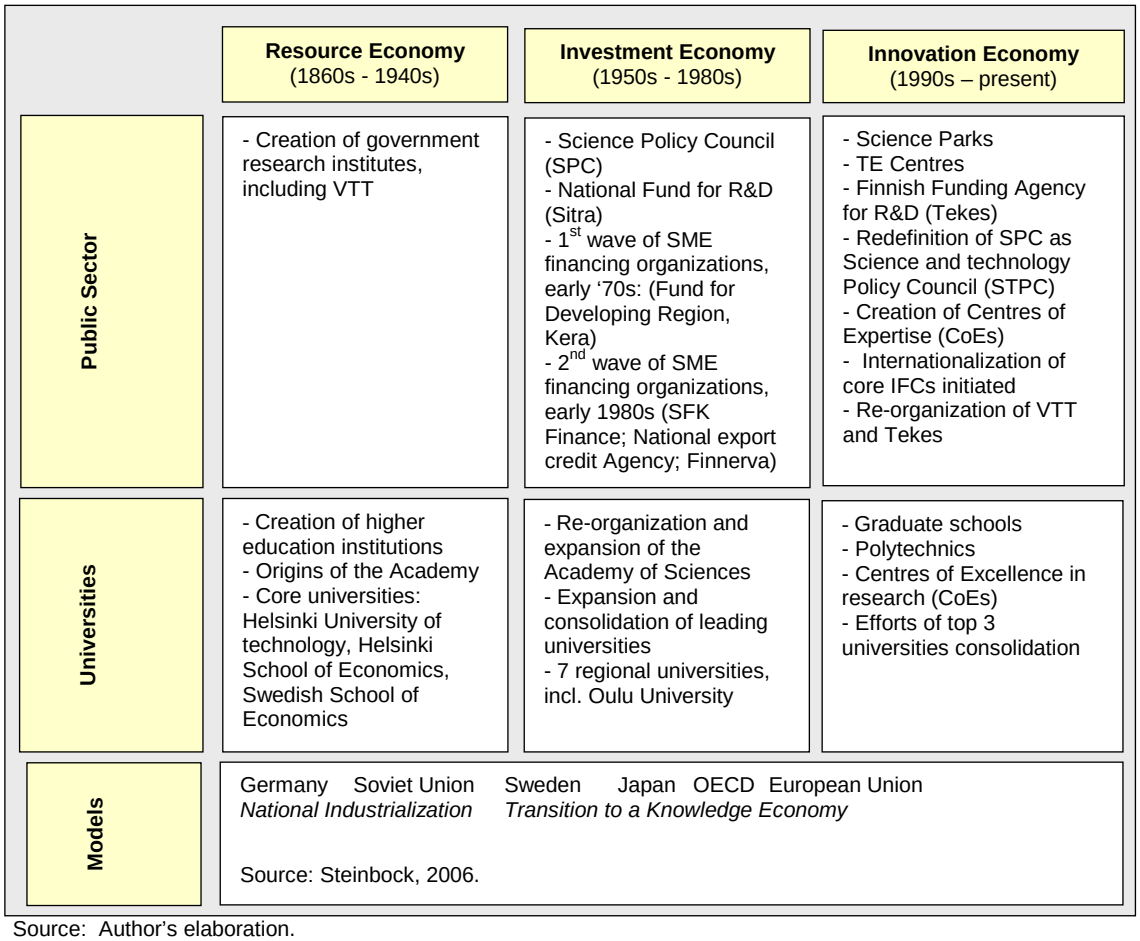
5) Finnpro and Finnerva

Finnpro is involved in encouraging the participation of small companies in internationalisation; Finnvera is the institution on the public funding side. Their aim is to provide funding for SME and thus acts more like a bank. Very little if any of that money is used for R&D. Finnvera has a Board of 10 chaired by MTI con 4 representatives of the private sector (3 business and one labour). Meanwhile, Finnpro has a Board of 8, of which half are from the business sector.

D. Private-public alliance

Public-private alliances are well integrated into the Finnish research system. Public institutional development in support of alliance and a knowledge economy had a relatively early birth in Finland (see figure 23). However, rather than being organized as separate structures, they are part of the governance of the public research system. As has been seen, typical examples include industry representation in the Science and Technology Policy Council and in the board of the Academy of Finland. Also Tekes technology Programs are public-private alliances by nature. Approximately half of Program budgets are financed by Tekes, and the other half by industry. These agencies, in turn, finance and maintain overlapping networks of S&T and R&D activities, including Technology and Entrepreneurship Centres (TE) and Government Research Institutes, Centres of Expertise, Science Parks, Centres of Excellence, and Graduate Schools. The primary clients of all Institutions for Collaboration (IFCs) are SMEs. With government funding, Tekes and TE-Centres provide direct subsidies for the R&D activities of large corporations, which in turn cooperate with SMEs. Critics regard this financing as subsidies by another name, whereas Tekes's argument is that 'flagship companies' provide great opportunities for SMEs via networking and internationalization (Steinbock, 2006).

FIGURE 23
EVOLUTION OF FINNISH INSTITUTIONS FOR COLLABORATION

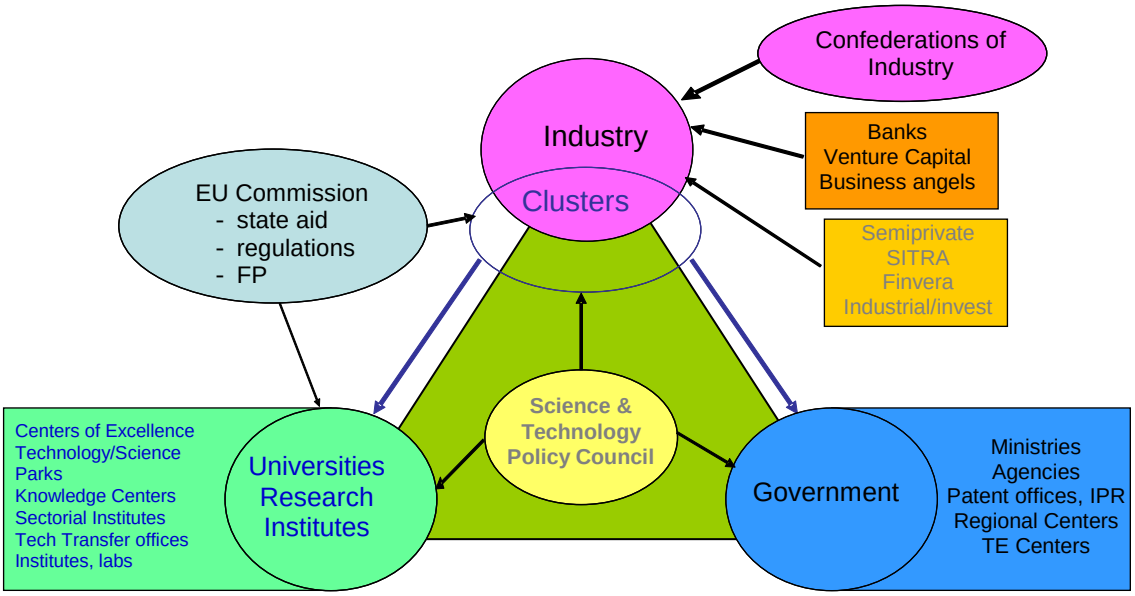


Source: Author's elaboration.

The aim of the cooperation is to improve the relevance of basic and applied research and to focus scarce national resources on the right topics. The point of departure for the cooperation is to consider science and technology as one entity. Basic research and the application of the research results are more and more linked to each other. The effective exploitation of national resources is a prerequisite for a constructive dialogue in the alliance.

The national focus is determined by the STPC, but this is not enough; because of the changing environment there is a continuous bottom up flow of requests stemming form business and social challenges, which must also be addressed. Networking between the public and private sectors in Finland is thus an important element to the country's strong economic performance. This characteristic is internationally recognized. In 2003, about 82 per cent of all corporate projects included an element of networking, the most important of which being co-operation with research organizations. According to Eurostat, Finland makes the most use of networking between industry, academia and research institutes (Foreign Affairs & International Trade Canada, 2005). The "triple helix development" in figure 24 describes the convergence of research in Finland as well as the interactions between the different players.

FIGURE 24
THE TRIPLE HELIX



Source: IKED.

The "Triple Helix" has been a normal working principle since the mid-1980s. The cooperation between industry, academia and administration is strongly guided by the Science and Technology Policy Council chaired by the Prime Minister. The guidelines given by the Council are the backbone for the actions of different operators in the R&D field as well as for financial contributions from state (Kaukonen & Nieminen, 1999).

E. The cluster approach

Finland, as already mentioned, has become known for its clusters, especially in ICT. The cluster approach was introduced by the cluster study coordinated by the Research Institute of the Finnish Economy (ETLA) in the early 1990s. The approach dominated the design of the policy guidelines outlined during 1993 in a White Paper ("National Industrial Strategy") by the Ministry of Trade and Industry (Blomqvist, 2007). Finland's industrial policy is characterised as having "moved from an interventionist policy to a pro-market approach". Direct subsidies to Finnish companies have been reduced and the policy focus has shifted to the creation of "advanced and specialised" factor conditions. Finland's main policy approach can be characterised as an increased market orientation through stricter competition policy and the strengthening of cluster factor conditions, in particular on the R&D supply side. Analysts conclude that the main impact on S&T policy has been the reorientation of the science and technology centres to focus on Finland's emerging technological clusters (Ylä-Antilla & Palmberg, 2007).

This cluster approach has been reflected in subsequent government actions emphasising inter-organisational cooperation as well as accumulation and transfer of know-how. The setting for the new industrial policy was characterised by informal communication between the government, industry, academia and the labour market (Ylä-Antilla & Palmberg, 2007). Hence, a strengthening of the Triple Helix. Inter-ministerial cluster programs were launched in 1996 in order to strengthen sectoral research, improve cooperation between different stakeholders and spur economic relevance for industry,

employment and competitiveness. This resulted in a shift of focus from Ministries such as Agriculture, Health, Environment and Traffic in transferring significant amounts of non-earmarked R&D outflow away from free projects towards these cluster programs. Although the coordination of these programs is the responsibility of a division within the host ministry, the planning, administration and funding of the programs attract a wide range of stakeholders such as Tekes, the Academy of Finland and the private sector, collecting competitive research funding to implement shared research programs.[2] The role of the Science and Technology Policy Council of Finland is then to advise and guide the Council of State and its Ministries on how to best develop these cluster programs (www.Tekes.fi).

Industrial associations acting as influential intermediaries between the industry and the public sector are other institutions with a significant role in the Finnish policy arena. However, the major role in the cluster-policy implementation was the government's commitment to R&D funding (Kaukonen & Nieminen, 1999).

Consequently over the years, the extension and strengthening of network co-operation has become one of the key elements in the development of the Finnish innovation system. A number of projects and initiatives have been created to promote the transfer and utilisation of knowledge.

F. Cooperation programs

Cooperation through research and technology programs is one important avenue for the development of Finnish national innovation system. Cooperation has paved the way to ever wider national research and technology programs and program clusters. Most of the national research and technology programs in Finland are funded and administered by the Academy of Finland and Tekes.

The Academy of Finland has been involved in research programs for strengthening national and international cooperation. The aim of cooperation is to promote interaction between basic and applied research and between technology and product development; to increase multidisciplinary and interdisciplinary research; to make sure that research programs can build up a sufficient critical mass; to avoid overlap in research funding; to intensify the exchange and transfer of information between different actors in the field and to step up communication about and utilisation of research knowledge.

The different programs which are aiming at the development of long-term oriented networks between innovative enterprises and public science institutions are Cluster Programs, Centres of Expertise, Technology Programs, and National Centres of Excellence.

"National Cluster Program" is the generic term for a group of programs with similar focus initiated by different ministries. Cluster programs were formed to support the R&D that strengthens industrial clusters in Finland, by allocating funds for their development. The aim of these clusters was to transfer and accumulate knowledge in chosen fields by promoting co-operation among various actors, including both the producers and users of knowledge. They also aimed to break boundaries between different sciences and fields and thus promote new innovations.

Technology Programs are used to promote development in specific sectors of technology or industry, and to pass on results of the research work to business. The Technology Programs are planned in co-operation with companies, research institutes, and Tekes. Tekes programs are becoming more and more industry-driven (see Box 6).

Centres of Excellence aim to establish the basis for the emergence of creative and efficient research and training environments that can generate top international research. In addition, they have the objective of raising the quality of Finnish research and to improve its international competitiveness, visibility and reputation. The aim is to create an information base required for cultural, social and industrial development, and to establish a solid base for a national innovation system.

Centres of Expertise aim to enhance regional competitiveness and to increase the number of high-tech products, companies and jobs. To achieve this goal, the program will be used to implement projects

[2] http://www.csta-cest.ca/index.php?ID=393&Lang=EN.

reflecting the needs of industry encourage industry, research and training sectors to co-operate, ensure rapid transfer of the latest knowledge and know-how to companies, exploit local creativity and innovation and enhance networking between the parties of regional development. The program offers catalytic seed capital for networking and development projects. The State Audit Office's evaluation considers the Centre of Expertise Program as a top act in Finnish Regional Policy.

There also exist a number of joint programs from other institutions, which contribute to the goals set by the Science and Technology Policy Council. Many of these public-private partnership programs are designed to create cooperation among actors at the regional level; this is especially true concerning university-private enterprise cooperation.

BOX 6
THE NATIONAL TECHNOLOGY PROGRAMS

The main focus of Tekes is on the National Technology Programs. They have played a central role in improving the performance and competitiveness of the Finnish industries. Tekes uses technology programs to allocate its funding, networking and expert services to areas that are important for business and society. Tekes launches programs in areas of application and technology that are in line with the policies outlined in Tekes' strategy, which in turn takes into account the plans of the STPC. Tekes allocates approximately half the funding granted to companies, universities and research institutes through technology programs. The allocation of funding is Tekes' internal decision, which can vary annually. Tekes technology programs have been contributing to changes in the Finnish innovation environment for twenty years.

There is a difference in funding regarding the basic and applied research programs. The basic research programs financed by the Academy are selected in cooperation with the universities and assessed in peer reviews, usually by foreign experts. The National Technology Programs run by Tekes are selected in cooperation with universities and companies. The assessment is carried out internally by the Tekes expert staff. Approval of the topics and funding decisions is made by the board of Tekes where the ministries, universities and research institutes have their representation. The funding is allocated only to legal persons, not individuals. The legal persons (companies, institutes, universities) are responsible and accountable according to the legislation concerned. In the case of programs a consortium is usually formed where one entity will take the responsibility to manage the program. Each program also has a steering group responsible for the content and a manager, who is responsible for running it. The funding will take place annually after Tekes receives an annual report. Payments are made after the reporting and collection of bills. Only universities may receive payment in advance.

The technology programs consist of research projects by companies, universities and research institutes, plus services that support companies' business operations, such as shared visions, seminars, training programs and international visits.

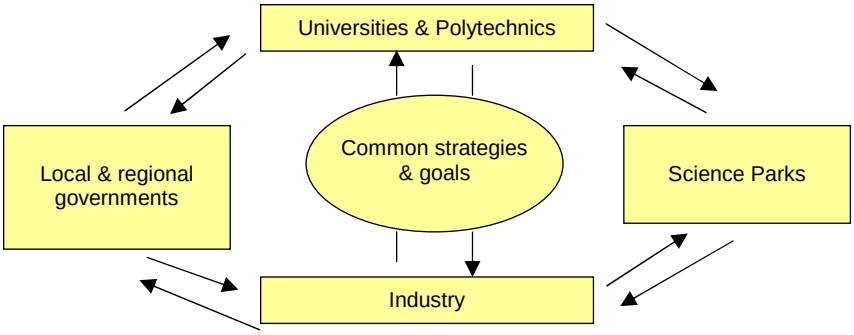
The technology programs provide opportunities for companies to network and develop business expertise and skills in international operations. In the programs they receive Tekes financing for developing products, production, service concepts and business expertise, and also the very latest information about different areas of technology and business.

Source: Author's elaboration.

G. University cooperation and links to private interests

The Finnish science parks have been established in close proximity to the universities, to create strong knowledge and innovation clusters. The science parks in turn are homes to industrial companies and research units as well as different kinds of private, semi-public and public service organisations. The Finnish Science Park Association (TEKEL) was founded in 1988. TEKEL is a networking agency between the different science parks. It has 22 member centres, each with their own general technology. These centres are known as Centres of Excellence (CoE). (www.tekel.fi). The CoE programs are implemented through cooperation between industry, local government, technology centres, universities, polytechnics, research institutes and other organizations of public administration.

FIGURE 25
STRUCTURE OF THE REGIONAL CENTRES OF EXCELLENCE



Source: Author's elaboration.

One main purpose of the programs is to bring leading experts in research, education and industry in a region or network into close interaction within one specific field. The benefits of the synergy are improved innovation environment and regional development (Ahlbäck, 2005).

The task of technology transfer companies set up within the science parks is to promote the commercialisation of research results from universities and research institutes. The companies help their customers in evaluating new research results, patenting procedures, licence negotiations and also help SMEs and start-ups in business development and marketing. A task similar to the technology transfer companies is conducted by industrial liaison offices and innovation centres. Despite the fact that not all universities are located near a science park, at least all universities have some form of industrial liaison offices and run innovation centres. In this way the university sector attempts to promote research and technology transfer by helping researchers in applying for external research funding, drafting contracts and managing research projects. The many technology incubators situated in the technology centres and science parks offer various services for start-up companies to develop and more established companies to grow and internationalise. Incubators get their backing from a variety of organisations in the public sector, large and medium sized companies as well as business associations (Ahlbäck, 2005).

IV. Implementation strategies for innovation promotion

A. How implementing activities are coordinated among agencies

The Science and Technology Policy Council is chiefly responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. Furthermore it develops 3 year outlines, or strategic plans, for how the innovation policy should be formulated. Nevertheless, the Council gives only, albeit very influential, recommendations – not orders. Each ministry and government authority must implement the recommendations to their best capacity and judgement.

Much of the prerequisites of the good functioning of the Finnish research and innovation system are created within different policy sectors. The main ministries responsible for research and innovation policy are the Ministry of Education, which is responsible for science policy and the Ministry of Trade and Industry, which is responsible for technology policy. Over the past years the cooperation has increased significantly between these two ministries in issues related to science and innovation. This is partially due to their similar and joint objectives to promote research funding in government budget, for which their close participation in Science and Technology Policy Council has provided a good platform.

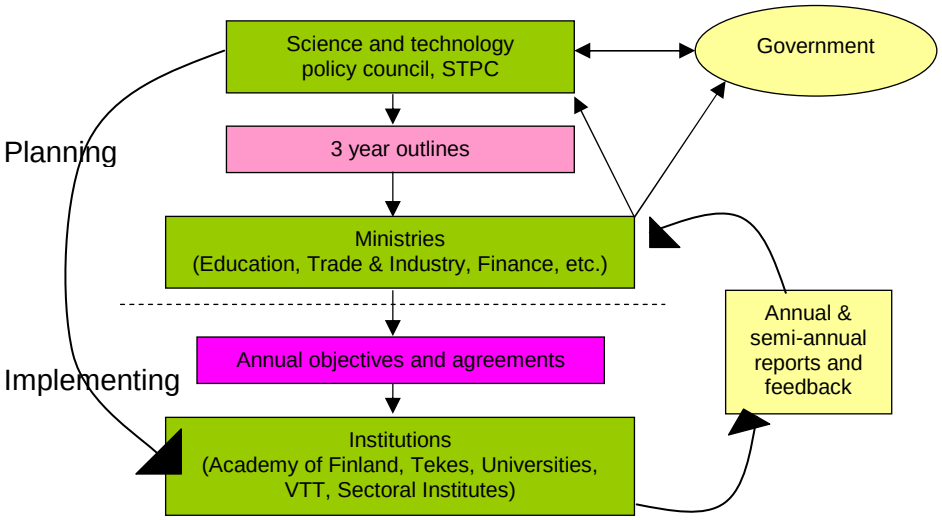
The main responsibility of the Ministry of Education in science policy is to promote the development of basic research and its infrastructure. In the administrative field of the Ministry of Education

are all the universities (20) and the Academy of Finland. The Ministry of Trade and Industry is the second largest research ministry in Finland. Under the administrative field of MTI are Tekes and several research institutions. The second tier research ministries are Ministry of Social Affairs and Health and Ministry of Agriculture and Forestry. The other ministries, in order of their research volume, are Ministry of Defense, Ministry of Transport and Communications and Ministry of Environment.

In terms of the implementation of the recommendations of the Council, the ministries, principally the Ministry of Education and Ministry of Trade and Industry, will conduct detailed contract discussions with their respective implementing agencies; i.e., the Academy of Finland and Tekes.

The annual contract includes the objectives and actions for the coming year and will be followed up three times a year. It is worth noting that after concluding the contract the Ministries are not involved in the day to day work of the agencies; they are given a free hand to develop their contract commitments. The ministries and the agencies that represent the government in the Science and Technology Policy Council will report progress to the council meetings, which are held three to four times annually. The cooperation between the authorities is also reported in the Council. The modes of cooperation are decided by the authorities themselves depending on the needs and topics of interest. There are no instructions emerging from the Council level to the authorities regarding cooperation. Examples of cooperation are given below in the national Programs. Securing the interest of different parties is carried out through the work of the Science and Technology Policy Council where they all are represented. The sectoral ministries (e.g. agriculture, forestry, defence etc.) will follow the recommendations of the Council and consequently propose their R&D needs to the state budget. The final decision made by the parliament. Figure 26 gives a good indication on how activities concerning innovation are processed in the Finnish system.

FIGURE 26
PLANNING AND IMPLEMENTING OF TECHNOLOGY AND INNOVATION POLICY

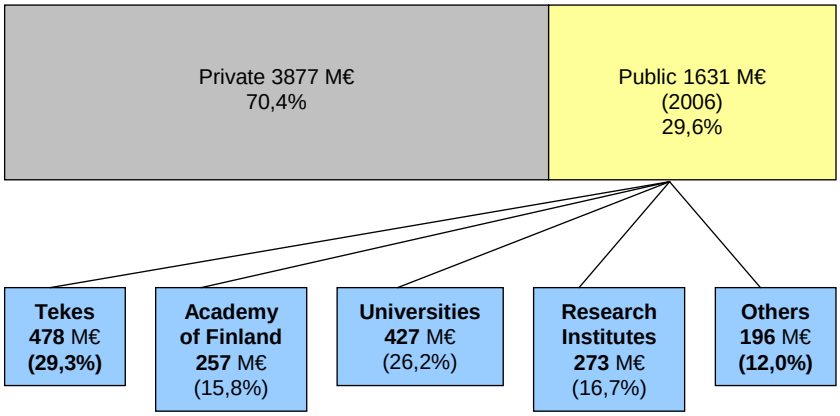


Source: Author

B. Funding

Figure 27 gives an overview of how the allocation of resources is done within the Finnish innovation system. Here one clearly sees that Tekes and the Academy of Finland receives the largest funds, with over 45 per cent of total resources.

FIGURE 27
R&D EXPENDITURES IN FINLAND, 2005
(5500 M€; 3.48%/GDP)



Source: Statistics Finland.

Both Tekes and the Academy funding are project based and fully competitive, whether within the Programs or single individual projects.

The universities receive their basic funds directly through the Ministry of Education. This funding is mainly for research infrastructure, facilities, equipment and the salaries of the staff. The funding from the Academy and Tekes will be used for the research, in few cases for special equipment, travel and salaries of the project staff. A double salary is not permitted for university staff. Only if the management of a project requires considerable extra effort does a university professor receive a small bonus.

The legislation regarding the Academy and Tekes protects the activities in those authorities. However, the main mandates come through the Science and Technology Policy Council, which, as mentioned, is chaired by the Prime Minister. The industrial R&D activity is ensured by the significant amount of money allocated in the state budget. The Science and Technology Policy Council every three years prepare a document which indicates strategic directions and the needs for funding in euros. It is up to the government and parliament to adopt the funding in each year's budget.

Increasingly, public R&D funding is allocated on the basis of competition and progressively targeted to support the R&D and innovation activities of SMEs. Furthermore, there is variety of public support methods that are suitable for supporting international R&D in SMEs. The appropriate Finnish support methods are general and flexible, which means that they can be used for multiple activities. Nevertheless, there is a deficiency of specific policy methods which are aimed at supporting international-based R&D.

C. Evaluation mechanisms

Evaluation activities are extensively and systematically carried out in Finland. Evaluations have focused on research Programs, research organizations, and research funding organizations as well as to some extent on research policy.

The Academy of Finland has carried out evaluations mainly on two levels: at the level of research Programs and at the level of research fields. All research Programs of the Academy of Finland are evaluated against the starting-points of the programme, its objectives and funding volume. The main focus is on the performance of the programme as a whole as well as on the added value it has generated, but evaluations are also carried out at the level of individual thematic areas and projects (Academy of Finland Research Programme Strategy 2003). Research programme evaluations typically focus on the following issues:

- Scientific results of the research programme;
- impacts of the research programme;
- implementation of the research programme;
- preparation and planning of the contents of the research programme;
- funding decisions and coordination.

As for the evaluations of research fields, the focus is typically on the following issues (Valovirta 2001):

- Scientific quality of research carried out by Finnish organizations;
- scientific relevance of future research plans;
- the appropriateness of research methods;
- sufficiency of resources;
- capacity of research groups and organizations;
- interaction with the international scientific community.

Research Councils, the Academy's Board and other funding bodies supporting research have a key role to play in utilizing the results of evaluations. Research Councils make use of the recommendations made on the strength of the evaluations. Based on the recommendations, they draw up an after-care plan for the programme, including proposals on the implementation of the recommendations in so far as they are considered justified (Academy of Finland Research programme Strategy 2003).

During recent years, the importance of evaluating the impacts of research has increased. This is trend is evident both in applied as well as in basic research. The underlying reason for this development is the increased management of public sector organizations based on agreed performance indicators as part of their annual programme agreements. There are increasing pressures also for research organizations to generate evidence of impacts of their activities and related expenditures. Another trend evident in Finnish evaluation practice is the shift from evaluation of individual research projects to impact evaluation at the programme level. Tekes has been particularly active in initiating evaluations that focus on the added value of programme-level activities and services (see Box 7) for the evaluation of a technology programme (Erawatch, 2007).

BOX 7
TEKES: EVALUATION OF PROGRAMS IN ELECTRONICS AND TELECOMMUNICATIONS

Tekes is the agency which promotes companies' innovation. Currently, it annually awards 247 million euros for technological programs in strategic areas, which are identified by the agency and the business community. The electronic and telecommunication sector were favoured with three programs between 1997 and 2001: "Electronics for the Information Society – ETX", "Telecommunications – Creating a Global Village" and the "Telectronics I Research Programme", this last programme being financed by the Finnish Academy. As a whole the cost was 300 million euros.

All three programs were subject to a mid-term evaluation. In many of the cases, the evaluators approved the development of the programs, but raised concerns regarding the programs' clarity in resolving problems of specific technical and trade relevance for Finland. A new assessment was carried out, but now by an external consulting company, two government agencies and an expert panel. The evaluation focused on four questions: the first one referred to the selection of the strategy and research portfolio of the three programs along with its requirement of Finnish economic development. The second question concentrated on the programs' and projects' impacts on the Finnish ICT Cluster. This included the effects on the network and on individual participants. As third question the group assessed the programs' added value and the improvement in their management. Eventually, they explored how the two industry-focused programs could interact with the programme financed by the Academia, which has a more scientific approach.

(continues)

BOX 7 (concluded)

To give an accurate answer to these questions, 7 techniques were employed:

a) Analysis of the networks formed by the project: the Tekes database was used in order to map the links among companies and between them and public institutions.

b) In-depth interviews with leaders of different areas who participated in the projects.

c) An expert panel review: programs' management was reviewed as well as the operation of some essential projects.

d) Strategic interviews of firms in order to test the programs' strategies and evaluate the gap which may exist with respect to the expectations of CEOs.

e) Interviews of project leaders, to examine their opinions about the project operation and the link with companies and public institutions.

f) Analysis of self-evaluation surveys.

g) g) Analysis of foreign programs: four foreign programs' strategies were identified and reviewed in order to compare the programs being assessed with them.

The original questions were answered based on a specific group of methodologies; as can be seen in the following table:

TABLE 4
EVALUATION TECHNIQUES

Object evaluation	Mapping networks	Interview of theme leaders	Peer review	Strategic firm interviews	Project level interviews	Comparison with foreign programs
Strategy and portfolio			X	X	X	X
Effects on ICT cluster	X	X	X	X	X	
Effects on theme groups		X	X	X	X	X
Interplay with telectronics	X		X		X	

This mixed group of methods facilitated a quite complete perspective on the programs' impact on telectronics in Finland. In addition the evaluators were able to formulate several recommendations on the programs' management, the interplay of projects, the necessity to internationalize innovation, and the requirement for further cooperation between the Finnish Academia and Tekes, the latter being the agency responsible for promoting innovation in firms.

Source: Author.

D. Main innovation and policy challenges

The European trend chart on Finland 2006 identified three main challenges for the Finnish innovation system. Firstly, broaden the foundation for innovative growth aspiring businesses. Secondly, raise Finland's attraction for more investments. And lastly, guarantee the creation of globally competitive research and competence.

Nowadays, more competition is emerging in ICT, especially from developing countries in Asia and recent EU member countries. To face these challenges a range of policies and actions are critical in order to protect the country's edge in science and technology. Most important is to continue investments in research, strategic specialisation, facilitating critical mass in selected areas as well as promote internationally competitive clusters of expertise and excellence and substantial international networking. This should be combined with increased international movement of Finnish experts and researchers and intensified attraction of international experts to Finland (see Table 4).

TABLE 5
NATIONAL INNOVATION GOVERNANCE: STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS (SWOT) OVERVIEW

Strengths	Weakness
• Openness and intensive co-operation between actors of innovation system: relatively flat governance system allowing information flows between different actors. • Number of players participating in science, technology and innovation policy making at the highest level relatively small and building on mutual trust and consensus. • Systematic evaluation culture which increases transparency.	• Innovation policy-making remaining within an established circle of stakeholders, which may complicate the move towards more horizontal policy-making. • Number of actors and interested parties participating in implementation of innovation policy in different sectors and at national, regional and local level set a challenge for coherence and effectiveness of innovation policy. • Focus still to certain extent reflects traditional duality between science and technology policy domains even though changes are currently taking place.
Opportunities	**Threats**
• Compensating for the small size and geographical remoteness with active, strategically sound co-operation policy by strengthening collaboration and co-ordination between innovation governance at the regional and national level. • Active participation in the evolving European and international innovation governance structures.	• Inability to carry out truly cross-sector innovation policy, i.e. move from science and technology-focused policy towards broad innovation policy. • Inability to implement recent proposals and recommendations concerning reform of public research structures and innovation

Source: European Trend Chart on Innovation, Annual Innovation Policy Trends and Appraisal Report, FINLAND 2006

The organization of the Finnish State gives leeway and independence to the ministers vis-à-vis the Prime Minister with regard to the political framework of the government's policy programs. Thus, the strength of the innovative governance structure in Finland is visible when examining how the Prime Minister and ministers come together with representatives from technology and science fields; for example, stakeholders and policy makers within their respective areas. This type of collaboration is manifest in the Science and Technology Policy council which clearly demonstrates the straightforward flows of information between the government and private actors. Moreover, the collaboration is further enhanced by the ministerial departments' flexibility to pursue these types of partnerships.

The systematic evaluation culture is also considered to be one of the strengths of the Finnish innovation governance system. Not just policy instruments but also science, technology and innovation support organisations have been under regular evaluation in Finland for a long time. In recent years, science, technology and innovation policy makers have also made conscious efforts to establish interactive intelligence platforms between the decision makers and the research community.

An example of the weakness in the Finnish Innovation Governance system comes forth when looking at the socio-political structure which at times blocks policy formation and implementation. Literature on the subject describes Finland – although being unitary and decentralized – as being fragmented at the same time.

The attempt to deepen the cooperation between the central state administration and private actors is slowed due to the dominant role of ministerial departments. Thus, the main challenge still is to strive to facilitate a more horizontal collaboration process. Failure to truly carry out a cross-sector innovation policy may pose a serious future threat to the system.

It is a widely held opinion that Finland can compensate for the small size and geographical remoteness with active, strategically sound co-operation. Part of this effort is strengthening the collaboration and co-ordination between innovation governance at the regional and national level. A parallel, broader definition of innovation policy with a horizontal approach crossing the boundaries between the administrative sectors in policy making is necessary. At the same time, an inability to carry out a truly cross-sector innovation policy can be considered a threat to the system.

At the supra-national level Finland is an active participant in cross-national cooperation, such as at the EU- level, but also within the framework of Nordic and Baltic States collaboration. This streamlining of innovation and research efforts across countries adds a tremendous strength with regards to innovation. However, there are still quite a few challenges due to the different rate of progress and efforts in each country and the willingness to synchronize these processes. A concrete example of this is illustrated by the mismatch of opinions between the European Research Area and European Research Council initiatives related to Tekes and The Academy of Finland, which are the two most important public R&D funding agencies. Tekes' approach is a cautious one while The Academy has a more proactive stance.

Overall there is a need for a broader cooperation in the innovation field between national, regional and local actors which has led to a multitude of regional and specialised programs that come up with their own innovation structures. These programs would have benefited from a broader cooperative approach. In other words, there is a pressing need for all actors involved in innovation policy to synchronize their efforts.

Furthermore, it is crucial to commercialise universities' research results to a more significant degree than is the case today. Currently the Science and Technology Council of Finland is initiating a national strategy for the development and strengthening of science and technology clusters and centres of excellence (Oksanen, 2006).

The final challenges for the Finnish economy, which also holds for its neighbour Sweden, include an aging population and increasing needs for flexibility in the labour market. The working population will inevitably start to decline in only a couple of years, just as in the rest of Western Europe. This will weaken one of the economy's most important competitive advantages as the growth of a highly educated labour force slows down.

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Annexes

Annex 1
Networked support of innovation[3]

A. National Cluster Programs

1. Background

"National Cluster Programme" is the generic term for a group of programs with similar focus initiated by different ministries. Cluster programs were formed to support the R&D that strengthens industrial clusters in Finland, by allocating funds to their development. The aim of these clusters was to transfer and accumulate knowledge in chosen fields by promoting co-operation among various actors including both the producers and users of knowledge. They also aimed to break boundaries between different sciences and fields and thus promote new innovations

2. Objective

The focus of the initiative was to support the R&D that strengthens industrial clusters in Finland by allocating funds to their development.

3. Budget / conditions of funding

Overall more than EUR 100 million, 25 per cent of total programme funding is used for initiating and supporting clusters.

4. Target groups

- Large companies,
- SME,
- research institutes,
- universities,
- public authorities/organisations.

5. Innovation fields

- Forestry,
- welfare,
- transport,
- telecommunication.

6. Number of networks / supported projects

Number of supported networks/clusters: 4 (with a high number of participants; e.g. Forestry cluster w/ 67 Research Institutes and 67 companies and other organisations).

7. Geographic focus

National.

8. Entire value chain covered

Programs aiming at strengthening research, education, and industry.

[3] Source: Stahl-Rolf, Hamann, Wilkens & Hausberg, 2002; Gergils, 2006; www.aka.fi; www.Tekes.fi

B. Tekes Technology programs

1. Background

Tekes, the National Technology Agency, finances research and development (R&D) projects of companies and universities in Finland. The funds are awarded from state budget via the Ministry of Trade and Industry. Tekes also co-ordinates and finances Finnish participation in international technology initiatives.

Technology Programs are used to promote development in specific sectors of technology or industry, and to pass on results of the research work to business. The Technology Programs are planned in co-operation with companies, research institutes, and Tekes.

Tekes programs become more and more industry driven.

2. Objective

Tekes Technology Programs focus on the increase of co-operation between research institutes and private sector

3. Budget / conditions of funding

Overall budget in 2006: about EUR 465 million

4. Target groups

- Large industry,
- SMEs,
- research institutes,
- universities.

5. Innovation fields

Micro technology, Biotechnology, Business Administration, Engineering, Real Estates, Design, Information Technology, E-Business, Climate Research, Wood Research, Diagnostics, Energy.

6. Number of networks / supported projects

Forty Five.

7. Geographic focus

National.

8. Entire value chain covered

Tekes is gradually becoming more and more industry driven. So education is not vital for funding.

C. Centres of excellence

1. Background

The aim of the programme is to establish the basis for the emergence of creative and efficient research and training environments that can generate top international research. In addition, it aims to raise the quality in Finnish research and to improve its international competitiveness, visibility and prestige. The aim is to create an information base required for cultural, social and industrial development, and to create a solid base for a national innovation system.

2. Objective

Beside individual units, the CoE-Programme takes into account the importance of so-called umbrella organisations. Umbrella organizations that have at least one CoE operating under the "umbrella" are eligible for core facility funding from the CoE-Programme.

3. Budget / conditions of funding

- First three years EUR 336.000/year per Centre of Excellence.
- In addition the seven umbrella organisations were funded with EUR 3.5 million per three-year period.

4. Target groups

- Research institutes,
- universities,
- industry.

5. Innovation fields

Biotechnology, Material Research, Ecology, Chemistry, Molecular Biology, Physics, Information Technology, Social Sciences, Mathematics, Medicine, Energy

6. Number of networks / supported projects

- 38 presently,
- 29 (Period 2000-2005),
- 17 (Period 1995-1999),
- appointed 23 (period 2006-2011),
- appointed 18 (2008-2013).

7. Geographic focus

National.

8. Entire value chain covered

Centres of Excellence are research driven institutions. Industry may co-operate, but this is not a crucial factor. This programme aims to strengthen the research position of Finland.

D. Centres of Expertise

1. Background

The aim is to enhance regional competitiveness and to increase the number of high-tech products, companies and jobs. To achieve this goal, the programme will be used to implement projects reflecting the needs of industry, to encourage industry, research and training sectors to co-operate, to ensure rapid transfer of the latest knowledge and know-how to companies, to exploit local creativity and innovation and to enhance networking between the parties of regional development. Also provides catalytic seed capital for networking and development projects.

The State Audit Office's evaluation considers the Centre of Expertise Programme a top act of the Finnish Regional Policy.

2. Objective

- Education and training,
- job creation,

- (inter)national co-operation,
- R&D and innovation,
- regional development.

3. Budget / conditions of funding

Overall budget of EUR 5.1 million per year (1999-2006).

4. Target groups

- Large companies,
- SME,
- research institutes,
- universities,
- public authorities/organisations.

5. Innovation fields

Biotechnology, Food, Information Technology, Distance Technology, Experience Industry, Engineering, Metal Structures, Cultural Business, Logistics and Expertise in Russia, Pharmaceutical Development, Communications and New Media. Data Technology, Environmental Technology.

6. Number of networks / supported projects

Forty Three.

7. Geographic focus

Regional.

8. Entire value chain covered

Industry driven programme enhancing the strength of economy.

Annex 2
The Science and Technology Policy Council

TABLE A1
SCIENCE AND TECHNOLOGY

	Science and Technology Policy Council of Finland
Mission	The Science and Technology Policy Council of Finland, chaired by the Prime Minister, advises the Council of State and its Ministries on important matters concerning research, technology and their utilization and evaluation. The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole [online] <http://www.minedu.fi/OPM/Tiede/tiede-_ja_teknologianeuvosto/?lang=en>.
Status	Public agency acting as a research policy advisory body.
Activities	As mentioned, the Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. The key tasks of the Science and Technology Policy Council are: • To direct S&T policy and make it nationally compatible and to prepare relevant plans and proposals for the Council of State. • To deal with the overall development of scientific research and education, to prepare relevant plans and reviews for the Council of State, and to follow up the development and the need of research in the various fields. • To deal with, follow up and assess measures taken to develop and apply technology, and to prevent or solve eventual problems involved in this. • To deal with important issues relating to Finland's participation in international scientific and technological co-operation to issue statements on the allocation of public science and technology funds to the various ministries, and on the allocation of these funds to the various fields. • To handle the most important legislative matters pertaining to the organization and prerequisites of research and the promotion and implementation of technology. • To take initiative and make proposals in matters under its competence for the Council of State and its ministries.
Summary of key activities	The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as for the national innovation system as a whole. The key tasks of the Science and Technology Policy Council are: • To direct S&T policy and make it nationally compatible and to prepare relevant plans and proposals for the Council of State. • To deal with the overall development of scientific research and education. • To prepare relevant plans and reviews for the Council of State, and to follow up the development and the need for research in the various fields. • To deal with, follow up and assess measures taken to develop and apply technology, and to prevent or solve eventual problems involved in this. • To deal with important issues relating to Finland's participation in international scientific and technological co-operation. • To issue statements on the allocation of public science and technology funds to the various ministries, and on the allocation of these funds to the various fields. • To handle the most important legislative matters pertaining to the organization and prerequisites of research and the promotion and implementation of technology. • To take initiative and make proposals in matters under its competence for the Council of State and its ministries.
Background	The Science and Technology Policy Council of Finland was established in 1987. The Council continues, with a slightly different emphasis, the tasks performed by its predecessor the Science Policy Council, which was established in 1963.

(continues)

TABLE A1 (concluded)

Main Structure	The Science and Technology Council consists of three separate bodies, the Council, the Subcommittees and the Secretariat. The Council is chaired by the Prime Minister. The membership consists of the Minister of Education and Science, the Minister of Trade and Industry, the Minister of Finance, and 0-4 other ministers appointed by the Council of State. In addition to them the membership includes ten other members well versed in science and technology. These members must include representatives of the Academy of Finland, the National Technology Agency of Finland, universities and industry as well as employers' and employees' organizations. The Council of State appoints the members for the term of the Parliament. The Council has a science policy subcommittee and a technology policy subcommittee with preparatory tasks. These are chaired by the Minister of Education and Science and by the Minister of Trade and Industry, respectively. The Council's Secretariat consists of one full-time Secretary General and two full-time Chief planning Officers. They are appointed for a four-year term. The clerical tasks are taken care of at the Ministry of Education.
Characteristics of operation	The full council has meetings two to four times a year and the subcommittees meet on average ten times a year. The Council also holds joint meetings on an ad hoc basis with other Finnish high-level policy groups and councils, such as the Economics Council or the Higher Education Evaluation Council. One of the main tasks of the Council is to publish a science and technology policy review every third year, which amounts to a national strategy and vision for the development of the national innovation system. The reviews analyze past developments and draw conclusions as well as make proposals for the future, including resource allocation, , with most of the recommendations being adhered to by the ministries concerned. The triennial policy statements of the council are: 1987: Science and Technology Policy Review 1987. 1990: Guidelines for Science and Technology in the 1990s. 1993: Towards an Innovative Society: A Development Strategy for Finland. 1996: Finland: A Knowledge-based Society. 2000: Review 2000: The Challenge of Knowledge and Know-How. 2003: Knowledge, innovation and internationalization.
Research policy priorities	National targets for public and private investment in R&D; policy mix; governance structure; and development of long term research agendas.
Priorities	All research.
Sectoral priorities	Can be addressed in a 3-year review, e.g., in the 2006 exercise.
Geographical priorities	None.
Overview	The target group of the activities of the Science and Technology Policy Council is the Finnish science and technology policy as well as of the national innovation system as a whole.
Specific targets	Universities; public research organisation; companies; government; not for profit.
Funding	Funding for the Science and Technology Policy come from the Ministry of Education. It is attached as an expert body under Ministry of Education. Source of funds (%) Government: 100%.
Expenditure/ Destination of funds	The funds go mainly to administration and the preparation of policy reviews. The Science and Technology Policy Council also funds research and evaluation projects related to science and technology policy.
Funding cycles	The funding cycle is 3 years. The current term for the council is March 1, 2005 to February 29 2008.
Evaluation and review	There have been no evaluations of the Science and Technology Policy Council carried out. However, the science and technology policy reviews carried out every third year also analyze past developments and in that way indirectly evaluates the activities of the Council.

Source: Erawatch, 2006.

Annex 3
The Academy of Finland

TABLE A2

	The Academy of Finland
Mission	The Academy of Finland provides funding for high-quality scientific research, serves as an expert in science and science policy, and strengthens the position of science and research (www.aka.fi).
International representation	The Academy of Finland has international offices in Brussels, Belgium and New York, USA.
Status	Government agency.
Activities	Research funder; Research policy and advisory body.
Main activities	The Academy of Finland, despite its somewhat misleading name, is an expert organization in research funding and science policy. The Academy's object is to promote high-level scientific research through long-term quality-based research funding, science and science policy expertise and efforts to strengthen the position of science and scientific research. Academy support for research at Finnish universities and research institutes amounts to over EUR 200 million. This represents more than 14 per cent of total government research funding. Each year Academy-funded projects account for a total of some 3,000 researcher/years (Academy of Finland, 26.1.2006).
Research Funder	The Academy of Finland has a range of different funding instruments for different purposes: it provides funding for research projects, research programs, centres of excellence in research, researcher training, international cooperation as well as research posts for Academy Professors and Academy Research Fellows (www.aka.fi).
Research policy advisory body	The Academy of Finland outlines science policy strategies, issues statements on questions of science policy and compiles and commissions science policy reports. The Academy also evaluates research. All evaluations are commissioned out to third-party experts, who usually are from outside Finland (Academy of Finland, 17.1.2006).
Background	The first State science policy board was founded in 1918, and the first Act regarding the Academy of Finland was promulgated in 1939, although its enforcement had to be postponed because of the outbreak of World War II. The so-called "old Academy" was launched in 1948 and the Academy of Finland in its present constitution was established in 1970. The role of Academy of Finland as a research funding body has grown more significant after the government launched an additional funding programme in 1997–1999 to increase research intensity. As a result, the total budget of the Academy has grown from 75.6 million euros in 1992 to 257.4 million euros in 2006.
Main Structure	The organization of the Academy of Finland consists of the Board, research councils, other science experts and the Administrative Office. The highest decision making organ is the Board, whose seven members are responsible for the Academy's science policy line and the allocation of research appropriations to research councils. The research councils decide on research funding within their respective fields and act as experts in science policy issues. There are four research Councils: Culture and Society, Natural Sciences and Engineering, Health, and Biosciences and Environment. In addition to a Chairperson there are 10 members in each Council. The Board and the members of the research councils are appointed by the Council of State for a three-year term. The Administrative Office has responsibility for the Academy's administration and its development.
Parent organisation	Ministry of Education.
Characteristics of operation	The main operation of the Academy is to provide research funding through various instruments. In December 2003, the Academy had a total of 34 funding forms. Project funding is the largest funding instrument of the Academy and accounts for approximately 40% of all funding. Another important instrument are the Finnish centers of excellence (CoE). There were 26 CoEs in the 2000-2005 programme and 16 CoEs in the 2002-2007 programme. In 2004 CoE funding accounted for 8% of the Academy of Finland funding. A third important instrument is the research programs that are composed of a number of research projects that are focused on a defined subject area or set of problems of societal relevance. In 2003, there were 19 research programs in different fields. In addition, the Academy funds stages of doctoral training and postdoctoral research with several funding instruments and also supports international cooperation. (Annual Report, 2004)

(continues)

TABLE A2 (concluded)

Number of employees/ administrative staff	162 (2004). In 2004 there were 149 permanent and 13 part time employees. In addition the Academy uses extensively external experts in evaluations.
Overview priorities	The general priorities are promotion of welfare, culture and the national economy by means of science.
Research policy priorities	National targets for public and private investment in R&D; grants to public sector research institutions; strengthen and create centres/networks of excellence; raise interest of the young in science and technology; develop more favourable employment conditions to attract researchers; enhancing the mobility of researchers; specific research programs.
Type of research prioritized	Problem driven (basic) research; Pre-competitive research; International research collaboration.
Development of Priorities	The priorities have not changed considerably during the past years.
Evolution of priorities	The changes in research priorities over time are reflected in the reorganization research councils. The original two councils consisted of natural sciences and humanities. The organization was changed in 1961 and the Research Council for the Natural Sciences was divided into: • Natural Science Research Council, • Medical Research Council, • Research Council for Agriculture and Forestry, • Research Council for Technology. The Research Council for the Humanities was divided into Humanities and Social Sciences. In 1983 a new Research Council for the Environmental Sciences was set up. In 1995 the number of research councils was reduced to four that are: • Research Council for Culture and Society, • Research Council for Natural Sciences and Engineering, • Research Council for Health, • Research Council for Environment and Natural Resources (From 2001 renamed as the Research Council for Biosciences and Environment).
Target overview	The targets for the Academy of Finland are mainly university departments, academic research groups and individual researchers.
Budget (for 2004)	Total annual budget in Euro 207,836,000 Operation costs 31 million; Research funding 166 million; Funding for non-profit organizations 10 million.
Budget trends	The changes in the budget have mainly been due to an increase in research funding. The research funding has increased recently each year quite steadily. In 1998 the funding targeted for research funding accounted for 142.9 million euros. In 2005 it was 223.5 million euros.
Source of funding	The funding for the Academy of Finland comes mainly from the government budget. Relatively small amounts of funding comes from other government agencies, Nordic organizations and from the EU. Source of funds (%) Government: National 99.4%;Abroad: EU 0.1%; Abroad: Other 0.5%.
Expenditure/Destination of funds	In 2004 Academy of Finland research funding decisions accounted for 208 million Euros. Of this, 24 % went to research projects and other support, 39 % to researcher training, 12 % to research programs, 11 % to research posts, 8% to Centres of Excellence and 8 % to international cooperation.
Funding cycles	The Academy of Finland works on an annual budget cycle.
Evaluation and review	The Academy of Finland was evaluated by an international expert panel in 2003-2004. The evaluation can be found from: [online] <http://www.aka.fi/index.asp?id=eb9a8e15a46244d 989ac56c132e8d13a>

Source: Erawatch, 2007.

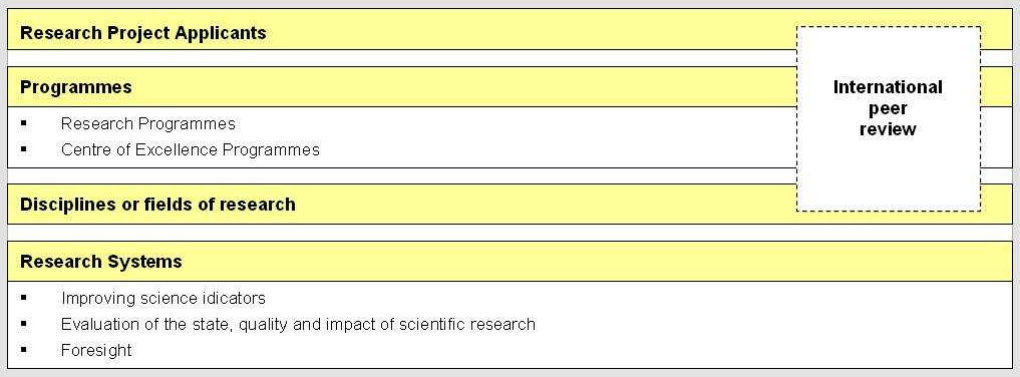
BOX 1
ADDITIONAL INFORMATION CONCERNING THE ACADEMY OF FINLAND

In 2004, the Academy received funding applications worth around 930 million euros. In all, 5,434 applications were submitted. In the call for general research grants, the amount of funding awarded was 12 per cent of the value of applications received. In 2003, the corresponding share was 14 per cent.

Research projects received 42 per cent of total Academy research funding in 2004. Research programs accounted for 12 per cent of all research funding decisions, researcher training for 19 per cent, research posts for 11 per cent, international cooperation for 8 per cent and Centre of Excellence Programs for 8 per cent.

Approximately 5,400 people (3,000 person-years of research) benefit from Academy research funding. Eighty-four per cent of Academy research funding was directed to researchers working at universities and university hospitals and 6 per cent was allocated to researchers working at research institutes.

FIGURE 1
REVIEW SYSTEM



Project assessment in the Academy

As above clearly indicates the Academy extensively applies a peer review system involving foreign experts. The final decision is made in the Board of the Academy.

For several years, the Academy of Finland has had at its disposal two rather different kinds of instruments for the purpose of supporting research within specific thematic areas, i.e. research programs and so-called targeted calls. Currently the programs and the targeted calls tend to overlap and therefore the relevance of the targeted calls is declining.

Source: Author.

BOX 2
STARTING POINTS AND OBJECTIVES FOR RESEARCH PROGRAMS

A research programme is composed of a number of research projects that are focused on a defined subject area or set of problems that are scheduled to run for a set period of time and that have a coordinated management. Research programs have both general science policy objectives and more specific goals that are unique to each programme. They are also expected to meet certain general requirements: a research programme shall be sufficiently broad and cover a long enough time span, but at the same time it should have a well-defined focus. It should provide added value when compared to separate funding for individual projects, and the programme's novelty value from a research policy point of view shall also be considered. Initiatives for a research programme may be prompted by internal development needs within a discipline or field of research or by needs to support a new, emerging field. An initiative may also arise from an issue or problem that is considered to be of societal import. Funding can also be allocated to a predefined field of research, thematic area or for a specific purpose.

Objectives of the research programs

Research programs will typically have the following general science policy objectives:

• To develop research environments,

• to coordinate scattered research capacities,

• to promote multidisciplinarity, interdisciplinarity and where possible transdisciplinarity,

• to develop national and international cooperation between researchers, funding bodies and end-users of research results,

(continues)

BOX 2 (concluded)

• to increase the international visibility of Finnish research through closer cooperation between researchers, research organisations and funding bodies, and

• to promote researcher training and professional careers in research.

The specific objectives for each programme are defined by the Academy's Board on the basis of the recommendations by the Research Council(s) concerned, and fine-tuned by the programme steering group.

Participation in research programs

As well as working on long-term plans aimed at setting up larger programs, the Academy shall be in a position to respond quickly to emerging funding needs within narrow subject areas or to interesting offers of cooperation.

However, as well as supporting broad research programs, the Academy's Board may allocate funds to major, jointly funded national or international research programs or programme clusters. Initiatives for such joint programs may come from some other funding body, or from the Academy itself, and the Academy may assume responsibility for programme coordination, even if its contribution in financial terms is not significant.

RESEARCH COUNCILS MAY ALLOCATE FUNDING AS PART OF OTHER FORMS OF SUPPORT. THE ACADEMY'S BOARD SHALL INCREASE FUNDING THROUGH RESEARCH COUNCILS BY ALLOWING THEM TO ALLOCATE FUNDING FOR SPECIAL PURPOSES WITHOUT THIS AFFECTING THE OVERALL VOLUME OF SO-CALLED GENERAL PROJECT FUNDING.

Source: Author.

BOX 3
RESEARCH PROGRAMS STRENGHTEN COOPERATION

In most research programs it has sponsored, the Academy of Finland has so far been the principal financer. In the future the Academy expects to be involved in more programs where it will be working closely with other funding bodies and where some other organisation, in most cases from some other country, will shoulder the main responsibility for the programme.

Cooperation through research and technology programs is one important avenue for the development of the national innovation system. Cooperation has paved the way to ever wider national research and technology programs and programme clusters. Most of the national research and technology programs in Finland are funded and administered by the Academy of Finland and Tekes.

A fruitful balance needs to be struck between cooperation and competition. The aim of cooperation is to promote interaction between basic and applied research and between technology and product development, to increase multidisciplinary and interdisciplinary research, to make sure that research programs can build up a sufficient critical mass, to avoid overlap in research funding, to intensify the exchange and transfer of information between different actors in the field and to step up communication about and utilisation of research knowledge.

Research programs are a platform for national and international cooperation. National cooperation enhances the competitiveness of the Finnish research system. The cooperation across disciplines has taken a form of cluster programs. These programs have been a useful form of cooperation. The resources that were made available through the Government's additional funding programme for research in 1997-1999 were used to support eight cluster research programs coordinated by different ministries. One of the aims of these programs was to find new ways of funding research and development. Some of the cluster programs have continued to run beyond 1999.

National funding cooperation creates a sound basis for the internationalisation of research programs. The Academy's experiences of diverse national funding cooperation and its extensive international contacts create a sound basis for the international networking of research programs, for jointly funded programs and for opening up these programs.

The linkage between national programs and international ones; e.g. eu framework programme, has been an on-going strategy of the finnish system. Both the academy and tekes have used their programs as a base for international cooperation .the system has guaranteed that the results of the international programs can be utilized in home country as well.

Source: Author.

BOX 4
CENTRES OF EXCELLENCE

The Centre of Excellence programme of the Academy of Finland has been approved in the Science and Technology Policy council and used as an instrument for the development of Finnish research quality and internationalisation. The funding term is annual, but the commitment of the academy is for 6+6 years.

At present there are 23 centres operating for which the Academy has reserved 29m€ for the period of 2006-2008, At the same time Tekes is contributing with 3m€ and Nokia with 0,3 m€. The aim of the Centres of Excellence is to improve multidisciplinary research, generate more international exposure, and improve the national and international networking of the research units.

Source: Author.

Annex 4
Finnish Funding Agency for Technology and Innovation (Tekes)

TABLE A3

	Finnish Funding Agency for Technology and Innovation, Tekes
Mission	Tekes boosts the development of Finnish industry and the service sector by technological means and through innovation. This will renew the economy and increase added-value, productivity and exports, thereby creating employment and enhancing well-being.
Offices/Branches	14
International representation	Tekes has international offices in Brussels, Beijing, San Jose, Shanghai, Tokyo, Washington D.C. The offices abroad provide contacts to Finnish companies, research institutes and universities in all fields of technology.
Status	Government: agency.
Activities	Research funder.
Main activity	Tekes finances industrial R&D projects as well as projects in universities and research institutes. Tekes especially promotes innovative, risk-intensive projects. Tekes provides expert services to assist companies in their search for ideas, the finalisation of business plans, and their quest to conduct meaningful and valuable research. Tekes also promotes the development of new research areas by implementing specific technology programmes around a specific field. Cooperation is encouraged between the different organisations as well as between differing fields of technology.
Research funder	Tekes funding may be a low-interest loan or a grant, depending on the stage of the innovation and the nature of the proposed project. It offers companies grants, capital loans and industrial loans. Industry R&D grants typically cover 15-45 % of eligible costs and R&D loans up to 70% of the eligible costs. Research grants can range from 50 per cent to 100 per cent of eligible costs. Grants are directed to the research work done at research institutes and universities. Usually projects are conducted in cooperation with companies.
Background	Tekes was founded primarily to assist Finland in the economic recession of the 1970's. Formed on the 1 July 1983 with a workforce of 20, a number that has now increased tenfold, Tekes was established to work with the major areas of technology. The Finnish government identified that improved technology would play a key role in economic resurgence and from the early 1990s the amount of R&D funding Tekes allocates has doubled [online] <http://www.Tekes.fi>
Main Structure	The Board is the principal governing body. The members include representatives from each of the major stakeholders in the research and innovation system including the social partners and directors of the major state research institutes. The role of the board is to formulate strategy and develop long-term plans and to approve the budget proposal. There is also a strategic management group led by the Director General. Tekes organisation matrix consists of separate branches for different support areas: activation, technology programmes and project funding. On the other side there are several dedicated branches for different activities: Technology and Research Areas, Regional Networks, International Networks and Finance and Administration. Moreover, there is a cross-cutting office for Industrial Branches and Support for Core Processes. The major part of Tekes' personnel work at the headquarters, dealing with the application and selection procedures, technology programmes, and with advice and activation of potential participants.
Component organisations	The Technology Development Departments at 14 regional Employment and Economic Development Centres also offer Tekes services throughout Finland.
Parent organisation	Tekes works under Ministry of Trade and Industry.
Characteristics of operation	In the science sector, Tekes provides funding for the research projects of universities, research institutes and polytechnics. Funding can be allocated to projects launched within technology programmes, individual research projects, international projects and their preparations. Tekes' experts will evaluate the project, the benefits pursued and the applicant as a whole. Funding can be provided both to basic research and applied research. However, Tekes funded projects are typically oriented to application of basic research, which means basic research with potential future applications already in sight.

(continues)

TABLE A3 (concluded)

Number of employees	266 (2005) About two thirds of the employees are experts and one third consists of management, administration and support services.
Overview	Tekes' general objectives are to support R&D activities in order strengthen the knowledge base, to support innovative growth companies, to increase regional vitality, to increase international innovation activities to help industries to improve productivity and to boost societal well-being through innovative activities.
Research policy priorities	Policy mixes that increase private investment in R&D; grants to public sector research institutions; developing public-private partnerships for R&D; improving R&D co-operation and technology transfer; promotion of R&D services to enterprises (esp. SMEs); grants to support business R&D, and R&D collaboration; specific research programmes.
Type of research prioritised	Problem driven (basic) research; applied industrial research; international research collaboration; networking.
Priorities	Protection and improvement of human earth; production, distribution and rational utilisation of energy; industrial production and technology.
Overview	Tekes has both application and technology related research priorities. The application focus areas are: renewing products and business models; environment and energy; health and well-being; services; security and safety; and work and leisure. The technology focus areas are selected strategic areas within ICT, biotechnology, materials technology and nanotechnology. Business competence is becoming equal in importance to technology competence (Tekes Annual Report 2005).
Overview targets	Tekes funds companies, research institutes and universities through dedicated project funding and technology programmes.
Specific targets	Universities; Public research organisation; Not for profit.
Total annual budget in Euro, 2005	418,216,000
Detailed annual budget	The allocation of Tekes funding (1 000s euro) was: • Operational costs: 26 752, • funds transferred from 2004: 4 224, • project and Programme development activities: 13 870, • project and Programme development activities transferred from 2004: 12 090, • R&D activities: 151 286, • grants for Research and Development activities: 145 931, • loans for Research and Development activities: 30 942, • capital loans for research and development activities: 33 121.
Budget trends	The Tekes budget has increased gradually. From 2003 to 2005 the growth was 7 %, most of which was in R&D funding. Tekes funding for research and development activities has grown steadily in recent years. In 1998 Tekes funding for R&D was 375 million euros, in 2002 399 million euros and in 2006 it is estimated to be 478 million euros.
Source of funds (%)	Government: National 99%; Abroad: EU 1%
Expenditure/Destination of funds	Most of Tekes funds go to support of Research and Development. The total Tekes R&D funding was 429 million euros. Of this, the biggest share, 179 million euros, was research funding for universities, research institutes and polytechnics. A total of 178 million was R&D grants to companies and 43 million euros R&D loans for companies. Capital lending for R&D to companies was 25 million euros and 4 million euros went to start-up loans to new companies. In 2005 there were a total of 745 public research projects funded by Tekes. Of all Tekes funding for public research in 2005, 116 million euros went to universities, 43 million to research institutes (39 million to VTT), 14 million to ESA participation fees and 6 million to other research funding. In the projects partially funded by Tekes the amount of Tekes funding was on average 78% of all funding.
Funding cycles	Tekes works to an annual budget cycle. However, the Tekes technology programmes typically last from 3 to 6 years.

(continues)

TABLE A3 (concluded)

Funding impact assessment processes	Evaluation is used to direct R&D funding as well as to develop technology programme activities. In order to evaluate the impact of technology and R&D funding, Tekes has defined indicators based on the objectives. Project-specific results and effects are also monitored and evaluated. Tekes commissions external experts to evaluate all technology programmes. External experts have also carried out several evaluations that cover the entire scope of Tekes activities. Furthermore, numerous separate evaluations have been carried out or commissioned to review Tekes as well as various functions from different points of view [online] <http://www.Tekes.fi>
Evaluation and review	Tekes' operations have been evaluated by several reviews conducted by external teams. The last evaluation was conducted as part of the evaluation of the Finnish Innovation Support System in 2003 (Ministry of Trade and Industry Finland Publications 5/2003).

BOX 5
ADDITIONAL INFORMATION TEKES

R&D funding / Tekes

Tekes has a simple set of funding instruments comprising only grants mainly for universities and SMEs, risk loans for industry especially SMEs, equity funding for start ups and some specific funding for encouragement of new entrepreneurs.

Technology programs are the main instrument to improve the technology acquisition and improvement of competitiveness in companies.

TULI programme promotes the launch of new businesses that originate firm research. The main goal is to transfer the commercial potential resulting from research projects to commercialisation and new ventures.

- Client specific, regional and sectoral specific support,
- promoting technological transfers,
- special Action for new Companies,
- promoting Internationalisation.

VARA programme facilitates the acquisition and transfer of knowledge and technologies to enterprises, encouraging in particular cross-border initiatives

Knowledge, skills and vision

- Foresight and technology strategy activities,
- technology awareness services,
- impact assessment and communications on results and impact of activities,
- innovation research,
- partnering,
- participation in innovation policy design and specific tasks assigned by the Ministry,
- the entrepreneurship policy programme and the information society programme.

TRIO programme aims at enhancing the competitiveness of firms by promoting internationalisation and improving the business environment for enterprises so that they are able to continue economically viable activities in Finland (jointly with the Finnish industry confederation). Tekes start-up loan.

TUPAS programme for SMEs to capture new technologies in cooperation with the research establishments and upgrading innovation related skills.

LIKSA, INTRO, DIILI programs to increase the number of new innovation intensive enterprises created and their survival and to increase the availability of private funding to enterprises (LIKSA terminated in 2006)

Projects are selected using criteria based on Tekes' mission statement. Funding is allocated to projects which are assessed to generate the greatest long term benefits to the national economy and society, either directly or indirectly, in relation to the public investments made.

Selection criteria for corporate R&D projects are:

- Business activity to be pursued.

Selection criteria for public research projects are:

(continues)

BOX 5 (concluded)

- Technology and competence to be developed,
- cooperation to be developed and utilized,
- utilisation of results,
- resources available for the project,
- direct affect on social, environmental and welfare aspects,
- impact of Tekes' funding and expert work.

All projects are selected using uniform criteria in all of Finland. Owing to EU regulations, project funding can be higher in areas eligible for Community structural funds. The aim of higher funding is to encourage beneficiaries to upgrade their capabilities and competencies to meet with international competition.

The project, the technology to be developed, the business aspired to, the resources and their benefits, are evaluated as a whole.

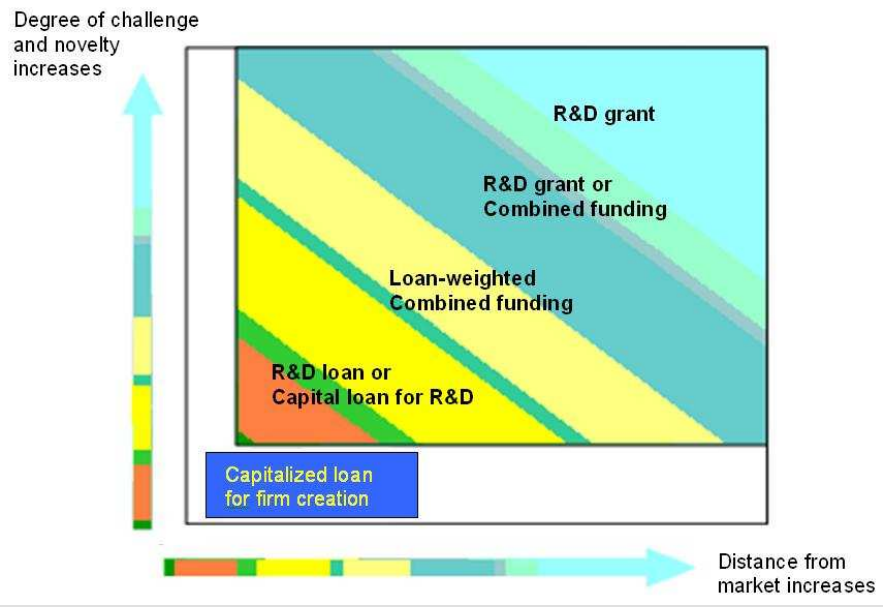
Tekes is responsible to make funding decisions internally. Only large allocations are treated and decided in the board of Tekes. The Academy has a different model as it applies a peer review for the large funding decisions, the smaller ones can be decided in the different committees.

The state funding is allocated annually both for Tekes and the Academy. Thereafter both institutions are free to make decisions, but must report to the respective ministries two or three times a year.

The funding criteria and corresponding instruments are linked together. The closer the market and the less challenging the project, the funding is usually a loan. In an opposite situation the support is a grant. Mixed funding is used extensively e.g. when first industrial research is conducted (grant) and then for the application and adaptation to market occurs (loan). Loans can be partially paid in advance (SME), but grants for industry are paid after the work has been conducted against invoices. The figure below demonstrates the usage of criteria.

The application of the funding criteria in Tekes

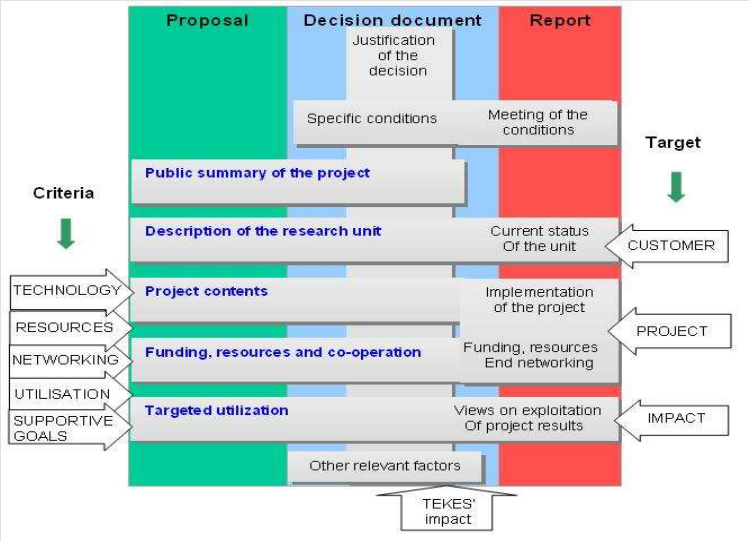
FIGURE 2
THE FUNDING PROCESS IN TEKES



Source: Tekes, 2007.

The whole funding process is carefully designed in order to take into account all relevant factors influencing the project success. The process includes the whole chain from the proposal handling to final report. The criteria are reflected against the results to be obtained. The final payment is done only against the final report of the project.

FIGURE 3
USE OF CRITERIA IN TEKES FUNDING PROCESS



Source: Tekes, 2007.

Funding process of Tekes

Tekes is applying internal assessment for all proposals. Tekes experts (some 150) will conduct assessment on the individual and for the program proposals. For each proposal a responsible person will be nominated, who will assess the proposal with a team of experts. As soon as the assessment has been carried out, the proposal goes to a panel where the interdisciplinary issues will be scrutinized. The decision making is delegated to different levels in the organization according to the amount of funding.

Basically the Director General is responsible for all funding decisions. The funding of large national programs is decided in the board of Tekes.

As mentioned, all assessments of projects are made in Tekes internally. The applicants are encouraged to contact Tekes's staff before mailing the applications. The applications can be sent by e-mail as well. A specific electronic signature has been developed to guarantee the originality of the application.

The industrial applications can be sent continuously and no calls of proposals are made. In case of the university proposals a call is opened twice a year. The main instrument/programme the national technology programs are opened periodically and the funding decisions are made usually once a year.

The participation and funding of technology programs

There are some 1,800 instances of corporate participation in the technology programs every year and about 500 instances of participation by research units. Tekes publishes information about programs that have started, financing and participants, and summaries of the programs' projects.

Tekes funding is intended for challenging and innovative projects, some of which will hopefully lead to global success stories. As mentioned, Tekes funding may be a low-interest loan or a grant, depending on the stage of the innovation and the nature of the proposed project.

Financing can also be awarded to foreign entities registered in Finland. Foreign-owned companies with R&D activities in Finland are not required to have a Finnish partner to be eligible for funding. The financed activities, however, should contribute to the national economy of Finland.

For a research project to become part of a programme, one can generally apply once a year. For company projects, applications can be made at any time. Companies can participate through their own projects or become part of joint research projects. Many programs place special emphasis on participation by SMEs and cooperation with major companies and research institutes.

The implementation of the programs

Tekes plans the technology programs in association with companies, universities and interest groups. The planning is done in work groups and open seminars. The decision to start a programme is taken by the Tekes Board

The programs last an average of five years. Their volumes range from 15 million to 200+ million euros. Tekes generally finances about half the costs of a programme.

Every programme has a supervisor and an operational team at Tekes, and possibly a programme manager outside Tekes who is responsible for the practical arrangements of the programme's operations.

Every programme has a steering group whose task is to direct the strategic areas of focus in the programme in accordance with the plan confirmed by the Tekes Board. The chairman of the steering group comes usually from industry. The steering group also follows the programme's progress, i.e. approves the annual implementation plan and monitors its performance.

Tekes selects experts in technology and business for the steering groups in its programs. Possessing both vision and extensive work experience, they do not represent their background organizations but are involved in a personal capacity. No remuneration is paid for participation in the steering group. The selected topics determine the need for interdisciplinary research. If so, the necessary institutions are contacted to join and to provide research resources for the project. The funding will be provided accordingly.

Tekes makes decisions about the financing of projects in line with its normal financing criteria and funding processes. A programme's steering group plays no part in decisions concerning the financing of projects.

The achievement of the programs' targets and the success of the projects are assessed once the programs are completed. This is done in most cases by foreign evaluators.

Figure 30 gives an illustration of the technology programs. It should be pointed out that the projects of universities and industry are joint programs where funding is taking place together with staff exchange. This contributes to the concurrent development thus avoiding the linear model of innovation. The model also allows continuous technology transfer which in turn makes a separate technology transfers obsolete. One important outcome from the technology programs is the intensive networking among companies and universities. About 80 per cent of the participating companies network with others and in case of large companies the rate is 100 per cent i.e. all large companies are in networks with smaller companies and universities.

There is also a substantial amount of international cooperation within the technology programs.

Source: Erawatch, 2007.

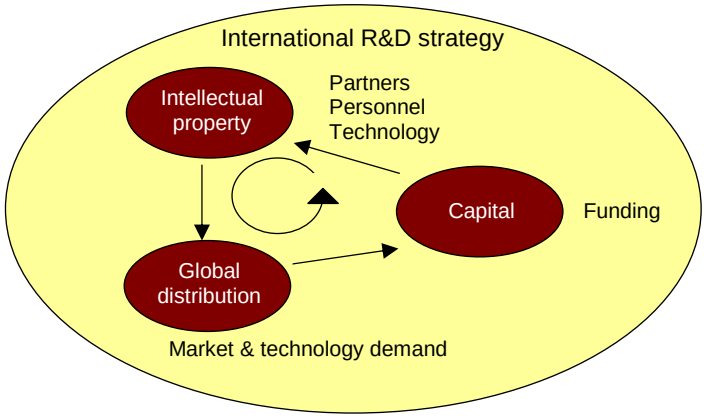
Annex 5:
Innovation and technology for SME

As both business environments and knowledge creation become more global, including R&D, SMEs are increasingly recognized as global actors (Frinking, Hjelt, Essers, Louma & Mahroum, 2002).

In comparison to the EU average, Finland's innovation performance in SMEs is high. Finland's weakest performance was found in indicators concerning SMEs innovating in-house, business finance of university R&D and community trademarks. However, the statistics are still on the same level as the EU average. In addition, Finland also holds an average place in the EU25 in terms of SMEs utilizing non-technical transformation.

A research project "Internationalisation of R&D – Implications to science and technology policy" was conducted by the ProACT research programme and funded by the Finnish Ministry of Trade and Industry, and Tekes, Gaia Group Oy (Gaia) and RAND Europe[4]. The project emphasized international R&D in growth seeking, technology and knowledge intensive SMEs. The emphasize was selected on the basis on both the important role SMEs have in facilitating future prosperity in the national economy and the fact that the current understanding of international R&D activities of SMEs is much less than the understanding of similar activities of large, multinational enterprises (MNEs).

FIGURE 4
THE NEEDS OF GROWTH SMES ENGAGED IN R&D RELATED TO THE KEY ELEMENTS OF KNOWLEDGE INTENSIVE BUSINESS



Source: Ahvenharju, Syrjänen, Helt,. & Frinking, 2006.

The aim of the analysis was to present proposals for developing the Finnish national innovation policy, especially with respect to supporting internationalisation of private sector R&D. Consequently the focus in the study was on support methods directly linked to international R&D in SMEs.

However, most SMEs are ill-equipped for participating in international R&D and require support to face the difficulties of a global R&D market. Nevertheless, whether governments are willing to offer the necessary support depends on possible domestic benefits of international joint R&D activities. Through international R&D collaborative performances, three sorts of advantages to society are generated:

- Reinforces national enterprise competitiveness,

[4] GAIA GROUP - a visionary leading expert partner to international organisations, corporations, public and private institutions looking for innovative solutions to sustainability, The RAND Corporation - a nonprofit institution that helps improve policy and decision making through research and analysis.

- improved technological intensity, and
- spillovers and knowledge transfer.

Evaluations carried out during recent years have appraised the performance of the Finnish innovation funding and service organisations. The country has been especially commended for its clear financing organization. A survey conducted by the ProACT programme illustrated that 87 per cent of the companies have acquired support for R&D, which for the most part comes from Tekes. However, the utilization of support instruments for internationalisation has been used less frequent, even though indicators show that 53 per cent of the companies have obtained some form of public support for internationalisation of their enterprises, primarily from Finpro.

Nonetheless, the same ProAct report also pin-points that during the initial stage there exists a lack of public support and seed funding. This problem was linked with the inadequate amount of venture capital funding and the unwillingness of banks' and capitalists' to take the risks. It also identified the necessity for public R&D for developing technology and products, especially in the initial stage of a company.

Today, Finnish innovation policy makers face multiple challenges when striving to promote internationally competitive growth in SMEs which are technology and knowledge intensive. According to Ahvenharju et.al, (2006) some of the aims and challenges can be summarised as:

- **Globalisation**[5]. The world economy has become increasingly integrated and new, previously closed sectors have opened up to competition. This means that private sector activities have become more and more global instead of national or cross-border. Globalisation and rapid technology development have made the world economic development more dynamic and consequently national economies are seen as more vulnerable and easily unbalanced. European economies are facing strong competition both from fast-growing developing economies and from the United States. In the Finnish public discussion globalisation is most often seen as a threat. At the same time, globalisation provides unique possibilities for co-operation and utilisation of international resources. Thus economic policies and structures require constant renewal and improvements.
- **EU Lisbon strategy and the Globalisation of science and technology.** The goal of the EU Lisbon strategy is to increase European competitiveness by making the most of a knowledge-based economy. Finland has been successful in achieving the goals set in the Lisbon strategy, but there is a need to further strengthen education and research and promote innovation. Further internationalisation of Finnish R&D activities is one way of keeping up with scientific development and strengthening Finnish know-how. Strong Finnish participation in the 7th Framework Programme is seen as essential to make the best use of European research efforts.
- **Promoting entrepreneurship and new growth enterprises.** The Finnish economic structure is dominated by large enterprises; although the number of SMEs is high, their relative effect on solving the unemployment problem has been insufficient. Especially transforming strong R&D investments into growth, employment and export is seen as a challenge.

When industrial production is gradually transferred to other countries, the generation of new growth enterprises and promotion of entrepreneurship becomes increasingly important. There have been several developments in Finland related to the promotion of entrepreneurship and supporting growth-seeking SMEs, and these are discussed below.

In order to tackle these obstacles, joint-ventures and the integration between different organisations which offer support to SMEs, has been emphasized. Accordingly, the need to restructure the Finnish enterprise system has been recognized.

[5] This is a name given in Finland to describe the phenomena how industrial production is transferred away from Finland, especially to China and other Asian countries.

An example of the new model of joint-ventures is the so-called "growth company services", which is a jointly organised service model by Finpro, Finnvera, T&E Centres[6] and Tekes.

Companies which are growth oriented and wish to use the service are offered a service a development team, which contain representatives from all the partner organisations.

The objective is to supply clients with more comprehensive support and to accelerate the detection of appropriate support tools.

Most Finnish high growth SMEs are acting in trade and services sectors. In contrast to large companies, Finnish SMEs are less active in R&D and innovation according to a recent survey conducted by the ProACT programme. Moreover, fewer than 40 per cent of companies with 10-19 employees and about 60 per cent of companies with 100-249 employees, had innovation activities (Ahvenharju, et al, 2006).

[6] Finpro – an association that promotes the internationalisation of Finnish enterprises, Finnvera – a government owned financing company, T&E Centres – Employment and Economic Development Centres.

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