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## ICT – the keys to renewal

Information and communication  
technology in Finland 2013



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### Overcoming boundaries with ICT

Finland is the best placed nation in the world to benefit from information and communication technology. Such is the verdict of the World Economic Forum in its ranking of 144 countries in order of networked readiness.

Among other things, Finland leads the ranking as a provider of new ICT services. Our education system and skilled workforce receive high praise that echoes many other international studies.

One ranking alone doesn't speak volumes, but in some curious way Finland has sustained its success in numerous international comparisons. The best country to be a mother, a great country to go to school, and a fantastic place to live. Our press is free like nowhere else, and our level of corruption is the lowest in the world along with Denmark and New Zealand. Our conditions for entrepreneurship are among the best, despite an oversized public sector and a consequently high tax level. Corporate tax will see an improvement when a pledged reduction takes effect in 2014.

All this suggests that Finland has the preconditions to spring into new growth despite a presently bleak economic outlook. ICT is a central tool in this effort - a form of springboard to the economy, which helps us overcome both real and imaginary boundaries.

Medical technology is a healthy example of a sector that has grown with astounding speed in defiance of economic trends. The sector has grown faster in Finland than in the world market. In 2012 our medical technology exports grew more than 22% and the sector's balance of trade rose to an all-time high. In this way medical technology also helps rejuvenate the broader economy that is in dire need of export-led resuscitation.

ICT is central in developing medical technology, as it is for the cleantech and gaming sectors that are in a strong tailwind. These fields contain vivid examples of firms that have innovated their products and business models to win the hearts of their customers. A similar message was emphasized by **Pekka Ala-Pietilä's** ICT 2015 working group in their report, which argues that Finland has the potential to renew all its industries if it merges new digital elements with traditional modes of activity.

Past successes cannot be relied on for future growth when technological and economic progress gallops ahead. Nokia's decision to sell its mobile phone business is an example of this which impacts the nation as a whole. Companies and researchers are doing their best to keep up with the pace. Finnish researchers have already developed medically viable 3D printed skin, organs built with stem cells and programmable fluids. Those who believe they have seen the pinnacle of technological progress will find themselves surprised for many times to come.

To Finns it is paramount that our companies succeed in their pursuit to create new. This is vital not only for profit, but also for the wellbeing of citizens. Success can be built only with work, which in turn is forged from innovation and investment.



Jukka Viitasaari  
 Director  
 The Federation of  
 Finnish Technology Industries

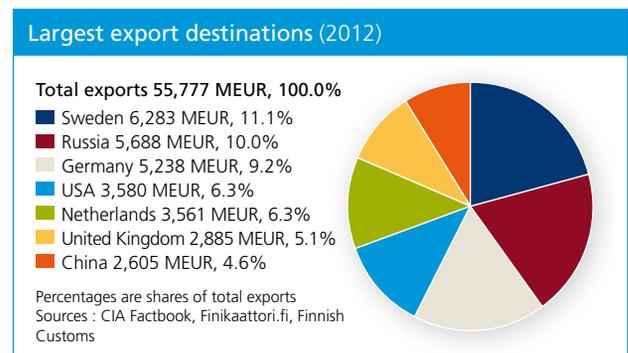
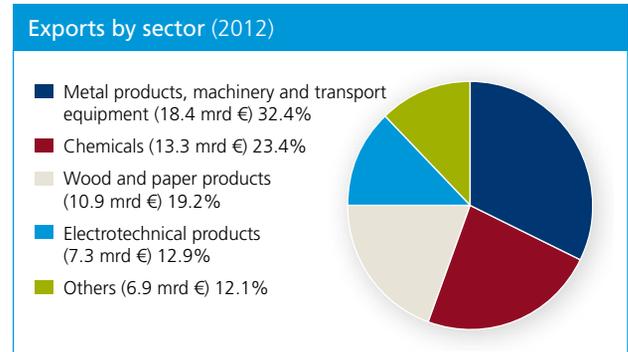




# 1. Finland compared to the world

International comparisons portray Finland as a small country, but by many metrics a successful one. Finland is the home of a diverse skill base which international companies increasingly seek to benefit from. Nevertheless, extensive research and development efforts should be more consistently transformed into successful products and services.

Finland basics (world rank in brackets)
<b>Population:</b> 5.4 million (113.)
<b>Area:</b> 338,145 km <sup>2</sup>
<b>Life expectancy:</b> 79.5 years (41.) (men 77.2, women 83.5)
<b>Over 65-year-olds:</b> 1 million – 18.5% of the population



## 1.1 A good place to be born

Finland is the best country in the world to be a mother. This is the conclusion of Save the Children organization in a study that found Finland to have among the lowest mortality rates for infants and mothers.

The metrics used in the study were the likelihood of death for mothers during pregnancy, mortality of under 5-year-olds, education levels of children, household income and the equality of women's rights. Statisticians at the UN estimate that 2.9 of every thousand Finnish children died in 2011. The figure in the United States was 7.5.

The comparison seemed to favour small countries and Nordic values, as all five Nordic countries achieved a ranking among the top six.

Best countries to be a mother
1. Finland
2. Sweden
3. Norway
4. Iceland
5. Netherlands
6. Denmark
7. Spain
8. Belgium
9. Germany
10. Australia

Source: Save the Children

Education and know-how are among Finland's key success factors in many comparisons of national competitiveness.

After infancy a Finnish child proceeds into the best education system on earth. Education and know-how are among Finland's key success factors in many comparisons of national competitiveness.

A report by Pearson, the UK-based education company, judged the Finnish education system to be the best among the 40 nations studied. The authors of the report titled 'The Learning Curve' noted that the systems in Finland and runner-up South Korea are strikingly different. The study finds that education in South Korea is strict and examination-based, while Finnish educational culture is relaxed and flexible. Both countries train highly skilled teachers and see education as a core cultural value.



### The world's best education systems

1. Finland
2. South Korea
3. Hong Kong - China
4. Japan
5. Singapore
6. United Kingdom
7. Netherlands
8. New Zealand
9. Switzerland
10. Canada

Source: The Learning Curve 2012, Pearson plc

Finnish ninth-graders have often grabbed the top position in the international comparison PISA. The latest study found Finnish secondary school students to be the third best in reading and sixth in mathematics. Despite a small drop, they also remain among the best in natural sciences when compared to their peers in OECD nations. Consistency is a clear strength in Finland, where the variance of results between schools is lower than in any other country.

Similarly, Finland has thrived in the international PIRLS and TIMSS studies. The former measures literacy among fourth-graders, while the latter tests fourth- and eighth-graders in mathematics and natural sciences.

Although Finnish youth performs well in ability tests, it is also stressed out and lacks motivation. Finnish children were the second weakest in a study that tested the study motivation of pupils. The PIRLS study asked young people to answer six questions regarding their own reading. In Finland, 59 per cent were found to be well motivated against an international average of 74 per cent. Seven per cent had a weak motivation in Finland, compared with an average of five per cent.

### Study motivation falls below average

	Very motivated	Some-what motivated	Weakly motivated
Finland in rank 44.	59	34	7
Average of 45 countries	74	21	5

Source: PIRLS 2011

A study by the World Health Organisation revealed that more Finnish school-goers find school burdensome than in most other countries. Samples were drawn from three age groups: 11-year-olds, 13-year-olds and 15-year-olds. With increasing age, Finnish school-goers' stress worsened relative to the international average.

Although young people do not seem to enjoy school, they continue their studies for a long time. 91 per cent of 25- to 34-year-olds in Finland have completed upper secondary school, whereas in Italy, France and Germany the figure is 71, 84 and 86 respectively.

Among Finnish 15- to 29-year-olds, 13 percent were not in employment or education in 2009 compared with an OECD average of 16 percent. The Netherlands and Luxembourg performed best in this comparison, with each having unemployment of just seven percent among the same age group.

At university level, Finland is focused on engineering, with fewer opportunities for commencing studies in humanities and economics-related fields.

### New students in 2010

	Humanities and education studies	Medicine and health	Social sciences, economics and law	Technical	Other
Finland	15	20	22	25	18
OECD average	21	13	32	15	20

Source: Education at a Glance, OECD

## 1.2 The freedom to operate

Economic freedoms in Finland are robust, even though the country does not quite reach the top spot in rankings. The Economic Freedom Network has assessed 144 countries against five metrics:

- Size of government
- Legal system and property rights
- Sound money
- Freedom to trade internationally
- Regulation

Finland ranks ninth based on the above criteria, and together with Switzerland it is the only European nation to make the top ten. The study highlights large government and labour regulation as Finland's weaknesses. Strengths are property rights and sound money.

Sound money, which includes access to stable currency, has weakened in many countries due to national indebtedness. For this reason the United States fell to 18th in the study, which is the lowest rank in its history.

Economic freedom		
Rank	Country	Points (Max. 10)
1.	Hong Kong	8.9
2.	Singapore	8.69
3.	New Zealand	8.36
4.	Switzerland	8.24
5.	Australia	7.97
5.	Canada	7.97
7.	Bahrain	7.94
8.	Mauritius	7.9
9.	Finland	7.88
10.	Chile	7.84

Source: Economic Freedom Network

The Heritage Foundation ranks Finland 16th in the world for economic freedom, and seventh in Europe. Finland's otherwise excellent score is brought down mainly by the large size of its public sector, the growth of national debt and the rigidity of its labour market.

The study places Finland second for intellectual property rights, freedom of investment and freedom from corruption. On a five-point scale, the Heritage Foundation classifies Finland among its second-best category of "mostly free" countries.

Corruption level is one metric of economic freedom in a country. According to a ranking by Transparency International, Finland is the least corrupt country in the world together with Denmark and New Zealand. The ranking includes 176 countries.

The least corrupt countries	
Country	Score
1. Denmark	90
1. Finland	90
1. New Zealand	90
4. Sweden	88
5. Singapore	87
6. Switzerland	86
7. Australia	85
7. Norway	85
9. Canada	84
9. Netherlands	84

Source: Transparency International

A freedom to operate also shines through in the actions of the press. For a third time, Finland took the top spot in an index that compares freedom of the press. The study conducted by Reporters Without Borders compares measures including media pluralism, impartiality, and the legislative framework.

Finland, like other Nordic countries, excels without exception in studies of general democracy. An example is the Austrian organization Democracy Ranking, which assesses the political system, gender equality, health and the economy. Here Finland ranks third after Norway and Sweden.

## 1.3 Prosperity and depression

Economic metrics place Finland among the elite of the well-off. The nation of just 5.5 million inhabitants produced 263 billion US dollars of gross domestic product in 2011, making it the 36th largest economy in the world. On a per capita basis this is 47 760 dollars, and places Finland 19th.

In a European context Finns have also done well. The disposable income of citizens increased in 2010 when most of the EU saw its disposable income decrease.

Finland also tends to rank among the best twenty per cent of countries in studies that use composite measures of prosperity. The Legatum Institute in the United Kingdom assesses 142 countries based on a set of measures in eight categories. The broad categories are the economy, entrepreneurship, governance, education, health, safety, personal freedom and social capital. The newest ranking by Legatum places Finland seventh.

Finland was most successful in the entrepreneurship and safety categories. In the case of entrepreneurship, some of Finland's strengths were low start-up costs.

Metrics of prosperity	
Category	Finland's rank
Economy	16
Entrepreneurship & Opportunity	3
Governance	5
Education	8
Health	12
Safety & Security	3
Personal freedom	19
Social capital	5

Source: Legatum Prosperity Index 2012

The UN's Human Development Report ranks Finland 21st among 187 countries. In the four-tier classification Finland belongs to the best class of "very high human development".

And yet, good governance, the world's best schools and comprehensive freedoms have not entirely translated into happiness. Finland's suicide rate, for example, is among the highest

in the EU. Indeed, on the matter of suicides, Finland has more in common with Eastern Europe.

16 people in a hundred thousand committed suicide in Finland in 2010, when the equivalent figure in a financially devastated Greece was three, in Spain 5.8 and in Italy 5.4.

The direction is nevertheless positive to the extent that, particularly among middle-aged men, suicides have substantially decreased in Finland in recent years.

Despite the prevalence of suicides, Finland ranks second in an international happiness index compiled by American professors.

Number of suicides in EU countries	
Country	Suicides per 100 000
Lithuania	29.4
Liechtenstein	26.7
Hungary	21.7
Latvia	18.2
Slovenia	17.2
<b>Finland</b>	<b>16.8</b>
Poland	15.3
Estonia	14.8
Croatia	14.7
France	14.7

Source: Eurostat

Finland holds one of its worst rankings in the Happy Planet index created by the UK-based New Economic Foundation. The aim of this index is to weigh prosperity against the associated ecological footprint. The study reflects the thought that prosperity has more value when it is achieved with minimal harm to others.

Finland ranks only 70th on the Happy Planet list. Western European nations perform poorly in general – Norway, the best country in the region, comes in at 29.

## 1.4 Excellent competitiveness yields average results

Finland fares well or even superbly in international studies of competitiveness. Despite being competitive, Finland has seen its market shares shrink in international trade since 2008.

Experts disagree on why an apparently strong competitiveness brings Finland only mediocre results. According to the Research Institute of the Finnish Economy, international studies describe long term, structural competitiveness. Finland's inability to capitalize on its competitive potential speaks to a short term competitiveness problem, which results from factors including wage levels and challenges in the ICT sector.

Professor **Pertti Haaparanta** has claimed that Finland's challenges stem mainly from the fact that many companies have been slow to renew their product lines.

A competitiveness ranking by the World Economic Forum places Finland third. Like many other studies, the WEF points to a functioning public sector, well-run companies and quality education that develops a skilled workforce. Challenges in Finland were mainly high taxation and a rigid labour market.

Top countries by competitiveness	
Rank	Country
1.	Switzerland
2.	Singapore
3.	Finland
4.	Germany
5.	USA
6.	Sweden
7.	Hong Kong
8.	Netherlands
9.	Japan
10.	United Kingdom

Source: WEF. The Global Competitiveness Report 2013-2014

The Swiss business school IMD places Finland 20th in its competitiveness ranking. This rank has gradually weakened for many years, as Finland still used to hold the sixth spot in 2005. The report by IMD emphasizes that Finland must renew its competitiveness in response to a changing environment. IMD bases its assessment on economic performance, efficiency of governance, efficiency of the private sector and infrastructure.

Competitiveness studies suggest that Finland has strong building blocks for growth, although challenges are self-evident. Of those building blocks, ICT is perhaps the most robust. A working group set up by the Ministry of Employment and the Economy, in search of paths to growth, released a report estimating that ICT is "the single most important technology on which improvements in growth and productivity can be built". The report also notes that Finland must renew itself across all industries by merging digital elements with traditional methods.

## 1.5 The world's leading ICT country

From this perspective the outlook is bright, as Finland is the strongest information technology country in the world according to the World Economic Forum. The WEF compares 144 countries against ten metrics. Finland makes the top ten on nine of them.

The best ICT country in the world	
1.	Finland
2.	Singapore
3.	Sweden
4.	Netherlands
5.	Norway
6.	Switzerland
7.	United Kingdom
8.	Denmark
9.	USA
10.	Taiwan

Source: The Global Information Technology Report 2013, WEF.

The WEF gives Finland credit particularly for know-how, infrastructure and the development of new products and services. The report praised public ICT services as well as the political and legislative context around ICT. Protection for intangible rights is excellent in Finland, and software piracy is rare by international standards.

The report characterizes Finland as an innovation hub. This has not gone unnoticed by many ICT firms that have brought research and development activities into the country. In the span of a few years, ICT firms such as Ericsson, Intel, Electronic Arts, Huawei and Samsung have started R&D activity in Finland.

The innovativeness of nations is a characteristic difficult to measure. In a study by professor **Richard Florida** some years ago, Finland was the most innovative nation in the world. In a ranking by the EU from 2013, Finland was the most innovative country in the union after Sweden, Germany and Denmark. These four countries in the study formed a group called “innovation leaders”.

The EU compared national innovativeness by eight dimensions, of which three were enablers (human resources, research systems and finance and other support), three were firm activities (investments, linkages & entrepreneurship as well as intellectual assets) and two were outputs (innovation and economic effects).

Finland was clearly better than EU average on all dimensions. Finland received the most credit for its human resources, linkages & entrepreneurship as well as finance and other support. Research systems and the economic effects of innovation were relative weaknesses.

The great innovation challenge in Finland is that while plenty is spent on research and development, these investments produce few breakthroughs. Statistics compiled by the international patent organization WIPO show that there were 18.5 patent applications per each billion of GDP in 2011, which is close to average. The equivalent figure in France was 12.4 and in the UK 9.9. On the other hand, South Korea processed an astounding 100 patents per one billion in GDP, while in Japan and Germany the figure was 73.4 and 26 respectively.

In Finland each million put into R&D produced only 0.7 patents, when in South Korea it produced 3.7, in China 3.5 and in Poland 3.2.

#### A mediocre number of patents Patent applications per one billion GDP in 2011

Country	instances
1. South Korea	100.7
2. Japan	73.4
3. China	41.8
4. Switzerland	26.6
5. Germany	26
6. World (average)	20.3
7. USA	18.7
8. Denmark	18.7
9. Finland	18.5
10. Sweden	16.9
11. New Zealand	14.6
12. Belarus	14.3
13. Netherlands	13.2
14. Luxembourg	12.8
15. Russia	12.8
16. Austria	12.7
17. France	12.4

Sources: Wipo Statistics Database and World Bank



## 1.6 A tranquil working life

The quality of Finnish working life is good by international comparison. According to a study by the European Foundation for the Improvement of Living and Working Conditions Finland is ahead of the 15 reference countries in most areas concerning working conditions. Finland performed best in the organization of work, social relations, psychosocial factors and work-life balance.

In turn, Finland falls below average in matters of health and wellbeing, the threat of workplace violence as well as harassment and discrimination.

To some extent the results from this survey are contradictory. On the one hand, Finns feel a sense of empowerment and an ability to influence their own pace of work. On the other, they are subordinated to strict schedules. In addition, only in Italy and Greece are fewer people holistically satisfied with their working conditions than in Finland. In this respect, the Finnish government's program to achieve the best working life in Europe by 2020 is a step in the right direction.

Working hours at least are not a source of despair, with the realized working week of 35.5 hours being around the European average, according to the International Labour Organization.

Employment contracts in Finland are normal by European standards. About 15 per cent of the workforce is in part-time employment, and 15.5 per cent in fixed term contracts. The amount of fixed term employment is nevertheless rising. According to analysis by the Ministry of Employment and the Economy, 63 per cent of new jobs in 2011 were fixed term.

Finland sees industrial action to an amount consistent with European average according to ILO statistics. Because the amount of industrial action varies greatly by year, the below table depicts strikes over the last three years in 15 European countries. The countries are ordered by calculating how many days each has lost to strikes per one thousand inhabitants over three years.

The comparison shows that Southern European countries like Spain and France are clearly more prone to strikes than Finland, whereas Northern countries like Sweden, Germany, Switzerland and the Netherlands are considerably more peaceful. Among Northern countries, Denmark is a clear exception as it rises to the bad end of the spectrum due to a public sector strike in 2008.

Days lost to strikes (thousands)					
Country	2006	2007	2008	Average	Strike days/ 1000 people
Denmark	86	92	1 869	682	123
Spain	928	1,188	1,510	1,209	26
France	1,421	1,553	1,419	1,464	23
Belgium	89	127	263	160	15
Norway	147	4	63	71	14
United Kingdom	755	1041	759	852	14
Finland	85	94	17	65	12
Italy	555	930	723	747	12
Turkey	166	1,354	145	555	7
Poland	31	186	276	164	4
Sweden	2	14	107	41	4
Germany	429	286	132	282	3
Netherlands	16	26	121	54	3
Switzerland	8	7	14	10	1
Ireland	7	6	4	6	1

Source: ILO Laborsta (calculations by Attention Communication)

Unemployment is below EU average in Finland, but rising. While in March 2013 the EU average was 10.9 per cent and the Eurozone average 12.1 per cent, Finland maintained unemployment around eight per cent. The highest unemployment in the region was in Spain at 26.7 per cent, while Austria had the lowest at 4.7 per cent.

## 1.7 More foreign investment

Finnish professional services, healthcare, environmental technology and ICT are of particular interest to foreign investors. Cross-border investment decreased worldwide in 2012 by 18 per cent. Figures by Invest in Finland suggest that 153 foreign companies began operations in Finland during that time, which is 11 per cent less than the previous year.

In contrast, according to a study by Ernst & Young, the amount of foreign investment that generates new business in Finland has grown for the third year running. The year 2012 saw 75 new investment projects, which was 20 per cent more than the previous year. This statistic makes Finland the 12th most attractive investment destination in Europe. However, a comparison of units paints a picture somewhat rosier than reality, because Finland performs worse when measured in dollars invested or jobs created.

Number of new foreign companies in Finland by sector	
Professional services	40
Medicine and health	25
Retail	21
Cleantech	18
ICT	17
Logistics	6
Tourism	4
Mining	3
Others	19

Source: Invest in Finland

In 2012 Finland welcomed 75 new investment projects – 20 per cent more than the previous year.

Foreign direct investment into European countries (instances)			
Country	2011	2012	Change %
1. United Kingdom	679	697	2.7
2. Germany	597	624	4.5
3. France	540	471	-12.8
4. Spain	273	274	0.4
5. Belgium	153	169	10.5
6. Netherlands	170	161	-5.3
7. Poland	121	148	22.3
8. Russia	128	128	0
9. Ireland	106	123	16
10. Turkey	97	95	-2.1
11. Serbia	67	78	16.4
12. Finland	62	75	21
13. Czech Republic	66	64	-3
14. Switzerland	99	61	-38.4
15. Italy	80	60	-25
Others	669	569	-14.9
<b>Total</b>	<b>3 907</b>	<b>3 797</b>	<b>-2.8</b>

Source: Ernst & Young's attractiveness survey Europe 2013

Investments by foreign institutional investors into Finnish private equity funds have also increased. All capital flows into such funds have grown since a slump in 2012, and the share of investment by foreign investors has also increased. PE funds raised 510 million euros in the last quarter of 2012 and the first quarter of 2013 combined, of which 35 per cent came from outside Finland according to the private equity association EVCA.



## 2. The market for information and communication technology

The ICT market is in good shape despite the economic shadow of recession.

### 2.1 An economy shadowed by Europe and slow exports

On the surface, the Finnish economy looks relatively healthy by European standards. Beneath, there are many simultaneous concerns which, put together, can have an impact that is both severe and unpredictable.

A few important exporters, particularly in forestry and electronics, have lost footing amid technological change. A reconfiguration of global supply chains has in turn shifted domestic firms' production from Finland to rapidly growing Asian markets. Economic difficulties in Europe also hinder the outlook for growth.

In the long term, the concern is that an ageing population will burden public finances, making economic balance more difficult to achieve.

There are nevertheless glimmers of light amidst the clouds, of which the brightest are the investments made by foreign technology firms into Finland, and the strengthening of domestic tech entrepreneurship.

The delay in European recovery has surprised economists many times over. Research institutions made hopeful economic forecasts in early 2012, but the optimism eroded by autumn.

In the first half of 2013, forecasts carried the same spirit as they had a year before. Forecasts made in the spring predicted that growth would begin by year's end and continue throughout 2014. The Bank of Finland, Nordea, Tapiola and others estimated total production to stay slightly negative during 2013, and to begin a shy rise in 2014.

Faith in the prospect of growth is diminished by, for example, an investment survey by the Confederation of Finnish Industries, which showed that investment is likely to contract in 2013 by over ten per cent. The outlook is darkened by the fact that the stagnation of exports has spread into domestic consumption.

Evidently, growth optimism rests on thin ice. The IMF has warned that the weak economic prospects of Western Europe shall remain as such for years to come. The finance conglomerate Nordea forecasts that “no obvious catalysts of growth are visible in the Finnish economy”. The Federation of Finnish Technology Industries in turn states that “the situation in Finland is made dire by the fact that exports have fared much better in competing nations since 2009”.

The Research Institute of the Finnish Economy indeed estimates that achieving the forecasted improvement in exports for next year requires improvements in competitiveness and sizeable investments into the development and marketing of new products.

### Uncertain hope

Economists expect once again that the long overdue turn in European growth will begin during 2013. The turn is, however, not visible in annual growth figures which remain close to zero in Finland much like in Europe at large. Overall GDP growth in the Eurozone may even sink into the red.

Subdued growth forecasts in Finland				
	2012	2013	2014	2015
GDP, change %	-0.2	0.3	1.8	2.9
Imports, change %	-3.7	-0.5	2.7	3.6
Exports, change %	-1.4	0.5	3.5	4.4
Investment, change %	-2.9	-2.4	3.4	4.6
Consumption, change %	1.4	0.3	1	1.6
Unemployment %	7.7	8.3	8.1	7.8
Balance of payments, % of GDP	-1.6	-1.1	-0.3	0.2

Source: ETLA, the Research Institute of the Finnish Economy

Optimists predict that in 2013 European economic growth will also pull Finland into a rate of growth around two per cent. Pessimists see a stagnated economy. The retail sector is particularly worried about the slow-down in private consumption. Consumption is constrained by tax hikes as well as crumbling

consumer confidence. Industrial investments are withheld because of low utilization of existing capacity.

Investment is unlikely to speed up much until 2015, when companies might require production capacity to meet growing demand.

Growth outlooks are therefore restrained, and are also shadowed by possible deepening of the financial crisis. A deeper state of crisis would again put the brakes on investment plans and on the willingness of banks to finance them.

Finnish economic forecast by the Bank of Finland				
	2012	2013	2014	2015
GDP, change %	-0.2	-0.8	0.7	1.5
Imports, change %	-3.7	0.8	2.8	4.6
Export, change %	-1.4	1.2	3.5	4.7
Private consumption, change %	1.6	-0.9	0.2	1.2
Public consumption, change %	0.8	0.8	0.1	0.4
Private fixed investment, change %	-3.4	-3.6	2	3.9
Public fixed investment, change %	0.5	0.4	-0.1	0
Unemployment %	7.7	8.5	8.6	8.3
Balance of payments, % of GDP	-1.9	-1.5	-1.3	-1.2

Source: Bank of Finland



## 2.2 A historic pause and staggering growth in the telecommunications market

Statistics by the Finnish Communications Regulatory Authority show that the mobile minutes used by Finns decreased in 2012 for the first time. The decrease was seen in households and corporate users alike.

If measured by units of calls, the decline began a year earlier. In 2010 Finns made 148 million more phone calls than in 2012. The percentage drop was 2.9. Minutes called decreased only by 0.6 per cent, so the decline is quite faint. In any case, the change suggests the market for voice telecoms may have reached its peak.

Mobile subscriptions and usage in Finland				
	2009	2010	2011	2012
Mobile subscriptions (thousands)	7,700	8,390	8,940	9,300
Calls (millions of units)	4,986	5,136	5,111	4,988
Minutes (millions)	15,120	15,919	16,105	16,016
Text messages (millions);	3,800	4,003	4,565	5,495
Multimedia messages (millions)	40	41	51	64
Data usage (terabytes)	16,135	21,668	61,948	96,465

Source: Finnish Communications Regulatory Authority

Mobile data use has increased almost 200-fold in five years.

The number of fixed-line subscriptions and the amount of calls for which they were used has continued to decrease for many years.

Landline usage in Finland				
	2009	2010	2011	2012
Subscriptions (thousands)	1,430	1,250	1,080	890
Calls (millions)	692	580	484	414
Minutes (millions)	2,321	1,866	1,532	1,259

Source: Finnish Communications Regulatory Authority

In other segments, the telecommunications market continued its strong growth. The number of multimedia messages grew by a quarter in 2012, and Finns also used 20 per cent more text messages than the previous year. A Finnish person sent a thousand text messages on average in 2012. Text messages may also be close to their peak, as according to the Finnish Communications Regulatory Authority their growth stalled in the final half of the year.

The most significant change in mobile communications was the explosive growth of data transfer services. The number of mobile broadband subscriptions grew by 34 per cent to more than 4.7 million last year. This means that almost half of subscriptions include a data plan. Collectively the 5.5 million inhabitants of Finland hold a staggering 9.3 million mobile subscriptions.

Owing to rapid growth, mobile data usage has increased almost 200-fold in five years. Last year saw growth of 55 per cent.

The abovementioned 4.7 million subscriptions includes both those with limited and with unlimited data plans. 50.5 per cent had limits on data usage. To begin with, almost all monthly data plans were unlimited. It will be interesting to see whether the rapid growth of data usage will lead to a substantial proliferation of capped data subscriptions in the future.

Statistics by the Finnish Communications Regulatory Authority show that the share of households using mobile devices as their only method of data transfer has increased from 20 to 26 per cent in three years. Fixed broadband subscriptions nevertheless increased last year. The fastest growth took place among

property and condominium subscriptions. A key driver in the growth of fixed broadband subscriptions is IPTV technology, with which consumers receive television broadcasts. At the end of last year there were 265 000 IPTV subscriptions in about 10 per cent of households.

Broadband subscription developments 2009-2012 (1000s)				
	2009	2010	2011	2012
DSL	1,186	1,113	1,125	1,079
Property & condominium	107	158	173	230
Cable modem	223	241	264	292
FFTH (optical fiber network)	13	20	26	41
Wireless fixed broadband	32	27	17	11
Other	6	1	1	0
Fixed broadband total	1,566	1,559	1,606	1,654
Mobile broadband	908	1,636	3,550	4,764
<b>Fixed and mobile broadband total</b>	<b>2,474</b>	<b>3,196</b>	<b>5,156</b>	<b>6,417</b>

Source: Finnish Communications Regulatory Authority

According to analysis by the Finnish Communications Regulatory Authority, list prices for mobile broadband subscriptions remained unchanged last year. In the previous year, monthly prices paid by customers had nevertheless decreased by an average of 2.5 euros due to promotions.

New EU rules on roaming prices brought down the prices of calls, text messages, and data usage for those travelling inside the union.

Prices of landline calls have instead increased by about one third in five years.

## 2.3 Tablets and services rule the IT market

Economic uncertainty hinders the growth of the information technology market to a larger degree than it does telecommunications. The market research firm Market-Visio says the IT market grew 2.4 per cent last year. This year (2013) as well as next, growth will slow to just above two per cent.

Market-Visio measures end user consumption, which means the amount of money that firms, other organizations and consumers spend on devices, software and external services.

Last year the value of this market totalled 5.83 billion euros in value, this year it is 5.95 billion and it will grow to about 6.1 billion next year.

IT services account for about 53 per cent of the market. Devices make up one quarter, and software the remaining fifth.

Finnish IT market 2011-2014				
	2011	2012	2013e	2014e
Devices (€, millions)	1,498	1,523	1,530	1,521
Growth (%)	1.6	1.7	0.5	-0.6
Software (€, millions)	1,208	1,243	1,276	1,324
Growth (%)	4.1	2.9	2.6	3.8
IT services (€, millions)	2,985	3,063	3,147	3,241
Growth (%)	3.3	2.6	2.7	3
<b>Total IT market (€, millions)</b>	<b>5,691</b>	<b>5,829</b>	<b>5,953</b>	<b>6,086</b>
<b>Growth (%)</b>	<b>3</b>	<b>2.4</b>	<b>2.1</b>	<b>2.2</b>

Source: Market-Visio 6/2013

Large trends in the **devices market** are the fall in desktop computer sales and the rapid rise of tablets. The downhill in desktop computers that has continued for a few years will deepen to 16 per cent this year. Sales of tablets instead increased sevenfold during 2011. Even this year growth is racing at 60 per cent.

Tablet sales will overtake desktop sales this year by a clear margin. Even laptop sales are declining, but their market will still remain larger than the tablet market next year.

The value of the storage device market is diminishing, even as the need for storage capacity grows. The growth of the

market is prevented by falling prices, as well as increased use of storage services.

Cameras and video equipment saw their sales fall dramatically last year, and the fall will continue this year. Market-Visio estimates that a third of the photography market will evaporate in the next three years.

The IT devices market in Finland 2011-2014				
	2011	2012	2013e	2014e
Laptops (€, millions)	394	383	349	329
Growth (%)	-4.4	-2.8	-8.9	-5.7
Desktop PCs (€, millions)	182	165	138	127
Growth (%)	-6.7	-9.3	-16.4	-8
Tablets (€, millions)	58	142	231	241
Growth (%)	728.6	145	62.7	4.1
Storage (€, millions)	195	187	186	188
Growth (%)	-2.5	-4.1	-0.5	1.1
Printers and copiers (€, millions)	124	126	128	131
Growth (%)	0.8	1.6	1.6	2.3
Power adapters (€, millions)	97	100	101	104
Growth (%)	-3	3.1	1	3
Photography & video (€, millions)	148	127	114	110
Growth (%)	1.4	-14.2	-10.2	-3.5
Other devices and IT components (€, millions)	151	149	147	152
Growth (%)	2	-1.3	-1.3	3.4
<b>Total devices market (€, millions)</b>	<b>1,498</b>	<b>1,523</b>	<b>1,530</b>	<b>1,521</b>
Growth (%)	1.6	1.7	0.5	-0.6

Lähde: Market-Visio 6/2013

The **software market** maintains similar growth to devices, growing at a speed of a few per cent. Unexpectedly slow sales of desktop PCs limit the sales of operating systems. The unwillingness of organizations to upgrade to Windows 8 has also surprised market analysts.

Demand for business intelligence and data warehouse software, aimed at supporting organizational decision making, has often grown by 6-9 per cent per year. According to Market-Visio, demand for these products will grow from 71 million in 2011 to 90 million in 2015.

In such a case, they will grow into the largest application software segment, leaving behind office and teamwork software as well as financial software.

Information security software has displayed the strongest growth among infrastructure software, and sees its demand grow by about five per cent annually.

Finnish software market 2011-2014				
	2011	2012	2013e	2014e
Application software (millions €)	680	697	715	742
Growth %	4.4	2.6	2.6	3.7
Infrastructure software (millions €)	528	546	561	582
Growth %	3.7	3.4	2.7	3.8
<b>Software market total (millions €)</b>	<b>1,208</b>	<b>1,243</b>	<b>1,276</b>	<b>1,324</b>
Growth %	4.1	2.9	2.6	3.8

Source: Market-Visio 6/2013

The only small minus in the **services** business is in hardware support and maintenance services. Growth in IT training services is also very slight.

Otherwise the services market is in decent growth. The most rapid growth takes place in application management services, which have often grown 6-7 per cent annually. The largest single segment - management, operational and network services - is likewise growing briskly at more than 3.5 per cent. Organizations are increasingly deciding that being the owners of servers and software is not a strategic priority.

Finnish IT-services market 2011-2014				
	2011	2012	2013e	2014e
IT consulting services (€, millions)	227	234	240	247
Growth (%)	3.4	3.1	2.8	2.7
Software development, integration and deployment services (€, millions)	784	805	827	850
Growth (%)	4.1	2.7	2.7	2.7
Packaged software maintenance and support (€, millions)	206	213	222	229
Growth (%)	3.5	3.4	4	3.4
Hardware maintenance and support (€, millions)	282	280	278	277
Growth (%)	0	-0.7	-0.7	-0.4
Management, operational and network services (€, millions)	1,349	1,394	1,441	1,497
Growth (%)	3.5	3.3	3.4	3.8
Software management services (€, millions)	359	383	408	437
Growth (%)	7.3	6.7	6.5	7
Infrastructure services (€, millions)	990	1,011	1,033	1,060
Growth (%)	2.2	2.1	2.2	2.6
IT training services (€, millions)	138	137	137	143
Growth (%)	2.6	-0.1	1.2	2.5
<b>Total services market (€, millions)</b>	<b>2,985</b>	<b>3,063</b>	<b>3,147</b>	<b>3,241</b>
Growth (%)	3.3	2.6	2.7	3

Source: Market-Visio 6/2013



Finnish software firms are in turn growing faster than the domestic market. The 16th edition of a market player mapping shows that software firms and IT services firms grew their revenues by 5.8 per cent in 2012. The speed was faster than the 5.2 per cent the year before.

Profitability in the sector is improving according to the study, although differences between companies are large. IT services have underperformed relative to the index in the Helsinki stock exchange, which is in large part due to difficulties experienced by companies serving Nokia.

For both the economy and for companies themselves, it is significant that for the first time more than half of companies have international activity. The Nordic countries and Western Europe are the most important for exports, but rapidly growing Eastern Europe and Russia have become the third most important export destination before North America.

Growth is fastest in software management services, which continuously grow 6-7 per cent a year.



### 3. Overcoming boundaries with ICT

Renewal requires new modes of operation and an entrepreneurial hunger for growth. This is when growth can fuel productivity. Information security must also be improved, because a fear of data breaches slows down those that create new.

In Finland it is largely understood that ICT enables both companies and the public sector to overcome boundaries which in the past were beyond reach. For example, the Ministry of Employment and the Economy has stressed that ICT can help production-centric companies create new services, small companies access global markets and the public sector achieve operational efficiency.

A study by McKinsey & Company shows that more than 75 per cent of the benefits of the internet accrue to traditional industries, as they improve productivity, create work and enhance quality of life.

**Pekka Ylä-Anttila** at the Research Institute of the Finnish Economy has found that exports of services that leverage ICT have grown considerably faster than other exports in the 2000s. And yet, the digital revolution is only beginning.

New technology has already overturned the very logic of many industries. According to statistics of the Federation of Finnish Financial Services, only one per cent of Finns continue to pay their bills at a bank branch, while 86 per cent choose to operate online. The computer animated *The Flight Before Christmas* is by far the most viewed Finnish film in the world. Digital services accounted for 22 per cent of music sales in Finland. Digital services are in fact largely responsible for the first rise in music sales for ten years.

Nevertheless, the benefits of going digital do not materialize by themselves. "All business leaders – not just e-CEOs – should put the internet at the top of their strategic agenda," the McKinsey report encourages. Companies are to consider how they can best change their operating models to leverage ICT.

### Case: The Flight Before Christmas

Niko the flying reindeer has demonstrated his flying ability by reaching two of the top spots on the list of most viewed Finnish films. One enabler of this success was digital animation technology, which took the film into the same league with international films.

Technology is nevertheless just one factor. From the beginning, the producers also chose to adopt an international business model which included multinational cooperation in the production phase, the use of language options and finding a wide financing base. The first film had 21 financiers, while the second had 23. The screenwriters and directors were also international, bringing global execution onto a Finnish platform.

Adequate financing was the most crucial premise, because sales agents and distributors are unlikely to invest in a picture with a thin budget. After attracting Danish, Irish and German members to the production team as well as the services of the German agency Telepool, the movie had pooled the prerequisite components for international success. The budget of 6.1 million euros broke domestic records.

Successful and extensive marketing ensured that the movie was sold to over a hundred countries even before its opening night. CBS aired the film, making it the first European 3D animation to be shown by a national network in the US. The broadcast was watched by 7.6 million.

## 3.1 Business models in renewal

Companies are cautious to adopt new digital business models, despite their many benefits. A study by the Ministry of Transport and Communications shows that the utilization of cloud services in Finland is limited. Start-ups have been the fastest in cloud adoption, while large companies are merely testing their services.

The result is understandable, as revamping existing processes is challenging in large firms, and abandoning previously made IT investments feels wasteful. Companies fear losing control of software and services. Newly starting firms are free from these worries.

### Obstacles to leveraging the cloud

- Existing IT and business processes
- The movability and control of services
- Distrust of cloud services
- Understanding of cultural and business change
- Legal and regulatory factors
- Contract issues
- Information security
- Dependence on connectivity.

Source: Suomalainen pilvimaisema, Ministry of Transport and Communications

Challenges notwithstanding, cloud services are rapidly becoming more common. The below estimates by the Ministry of Transport and Communications are based on figures that exclude services like Facebook and Google which tend to be billed outside of Finland.

- 
- Cloud market 140 million euros in 2012
  - Growth about 40% in 2012-2014
  - Market to reach 380 million euros in 2015

Source: Suomalainen pilvimaisema, Ministry of Transport and Communications

The public sector has reacted well to the fact that developing new business models is important and challenging for companies. Business model development is therefore a central element in many public research and development initiatives which develop new technology.

Three of the six focus areas of the Finnish Funding Agency for Technology and Innovation, Tekes, are related to this: business in global value chains, services and intangibles as creators of value, and digital renewal of services and production.

Tekes encourages companies to take on business concepts that are based on understanding customer needs and new revenue models. This goal is seen more broadly in the Liideri-program, which helps companies renew their activities.

Digital business models are a focal point of development also for Digile Oy, the information and communications research firm. Digile's research programs have tried to develop business ecosystems in which results can be quickly commercialized.

TIVIT has also initiated the founding of Forge, a testing lab for cloud services, with which companies can develop their own cloud services.

New technology enables the renewal of business models throughout a company's processes. **Mikael Johanson** emphasizes in his doctoral thesis that social media revolutionizes the rules of user-centric design. It is more important than ever to include users in service design. In a World Economic Forum report titled "The Future of Manufacturing" it is argued that "the ability to innovate with speed is the most important competency that distinguishes successful countries and companies".

An international study by McKinsey shows that over 80 per cent of firms use at least one social media channel. The most typical tools are video conferences, blogs, networking and document sharing. Social media speeds up internal information flows, strengthens customer communication and decreases the costs of partner communication.

A study by Aalto University, University of Buffalo and Texas A&M University in turn shows that social media solutions strengthen the bond between customer and company. This is then seen in the customer's actual buying behaviour. Customers with a strong bond to the organization are more profitable than those without.

Etna researchers **Petri Rouvinen** and Pekka Ylä-Anttila in turn list several changes related to business models that have been spawned by technology:

- **Changing global division of labour** – developed countries increasingly specialize in services. Firms spread production and value chains worldwide: each link in the chain follows comparative locational advantages.
- **Digitization of services** – old notions of what is a service cease to hold. An increasing portion of services – data processing, training, retail, travel, entertainment – can be digitized at least partly. The ideas that services are consumed and produced simultaneously, and cannot be stored or moved, are no longer true.
- **The evaporating line between industry and services** – services and industry should not be juxtaposed. They complement one another. The border between the two has faded, and in some cases has entirely washed away.

Source: Uutta arvoa palveluista. Pajarinen, Rouvinen, Ylä-Anttila.



### Case: Enevo optimized refuse collection routes

The business model of Finnish Enevo Oy is to optimize the timetables and routes of garbage trucks. Enevo's sensors measure when waste bins are full, and send the data to Enevo for a computerized calculation of the optimal pickup time and route.

The number of collections decreased by 44 per cent and net costs by 38 per cent in tests conducted in the Itä-Uudenmaa refuse management zone.

The solution offers real time information as well as statistics of longer term changes (fill rate, estimated fill dates, collection dates, seasonal trends). Billing is based on the refuse bins being followed.

The service by Enevo is a novel mode of operation – one that is changing the business model of refuse management companies. They can now offer customers true care for cleanliness and safety.

Finnish industry already utilizes ICT in significant ways. According to ETLA researcher **Tuomo Nikulainen**, software-dependent products accounted for about a third of Finnish exports in 2010. German industry has a still firmer grip on the times, as shown by the Industrie 4.0 concept that aims for an industrial revolution in which all industrial machinery, devices and processes are online. The goal is also to steer them with interoperable tools.

Many people expect 3D printing to overturn entire industries. When people can print a spare component at home, an entire step disappears between industry and customer.

A book by **Timo Pauku** describes how three dimensional printing can also speed up product design. For example, 2 500 airplane parts were designed in India in one month, when the job would have taken a year with traditional methods.

The US president **Barack Obama** has expressed hopes that 3D printing could return jobs to the United States which have migrated to China.

## 3.2 Finland is paving the way for growth entrepreneurship

Analysis by the Ministry of Employment and the Economy shows that 90 per cent of new jobs in Finland in 2011 were created by firms of less than 50 employees with expectations of growth. Actual growth companies in turn created about 60 500 jobs between 2009 and 2011. The number of growth companies during that time was only 758, and yet their societal impact was tremendous. This is why fostering growth companies is vital.

There were 18 per cent more growth companies at the end of 2011 than one year before. It is difficult to say whether this leap was caused by economic trends or entrepreneurial enthusiasm.

The international GEM study into entrepreneurship shows that the growth targets of Finnish companies are more modest than in most other EU states. Public opinion in Finland is very positive for entrepreneurship, but hunger for growth among entrepreneurs is scant.

The table on the next page shows the number of firms, as a proportion of population, that plan to grow by more than five employees over the next five years. Although the statistics deal with intentions, they are telling of the growth optimism and ambitions among entrepreneurs.

The table shows that the growth expectations of Finnish entrepreneurs are among the EU's weakest. Lower growth than in Finland and Sweden is expected only by entrepreneurs in the crisis-ridden states of Greece, Spain and Italy.

**Low growth expectations among Finnish entrepreneurs**  
Number of firms expecting moderate growth, as a proportion of population

Country	
1. Latvia	7.1
2. Estonia	5.4
3. Rumania	4.5
4. Slovakia	3.5
5. Lithuania	3.3
6. Hungary	3.1
7. Poland	2.8
8. United Kingdom	2.8
9. Portugal	2
10. Ireland	2
11. Netherlands	1.9
12. Denmark	1.7
13. Slovenia	1.4
14. Germany	1.4
15. France	1.3
16. Belgium	1.3
17. Austria	1.2
18. Finland	1.1
19. Sweden	1.1
20. Greece	0.9
21. Italy	0.8
22. Spain	0.8
<b>Selected non-EU countries</b>	
USA	3.9
China	3.2
Japan	1.3
Chile	8.4
Brazil	2.2
Egypt	4.9
Israel	1.7

Source: GEM 2012 Global Report

An EU report on growth companies reminds us that a country looking to foster growth entrepreneurship should not pick out winning sectors, but rather create conditions conducive to growth. The report argues that the greatest concern for SMEs is getting capital. Therefore a central form of support for growth entrepreneurship should be the opening of financing channels. Finland's rather high corporate tax has been another important worry for companies.

The decision on Finnish central government spending limits for 2014-2017 includes notable development proposals for both increasing financing and easing taxation.

- Finnish Industry Investment Ltd will be capitalized by 30 million euros each year during the timeframe, with the purpose of founding a growth fund aimed at growth stage companies.
- Equity investments in Finnvera Oyj will be increased by five million euros in 2014-2017, and the funds directed towards facilitating start-up growth.
- 20 million euros of Tekes funds will be used annually for seed-stage capital.
- Corporate tax will be lowered by 4.5 percentage points to 20 per cent from 2014.

Source: Central Government Spending Limits 2014-2017



### 3.3 Productivity creates welfare

Improving productivity is of paramount importance to welfare in the near term. Economic growth is a function of productivity gains and the amount of work available. Because the amount of work will decrease in the next years, growth must be based almost entirely on improvements in productivity.

Regrettably the improvement of productivity has also been slowing down for a long time. Recently the slowdown has resulted from Finland losing jobs in highly productive sectors and creating jobs in less productive ones. Finding new growth would therefore require an upspring of jobs in highly productive industries. Professor **Matti Pohjola**, among others, has argued that ICT is the best opportunity to improve productivity and spur new growth.

Economic researchers agree that technology is the primary catalyst of growth. Researchers have also emphasized that technology should be interpreted as including leadership, social organization and culture. This includes the more efficient use of all factors of production. It means, for example, the streamlining of organizational structure, the improvement of internal process efficiency, the outsourcing of support functions and better management of customer data.

The internet is expected to refresh the activities of companies to a larger extent than ICT devices have done so far. A McKinsey study shows that SMEs that are active online have grown twice as fast as firms of similar size that are passive online. A Deloitte study of the retail sector shows that digital solutions have helped retailers cut costs and increase sales.

Creative destruction is a healing force for economic productivity. The Ministry of Employment and the Economy estimates that about a third of overall productivity gains in Finnish industry are explained by creative destruction. Finland must support growth entrepreneurship to speed up this process.

A notable portion of productivity gains nevertheless arise from rationalizing existing operations. This means doing things smarter rather than faster. A survey of almost 4 000 organizations by Tykes shows that work life development programs have in general improved effectiveness as well as the quality of the working life in Finnish workplaces.



#### Positive effects of work life development programs

- New modes of operation have been adopted
- Modes of operation have become clearer and more efficient
- Enthusiasm and ability for development have improved
- Opportunities for employee impact have increased
- Employee understanding of their own and the organization's work has improved
- Leadership models have evolved
- Cooperation of leadership and workforce has improved
- Tasks and responsibilities have been clarified
- The use of expert skills in development has increased
- Skills in project work have improved in workplaces

Source: Results from self-assessments in projects of Work Life Development Program Tykes (1996-2010)

As evidenced above, developing productivity requires a multitude of changes in workplaces. The development of leadership therefore plays a crucial role also in programs in which the development of technology is the primary goal. For example the metals and engineering competence cluster Fimecc Oy emphasizes, that Fimecc programs focus on changing the culture of leadership and development. The goal is to achieve less planning, more experimental actions and more dynamic control.

### Case: Traffic control for construction machinery

As part of Fimecc's Effima-program, Navitec Systems Oy has developed a traffic control system for moving construction machinery that enables one person to operate several machines at once.

Navitec makes, for example, navigation systems tailored for unmanned excavators which can locate and steer the machine. The system can drive a machine along a set route, detect collision hazards in the environment and synchronize the machine's work tasks with its movement and location.

Navitec Mission Control System is a control room system for centralized control and monitoring of machinery. It manages the activities of many machines.

The greatest pressures to develop productivity rest currently on the public sector. The public sector has more to do as an aging population requires more services. On the other hand, the number of taxpayers is decreasing due to this demographic shift. As costs grow, income diminishes. The resulting hole cannot be filled with elevated taxation, because this would put unreasonable strain on national competitiveness.

Having studied the productivity of the public sector, **Osmo Soininvaara** describes developments in the economy as follows: "Because the growth of productivity varies greatly by sector, before long the majority of labour will be spent in low productivity work. After enormous increases in productivity first in agriculture and then in industry, our sights are now shifted onto the public sector whose productivity growth has been much weaker".

Not all modes of operation in the private sector can be seamlessly injected into any area of the public sector. Very many models can nevertheless function in both domains. For example the ICT 2015 working group encouraged the public sector to increase its use of pilot projects in the development of new services. Pilots combine the quick onset of activities and the

limiting of risk. The public sector can then achieve innovative solutions that improve the quality and efficiency of service.

### Case: Vaasa commercialized recreation services for the elderly

The Age Center in Vaasa commercialized all recreation services for the elderly. Because of the commercialization, recreation instructors were freed to spend 67 per cent of their working time in client-facing work, where before only 48 per cent of time had been spent with clients. Employee satisfaction increased at the same time.

The commercialization enabled long term planning, to which employees are also able to contribute more than before. Even with more hands at the drawing board, the efficiency of planning has increased.

Better employee satisfaction brought along workplace flexibility, which in turn mitigated the problem of substitutes. At the same time, the commercialization made the working day of each employee more diverse.



### 3.4 Information security risks hinder renewal

Threats related to information security slow down the adoption of many new digital solutions. The concerns are not groundless, as denial-of-service attacks, data breaches and ransom malware are a regular nuisance for companies and citizens alike. According to the Finnish Communications Regulatory Authority (FICORA), the risk of user identity theft has also increased substantially.

FICORA's information security unit CERT-FI was contacted 4208 times last year, which was 10 per cent more than the year before.

Cyber criminals keenly exploit vulnerabilities in the publishing and content creation systems of websites, and can use this to spread inappropriate content, pass on malware or conduct denial-of-service attacks.

Cyber-attacks are in part hacker vandalism, but also include goal-oriented crime and state-run espionage.

Information security know-how is more important than ever, if companies and public institutions wish to capitalize on the opportunities of the digital economy. This is why the ICT 2015 working group of the Ministry of Employment and the Economy has emphasized that a cluster of information security professionals, companies, services and research with international gravity should be created in Finland.

Finland holds information security know-how that is among Europe's cutting edge, but the edge is thin. The fact that the world's largest information security firm McAfee made an offer to buy the Finnish listed firm Stonesoft in April is evidence of this know-how. McAfee's leadership has communicated that the acquisition of know-how is specifically what inspires this purchase.

The lack of breadth in know-how can nevertheless be seen in an Aalto University study, which found nearly 3000 automation systems open to network attacks. The researchers found that the devices should not even have been connected to the internet, where the vulnerability to attacks exists. Automation systems deal with matters including power management, industrial automation and construction automation. The systems control power plants, alarms and door locks. According to Aalto, digital trespassers can inflict tremendous damage with such systems. Especially remote control systems had weaknesses.

The researchers claimed that Finland has a large amount of automation devices connected to the internet by international standards.

A study early this year by the consulting firm Mandiant reported that over one hundred large American companies were victims of a cyber-attack. The event unfolded as hackers stole the master keys of RSA Security TokenID owned by EMC. With them, the culprit was able to access companies' information networks.

The Finnish Information Security Cluster (FISC) recommends more thorough preparation for risks

#### Information security basics

- Map vulnerabilities in advance.
- Train users.
- Maintain workstations properly.
- Build systems where malicious software from emails does not infect the core of the corporate network.
- Monitor systems for security risks.
- Maintain up-to-date virus protection.
- Take into account new operating models like increased working from home, where employees use their own devices and programs.
- Ensure cloud security.

Source: FISC ry

The ICT 2015 working group in turn suggested in their report that institutions of higher education direct their resources toward information security training and research. In addition, the group suggested that system-level security thinking should be targeted in Finland instead of focusing on securing individual devices. Spearhead initiatives should be carried out in both the private and the public sectors to achieve this.

The ICT 2015 working group proceeded to suggest the establishment of a national cyber-security center, as had been proposed in the national cyber-security strategy.



## 4. ICT as an engine of growth

Many large megatrends are pulling the ICT sector towards growth. Especially a mobile way of life, the need to improve efficiency and service level as well as solutions to environmental problems rest more and more on ICT know-how.

### 4.1 The Nokia upheavals continue

The challenges of the Nokia mobile phone business have left an impression on many that the Finnish communications cluster is being extinguished in its entirety.

The picture was reinforced by the news in early September 2013 that Nokia will sell its mobile device operations to Microsoft. The 5.5 billion euro deal leaves Nokia to focus on developing its network business, mapping and data services and technology. When the deal is finalized toward the end of 2014, about 32 000 employees will be transferred to the employment of Microsoft.

The news of the sale sparked concern and confusion in Finland. In its time, the rise of Nokia helped Finland lift itself from the deep recession of the 1990s. Now the sale of a success story is shattering.

When viewed through a brighter lens, the deal can be seen as a positive signal that Finnish know-how is of interest to foreign enterprises. The sale significantly strengthens Nokia's financial position. For Microsoft, the purchase opens a new road through which to grow its mobile communications business.

Microsoft CEO **Steve Ballmer** claims the company has no intention to move operations from Finland. The company will also establish a data center in Finland which will serve its European clients.

The rapid increase in telecommunications is a chance for Finland. Research firm Rewheel reports that the prices for transferring mobile data in Finland are among the cheapest in Europe. In Germany, for example, data transfer costs 15 times as much as in Finland. This in turn has spurred the use of mobile data services. According to FICORA, data usage has grown 200-fold in five years.

The rapidly growing use of data transfer services has in turn given confidence to entrepreneurs, who have developed

innovative services. The innovations have found interest among international corporations and have even led to acquisitions. In early June, US-based Shopper Talk bought Rapid Blues Solutions Oy, a Finnish firm specialized in customer analysis.

International telecoms companies have taken note of Finnish know-how. Ericsson, Huawei, Intel and Samsung are among the firms that have brought R&D activities to Finland in the space of a few years.

Telecommunications know-how is vital for economic growth, because the amount of data transferred will grow explosively in the next years, as billions of new devices are connected to the internet.

In order to strengthen telecommunications know-how, the ICT 2015 working group has proposed a R&D initiative spanning several years. Focal points for development could be services based on cloud computing and data analytics as well as connecting mobile technology with other technologies like multimedia and sensor technology.

Developing telecommunications know-how is of course already the topic of several public programs, some of which are applied cross-disciplinary ventures.



- **The smart simulators of Tampere.** The Tampere University of Technology Smart Simulators research group seeks to apply new, smart and innovative methods to practical problems. At the core of the group are researchers in hydraulics, automation, mathematics and production. The group works closely together with industry. It has participated, for example, in the MetsäOnline initiative, which seeks to improve the efficiency and training quality around the supply chain of wood.
- **Smart radio technology.** The Tekes trial environment for cognitive radio and networks is a multi-year venture that seeks to develop smart radio technology that is able to self-select unoccupied frequencies and networks to ensure seamless communication.
- **Energy-efficient networks in Oulu.** The wireless communications research unit at the University of Oulu is developing, among other things, energy efficient signal processing for the wireless systems and networks of tomorrow. The goal is to enable wireless machine-to-machine solutions in an energy-efficient way.

Telecommunications know-how will also be strengthened by a common national IT architecture proposed by the ICT 2015 working group, for which government funding has already been set aside. The common architecture will enable easier use of information across organizational boundaries, which decreases work overlap and improves service.

#### Case: Know-how from Oulu for Telekom Deutschland

Lewel Group from Oulu is developing machine-to-machine (M2M) solutions for current and new customers of Telekom Deutschland.

Machine-to-machine communication means the automatic transfer of information between, for example, machines and central control rooms. M2M solutions can be used to improve processes in any sector. M2M also enables remote monitoring of machines as well as seamless following of processes, such as monitoring the dispatch of packages or the cold chain of frozen goods.

## 4.2 Revolution in healthcare methods

Technological progress opens novel opportunities for the development of healthcare. In coming years patients can be helped in countless ways that still seem like science fiction to many.

One of the greatest socioeconomic opportunities has to do with the combination of mobile healthcare and mobile finance, opined the World Economic Forum a few years ago. Electronic solutions offer cost efficient opportunities to people in developing nations who have mobile phones but no bank account. For example, expecting mothers could be offered electronic vouchers that can be used to pay for medical services related to pregnancy.

Electronic healthcare services can help the availability of healthcare, the payment process and the administration of healthcare facilities.

The VTT program for health and welfare technology is based on the premise that healthcare services must be changed radically in order for results to be achieved cost-efficiently. VTT argues the solutions of the future must be:

- **Pre-emptive** – offer opportunities to prevent diseases before their onset
- **Predictive** – offer tools and methods for disease diagnostics
- **Participative** – enable the participation of citizens and patients in the management of their own health and illness
- **Personal** – applied to individual needs.

One example of VTT's activities in this area is the multinational EU-initiative PredictAD, where methods have been developed for the earlier diagnosis and more effective treatment of Alzheimer's disease.

Healthcare is the second largest segment of Finnish hi-tech exports after telecommunications. In 2012 its exports grew 22 per cent. The sector's exports have grown at an average annual rate of 8.2 per cent over 2008-2012, while the global healthcare technology sector has grown an average of five per cent annually.

Although imports in the sector grew to their all-time high in 2012, the current account surplus also grew to a record high 735 million euros, up 44.2 per cent from the year before. The largest trade destination was the US, which received 35 per cent of all exports in the sector.

Another sign of growth is the fact that of the 60 member companies of healthcare technology association FIHTA ry, half have been founded after the year 2000. FIHTA deems it important that the government should support the sector's growth with determination. FIHTA suggests, for example, that the state should lead the development of new long-term financing instruments for start-ups and growth companies, the fusion of the sector's R&D activity with core activities of university hospitals, and the development and retention of Finnish know-how in the sector.

### Case: BlindSquare looks on behalf of the sight-impaired

The BlindSquare software developed by Finnish MIPSoft helps the sight-impaired navigate their surroundings. With the mobile device compatible application, a person can hear their location, the nearest intersection as well as services like restaurants and shops within their desired range.

The application guides its users toward their destination, and helps them get off at the correct bus stop. Synthetic speech is currently available in ten languages.

BlindSquare won the award for the best mobile health service at the Mobile World Congress in Barcelona.

Ever more revolutionary products are being shaped on research desks around the world, involving nanotechnology, 3D printing, stem cells and synthetic life. For example, Aalto University researchers have participated in an EU effort called ArtiVasc 3D which attempts to produce 3D-printed artificial skin complete with vascular elements.

The synthetic skin could first be used as a substitute to animal testing in the pharmaceutical and cosmetics industries. It could also enable the development of skin transplants for injuries such as burns.

### 4.3 Cleantech responds to global challenges

Global questions of energy and the environment are in dire need of solutions, and finding them requires cross-disciplinary know-how. There are approximately 2 000 cleantech firms in Finland which bring in aggregated revenues of 20 billion euros. The sector employs 50 000 people.

Finland is a cleantech country larger than its size. Finland's share of the global market is about one per cent, even though its share of world GDP is only 0,4 per cent. The Finnish government aims to double the size of cleantech by 2020.

ICT plays a central part in cleantech solutions. For instance, the Smart Grids and Energy Markets (SGEM) program of the energy and environment expertise cluster Cleen investigates, among other things, how an active customer can be a key actor in the smart power grid environment. The program also studies what requirements smart grids place on ICT solutions and on information security.

Finnish industry has long strived toward energy conservation. This is likely explained by a notably large amount of heavy industry that requires a large amount of energy. Companies that deliver industrial machines and systems have created innovative processes that help their clients conserve energy. This development continues in Finnish universities and companies.



- **Smart street lights.** A group of companies, in a project led by VTT, has developed smart street lights that adapt to conditions with the help sensors and wireless control. Lighting can be adjusted according to snow or traffic levels, for example.
- **World record for the efficiency coefficient of nanostructured solar cells.** Aalto University researchers have achieved an 18.7 per cent efficiency ratio in nanostructured solar cells. A low-reflection surface of black silicon retains a larger portion of solar rays for use.
- **Aalto University researchers are developing thermo-electric materials** that can help transform waste heat into electricity in homes and factories. The materials under development are based on oxides that are environmentally benign.

#### Case: Eco-cities into China

DigiEcoCity Oy has already signed two contracts to build cities of 100 000 inhabitants in China. The company specializes in the design and construction of sustainable environments with diverse digital services for citizens.

Digital services like online banking and electronic healthcare services will partly replace physical services. Public services, jobs and recreational services are all within walking distance of each other. People-friendly cities are set to be an alternative for crowded metro-polises. Eco-cities produce more energy than they consume.

China has plenty of room for new thinking, as an estimated 400 million Chinese citizens move from rural to urban areas by 2020.

## 4.4 The small but large nation of games

Finland has become a hot topic in the gaming sector, and even international gaming companies seek Finnish talent. This reputation owes much to Rovio and Supercell, the two industry superstars responsible for the games Angry Birds, Clash of Clans and Hay Day.

Before these two success stories, Finland was the origin of several hit games like Max Payne and Alan Wake, which created the country's games industry skill base.

According to the gaming industry association Neogames, the games business employed 1 800 people last year, and earned 250 million euros in revenues. The sector is predicted to grow into a 1.5 billion euro cluster by 2020.

Current growth rates give reason to be hopeful. Rovio's turnover was 5.2 million already in 2010, and was 152 million last year. Supercell earned revenues of 76 million last year, but in just the first quarter of 2013 its quarterly revenues have grown to 136 million. Kauppalehti newspaper estimates that the firm's turnover could reach 600 million this year.

The sector's growth has partly been fuelled by Tekes's Skene-program, the aim of which has been to make Finland a significant centre of the gaming industry.

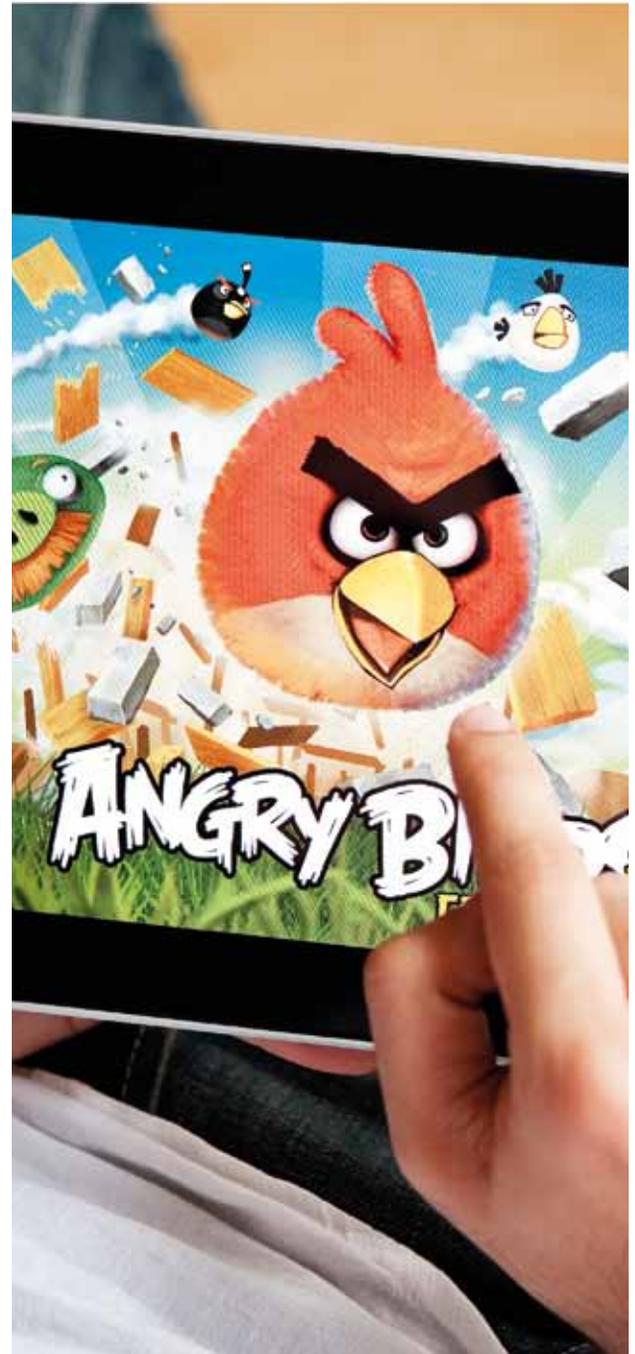
International investors have also found the Finnish gaming industry. Supercell's owners recently sold 16.5 per cent of their shares to private equity investors Index Ventures, IVP and Atomico.

The games industry itself sees several reasons why Finland is on top form:

### Why Finland?

- Innovation meets exceptional know-how
- Value for money
- Tekes funding
- Reliability
- Flexibility
- World class sector training
- A strong culture of gaming and game development

Source: Neogames





Decision makers should do everything in their power to ensure that public administration, laws and standards support the crossing of boundaries and the creation of new.

Efforts to improve the operating environment of companies in 2014-2017:

30 million euros annually directed toward establishing growth funds for growth-stage companies.

Equity investments in Finnvera Oyj increased by 5 million euros annually to develop growth of start-ups.

20 million euros from the Finnish Funding Agency for Technology and Innovation (Tekes) directed annually to seed capital.

Corporate tax lowered by 4.5 percentage points to 20 per cent from 2014.

## 5. 21 paths to a frictionless Finland

The ICT 2015 working group of the Ministry of Employment and the Economy sought ways during 2012 with which Finland could create new growth with the help of ICT know-how.

Personnel cuts in the Nokia cluster inspired the Ministry of Employment and the Economy to establish a working group that began to seek ways of improving growth in 2012. The report produced by the group included 21 mutually supportive paths that Finland must follow. To implement the recommendations and develop new ideas, an ICT expert working group was established in the Prime Minister's Office, working on a ten year horizon.

The 21 paths are as follows:

### 1. Building a unified, national service architecture

This enables information to be used easier across organizational boundaries. The solution helps reduce overlaps in work and improve customer service. Planning is led by the Ministry of Finance. The health awareness service Taltioni can be the first service to join the new architecture.

### 2. Building the infrastructure required by the real-time economy of companies

Information streams inside companies as well as between companies and public administration are to be automated in a way that reduces routine labour, improves risk control and retains up-to-date information. This applies to eg. wages, VAT-data and accounting. Estimated savings of four billion euros are unlocked annually.

### 3. Consolidation of mobile and fixed ICT infrastructures

Licenses are to be admitted for the 800MHz broadband frequency band, and test frequencies in the 700MHz and 3GHz ranges made available to universities and companies. In addition, the manufacturing of optic fibre cables is to be sped up with new lighter solutions like micro-trenching.

### 4. Creation of an open data ecosystem

A cooperation network for open information is to be assembled. A data-opening program will be launched under the direction of Ministry of Transport and Communications. The functioning of law and regulation must be ensured to capitalize on data.

## Competences

### 5. Combining forces for the 10-year ICT 2023 research, development and innovation program

Gathering separate measures to lift the level of ICT know-how into a 10-year program, the steering group of which will be formed by Tekes and the Academy of Finland. The program implements R&D projects shared by the public and private sector, and links to the most important international research programs.

### 6. Digital services and content

Starting the digitization of municipality services with pilot projects in eg. Oulu and Mikkeli. The development and distribution of services is to be done using the municipalities' service development organization Tiera. Cloud service know-how is to be developed by founding the Forge cloud laboratory.

### 7. Games and gamification

Increasing the amount and quality of the training for the games industry to meet the need. Implementing the first pilot projects for taking gaming beyond the games sector through Taltioni.

### 8. Data security

Increasing education and research in the data security sector. Developing export events for the sector, and establishing a cyber-security centre.



### 9. Mobile competence

Starting a multi-year R&D initiative and increasing academic research in the framework of the R&D program.

### 10. Big Data

Increasing training and research around big data. Starting a development initiative to advance big data know-how.

### 11. Creation of an efficient chain of research, application, productisation and commercialisation into shape

Developing of new types of cooperation programs and clarifying the division of work between universities and universities of applied science.

### 12. Promotion of general educational policy

Implementing an initiative for the anticipating of labour and competence requirements, and accounting for the needs of the internet age in school curriculums.

### 13. Promotion of a focused educational policy in conditions of sudden structural change

Retraining for the needs of companies. Tailoring retraining for the needs of companies and employees, and taking lifelong education into institutes of higher education.

## Financing

### 14. Funding program to cover the needs of early-stage and growth-stage companies

Through the program, the government invests in start-ups and growth companies through two different funding models.

### 15. Measures for increasing the viability of investment and taking risk

The introduction of small and medium enterprise bonds, and the implementation of a tax incentive for innovation.

## New operating methods

### 16. Pioneering public services

Creating a model of precommercial pilots for the public sector, with which new service solutions can be tried with limited risk. Simultaneously conditions that discriminate against SMEs will be cut from public purchases, and a development centre founded for procurement skills within social and health services.

### 17. Collision and network projects

Encouraging regions and sectors to build skill clusters around current market actors, in which parties reinforce each other's know-how. Supporting the development of regional competitiveness with skill programs that aim to create new, internationally successful business activity. The open-systems competence cluster is to serve as a pilot.

### 18. Collisions in the time of structural change – acute solutions for the Nokia cluster's problems

Commercializing the liberated ICT competence into exportable condition. Capitalizing on the study into the German and Swiss markets – each with acute need of ICT professionals – made as part of the ICT 2015 program.

### 19. Simplifying the tangle of services and legislation

Simplifying the service jungle of SMEs from the point of view of the customer with the The Kasvun Tehoketju (Power Chain of Growth) initiative. Decreasing elements from legislation that discriminate against the digital economy: equating digital services with their physical equivalent (eg. e-books) and lowering energy tax for data centres into line with other industries.

### 20. Rapid implementation

Speeding the digitization of the services of ministries with the Kide initiative. Development of a subsidised 'leased CIO' program. Developing e-business know-how among SMEs.

### 21. Long-term development

Establishing an ICT Expert Group in the Prime Minister's Office. The group will support, coordinate and speed up the implementation of the ten year ICT program. A market and competitor monitoring unit will be established as part of Tekes to support the ICT working group.

## Online ICT services in Finland

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[www.aaltowib.com](http://www.aaltowib.com)

[www.abo.fi/student/content/topic/topic/](http://www.abo.fi/student/content/topic/topic/)

[ictbibl/?setlanguage=fi](http://ictbibl/?setlanguage=fi) (ICT library in Turku)

[www.cleen.fi](http://www.cleen.fi)

[www.digi.fi](http://www.digi.fi) (The ICT branch group of the Federation of Finnish Technology Industries)

[www.digile.fi](http://www.digile.fi)

[www.digitoday.fi](http://www.digitoday.fi)

<http://eit.ictlabs.eu/ict-labs/nodes-co-location-centres/>

[helsinki](http://helsinki.ictlabs.eu) (the ICT lab of the European Institute of Innovation and Technology)

[www.elker.fi](http://www.elker.fi) (ICT Producer Co-operative)

[www.ficom.fi](http://www.ficom.fi)

[www.fimecc.fi](http://www.fimecc.fi)

[www.fisc.fi](http://www.fisc.fi)

[www.hermia.fi/neogames](http://www.hermia.fi/neogames)

[www.hetky.fi/ict-ladies-verkosto](http://www.hetky.fi/ict-ladies-verkosto) (ICT Ladies network)

[www.hse.fi/FI/units.depts.d/d\\_1/bustech](http://www.hse.fi/FI/units.depts.d/d_1/bustech) (Aalto University Department of Information and Service Economy)

[www.ict2015.fi](http://www.ict2015.fi)

[www.ictportti.fi](http://www.ictportti.fi) (the joint project of Turku University of Applied Sciences, University of Turku, and Turku Science Park Ltd, which helps SMEs utilise ICT more efficiently.)

[www.jyu.fi/it](http://www.jyu.fi/it) (The IT Faculty of the University of Jyväskylä)

[www.kasvufoorumi.fi](http://www.kasvufoorumi.fi)

[www.keksintosaatio.fi](http://www.keksintosaatio.fi)

[www.lvm.fi](http://www.lvm.fi)

[www.marketvisio.fi](http://www.marketvisio.fi)

[www.nestnewyork.com](http://www.nestnewyork.com) (a start-up incubator in Manhattan)

[www.ohjelmistoyrittajat.fi](http://www.ohjelmistoyrittajat.fi)

[www.softwareindustrysurvey.org](http://www.softwareindustrysurvey.org) (a mapping of software companies)

[www.oske.net/ubi](http://www.oske.net/ubi) (Ubiquitous Computing Cluster Programme)

[www.protomo.fi](http://www.protomo.fi)

[www.railsgirls.com](http://www.railsgirls.com)

[www.startupsauna.com](http://www.startupsauna.com)

[www.tekes.fi](http://www.tekes.fi)

[www.tekes.fi/info/niy](http://www.tekes.fi/info/niy)

[www.tekes.fi/info/tempo](http://www.tekes.fi/info/tempo)

[www.tekes.fi/ohjelmat/dtp](http://www.tekes.fi/ohjelmat/dtp)

[www.tekes.fi/ohjelmat/ubicom](http://www.tekes.fi/ohjelmat/ubicom)

[www.teknologiainfo.net](http://www.teknologiainfo.net) (the online store of the Federation of Finnish Technology Industries)

[www.teleforum-ry.fi](http://www.teleforum-ry.fi)

[www.tem.fi](http://www.tem.fi)

[www.tieke.fi](http://www.tieke.fi)

[www.tietokone.fi](http://www.tietokone.fi)

[www.tietoviikko.fi](http://www.tietoviikko.fi)

[www.ttlry.fi](http://www.ttlry.fi)

[www.tucs.fi](http://www.tucs.fi) (Turku Centre for Computer Science)

[www.turkusciencepark.com/default.asp?viewID=268](http://www.turkusciencepark.com/default.asp?viewID=268)  
(ICT Turku)

[www.tut.fi](http://www.tut.fi) (Tampere University of Technology)

[www.uta.fi/sis](http://www.uta.fi/sis) (the School of Information Sciences at the University of Tampere)

[www.viestintavirasto.fi](http://www.viestintavirasto.fi)

[www.vigo.fi](http://www.vigo.fi)

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## DIGI.FI – The ICT branch group of the Federation of Finnish Technology Industries (www.digi.fi)

The ICT branch group, DIGI.FI, consists of all the ICT member companies of the Federation of Finnish Technology Industries. DIGI.FI's board of directors can also accept member applications from other companies and associations that operate in Finland.

Units within the sector located in Finland employ 53 000 people. The Finnish net sales of the companies was 7.5 billion euros.

### Board of directors in 2013

#### Chairman:

Kimmo Alkio, CEO, Tieto Oyj

#### Vice chairman:

Ari Rahkonen, General Manager, Microsoft Oy,

#### Members:

Heikki Nikku, Managing Director, CGI Oy

Harry Nyström, Managing Director, Canon Oy

Ari Rikkilä, CEO, Nervogrid Oy

Timo Soinen, CEO, Sunduka Oy

Hannu Vaajoensuu, Chairman of the Board, Basware Oyj

Jukka Viitasaari, Director, The Federation of Finnish Technology Industries, secretary

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