

# **Nordic foresights and visions on ICT in healthcare, security, the experience economy and production systems**

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**Draft report**

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## Introduction

The aim of this mapping report is to give a comprehensive overview of the Nordic countries government's discourse on the present and future opportunities related to the use of ICT within healthcare, security, the experience economy and traditional industry. More specifically the aim of the study is to identify visions, strategic rationales and reflections on future challenges within the four areas.

The analysis is conducted as a desk-study, which means that only publicly available material on the four subjects has been used. This material is mainly technological foresights, scenarios, and reports on visions and research for development strategies for the Nordic countries.

This means that the material available not necessarily is representative of a given country's political priorities and policies within a given area. The material reflects *a focus on the area as such* from the political level and an analysis of challenges and opportunities in the given area (most often made by researchers located outside the government organisations).

It is important to reflect on this, since it means that the content of this report does not represent the political will and strategies of the governments of the Nordic countries but rather an overview of how the Nordic countries approach and analyses the four areas, and what opportunities for action national governments may have in relation to the four area.

The material available in the four countries has differed a great deal in scope and scale. This is only natural since it reflects the difference in policy priorities as well as the difference in administrative structures and processes in the Nordic countries. But the difference in scope and scale means that this report also has the task to convey a more general description of the how the Nordic countries define the four focus areas.

## **ICT Nordic Foresight (Denmark)**

- Desk Research Report

### ***Publications used***

This desk research is based on foresights, future scenarios, and reports published in Denmark within the four selected areas of interest. The publications in relation to the four areas of interest fall into three types of categories: 1) General technology and economic orientated foresight activities on a national or “macro” level. The foresight studies are produced by the Ministry of Science, Technology and Innovation and aim is to identify general trends and policy opportunities/challenges related to the development of a specific sector or value chain. 2) Foresight studies that focus on specific ICT technologies and/or specific user groups. These studies are also produced by the Ministry of Science, Technology and Innovation with the overall purpose to develop actions plans that may be taken to improve competitiveness and effectiveness within a specific economic area. 3) Reports and policy papers deriving at a Ministry and Agency level which map and identifies the possibilities and possible threats in relation to the impact of ICT within the four selected areas of interest.

### **Ministry of Science, Technology and Innovation**










As pointed out the Ministry of Science, Technology and Innovation and the associated institutions plays a central role in the development of foresight studies and reports in relation to the four selected areas of interest. The Danish Ministry of Science, Technology and Innovation was created in November 2001 in extension of the former Ministry of Information Technology and Research to comprise the universities (research and education), industrial research and Denmark's policy on technology and innovation. The object of the Ministry is to promote the interaction of trade and industry, centres of research and education and to strengthen coordination in pursuance of industry and research policy.

A number of institutions and commissions are associated with the Ministry of Science, Technology and Innovation, including the universities, Danish Research Agency, Risø National Laboratory, the National IT and Telecom Agency, the Secretariat of the Danish Rectors' Conference, the authorised technological service institutes (GTS institutes), Advanced Technology Group (the Industry Association for the GTS institutes) and the Innovation Group.

### The Programme of foresight studies

In 2002 the Danish government granted a technology foresight programme during a three year period from 2001 today administrated by the Ministry of Science, Technology and Innovation. The technology foresight project was originally part of a comprehensive strategy — the so-called ‘dk21’ strategy — whose aim was to ask how industrial development policy can support the development of a sustainable society. Although this ambitious strategy has been abandoned by the new government, the technology foresight programme has survived.

Figure 1: Foresight studies since 2001

→ Foresights in progress	→ Foresights completed
AGEING SOCIETY 2030 	BIO- AND HEALTHCARE 
ICT - FROM FARM TO TABLE 	GREEN TECHNOLOGIES 
COGNITION AND ROBOTICS 	HYGIENE 
MOBILE AND WIRELESS 	NANO TECHNOLOGIES 
	PERVASIVE COMPUTING 

Source: Ministry of Science, Technology and Innovation

The basic idea is to test the potential of foresight as a policy-making instrument in the Danish context, and to do so in particular for those ministries with substantial responsibility for the innovation system broadly understood — i.e. the Ministry of Science, Technology and Innovation, the Ministry of Education, and the Ministry of Economy, Trade and Industry.

The technological foresights studies arrives from a growth and welfare perspective, where the foresight studies is seen as a tool to direct decisions about where to allocate scarce resources, of both business and society, in order to have the greatest effect in respect to create higher growth and

better welfare. The studies are seen as one out of several inputs available to politicians and businesses when making decisions concerning investments in the future, for example to provided background when venturing into new areas or transitions of traditional sectors.

Furthermore, technological Foresight is also used as a tool of strengthen dialogue between business and research communities, which is a one of the top aims of the industrial policy in Denmark these years.

Each foresight study is produced by external consultants in cooperation with a steering committee and the Ministry. The methods of the studies are diverse and tailored to each specific foresight study depending on the goals, stakeholders, budget etc. Though the foresights are labelled as technology foresights it does not arrive from a technology deterministic view, but emphasis a range of social, psychological and economic drivers of change.

There are three technology foresights and some central reports in Denmark that describes aspects of ICT development in the four areas of importance in the mapping, namely;

Table 2: Publications used for the mapping

<p><b>Studies related to ICT and Robotics in the production systems:</b></p> <ul style="list-style-type: none"> <li>-Technological Foresight on Cognition and Robotics (back ground reports exists but the foresight is not published yet)</li> <li>- Danish Research and business in relation to cognition and robotics, Work report from the Technological Foresight on Cognition and Robotics, Danish Ministry of Science, Technology and Innovation, 2005</li> <li>- Business visions and strengths in relation to innovation in robotics, Work report from the Technological Foresight on Cognition and Robotics, Danish Ministry of Science, Technology and Innovation, 2005</li> <li>- Explorative interviews with users - visions in relation to innovation in robotics, Work report from the Technological Foresight on Cognition and Robotics, Danish Ministry of Science, Technology and Innovation, 2005</li> <li>- Businesses - visions in relation to innovation in robotics, Work report from the Technological Foresight on Cognition and Robotics, Danish Ministry of Science, Technology and Innovation, 2005</li> </ul>	<p><b>Studies related to ICT in relation to Healthcare:</b></p> <ul style="list-style-type: none"> <li>-Technological Foresight on Bio- and Healthcare technologies (2003)</li> <li>- Technological Foresight on Pervasive Computing</li> <li>- Future of Healthcare (2002) paper prepared for the Danish Ministry of Science, Technology and Innovation</li> <li>- National IT-Strategy of the healthcare system 2003-2007 - published by the Ministry of the Interior and Health</li> </ul>
<p><b>Studies related to ICT in the Experience Economy:</b></p> <ul style="list-style-type: none"> <li>- No specific foresights</li> <li>- Report on “The role of ICT in the experience Economy” (2005)</li> <li>- Denmark should win on creativity: Perspectives on the Danish research and education system, Working Group in relation to the experience economy, marts 2005, report for Danish Ministry of Science, Technology and Innovation</li> <li>-Denmark in the culture and experience economy – 5 new ways, Danish Government, September, 2003</li> </ul>	<p><b>Studies related to ICT and Security:</b></p> <ul style="list-style-type: none"> <li>- No specific foresights or reports</li> <li>- National growth strategy of information and communication technology (ICT), ICT-Forum, working paper of 3 of may 2005</li> <li>- IT and telecom 2005, Danish Government, May, 2005</li> <li>- Focus on the future. Information and communication technology – result of a dialog, Danish Government, 2004</li> </ul>

The mapping that follows is based in the publications in table 2.



### **Other publications used**

It appears that there are not relevant foresight studies within all four selected area in this study. To compensate we have searched for relevant reports published by national agencies or national ministries, highlighting issues related to general policy visions and SWOT perspectives of ICT in the four selected areas.

To supplement in the area of ICT in healthcare we also refers to the Senior Watch project. The project is funded by the European Community under the IST program (1998-2002) and has a general European emphasis. The aim of the project is to cast light on how to better integrate the still growing group of older people in the Information Technology Society and to guide industry, research, technological development and policy. The reports used here include a *technology watch report*, which examines future technological possibilities to realise information technological services and products, which meet the requirements of older people. As with the other country reports, a Senior Watch comparison of current and future use of ICT in the healthcare and wellness sector among seniors in 15 EU countries.

## **Healthcare**

### **Definition and general perception of the area**

There are two foresight studies of relevance in relation to the development of ICT in the healthcare sector; Technological Foresight on Bio- and Healthcare technologies and Technological Foresight of Pervasive Computing, both published in 2002. None of them have an explicit focus on the future scenarios of ICT in the Danish healthcare sector, but the studies describes different aspects in relation to the future development of healthcare and the use of pervasive healthcare in Denmark. To compensate this mapping includes other types of national reports that describe the position of ICT and healthcare in Denmark.

### **General aspects of ICT and the healthcare sector in Denmark**

The European Senior Watch Observatory and Inventory take the pulse of the ICT development and dissemination among European seniors. The project is funded by the European Community under the IST program (1998-2002) and has a general European emphasis. The aim of the project is to cast light on how to better integrate the still growing group of older people in the Information Technology Society and to guide industry, research, technological development and policy. The reports used here include a *technology watch report*, which examines future technological possibilities to realise information technological services and products, which meet the requirements of older people. As with the other country reports, a Senior Watch comparison of current and future use of ICT in the healthcare and wellness sector among seniors in 15 EU countries.

The comparative analysis highlight following aspects in relation to ICT and the Danish healthcare system:

- Denmark is known for a very well developed public sector, where home care sector is completely provided and founded by the public sector, showing a widely use of ICT in healthcare. One example is telecare, with a high use of active/passive alarm services and remote support of mobile care staff (provided free of charge)
- Denmark is among the few countries that have a explicit policy addressing ICT's in general healthcare

- Denmark is a front runner in relation to e-health – with I shown by an indicator on how many practitioners using internet to transfer patient identifiable data
- Denmark has a specific public procurement policy that focus on access to appropriate ICT devises for employees with disabilities
- There is activities too ensuring that all public institutions are engaged in providing of common e-procurement policy
- Denmark allocates research funding for specific for ICT and healthcare development

### **National IT-strategy of the healthcare system**

As mentioned previously Denmark have an explicit strategy and policy addressing ICT in healthcare, which is presented in the “National IT-Strategy of the healthcare system 2003-2007” published by the Ministry of the Interior and Health. The strategy provides a framework of making priorities in relation to IT-utilization in the healthcare sector, which in counts following objectives:

- Contribute to improvements of the quality, service and continuity in the treatment process
- Assure a better communication between all parts in the healthcare sector
- Contribute to a quick and safe access for the single patient/citizen to information regarding patient records and the services and quality of the healthcare system
- Assure a interconnection with the general objectives of the digitalisation of the public sector in Denmark

The strategy provides a status and some general considerations in relation to the implementation process of the strategy, describing some core initiatives that would strengthen the coordination of the IT-effort on a central level and create the necessary conditions for an effective utilization of IT in healthcare system at different areas of services.

The National IT and Telecom Agency is responsible for the IT-development in relation to developing protocol's, interfaces and standards for communication. The Ministry of the Interior and Health is the overall responsible authority in relation to the development and planning in the healthcare system.

#### *Electronic patient record*

One central tool to provide continued treatment processes and service information is the development and adaptation of electronic patient record system – in Danish known as EPJ (Elektronisk Patientjournaler). All hospitals shall have computerize EPJ before the end of 2005. The implementation of EPJ creates organisational change in the healthcare system, as most operations will be addressed according to the patient process or patient treatment.

At the moment EPJ is criticized by media and experts. It is emphasised that it will take many years before we will see the real benefits of the EPJ system, as the architecture and set up of the EPJ is not fully integrated.

### *MedCom*

The MedCom project provides another example of initiatives that seeks to integrate information around the care and treatment of patients in and between the different partners of the Danish healthcare system. The MedCom project aims to insure direct interconnection of care-services between hospitals and municipalities, by developing and testing the electronic information and communication across that organisations providing the care-services in the patient process. The project has been running for about 8 years now, and is still focussing on different aspects of the interconnection of care-services systems between hospitals and municipalities.

### *Sundhed.dk*

The Ministry of the Interior and Health established a common public healthcare portal on the internet in 2004 - called sundhed.dk. Sundhed.dk gives citizens easy access to range of different information about public healthcare, which earlier were spread among many actors and institutions. The portal is seen as one way of providing an overview for the citizens, and at the same time it opens up for a strengthened individual patient process, as it is planned that the portal should provide access to patient journals and personal healthcare information for each citizen. Today the portal includes vital services, for example booking time for consultations, renewing the prescriptions and to pursue e-mail consultations with the doctor. Until now around 70-80.000 citizens have used the portal each month since the launch.

## **Foresight studies related to IT and healthcare in Denmark**

As mentioned, two foresight studies have relevance in relation to the development of ICT in the healthcare sector; Technological Foresight on Bio- and Healthcare technologies and Technological Foresight of Pervasive Computing. None of them have an explicit focus on the future scenarios of ICT in the Danish healthcare sector, but the studies provide different aspects and recommendations that will influence the future development of ICT and healthcare in Denmark.

### **Foresight on pervasive computing**

The foresight study on pervasive computing focuses on the future development and adaptation of pervasive computing, that I characterised by a being embedded, weable and persistent in all thoughts of things and systems. Pervasive computing gives us the possibility of increasing communication with things and systems – and makes things communicate intelligently with other things.

### **Central drivers that effects the development and need for ICT in healthcare**

In overall terms the study concludes that pervasive computing has a big future potential for the Danish business sector and the public sector. The foresight study focuses on two core drivers of change which will have a high impact on the Danish potential of adapting pervasive computing the next 15 years. It relates to a *marked or a policy driven process*. The *marked driven development* is characterised by a non coordinated process where the development of pervasive computing is primarily pushed by the market forces. The *policy driven development* states an early and more coordinated contribution where the public sector plays a central role creating the frameworks and incitements for adapting and integrating new pervasive computing technologies in cooperation with the private sector. Given the size of the public healthcare sector in Denmark, it is obviously that the future policy and development of public healthcare is a central strategic factor for the spread and use of pervasive computing. It is concluded that Denmark has a unique possibility of shaping the future of pervasive computing with a proactive public sector.

*Making IT in the healthcare sector a highly profiled project in the future*

The foresight study recommends that Denmark concentrate on developing pervasive computing in competence clusters or sectors where Denmark have a strong position already. The competence clusters relates to a study in 1998 from the former Danish Ministry on Trade and Industry that identifies a number of sectors or groups of companies that have achieved an international distinction by developing certain competences and strengths. The competence clusters is characterised by business areas that create high growth of value and employment and that perform well on international markets. In relation to the healthcare sector it in counts for the following competence cluster:

- Medico Industry
- Sensor Technology
- Bio Information
- Handicap aids (rehabilitation aids)

The technology foresight study suggests that Denmark set up a highly profiled project concerning IT in the healthcare system in Denmark. Especially one of the scenarios appoints out that there are great spin-offs effects and potential for exports in integrating pervasive computing in the healthcare sector. This has to do with the existence of the following premises:

- The Danish healthcare sector is big and have the critical mass to attain develop projects within pervasive computing. This gives the public sector a opportunity to require the need for new services and products, and thereby stimulate the private supplies though a technology pull mechanism
- The healthcare sector is used to handling ICT technologies, and this extend for all levels of the personnel
- There are already a range of different projects within the areas of pervasive computing in the healthcare sector. Setting op a highly profiled project should build on the existing projects and initiatives.

The positive effects expected is a more effective healthcare sector and creation of welfare, reducing mistakes and create better treatment processes for the patients, according to the foresight study.

### *Technological foresight of bio- and healthcare*

As mentioned earlier there is no explicit focus on ICT technologies in the technology foresight of bio- and healthcare technologies. ICT technologies are primarily referred to as pervasive computing or pervasive healthcare, which means that there is an overlap to the technology foresight study on pervasive computing.

The overall mission of the study is to review the healthcare challenges that Denmark could be facing in the next 10-20 years and consider how technology could help to meet these changes.

The point of departure for developing a foresight study within bio- and healthcare technologies is that the study can contribute to an optimal use of resources and investments – both private and public – where the benefits and effects are highest both in relation to growth and prosperity. The foresight study is also seen as a tool for creating a dialog between politicians, NGO's, the Danish business sector and research institutions about priorities of the future in relation to the development of the Danish biotech and healthcare sector.

Furthermore the foresight study was expected to provide recommendations of activities that can promote the most promising of the future scenarios. But the result shows that the recommendations are not made in relation to picking out the favourable scenario, but rather seen in relation to the broader implications of central drivers on the innovation system.

### **Central drivers that effects the development and need for ICT in healthcare**

#### *Tailored individual healthcare solutions*

Tailored individual healthcare solutions are one of the central drives in the Danish foresight study. The individual focus is both related to future treatment and drug development. The primary technological driver making this key driver realistic is the mapping of the human genome, which makes it possible to design treatment and drugs for individual needs and replace tissues and organs grown from stem cells. This development is expected to revolutionise the healthcare business, and change the possibilities of healthcare treatment in Denmark. It is also influenced by a range of social drives that related to the increase of demanding and well-informed patients (consumer patient) and a growing segment of aging population that needs individual solutions.

The Danish foresight study reach the conclusion that tailored treatment and integrated computer systems in the treatment and monitoring systems of great importance in the future. The concrete influence on the development in Denmark will depend on the political, economical and ethic priorities in the future, which leads to the following recommendations in relation to ICT development:

- **Strengthen the research** – increase the application of science in areas of pervasive computing and medico technologies though a stronger cooperation between universities/hospitals and the Danish business sector. Furthermore, breakdown the barriers of making interdisciplinary research and invest in research where Denmark already has an international strength and position
- **Upgrade the education system** – create more educations which integrate technical and medical training and increase the internationalisation of the Danish educations. Furthermore change the merit ranking, by making practical experience counts
- **Intensify technology transfer and innovation** – with no specific implications in relation to ICT
- **Create an offensive ethic debate** – Create a debate in the ownership to the data tog patients

### R&D within IT and healthcare

A study by Aalborg University shows that the Danish healthcare institutions and milieus have a strong cooperation with private IT-suppliers on developing new IT systems for the healthcare sector. The mapping also concludes that the Danish R&D environment within ICT and healthcare is dynamic and characterised by a diversity and high degree of interdisciplinary research (19).

Table 3: Mapping of research within ICT and Healthcare (19)

Institution	Areas of research
Copenhagen Business School (CBS) Centre for research on IT and policy organizations (CIPS)	The influence of users in IT development, Regulation and control, Development of e-business, ICT in the healthcare sector,
Danish Technical University Informatics and Mathematical Modelling	Medical Image Analysis
Danish Technical University (DTU) Centre of Tele Informatics	Involved in HealthcareIT-project (HIT) together with Roskilde University and IT University of Copehagen
Aarhus School of Business Institute for Marketing, Informatics and statistics	Evaluating digital solutions used in the healthcare system



IT University of Copenhagen Department of Innovation	Clinical digital analysis and Clinical Image analysis
IT University of Copenhagen Department of Design and Use of IT	Involved in HealthcareIT-project (HIT) together with DTU and Roskilde University Sundheds.dk
Copenhagen University Image research, Institute of Computer Science (DIKU)	Computing Natural Shapes (CNS) Open Tissue (OT) 3DMed
Roskilde University Institute of Computer Science	Projects regarding Diabetes/healthcare IT and homecare/healthcare IT
University of Southern Denmark Centre on applied healthcare information (sundhedstjeneste forskning) and Technology assessment (CAST)	Assessment of treatments and technologies in the healthcare systems
Aalborg University Represented by many centres and research groups in the area of ICT and healthcare	EPJ (electronic patient journal) – observatory Many research areas of specific use of IT in the healthcare sector, for example usability
Aarhus University Four central centres in ICT and healthcare	STS-studies, pervasive computing, pervasive healthcare

All in all Denmark seems to be in a strong position regarding the future development and exploitation of new products related to pervasive computing/pervasive healthcare and the use of ICT in the public healthcare sector. The size and political focus on the healthcare sector in Denmark provided an opportunity to strengthen the role of the public sector pushing the development of ICT and healthcare in a proactive manner.

The Danish tradition of interdisciplinary research and cooperation between ICT supplies and healthcare sector creates a platform which provided a competitive advantage of the branches or industries connected to the healthcare system, for example Medico Industry, Handicap Aids, Pharmaceuticals, Bio Informatics etc.

The treats regarding the future development of ICT and healthcare is not discussed in any systematic manner in the foresight studies or reports, which makes it difficult to make a complete evaluation of the future development of ICT and healthcare.

## ***Production economy***

### **Definition and general perception of the area**

There is no exclusive focus on the use of ICT solely in the manufacturing or productions system in Denmark, but the foresight studies of Farm to Table, Pervasive computing and Green technologies

reflect that attention is given to areas of manufacturing where Denmark already have achieved some overall strength and competences according to the industrial structure of Denmark.

Another aspect of the industrial structure in Denmark is the company size dominated by small and medium enterprises SME (up to 249 employees) counting 98 percent of all companies in Denmark, which have caused some political attention regarding the adoption of IT in SME and resulted in recent analysis of the barriers towards adopting and investing in IT in SME. The analysis shows that SME (10-100 employees) find it difficult to review the market for IT solutions. This is especially a barrier for SME's in traditional production, retail, manual service and the building sector, where there exists a lack of competences in relation to invest and use information technologies (18).

Generally speaking one could state that the primarily political aims related to ICT and manufacturing today arrives from the interest of making better conditions and framework for SME adopting new information and communication technologies. In broader terms the approach on ICT and manufacturing arrive from a common notion that ICT is a way to stay competitive and insure that production and manufacturing activities is profitable in Denmark in the future. Increasing the adoption of ICT is therefore seen as a tool for making trade and industry more innovative and effective (17). The foresight study of Cognition and Robotics is part of this notion, and one of the reasons why we have chosen to focus on robotics in this mapping of ICT and manufacturing in Denmark.

### **The area of robotics in the manufacturing system**

As mentioned the overall aim of discussing and addressing robotics arrives from the perspective that Denmark is forced to strengthen their position in the global competition, through a strong focus on productivity and flexible organisation. In this sense adoption of robotic systems is seen as a tool to insure that production and manufacturing activities in Denmark is still profitable compared to other low-labour-cost countries in Eastern Europe and Asia. Robotics is thereby a way of preventing outsourcing and the loss of workplaces in Denmark.

Despite the relatively distinctive progress in the area of robotics, there seems to be a long way of making the robotics more intelligent, which is why this foresight study also focus on the research of cognition in relation to the development and adoption of robot technologies in the future. The

research of cognition arrives from sociology and psychology, focusing on processes and conditions that shapes the human acknowledgement and ability to handle both physical and virtual objects.

Robotics is defined as all types of mechanical constructions for example Micro Electronic Mechanical Systems (MEMS), actuators, sensors, membranes, and the computer systems that makes it possible to combine physical action and communication - for example artificial speak and movements like push, pull and lifting (14).

The area of robotics is divided into to two areas; *industrial robotics* and *service robotics*, this separation is also apparent in the general vision of market development and the competitive advantages in Denmark in the foresight study (14).

### **Five areas of business potentials in the future**

The study examines some future features of the robotics towards 2015. The features relates to developing more flexible, better programmed and integrated robots that through sensor technologies will be better to monitor, detect, analyse, screen and discover different situations (14). These new characteristics provide some future business opportunities in different sectors of the society, which in counts:

- Industry
- Healthcare
- Biological production
- Experience, learning and play
- Diverse (environment, building and construction etc.)

Again it is no coincidence the sectors relate to existing competence clusters or sectors where Denmark have a strong position already, as mentions in the mapping of ICT and healthcare and the foresight study on pervasive computing.

### **Potential of robotics in the industry**

The future opportunities connected to adopting robotics in the industry arrives from the spread of productions cells. A production cell exists of machines, sensors, robots and operators. The integration and communication between the elements of the cell is effective and targeted against a

extremely varied singly production, with a high variation in the processes. The cell is highly productive and collects all data in all production process that insure the demand regarding quality, traceability and documentation (14).

The study concludes that Denmark is already in the beginning of adopting these type's of future production features and technologies, which is emphasised in the following points (14):

- The development of individualised products emphasises a production of big variation and small batches. This provides big challenges for automation of the manufacturing processes, that to some extent already have been solves in Denmark, due to characteristics of the productions processes in the Danish industry recent years
- Denmark is also characterised by performing research within production technologies and optimizing processes, especially in the software-related areas like simulation and controlling productions processes, counting the optimal cell lay out, cell controlling, sensor integration, vision identification, optimal controlling of painting and weld processes. These areas is particular interesting in a European light, as these competencies match the research areas needed in the ManuFuture<sup>1</sup> vision, to make the European manufacturing industry competitive in the future
- There is a strong focus on the cooperation between public research institutions and businesses in connection to sharing knowledge and business opportunities in Denmark. Together with the strengths of creating new solutions through user-driven innovation, there are considerable opportunities for developing technology exporting development units and attracting development units from big international companies in the sector within specific niche technologies.

### **Clusters and user-driven innovation**

Even though the foresight study of cognition and robotics are not completed yet, there are some recommendations for the future research within the cognition and robotics. It is stated that the research would benefit if it was directed and promoted into developing clusters based on a user-based or user-driven innovation. One example of this strategy is already seen in the cluster of Robotics in southern Denmark – RoboCluster.

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<sup>1</sup> ManuFuture – European vision for the manufacturing industry until 2020

### *Robocluster*

Robocluster is a cluster of competencies in robotics in southern Denmark. The cluster comprises 40-45 interested parties. The Odense municipalities and Funen Country initiated RoboCluster as part of a regional strategy of industrial promotion of four focus areas that apart from robotics also includes biotechnology and health, IT and communication, and gardening industry. RoboCluster where established in the mid 1990s by a range of high-tech experts from AP. Møller and the university of southern Denmark. RoboCluster comprise a full value chain from educational and research institutes, through robot development companies and suppliers to users of robotics systems, all with high competencies in the area of robotics.

### **Mapping R&D within robotics and cognition**

The industrial structure in Denmark is one of the reasons why the research in Denmark have such a strong focus on user-driven innovation in the area of robotics. The strong dominance of SME's, have influenced the requirements and requests for robotic solutions, to be relatively cheap and flexible. This has especially pushed the development of the basic technologies and the integration systems of the robotics in Denmark (14).

A mapping study of the research of cognition, robotics and users-oriented shows that Denmark has a considerable amount of research environment within utilization and application of the robot technology. More than half of the research institutions highlight specific projects or applications in relation to their research areas. Furthermore, it is important to mention that most of these projects are developed in close interaction and cooperation with the Danish industry and their industrial partners (13).

The following table provides an overview of the research institutions working within the areas of cognitive-, robotics-, and user-orientated research (13).

Table 4: Categorisation of research according to primary field of research (13)

	<b>Research</b>
<b>Cognitive research</b>	<ul style="list-style-type: none"> <li>- Centre of philosophy of nature and science studies, KU</li> <li>- Learning Lab, DPU</li> <li>- Centre of visual cognition, KU</li> <li>- NISLab, SDU</li> <li>- Institute of psychology, AU</li> <li>- Cognitive Psychology Unit, AUC</li> <li>- Centre of sensory Interaction, AUC</li> <li>- CFIN, AU</li> <li>- CVMT, AU</li> <li>- Namicon, AU</li> </ul>
<b>Robotics research</b>	<ul style="list-style-type: none"> <li>- Institute of Management, policy and philosophy, CBS</li> <li>- Mærsk McKinney Møller Institute, SDU</li> <li>- MEK, DTU Ørsted DTU</li> <li>- Institute of production, AUC</li> <li>- Centre of sensory Interaction, AUC</li> <li>- CVMT, AU</li> <li>- Danish Meat Research Institute</li> </ul>
<b>User-orientated research</b>	<ul style="list-style-type: none"> <li>- Institute of Management, policy and philosophy, CBS</li> <li>- MEK, CBS</li> <li>- Ørsted, DTU</li> <li>- Institute of Information and Media Studies</li> <li>- Institute of psychology</li> <li>- AUCFIN, AU</li> </ul>

The publications published so far in foresight study of Cognition and Robotics indicates that Denmark posses a strong competitive position within robotics based on clusters of high tech companies and research institutions specialising in autoimmunisation, productions technology and robotics. The high technology level in Denmark insures flexibility and allows small scale batch production, which fit the future demands regarding the used of productions cells, that is seen as the future production features and technologies.

## ***Experience economy***

### **Definition and general perception of the area**

There are no technological foresight studies that relate to the future development of the experience economy in Denmark, though it is mentioned as a potential area of development in the technological foresight study on cognition and robotics and the foresight study of pervasive computing. Despite the lack of foresight studies there has been quite a lot of focus in the public and political policy on the experience economy in Denmark since the late 1990s. This has resulted in a several publications on the economic growth connected to the production within the cultural businesses, but none of these central publications emphasise the role of ICT in the experience economy(12).

In 2005 Rambøll Management produced a study on “The role of ICT in the experience economy”, initiated by the Ministry of Science, Technology and Innovation. The report states that there is an increase in experiences based on ICT. It also highlights that experience economy is not just a group of branches or sectors, but an area that goes across branches, as experiences becomes part of both physical and services. This makes the definition of ICT in the experiences economy is very broad. The report makes the following categorisation of the actors or branches in the area of the experience economy:

- 1) Producers of experiences – where the primarily product is the experience and where ICT is used to support new or existing experiences (examples: LEGO, Bruun Rasmussen)
- 2) Producers of ICT-based experiences – where the primarily product is both an experiences and ICT, and where the product is a ICT-based experience in itself (examples: I.O. Interactive, Apples IPOD)
- 3) Producers of ICT, where the product is primarily based in ICT and the experience is used to sell the ICT-product (examples:3 Mobil, NDS)
- 4) Other branches that uses ICY based experiences in different ways – where the product can be any product and ICT-based experiences are used to marketing and sell the product (examples: SAS, Levi Strauss)

### **Visions of ICT and the experience economy**

The area of experience economy has grown as nations become wealthier and people have more money to spend. This development has provided new stages and new markets for the arts and culture, the world of sport and the corporate sector. The area is recognised as competitive advantages in Denmark, and it pointed out that Denmark have a great potential for developing the market of ICT-based experiences. The report estimate that Denmark could reach a turnover of 100 billions DKK in the next 10 years, if Denmark management to obtain 2% of the world market (7).

Though there are no direct visions related to the ICT-perspective on the experience economy, it is stated that Denmark should be better at using the synergies between culture, sports and business to promote the potentials for growth and development within the culture- and experiences economy (12).

### **Political initiatives of ICT and the experience economy**

The Ministry of Science, Technology and Innovation appointed a working group in June 2004 to look closer at the need for of competences in the growing segments of the experience economy. The working group have produced a set of concrete recommendations in relation to developing a range of new research based educations and competences appointed towards the culture and experience economy. The recommendations are not directly linked to the questions around the future development of ICT and the experience economy (10). In general there are no explicit political initiatives at a national level supporting the growth ICT-based experiences.

### **Identified strengths for the development of ICT and the experience economy**

The report identifies strength in relation to exploring ICT-based experiences in Denmark, some are highly connected to the cultural and social dimensions of the Danish society, and states the following parameters (7):

- The report estimates that 21 percent of the working force in Denmark is employed in creative positions. It is also highlighted that Denmark have experienced the one of the highest annual average increase of employees in creative positions in Europe since 1995



- In a historical perspective Denmark is characterised by high public investments in the cultural life both at a national, regional and local level
- Denmark have developed core competences and business potentials in the branches of games, film and music
- The high educational level in Denmark contains a structural strengths in the Danish society, and have pushed the ability and room for creativity and innovation
- Denmark have a strengths in relation to the development of user-based electronics, which arrives from a traditions of design and innovation in Denmark

### **Identified barriers for the development of ICT and the experience economy**

The report also identifies a range of barriers for exploring ICT-based experiences in Denmark, based on expert interviews and case studies. Some of the barriers in count following problems:

- The technology is expensive to buy and to develop
- The area is dominated by many SME's with a limited economic disposal for integrating ICT
- A great deal of the SME do not wish to grow, which is one of the reasons why they do not invest - or take risks investment – developing new products
- There is a lack of investors in the SME's that wants to invest in new products where the market potential is not proven yet
- There is a lack of contact to the research environments at the universities
- Some areas can require qualified employees with the right competence profile
- The technological infrastructure in Denmark is missing in some areas

### **R&D in relation to ICT and the experience economy**

Research in ICT-based experiences is a result of a hybrid between many different research areas and traditions. There are no real mapping of the Danish research and development, but the following figure provides an overview of research institutions within part of the area:

(Not in english yet))

Table 5: Mapping the research institution in the area of ICT and the experience economy (7)

<b>Institution</b>	<b>Research area</b>
CBS – Centre for Creative Industries Research	Kreative Industrier – og den værdi kreativitet skaber

IT Universitetet – Institut for Digital Æstetisk og Kommunikation	Computerspil
Aalborg Universitet – VR Media Lab	Virtual reality
RUC – Center for Viden og Design i Nye Medier	Interaktive installationer i komplekse rum (performative rum)
Århus Handelshøjskole – Strategy-Lab under Institut for Ledelse	Strategilaboratorium udforsker kreativitet i snitfladen mellem forskningsteori og erhvervspraksis i kreative virksomheder
Århus Universitet – Centre for Pervasive Computing	Pervasive Computing
Århus Universitet – Centre for Advanced Visualization and Interaction	Design og brug af 3D teknologi inden for arkitektur, kunst og underholdning
Kunstakademiets Arkitektskole – Center for Designforskning	Kreativitet, æstetisk og oplevelser relateret til design
Alexandra Institutet	Forsøger at bygge bro mellem IT-forskning og erhvervsliv
Innovation Lab	Fokus på fremtidens IT-udvikling (ej forskningsenhed)

It is emphasized that there is a need for coordination across research areas and institutions to provided better frameworks for interdisciplinary research. Furthermore, it is stated that there is a lack of cooperation between public research and the business segment, which highlight the need fore initiatives that will fulfil the potential of greater cooperation between the public research and the private business (7).

To summarise, experience economy is recognised as competitive advantages in Denmark, especially IT-based experiences is a area of great potential, which have not fully been exploited yet. The report from Rambøll Management estimate that Denmark could reach a turnover of 100 billions DKK in the next 10 years, providing that Denmark management to obtain 2% of the world market (7). Noted that there are several barriers identified for the growth of the industry - for example the business structure based on SME's and the lack of investors.

ICT as a vehicle of efficiency is well described in Denmark, but when it comes to ICT as a driven factor of innovation in the experience economy is not really documented and analysed as being a factor of competitiveness for the Danish businesses in the future.

## **Security**

### **Definition and general perception of the area**

The reports concerning ICT and security in Denmark is primarily related to government publications emphasising visions regarding information and communication technologies and so-called “status” report from the National IT and Telecom Agency accounting for the use of ICT in society. The definition of ICT and Security is more implicit than explicit concerning three areas of public attention:

- Making sure that citizens feel secure using new technology – for example handling payments through the internet
- Limiting the vulnerability of society – by minimizing possible threat from attacks on the IT system especially in the public sector
- Strengthen the awareness and strategic competences in both private and public sector on matters of ICT and security

Specific reports mapping the business sector developing, selling and producing solutions within ICT security is not published in Denmark nor is there any mapping of research environments in the area of ICT and security.

### **General visions and initiatives**

The Danish government aims that ICT security should be strengthened in Denmark. The strategy is to increase the cooperation between public and private sector regarding ICT security to insure a more advanced use of ICT in the society.

In the latest publication from the National It and Telecom Agency is highlighted that Denmark posses some core capabilities of ICT security within research and industry. It is furthermore stated “That the development in Denmark can be stimulated though a process focusing on the core capabilities for example Digital Identity. CRM-systems provide a good possibility for marketing Denmark as a front-mover in the area of Digital Identity” (9). In 2003 seven million DKK were addressed for the spread and use of digital signature in Denmark, which means that every citizens have the possibility of using digital signature. There are other examples of government initiatives;

### *NetsikkerhedNu*

A campaign called NetsikkerhedNU (Net security now) was launched in 2005 with the aim of strengthening the awareness of ICT security, with a broader perspective of developing a ICT-security culture in Denmark, where each ICT-user take responsibility for the use of ICT. The campaign is developed in close cooperation between The Danish Ministry of Science, Technology and Innovation, the industry and related organisation.

### *Danish Board of technology*

From 2006 the Danish Board of technology take over the role of assessing matters of ICT security from a separate board on ICT security that where established in 2003. The Danish Board of Technology is brought in to disseminate knowledge about technology, its possibilities and its effects on people, on society and on the environment. Furthermore, to promote a ongoing discussion about ICT- security, and evaluate the development of ICT security technology. The Board of Technology is an independent body established by the Danish Parliament (the Folketing) in 1995.

### *ICT security Panel*

The Danish Ministry of Science, Technology and Innovation have just launched an ICT security Panel that is established to provide an open cooperation and dialog around ICT security initiatives across the Danish society. The Panel is set for a period of two years and is seen as a tool for providing coordination between different initiatives in relation to ICT security. The Panel would therefore work in close contact with the Board of Technology and the office of ICT-security at the National IT and Telecom Agency.

Summarizing, there are no specific reports or technology foresight addressing the strengths or weaknesses of ICT security in Denmark. There seems to be some strength regarding the use of strategies of ICT-security in the public sector, where there is a tradition of handling personal data in a secure manner, based on permissions from the Danish Data protection Agency.

In a paper from the Danish government on the visions regarding the future development of ICT in Denmark it is mentioned that Denmark have a cluster of SME's within the area of ICT security, but it is not evaluated or described in any details (11).

In 2004 the former advisory board of ICT security identified a need for education and re-education in areas of ICT-security in the Danish educational system. There are no publications stating whether this have been addressed in more concrete actions yet.

## **ICT Nordic Foresight (Finland)**

### **- Desk Research Report**

#### ***Publications used***

This desk research report is based on 20 different publications written in English. This means that other possibly relevant publications written in Finnish have been excluded for language reasons. The search has been directed towards reports which have emphasis on foresights, future scenarios, roadmaps and visions for future development in the selected areas of interest. However, a fair number of publications with a more scientific and technology specific orientation have been included to cover the strong strategic focus on mobile technologies in Finland. A review of publishers and publications follows in the succeeding sections.

#### **Tekes**

Tekes is a state funded National Technology Agency and the main funding organisation for applied and industrial R&D in Finland. Its primary objective is to promote the competitiveness of Finnish industry and the service sector by technological means. (Tekes finances applied and industrial R&D in Finland to the extent of about 400 million euros annually. Tekes sets up various technology programmes to support cooperation and networking between companies and research centres in the Finnish innovation system.)

The reports referred to here include reports on mobile and network technologies and the pharma industry. They include concluding and summarising *technology program reports* and *technology reviews* with a forward-looking emphasis which serves as qualified recommendation and knowledge basis for policymakers.

#### **VVT/ESPOO**

VVT is an independent research centre on Manufacturing Technology Safety Engineering (formerly Technological Research Centre of Finland). VVT's research in machine automation is of primary interest in this report. Though the centre has great emphasis on safety issues in industrial development it is not the primary concern in the selected reports. Many VVT projects are taken up on behalf of and funded by Tekes programs.

Most VVT reports used in this desk research has takes on a technical and scientific approach and will therefore not present much insight on national strategic matters (such as regional or industry specific strengths and weaknesses). However, the reports do, to some extent, reflect on resent trends in technological developments and present visions and recommendations for future research and development. Also, the VVT reports include some technology roadmaps that present visions and scenarios for the future to guide national strategy. The reports are focused on network, mobile and ubiquitous technology and software, but troughs light on matters concerning security, the production economy and the experience economy.

### **Other publications**

The Senior Watch project has resulted in a series of publications on the perspectives of future potentials in ICT development and dissemination among European seniors. The project is funded by the European Community under the IST program (1998-2002) and has a general European emphasis. The aim of the project is to cast light on how to better integrate the still growing group of older people in the Information Technology Society and to guide industry, research, technological development and policy. The reports used here include a *technology watch report*, which examines future technological possibilities to realise information technological services and products, which meet the requirements of older people. As with the other country reports, a Senior Watch comparison of current and future use of ICT in the healthcare and wellness sector among seniors in 15 EU countries. The conclusions in this report on ICT policy related to seniors and the health care sector is of particular interest in the case of Finland.

Two report used is published by the Finnish Ministry of Transport and Communications. One deals with trust and security issues as a prerequisite in realising The New Economy in the case of Finnish banks. The other deals with national information security, and is written by a government advisory board.

All mentioned reports are listed in the reference list at the end of the report.

## General emphasis and rationales

The overall focus in the Finnish documents is how to develop and further exploit the potentials of mobile and network technologies. It goes for; (i) the development of *secure* network environments in homes, business and public institutions, (ii) the development of mobile, network, surveillance and control technologies in *industrial production* companies, (iii) and mobile technologies in the *health* and *experience* economies.

The strong involvement in mobile and network technology development is partly initiated and funded by the TEKES technology program “Nets – Networks for the Future”. Other recent Tekes programs with emphasis on ICT technologies include “ELMO - Miniaturizing Electronics Technology Programme” and “FENIX - Interactive Computing Technology Programme”.

To support and direct Finnish R&D, Tekes took on a task in 2004 to review international roadmaps on network and service technologies. The review formed a vision to guide future development in Finland. By supplementing expert views on markets and trends with visions adopted by the ICT community, the authors meant/hoped to present a “somewhat self-realising” vision for the timeframe 2004-2012 (8, preface).

The mobile and network (information) technologies form the strategic core and ‘point of departure’ in developing the economies of manufacturing, experience and partly health. The strong emphasis on the technological developments is driven by national competitiveness and workforce related concerns brought on by globalisation, internationalisation of trade and workforces, and the demographic developments in Finland (that predicts a larger group of seniors and smaller workforce in the near future).

The reports give a general impression of a national and industrial policy regime and research community that emphasizes the European and global aspects of developments and seek to position Finland as the vanguard in global mobile and network technology research and development and as a high developed information society. Though the reports are technology centred, many take market developments and trends in society into account. The two future-orientated vision reports (on health and mobile technology) along with the senior watch reports shows that socio-economic, demographic and cultural aspects are not neglected in the overall approaches.



## **Security**

The reports in this desk-search deal primarily with ICT-security or Information Security<sup>2</sup> (IS) from a technical perspective. To complement this, reports on ways to setup and manage ICT security systems in organisations, way to create trust and user-acceptance in ICT-based (service) systems/applications, and national information security issues have been included.

### **Definition and general perception of the area**

Secure technologies are seen as a prerequisite of advancing potentials and improving performance in the information society in general. This includes all areas of the economy, e.g. the new economy (finances) and traditional production industries, healthcare and experiences. With the mobile industry in front, Finland is getting more depending on a well-functioning and secure information society. Therefore secure and safety issues are given weight in their strategic priorities. This is well illustrated with the Government Resolution on National Information Security Strategy adapted in 2003.

There are no explicit definitions of security and an ICT context, but the National Information Security Strategy has led to five groups of projects that draw the outlines of where emphasis is put. The five groups or areas of interest are, (i) promotion of national and international information security corporation, (ii) promotion of national competitiveness and the operating potential of Finnish information and communications operators, (iii) improving information security risk management, (iv) safeguarding fundamental rights and protecting the nation's knowledge capital, and (v) increasing information security awareness and competence.

### **National information safety**

In 2003 Finland adopted The Government Resolution on the National Information Security Strategy, followed by an Action Plan in 2004. It was based on work by an advisory board in corporation with public and private stakeholders, and has attracted both national and international attention. The activities within the strategy seek to enhance different actors trust in the information society, and to exploit potentials and combat threats to the information society in both normal and exceptional circumstances (15, 15). The Finnish government sees Finland as frontrunners in developing national policy on information security in EU, and has prepared to start a European

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<sup>2</sup> “‘Information Security’ (IS) refers to protection of information, services, systems and telecommunications in whatever form. Information security involves features of technical security, behaviour of individuals, procedures of organisations and social conditions. Threats to Information Security include breaches of personal privacy, spam e-mail, industrial espionage, pirate copying, computer viruses, network terrorism and electronic warfare ” (15,14).

strategy along the lines of the Finnish, in their European presidency term in 2006 (15,4f). A milestone in Finnish information security policy is the Act on the Protection of Privacy in Electronic Communication (15, 12). The advisory board report concludes that Finland is “*firmly at the forefront of developments in information security*” (this has been granted by the European Information Security Award) (15, 8).

The 2004 status of general information security in Finland are outlined in Box XX. Most notably is that while Finnish households are average in an international comparison in IS, Finnish Businesses are among the best in EU.

### Technical perspectives of IS

The technical issues relates to the threats most of us know from home/office computers and the internet (system breakdowns, viruses, Trojan horses etc. (2,16ff)) along with problems of securing confidentiality, integrity, access, accountability, availability of data known from financial transactions, e-business, confidential information transactions etc. (4,93). Likewise, lack interoperability between subsystems that contribute to information security in organisations may give problems (3, 77). These technical problems are not unique Finnish problem, but rather problems that can be seen all over the world. Therefore we will not go deeper in to the technical details of the problems.

#### Box 1 Secure auctions for mobile agents

An example of a pilot project, that challenges the technological possibilities, is the more or less successful attempt to create and implement a secure financial auction for mobile agent. The project succeeded in developing and implementing the agent on a small scale market, but there are still a few problems to overcome before the agent can be implemented on large-scale mobile agent markets. In particular, the security of mobile agent residing on a remote platform has to be guaranteed without the assumption of trusted platforms (4, 3)

Examples of mobile agents are already seen within e-commerce and telecommunications, but a mobile agent in a financial auction is so far unseen.

What is interesting, thought, is that Finnish researchers take up the problems in a degree and practical manner, which enables them to identify and challenge them in diverse pilot- and demonstration projects. Such projects help Finland to be a first mover in the development. See Box 1 for an example. The technical aspects of ICT security are given much attention. From the list of reports it can be concluded that there is a general need for further research in improving security for both, management, automation and control systems, and network and mobile architectures, platforms and applications, which seem to form the ICT base in healthcare, production, experience (and other, e.g. finance) economies in Finland. One of the findings of the Government advisory board on national information security is that many projects have succeeded in dealing with technical issues, but it has proven difficult in many projects to ensure the necessary focus on awareness and financing (15, 9). In the following we take a look at this and more.

## **Security in and around organisations**

As mentioned, Finland's businesses are among the best secured in the EU. In the following we take a look at the ways industrial and public institutions in Finland use (or don't use) their ICT systems and take security precautions. Security objectives of state institutions most often relates to building and maintaining public trust, ensuring critical process functioning, ensuring user's ease of use, as well as securing coherence between tasks and legislation. Security objectives of industrial organisations most often relates integration information security in business processes, backing up the business strategy and ensuring product security (3,76).

A report made by VTT/ESPOO examines the use of information security metrics in Finnish industry and state institutions (3). One of the main conclusions is that measurement of security is relevant for all organization, but many public and industrial institutions do include human and historic factors in there measurement. Leadership, individual expertise, personal behaviour, operational environments, organisational culture and history are all important factors for the level of security of the organisations and should be included in the measurement as an on-going process.

The report points out that there is a need for knowledgeable management that understands the importance of managing information security. On the one hand you see managers that do not provide information security managers with enough authority to improve metrics development. On the other hand you see managers that do not understand the significance of information security, and force the IT-security leaders to take all responsibility. This leads to a situation where management does not commit to the decisions and there is a lack of strategic leadership concerning information security (3, 76).

Generally there is common objective in Finnish organisations to raise both awareness of security issues related and raise educations levels (particularly related to personal behaviour). Likewise there is a need for knowledgeable leader who understand that they have to guide the organisation's activities from the point of view of information security and its measurement. Inspiration can be taken in from quality process management to help these matters.

It is suggested that metrics is useful not only for defining the information security level in the organisation, but also for proving it to partners, and it is therefore seen as a competitive benefit with greater competitive potential in the future (3,78).

Despite these managerial, behavioural and knowledge related issues, the utilisation skills of the tools and methods on the technical level are high and the area is very well understood. This goes for

the less complicated methods such as risk assessment. However, there is, as noted above, little understanding and acting upon the risks of not using metrics as a process for measuring information security levels.

## Trust and user-acceptance

A final concern that can be identified in the assessment of strength and weaknesses regarding ICT security in Finland is that of trust and user-acceptance of the new technologies. This concerns the trust and readiness people have in letting technology take-over functions which until now has been

### **Box 2: Privacy protection in location-aware services**

Privacy protection in location-aware services is related to the right to locate a person, use the location, store the location and forward the location. Based on several case studies of location-aware services, researchers find that there is a trade-off between privacy protection and effortless use that needs to be resolved. In other words, the more seamless and easy the use of the services/applications gets, the more need there is to monitor users and locations. This raises privacy protection problems and forces providers of services to develop easy mechanisms for giving permission to use the (monitor) data for predefined purposes.

The research also shows that Finnish users are quite trusting towards service providers on this issue, and that acceptance of push services was high.

Source: (17,45f)

performed by humans. Because mobile services increasingly support individual users in their daily tasks and deals with personal data, user trust and security issues in the services is becoming more and more important for both application (hardware) and content (software) providers as well as network operators (16,iii). Box 2 gives an example of privacy protection issues in mobile context-aware services.

In Finland (and most other developed countries) trust in the financial markets and institutions plays a more and more central role in competing in the new economy. In the report on mobile agents in secure auctions it is concluded that people (in general, not only Finland) are not yet ready to let technology perform their financial business. Therefore mobile agents may not have the potential to become learning systems to be in use everywhere, but rather systems that perform predetermined actions (4, 91). Still, the Finnish people have a basic trust in banks (as an institution), and therefore show less scepticism in using technologies put forth by banks. Given that the banks

can maintain the trust they enjoy, the Finnish report predicts them a head start in offering services related to other parts of the economy (e.g. e-commerce) (1, 30).

As noted new information technologies provide opportunities for shopping on-line (e-commerce). Although, there have been almost no reported cases of fraud, when purchasing on-line with a credit card, only 10 % of the Finnish population have used a credit card to pay on-line and a considerable proportion of people are suspicious about it (15,13).

## All in all

*To summarise* there seems to be awareness technical threats and potentials within the ICT-security area in Finland. This goes for both researchers (and public funding), public and industrial institutions, although the skills and use of more simple security tools (such as risk assessment) in institutions is higher, than the use and skills of more complex metric systems. There are still institutional and cultural factors to strengthen. These include education, awareness and personal behaviour in general related to security issues. Peoples trust in technology systems security level seems to be based on trust in certain institutions (e.g. banks), rather than the technology itself.

## **Recommendations for the future**

One of the main challenges/issues for making better security measures in public and industrial organisations is to consider ways of by-passing the contradiction between measurement and privacy protection. One approach is to rationalise the systems. Another is to motivate people to commit to information security issues. The level of knowledge amongst the stakeholders, the manageability and measurability of information security, including skills to prioritise and continuously optimise dialogue between information security and organisation action, is seen as giving competitive value in the future. Therefore these issues are recommended to be taken up by further research and strategic development in the organisations (3, 78). Also there is a need for educational programs that would motivate people to commit to act according to given information security instructions and constantly learn more (3, 79).

Specific design recommendations for designing mobile services that induce user trust are found in (16,110).

## ***Healthcare***

Healthcare and wellness has high priority in Finland. It is integral in a number of research programmes and policies. A large public healthcare sector and a joint public and private innovation system (infrastructure) are set up to create and sustain healthy public and business environment. Finland has a *strong research community* and infrastructure in a global scale, but there seems to be a problem in turning path breaking research results into *profitable application and business* in the home industry. A SWOT analysis is presented in (7, 50). According to a Senior Watch comparative analysis on EU countries, Finland is rating 1<sup>st</sup> in their ICT orientation in *healthcare policies* (13,x) (as well as general ICT policy (13,22)).

## **Definitions, areas of interests and rationales**

The areas of interest in an ICT context include the public healthcare sector and pharmaceutical research and industry. The two sectors delimit the scope of Finnish healthcare in the reviewed reports. This means that a specific focus in medical equipment is left out. The healthcare and pharma sectors have been of strategic interest in it self, besides being a future user (area) of mobile and other ICT's. This strategic interest has led Tekes to fund the following technology programs "FinnWell - Future Healthcare Technology Programme", "Drug 2000 - Biomedicine, Drug Development and Pharmaceutical Technology" and "Innovation in Foods Technology Programme".

Research in biomedicine and biotechnology has been one of the strategic focus areas in Tekes, and has been met by long-term commitment and funding (8,1). To complement this, Tekes and the Finnish Pharma Cluster has made two vision reports in 2001 and 2004. The second report, which is included in this study, was made to reconsider initiatives from the first report, as a result of on-going deterioration of capital markets to drive commercial products out of a spearhead research community. In other words the Finnish Pharma Cluster did not rip the economic benefits from the strategic investment in research. This idle potential is properly the primary reason why the pharma sector has been given strategic attention lately. Another important reason for dealing with ICT in the health sector is the scenario (based on a demographic projection) of a larger group of seniors and disabled people and the following demand for better treatment and higher efficiency in the Finnish healthcare sector. Also, the scenario is likely in many European and other western countries, and therefore gives great export opportunities for Finnish industries.

## **Research in the pharma industry**

As noted, Finland has a strong research community in the health area. According to a Tekes foresight report, "*Finland has been well prepared for the molecular revolution, especially in the development of infrastructure and personnel for life science research*" (7,1). In later years Finnish R&D has been able to develop and launch 7 NCEs and 8 innovative products or product families on global markets, making them second to none in the world (7, 3). There can be no doubt that Finnish research has world class capabilities in pharmaceuticals as a basis for the future.

Unfortunately the reports reviewed in this desk research gives only little insight to what role ICT plays in this research, or whether any connections between the strong mobile and network industries/research community and the pharmaceutical research community can be identified. Still a few trends are put forth. Accordingly, 7 % of R&D expenditure on new technologies by leading pharma companies is spending on bioinformatics. In 2000 it was expected that pharma companies would increase their investment in IT by 50 % before 2005 (7, 29). New research areas such as genomics, genetics, proteomics, and metabolomics create enormous amounts of data that needs to

be collected, stored and processed. Therefore ICT is expected to be of prominence in the future also a technology that can push the speed of development of new pharma products.

## Commercialisation

The Finnish health-related industries have shown growth for several decades, but Finland still has a negative drug trading balance (in high contrast with Europe as a whole). Survey data has shown that Finland researches all the most cited in Scandinavia, ranking 6<sup>th</sup> in the world<sup>3</sup>. Though, life science has been on the agenda and given high priority as a science and technology area for funding, it has create a lucrative commercial industry so far (7, 1). Instead Finland has seen a rise in small, low capitalised companies doing drug discovery, development and offering services (CROs) that have not penetrated international markets. Now an earlier vision (from 2001) to double employment in the industries is more likely to become a question of maintaining currents employment (7,2).

## Policy

As mentioned, Finland is leading in addressing *ICT in healthcare policy*. In the following we mention a few policy areas to illustrate the Finnish strengths (and weaknesses) that differentiate Finland from other Nordic<sup>4</sup> and European countries. The Textbox 3 gives a description of the ICT/healthcare agenda in Finland. Along with Germany, Finland is the only European country that has specific policy addressing the IST needs of older people (13, 22). Finland is among a few European countries that that has existing policy addressing ICTs in general healthcare policy, (in Denmark recent policy initiatives address it as well) (13, 26). Although no specific regulation or legislation concerning design-for-all<sup>5</sup> exists in Finland, government statements and some government initiated research and development projects exist, and Finland appears to be leading the way along with the Netherlands (13,39). On the other hand Finland seems to be lacking behind Denmark, Norway and other EU-countries with regards to ICT/care procurement policies. There seem to be no policy at all to secure public procurement of

### BOX 3: The ICT/Healthcare agenda in Finland

“It can be said that in terms ICT healthcare policy, Finland is leading in the area in Europe. The importance of an efficient and accessible healthcare service is reported as paramount to Finland. Several Years ago (1996) the National Committee for the Strategy for Utilising of ICT in Social Welfare and Health Care was established to guide this work. At this time the committee, established by the Ministry of Social Affairs and Health, proposed a new citizen-centred care model of seamless health and welfare services, in which organisational and information barriers were to become invisible. This remains of the main targets of the Ministry and today’s Target and Action Programme TATO (2000-2003) continues this objective. Throughout all of TATO, the use of new technologies, ICTs and assistive technologies are regularly referred to as a priority in maintaining seamless services and delivering efficient healthcare services (13,27).

<sup>3</sup> With Denmark raking 7<sup>th</sup>. and Sweden 10<sup>th</sup>. (7,1).

<sup>4</sup> The report from Senior Watch does not include data from Sweden, and only to some degree from Norway.

<sup>5</sup> Policies to ensure that ICT’s is developed, designed and adapted to be accessible to old people and people with disabilities, or to establish special services and equipment in cases where the it cannot be archived.

ICT that enables disabled employees to use the applications (13, 41). Finland does not offer (as compared with Denmark and Norway) direct and indirect public financing of ICT-based assistive technology services but have some case-to-case funding. Assistive technology sectors in all three countries provide a range of services (13, 44). In 2003 it was reported that Finland did not have specific ICT/healthcare-related R&D policies, though activities in the area was increasing in terms of funding sourcing, pilot projects and initiatives (13, 48f).

## **Technologies and application areas**

In a technology Watch Report by the Senior Watch group we find a few examples of technology applications developed and/or used in Finland. One example is a homepage that display a model home centre with solutions/application that can make living at home easier for older and disabled people. Such applications include control over domestic equipment (heating, cooking, light, TV, telephones, doors etc.), safety systems and health monitoring equipment. For example health conditions (e.g. heart rate and blood pressure) can be monitored by sensors in arm wrists and mattresses (11, 44). Another important application area is in ensuring effective first aid by mobile communication. This includes giving guidance to health care personal and other people in accident sights, and guiding health care to the sight by positioning from a mobile alarm call (5, 19).

When comparing with other European countries, Finland seems to be offering an above average display of ICT-related application. These include a widely use of active alarm service, and an emerging use of passive alarm service, remote support of mobile care staff and advanced services using video (13, 35). This is a rather low use, compared to Denmark and Norway (13, 35). Other available applications include e-papers/e-books, TV captioning and text telephony & relay (13, 42). According to the Senior Watch report, the general use of DVD's, mobile phones, internet, home banking etc. among the 50+ population, Finland is in the upper end, but raking lower than for example Denmark. With some precaution<sup>6</sup> the Senior Watch notes that Finland is lagging behind the rest of Europe the use of internet among physicians (e-health) with Denmark among the front runners.

In Finland, you find the use of video telephones to assist deaf people communicating online by sign language via an interpretation service centre. By contacting the service centre, deaf people can communicate with hearing people at home or over long distances. Also the project has been to bring social services to deaf people (especially relevant to people in rural areas) (11, 48).

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<sup>6</sup> The results are base don data that does not show difference between to what extend physicians, community health centres and hospitals use the internet for interaction with medical colleagues in other establishments or with their patients, rather that only accessing their account or health information (13,17).



In the mobile network area, scientists from the Technical Research Centre of Finland, University of Oulu, have developed a prototype of a multimodal mobile telephone with Personal Virtual Services Based on Picocellular Networks. The prototype includes a mobile phone, palm computer, camera and binoculars, web access, superposition of e.g. location information on camera picture (11, 39).

With regards to future developments, there are pilot projects implemented to evaluate different systems for remote expert work (or telecare). Such systems would enable doctors and other experts to contribute to the curing of patients without been physically present (5, 13). Like the sign language service, this could help the problems of people living in rural/less populated areas where few medical specialists are found. Other possible future applications in Finland include reporting of actions/operations taken when visiting the costumer's home, a mobile system for supervision of work (guidance and control) and mobile systems for increasing the security of mobile personal (5,13).

*All in all* Finland seems to be in a strong position to further develop and exploit new products related to health and ICT. With strong research communities in both areas; public/political support; guiding policies; and a high level of use, ICT has the potential to further integrate into health care-related products, services and business processes in the future to support life science and the working of the Finnish health care sector in general.

## **Recommendations for the future**

Specific recommendations for the integrated area of ICT and health care are few. Recommendations for the pharmaceutical research and development is focused on developing innovative and profitable business models for the industry; expanding the support for applied research in biomedicine; and securing financing the most promising commercial drug development programs. In general the recommendations urge the Finnish pharma sector to make initiatives to exploit their capabilities commercially. A full list of recommendations can be found in (7, 52). Among these is a recommendation for the innovation system to support development and applications of IT technology and bioinformatics as these will play a crucial role in the success of biotech industry especially in the future.

From a technical perspective there is clearly a need for real-time connectivity (IP-level v. SMS) and higher bandwidth, to meet the needs of, e.g. remote consulting specialists in the medical imaging fields, that requires large displays and wide bandwidth data rates to the terminals. This need is

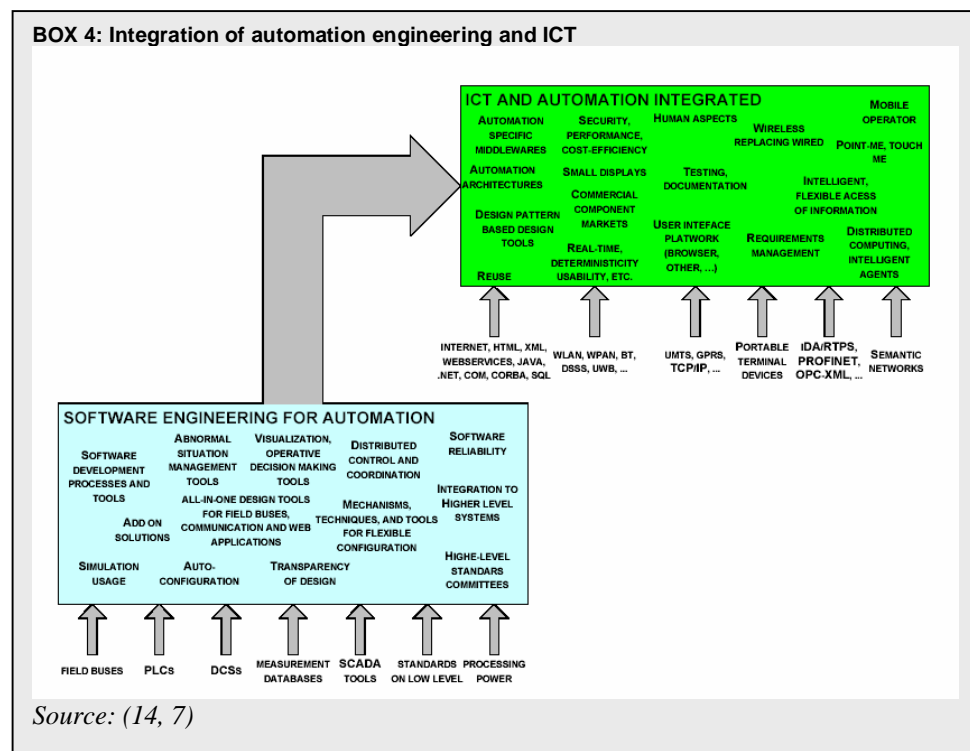
unique in healthcare and wellness sector, and contradicts with the general tasks for with mobile services are best suited (5, 40).

## Production economy

### Definition and general perception of the area

ICT in the Finnish production economy are analysed from two segments of applications, (i) the production of mobile and network applications for consumers and industry and (ii) the development of robotics and automated machines for the industries. When integrated/converged these two

segments seems to support Finnish production industries in their challenges set up by globalisation. Challenges, which seems key in the strategic development of business in Finland, and are argued for in all reports as problematic for their production industries. Robotics and automation changes in the way



Finnish industry produces products. Together with mobile and network applications these technologies enhances the production industry management, control and document the production processes and related services and enables them to meet some of the challenges of the globalisation including changes in the institutional/organisational/geographic setup and information flows. Box 4 illustrates the expected future integration of automation engineering and ICT. The following sections look into the productions economy from automation and robotics perspectives and a mobile perspective, followed by a review of production industries that use the above mentioned application. These include housing and building, forest industry, pulp and paper and other industrial services.

## Robotics and automation industry

New industry automation technologies often built on ICT. In fact, ICT is playing an ever enlarging role in implementing a multitude of novel functions, methods and technologies in automation systems (14, 1). To develop this area Finland has put up the Adaptive and Intelligent Systems Applications programme and following Intelligent Automation Systems technology program. Here a large number of projects focus on developing methods and algorithms to improve measurement, processing, diagnostics, optimization and control systems. To guide the programmes a number technology roadmaps were carried out, including the ones referred to here.

When dealing with automation the technical challenge is to create control architectures and interoperability between equipment, process control, operations management and various internet-based services applications from different vendors. All these applications are often geographically dispersed might be located (or integrated) outside the company in a business network. This adds complexity to the challenge, and instead of building familiar DCS and PLC applications, the suppliers of manufacturing equipment and control systems must be able to provide more comprehensive solutions. These include information management, optimisation, remote diagnostics, maintenance and continuous process improvement. In other words, what used to be discrete control and automation systems are becoming “*integral and seamless parts of entire plant information systems*” (14, 1). In the near future they must be integrated into systems to control business network, supply chains (lean production) and service business (14, 10). All in all, this adds to the conclusion that applications based on ICT are a good basis for the future in industrial automation (10, 97; 14, 1).

Finnish process automation industry has had a strong international position for decades, especially within pulp, paper and energy automation. Due to a supporting mobile industry (and technology push from ICT), production process automation based on electronics has shown rapid expansion in recent years (14, 1+3). The technological ICT base, both hardware and software, is mature enough to support and push forward the development of automation systems without major implications. Still, there are obstacles to pass. One of the biggest challenges in automation is to develop a system architecture that is compatible with both, older generation systems and new ICT systems, platforms, tools and interfaces of different vendors. Standardisation is another challenge. There are too many standards, and they are focused on lower levels of the automation system hierarchies. Similarly there are too many tools, platforms, languages for similar purposes and major vendors do not truly favour open systems, standards and interfaces. From a research perspective there is a need to strengthen ICT research from an automation point-of-view. (14,8ff). Applications to properly deal with dynamic data and security of communication media and devices are other issues to be dealt with.

To make better monitoring, diagnostics, signalling, control and actuation there is a general need to development better and more advanced algorithms. Software developers in Finland have been active in developing such algorithms (e.g. neural networks, fuzzy set and genetic algorithms), but the use and maintenance of these still require to much post-doc expertise to be viable (14, 5).

### **Mobility, networks and pervasiveness (electronics production)**

Mobile and network technologies can be seen as a generic technology that can provide applications and services in most economic areas (incl. the experience economy). The production of mobile and network technology applications (electronic devices) seem to amount for a considerable part of production economy in Finland. From the attention it is giving in terms of funding and strategic reports on mobile and network technology, this area seems to have first priority over other more traditional production industries. In a road map for mobile business applications, industrial services build on mobile technology is giving primary attention because it is seen as one the most important Finnish clusters with regards to size and growth potential. Because of the importance and size of the mobile industry in Finland, this industry is dealt with as a separate industry that supply technology and industrial services to other production industries under this headline (Production economy).

Finnish companies are seen as taking a lead position in the development, sale and use of wireless systems, pervasive computing, broadband packages and ICT in general (12, 7; 8, 62). Also, many Finnish ICT suppliers offer systems with open interfaces that make exchange of data possible between companies. On the other hand, Finnish companies are lacking behind the global scene in investing and implementing business network management systems to control supply chains and business networks and there is special need to catch up with the rest of the world in the implementation of XML-based systems and technologies (6, 91). To support this Finland has national XML technology development boards and boards for development XML standards (e.g. RosettaNet) for companies to join (6, 91).

With the lead in technological development, there seems to be a bigger recognition of the importance and challenge in developing user friendly, commercial services and a need to focus more on demands (5, 1).

One specific area of interest in the reviewed reports is pervasive software development and use. There seems to be a number of opportunities for Finnish software developers and industrial companies, although there seems to be at least a few major hurdles to pass before pervasive software and pervasive computing becomes a reality. These include a lack of willingness and understanding of the need for openness and wider co-operation, and the need to develop

interoperability and standards (8). Despite these hurdles Finnish companies are viewed to have a good chance to success in ubiquitous (pervasive) arena internationally due to their strong knowledge of mobile technologies and embedded software technologies. They have potential to develop applications for home environment, industry automation, and business and consumer electronics. See box 5 for a list of specific areas of business opportunities.

**Box 5: List of specific opportunity areas**

- Middleware components
- Ubiquitous computing environment and its components
- Sensors implemented locally to various conditions
- Small-size applications and services
- Personalised services
- Transfer into wireless communication (8,63)

## **Technologies and application areas**

The technologies for mobile services and applications available or under development are numerous in Finland. The list stretches from different mobile terminals (phones, PDA's etc.) to all kinds of connectivity technologies (cellular networks, WLAN, UMTS etc.). A full list and description can be found in (5, 25ff). Applications range from business-to-user or business-to-business vertical applications (information distribution and sharing within diverse (service) areas and core cooperate system such as ERP, CRM etc) to horizontal applications (mobile office services such as mobile calendars, phones, PDA's etc.). In the following sections we have presented some areas of special interest for mobile and network technologies in the Finnish production economy. Health care and tourism are both dealt with in separate sections.

*Industrial services* in general are where impacts of ICT are seen and will be seen in the near future. As for mobile health care personnel, mobile technologies are viewed as providing considerable opportunities for field service technicians and other mobile personnel in industrial services. One essential example is the way the information flow between the company systems and the service technician or sales person is managed. Today a lot of information gathered in the field is memorized or written on paper. When returning to the company the staff types the information into a central system. This leaves room for mistakes and time relays in the information flow. With mobile systems the technician or sales person can register data and information onsite, and at the same time draw on information from back office systems, when need in the sale or service situation (5, 14). Despite these opportunities there is a need to further develop mobile terminals for professional use, including development of better physical appearance and interfaces (5, 38)

*The housing and building industry* is controlled mainly by big construction companies that also develops and forces their own systems upon smaller subcontractors. This makes little room for developing commonly defined systems and interfaces, and the area is not seen as giving much potential for demanding new mobile business services in the future (5, 15)

*The forest industry* offers a big potential for the usage of mobile ICT. The systems and applications seem to be similar to those used in food production and chain. These include systems for securing traceability, positioning system for assisting harvesting, and systems to control transport and logistics in just-in-time production systems. The coverage of mobile networks is a matter of concern, due to the remoteness of the forests, paper mills and transport fleet (5, 15).

### **Meeting the challenges for Finnish production industries (All in All)**

With Nokia and the Finnish mobile industry as world class forerunners, Finland seems to be in advantageous position to meet the challenges of globalisation. These challenges include being able to (i) create and maintain highly effective, reliable and flexible productions, due to faster development of technologies and products/services and a transition away from labour intensive industries, and (ii) to create, maintain and control geographic dispersed business networks, supply chains and production units, due to a general focus on core competencies, outsourcing of tasks and a more complex set of demands from diverse stakeholders. All reviewed reports seem to agree that mobile and network technologies will be pivotal in dealing with these challenges and that Finnish industry is well set up for the task. This forces companies to focus on their business networks and supply chain, and trust, open information and co-operation on IT systems become more important. With the back-drop from the mobile industry, a strong automation industry in areas of pulp, paper and energy, and strong technology platform Finland seems to be in a position to provide automation technologies (based on ICT) to their production industries that will enable them to compete in future global markets and meet the challenges of globalisation.

### **Recommendations for the future**

There is a need to give more attention to creating commercial service and applications of mobile and network technologies. The technology is no longer the biggest challenge. This includes a focus on demands, user friendliness and a greater understanding of how the value chains/networks of mobile service solutions are structured (5, 1).

There is a need for Finnish companies to strategic investments in business network and supply chain management systems as part of a core competency strategy (6, 92). Companies can do this by starting to analyse and integrate internal systems, and move on to integrate external systems in their supply chain/network. To accomplish this in a bigger scale, there is a need to develop and agree upon a common XML standard in Finland (6,92f).

To strengthen Finnish position in the market for process control systems (within industrial automation) the following areas has been identified as important for future research and

development – intelligent data processing, control system architectures, human-system interaction, plant operational state management, abnormal situation management and standardisation of information flows (10, 14).

To push mobile business services forward there is a need for establishing connections to/from existing corporate IT system to mobile terminals and an efficient way to use these applications outside the office. Bandwidth is important, but securing good coverage by the mobile network is even more important to support mobile business services in Finland (5, 1).

From a technological perspective within automation and robotics, it is suggested to place more emphasis on the design of user interfaces. There is a need to break out of a traditional and technology orientated paradigm, and to include the role and capabilities of operators and the whole system context. Also, there is a need to develop standards for user interfaces, to make development cheaper and exploit potentials in reuse. Here the automation industry can build on development and experiences in the mobile industry (Phones and PDA's) (14, 5).

In general there is a need to develop intelligent automation systems that are able to assess and adapt to its environment (14, 6). To achieve this, there is a need to further integrate ICT concepts, platforms, languages and components into the old software engineering paradigm for automation developed in the 80's (14, 7ff).

One report suggests research in the new technology of semantic webs. Semantic webs bring new meta-information possibilities into the Internet and communication technologies, although any clear cut application potentials for business and industry are unclear (10, 93).

### ***Experience economy***

The experience economy, though it does not seem to amount for much attention and independent analysis, is mentioned on more than one occasion as a potential user (area) for new mobile technologies.

### **Definition and general perception of the area**

The reports give no indication whether the experience economy is an economic area of special attention, or why it would be. The lack of independent analysis leaves us without an explicit and distinctive definition of "the experience economy". Concepts like tourism, event management and marketing, consumer services and entertainment are the main references to the experience economy.

There is a clear reference between common definitions of experience economy and the uses of mobile solutions in tourism and event management and marketing. When it comes to entertainment and consumer services the reports seem to use somewhat diverse definitions. For example when they conclude that, '*entertainment issues such as novelty value is expected to increase in the future (5, 36)*'. Here the value of the technologies novelty is referred to as an entertainment issue. Usually the novelty value is seen as a value created by most luxurious and lifestyle products, and not as an experience or entertainment value. In another report, mobile applications and services are valued as a means to kill time and a handy alternative for home PC's, newspapers, radio or television (16, 86f). Here the value of the applications and services are divided into entertainment and utility, and the entertainment value can be seen as a part of the experience economy.

There are many opportunities within the mobile technology industry in Finland, to provide ICT based experiences. Whether or not Finland takes on strong positions in the use and development of ICT within specific segments of the experience economy are not clear, due to the little attention given to the area in the reports. The few relevant application areas presented in the reports can be summarized into the categories; *consumer service* and *tourism*.

Context-aware and location-based<sup>7</sup> mobile services form the technological platform of interest in the Finnish context. In 2002-2003 Tekes funded a project (Konnti) under the NETS program to design and implement context-aware service platform and services. The designed platform enables management and sharing of contexts, presence information and contextual content, and it provides context adaptation and context-aware messaging. Also, personalisation and context tools were implemented. The results of the project shows that the most promising applications for context-aware service are event guides, and as mentioned in 'production economy' and 'health care (18,135)' sections for professional use (18, 3).

## **Consumer services**

Mobile phones and PDA's give opportunities for experience-based services where Colour-display, GPRS/EDGE, WAP, MMS and Java Functionalities form the basic technologies. Built-in radio, MP3, video and still cameras, text messaging (SMS) and multimedia messaging (MMS) give opportunities to send and receive pictures and information (content sharing) that may *enhance experiences* in given context (e.g. exhibitions, site tours, tourist information, and sharing of (holiday) experiences). This type of content sharing on mobile applications is expected to grow, just

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<sup>7</sup> Context and location is not necessarily the same. Location is not the whole context and may not be the most important variable that makes the context. Context refers to different abstraction levels, e.g. the physical context (including location, infrastructure and other external conditions), social environment (including proximity of other people, social relation, collaborations etc.), personal context (including habits, mental states etc.) and tasks. ) (18, 13ff). Therefore consideration on the context is crucial in the development of new context services (18, 150).



like it has been observed on the Internet (5, 38). Mobile phones (and mobile technologies in general) also creates an opportunity for *content provisioning and distribution* of ring tones, Java games, music, logos, etc (smart messaging) that can provide experiences for users (5, 10). Ring tones and Java games seems to be the only content consumers are ready to pay for (5, 37). Likewise, other content providers (e.g. TV-stations) can exploit the possibilities of mobile technologies by offering complementary services in relation to the experience service they provide already. Finally mobile phones and PDA's are identified as given opportunities for event managers and users to spread and receive information on events (17, 39).

Generally speaking, mobile technologies in a consumer context offer opportunities for value creation based on increased revenue generation (5, 10). In 2004, almost all new mobile phones in Finnish markets already had the mentioned technologies (5, 7), although it is unclear how large the market is for providing (experience) services based on these technologies, or what efforts are put in to establishing terminals to support them. There seems to be a need for more information about useful mobile services and successful utilisation of mobile technology in general. Either there are no specific benefits or there are a not good enough marketing about the new possibilities. In consumer markets there is a strong focus on price competition and less focus on marketing the new possibilities. In business markets there is a need for more independent research on the benefits and complications mobile technology may rise (5, 36). There have been little success with internet-based services, and the way forward seems to be context-based services (e.g. location guidance) (16,132), as been developed for event information and tourism purposes.

In consumer markets mobile operators play a key role, but it seems that the market for mobile services is still emerging and developing, and there is a need for a better understanding of the way the markets and value chains/network are developing (5, 35).

### **Travel planning and Tourism**

Mobile technology offers a great opportunity to set up a tourist information system with easy access to information about specific sites or travel planning (location based-services), and the number of WLAN hotspots is increasing (5, 39). Some of the most obvious possibilities for travel planning are mobile booking systems, price information, reservation and payment for hotels, flights, car rentals etc.,

route information and guidance, and information about delays. Likewise, GPS technology can make

#### **Box 7: Location-based mobile services in different settings**

In a number of field studies, Finnish researchers tested the use of PDA's with topographic maps and PGS positioning as a guidance system for visitors of a nature park in Finland. Similar technologies have been tested as a 3D city model guidance system in Helsinki. Another project in city guidance has been made based on SMS technology. A survey, made in a northern Finnish ski resort, shows that people are keen on using similar context-aware and personalised services for tourist information. The general results from the studies show that personalised and context-aware contents and presentation of mobile maps could make the maps much more useful and functional for the users.

it easier to find your way in the city or when driving your car around a new country or region, and you can spend more energy on enjoying nature, architecture etc, and not on looking on a map. Box XX gives examples of more complex location-based or location-ware services for mobile applications. Other application areas for context-aware consumer-services include bowling halls, cafes, concert halls and other public places (17, 39). In the Kontti projects a platform for context-aware mobile services was tested as means to deliver site-information to visitors of a historical route and as an event guide at a theatre festival. The results show that the services created additional value to the users. From the theatre festival the results show that visitors, staff and performers find the services useful as a planning and communication tool (18, 96).

Location based services have been considered key in the development of mobile solutions that provide relevant and timely content/information to users (5, 37), and offers good potentials in environments such as public places, holiday resorts, sport fields and event venues (17, 47). In Finland there are ongoing activities for defining common interface protocols for information databases. Some large databases exist, but wider use of tourist information is still limited, due to limited access to proprietary databases (5, 14).

### **All in all**

Context-aware applications and services seem to be pivotal to the development of both new application developments in the mobile industry and as a means to develop the experience economy in Finland. The technology needs to be developed further and is only in the outset. Still, there are indications that Finnish users see the potential and eventually will accept the technology. Also, it is an area that the service-providers believe in (18, 129). Interviews with service-providers indicates that although a new generation of mobile devices are needed, context-aware services in events and mobile video for advertising, movie-trailers, music videos, and viewing news will be seen in the near future (18, 130). This is also seen in a technology roadmap on communication technologies (2002) where full video and multimedia services, personal area and ad-hoc networks, combined with wearable and reconfigurable terminals draw the picture of 2010 (19, 23). According to the service-providers, marketing and information on events are the most promising interesting and profiting use-cases for the future (18, 133). Media houses also show interest in context-aware applications, where editorial offices, editors and reporters can share contextual information, e.g. of different events and news at all times (18, 137)

### **Recommendations for the future**

In order to exploit the potentials of mobile context-aware applications and services in the experience economy, it is recommended to base the services on standard PDS' and mobile platforms in order to achieve a critical mass of users. Likewise, the services requires co-operation of

content and service providers (e.g. directory services, map providers, telecom operators and location providers) (17, 48). To ensure trust, user-acceptance and compliance to legislation, the trade-off between effortless use and privacy protection needs to be resolved for each individual service (17, 48). This includes creating easy mechanisms for users to give service providers permission to use data for predetermined purposes.

User tests of context-aware services show that there is a need to develop services that are not only web-based because of cumbersome connections rates and confirmation demands. In general there is a need to improve ease-of-use of the services (18,131). One important aspect of this, is to minimize the visual difference between know/familiar devices (e.g. mobile phone) and new browsers (18, 139). Another need from a technical perspective is to integrate positioning and sensor-based pointing (combined with e.g. RFID tags) to improve accuracy of context and information (18, 119ff).

In order to construct new context-aware service, e.g. in a business use case, it is recommended, that service-providers integrate the context-aware portal with their present systems. There seems to be an interesting business potential for service-providers not operating in the IT business. Therefore, it recommended to establish enhance communication and new partnerships between people and companies in the IT business and people from other service business, especially in the public and culture sectors (18, 144).

## **ICT Nordic Foresight (Sweden)**

### **- Desk Research Report**

#### ***Publications used***

This chapter is based on a variety of sources in Swedish and English. The majority of sources has been located in the second Swedish foresight (Teknisk Framsyn) carried out in 2003-2004. This round of foresights is the second in Sweden (the first took place in 1998-2001) and naturally some of the work is updates and reflections on the foresights made in 1998-2001.

The two rounds of foresight have had a broad representation of organisations behind the management and funding of the work. Kungl. Ingenjörsvetenskapsakademien (IVA), Närings- och teknikutvecklingsverket (NUTEK), Stiftelsen för Strategisk Forskning (SSF), Sveriges Industriförbund and VINNOVA has been behind both rounds of foresight, while Swedish LO, Vetenskabsrådet og Svensk Näringsliv were involved only in the second round of foresights.

The foresights reports have a coherent structure and interrelationship in the sense that different reports focuses on different areas and that there are meta reports that draw on the insights on all the focussed reports in order to establish a discourse for the strategic choices that Sweden face in now and in the future. All in all there are there are ten reports with particular focus areas and one meta-report that sums up the future challenges and opportunities for Sweden.

Apart from these publications a range of other publications made by or on behalf of public actors have been studied. These reports are also foresights, which means that the following description is based solely on foresights that typically have a 10-20 years perspective (although a few operate with a perspective of 25 years). Since the foresights are exploratory and made with the ambition to inform decision makers, no clear cut visions and/or specific recommendations can be identified.

Most of the foresights have been made as in a quite open and participatory design where major research institutions, social partners and consultancies have been represented in the working groups and panels that have steered the focus of the foresights.

Although the foresights are labelled as technological foresights it is explicitly stated that they are not technology deterministic and a range of economic, social and psychological drivers are introduced to frame the challenges and opportunities related to future use and development of technology.

Given the fact that the 2004 foresight is the most recent and most detailed most of the material and points described in the following is related to the 2004 foresight.

### ***General emphasis and rationale***

The rationale of the technology foresight project 2004 is that a range drivers of change (with globalisation as the most potent) is changing the way that citizens and companies of Sweden lives and works. Global competition, an increasing base of knowledge involved in products and services, a high level of complexity of the technology and societal structures and the need to identify sustainable ways of living are identified as the major driving forces in the world and for Sweden.

In the light of these challenges a vision for Sweden in the 21<sup>st</sup> century is needed and this vision can be related to a range strategic choices that must be made. Three of these choice use different angles to describe the fact that Sweden must dare to prioritise and focus resources on investments and projects since this is the only way to compete successfully in the globalised economy.

The three other choices are related to the structural premises that the society may offer for its citizens and companies. Modernisation of the public sector – in which ICT is expected to play an important role. Focus on the development skills and creativity of the workforce and active steps towards the development of a sustainable society.

On a more detailed level the ICT foresight identifies 7 areas are identified in which from from a Swedish ICT perspective seem particularly promising. These are the following:

1. Pervasive computing / Ambient intelligence
2. Complex systems
3. Middleware

4. Experience technology
5. Information management
6. ICT security
7. Architecture and infra structure

Two of the four focus area of the report is therefore directly related to the focus of this report, namely Experience technology and ICT security. This does not mean that ICT is not described in relation to health care and production technologies, but this is done in separate sub reports of the foresight. In the following we will take a closer look at the four focus areas of this mapping report.

## ***The experience economy***

### **Definitions and rationales**

Experience economy is described as “Upplevelsesteknologi” in the foresight and is identified as one out of 7 key areas where Sweden may have a good opportunity in a global perspective.

“Upplevelsesteknolog” is defined as Architecture, design, film/foto, literature, art, marketing communication, media, fashion, music, food, theatre, tourism and edutainment.

In the global economy the competitiveness of Sweden should increasingly be based on products and services that are hard to imitate and difficult to move (offshore). Development within different areas of the experience economy may fit these two competitive parameters quite well. The rationale behind this line of thought is that products in the experience economy is based on creative competencies which are to copy and develop by other countries. Furthermore a range of experiences (such as tourism) is geographically tied to Sweden.

### **Sweden’s position in the experience economy**

First of all the ICT and media convergence has created an important industry for content services and ICT equipment for these services. Sweden has companies and universities that are strong on ICT as well as content development such as infotainment and games and should therefore have a set of different opportunities in this area. But the report points to the fact that much of this development is expected to gravitate around Hollywood and other entertainment hot-spots around the world and this may make it difficult establish a strong position in this area. The development of tourism and experiences related to tourism is another area identified where new technologies may help to enhance the experience for tourists in Sweden and help to “sell” Sweden to tourist all over the world.

## ***IT security***

### **Definitions and rationales**

IT security is also identified as one of the seven focus areas of interest for Sweden. IT security is defined as security related to ICT (such as viruses, spam and phishing) and as “networked defence” technologies which is applications that aim to network autonomous defence and weapons systems in order to create a more secure environment for its users. The markets related to both areas are expected to grow significantly during the next decades, but there is also a range of technological challenges to overcome, such as development of standards and taxonomies for representation of information.

### **Sweden’s position in IT security**

Sweden is expected to have great opportunities to enable it to take a prominent position in the area of networked defence based on its strong research and commercial position in the tele-sector and defence industry especially in relation to wireless communication infrastructure and sensor technology. In relation to ICT security the size of the nation, its IT infrastructure and the set-up of the public administration are viewed as strengths that should enable Sweden to develop a range of different initiatives to enhance ICT security.

On the other hand the report identifies a potential weakness for Sweden, and that is the limited resources available for research and the fact that much of the research and commercial development is too fragmented to create the kind of focus and cohesion needed to build a competitive advantage in the area of networked defence.

## ***Production systems***

### **Definition and rationales**

Industrial production is a traditional stronghold of the Swedish economy but it is expected to come under significant pressure from globalisation in the coming decades. It is therefore

Drivers and trends such as individualisation of customer needs, globalisation and new ways to produce and do product development are identified as most important in the coming decades. In relation to these drivers the Swedish competitive position should be based on a high level of intellectual capital and R&D, which will allow companies located in Sweden and Sweden as a nation to stay “ahead” of companies and regions located where the structural costs such as taxes and the cost of labour may be lower.

ICT is expected to play an important role as a driver and a vehicle for the development and use of intellectual capital in the production system. This is expected to happen in relation to the following areas:

1. Development of complex systems of production. Development of complex production systems, robotics and sensor technology may help create production facilities that are very efficient and flexible at the same time. This will allow companies to produce high quality products at competitive prices use concepts of mass customisation to ensure that the customer’s individual needs are met.
2. Development of “intelligent products”. Miniaturisation of ICT components and their decreasing costs means that more and more products may be made “intelligent” via chips, RFID tags and sensor technology. In order to do this successfully companies must understand the technological opportunities as well as the customers needs for intelligent products.
3. The use of ICT to enable learning. New ways of production and new modes of product development means that learning and competence development of the workforce becomes a very important issues. Development in ICT related to 3D and visualisation techniques, simulation techniques and e-learning in more general terms is areas where ICT may help to facilitate the transition needed in the production systems.



## **Sweden's position in production systems**

The following strengths are identified in the foresight of 2004. Sweden has a strong industrial tradition with a range of globally oriented companies that have the ability to rise to challenges and opportunities related to globalisation and the use of ICT.

Sweden has high levels ICT competencies in educational organisation, companies and for citizens more generally means that Sweden is geared develop, implement and use complex systems based on ICT relatively easy compared to other nations where the use and familiarity with ICT is less pervasive in society.

Sweden has well developed ICT infrastructure which will allow companies to use ICT as means of communication and co-ordination. Furthermore continual development of the infrastructure has high political priority.

Companies in Sweden have traditionally had a co-operative attitude in the sense that projects and responsibilities often is delegated to the employees with hands on experience and the Swedish style of leadership is often referred to as consensus orientated. These are organisational and socio-psychological traits that will allow Swedish companies to utilise ICT potential to establish complex systems of collaboration and delegation easier and more successful than companies in countries where management styles are more centralised and closed.

The major weaknesses of Sweden are related to the development of the workforce and the structural settings influence on the competitiveness of private companies.

All though the work force in Sweden is well educated and ICT savvy, there are improvements to be made in the R&D base for development of production technologies and there is also challenges related to the recruitment of students and employees to the area of production technologies.

Consequently it is recommended that methods for more efficient recruitment for the universities and a stronger focus on natural science in schools and high-schools is needed.

In relation the structural setting the Swedish tax system and a complex set of rules and regulations related to tax, labour market issues and environmental issues are all considered to be quite strong barriers for especially the small and medium sized companies in Sweden.

## **Strategic opportunities and recommendation for actions**

In the following strategic opportunities and recommendations for actions directly or indirectly related to the use of ICT in production is described.

### Strategic opportunities

1. Focus on the introduction and “branding” of ICT and natural science through out the educational systems of Sweden.
2. Focus on the continual development of the ICT infrastructure in Sweden.
3. Create incentives for entrepreneurship and venture/business angle funding.

### Recommendations for action

Sweden should prioritise R&D and project funding on the following areas:

1. Integration of IT in products and processes.
2. Development of methods and technologies for modelling and simulation that may be used as a tool for communication through the lifecycle of a product/project.
3. Human to machine communication – interfaces and 3D modelling.

## ***Healthcare***

### **Definition and rationales**

ICT in relation to health care broadly speaking referred to in two different contexts. Broadly speaking ICT and health care are analysed in two different contexts:

The first is related to a convergence with other technology areas such as nanotechnology and biotechnology. The convergence in of these three technologies may mean that radically new forms of drugs and new forms of treatments may be developed. Themes within this area may be linked with the development of the national health care system but may are more likely to be linked with the pharmaceutical and medico industry also be linked

The second is ICT as a medium for diagnosis, treatment (telemedicine) and (re)organisation of backoffice systems in the health care sector. Themes within this area I closely linked with the development of the national health care systems.

All though both uses of ICT is mentioned the focus of the available studies is on the second definition and this will also be the focus of the remainder of the section.

The study identifies a range of drivers and incentives for the public sector and patients to focus on the development and implementation of ICT within the health care system.

The dominant driver the double pressure on the health care system established by the patients with their demands for more, better, more flexible and individual treatment on the one hand and the public administrations demand for increasing efficiency and cost focus on the other hand. There is a wide spread belief that implementation of ICT along with significant amount of structural and legal re-organisation may be the key to unlock this challenge. But none of this can be done with a more fundamental debate on the role of the health care systems and the political will to prioritise and focus on some areas at the expense of other areas.

## **Sweden's position in health care**

### **International division of surgery and complex care**

As in other areas, globalisation and the international division of labour and specialisation is also expected to influence the Swedish health care sector. Few nations will be able to host the most specialised competencies in all fields of surgery and complex care, and Sweden must therefore identify its most promising areas and focus on the continual development of them.

### **Tele medicine and tele care**

Development of sensors, communication infrastructure and a range of ICT enhanced equipment is expected to have a very positive influence on telemedicine and telecare in the years to come.

There may be strong incentives from patients as well as hospitals to use the possibilities within this area. From the patient perspective treatment in their own homes may be less stressful and more flexible than a visit to the doctor or the hospital. From the public health care perspective the use of telemedicine will reduce the pressure on hospital facilities and this may open for opportunities for a stronger focus on functional specialisation for hospitals. Sweden is expected to have good opportunities to develop this area since many of the technologies are developed and in use and geography of Sweden means that research and development within this area may harvest economic effects relatively fast compared to smaller countries.

### **Integration and back office re-organisation**

There are strong economic incentives for the use of electronic patient journals digitalisation of X-rays and a range of other modes of information that can be digitised. Such developments are expected to increase efficiency dramatically and may also become an important corner stone for a more flexible health care sector with a more frequent use of telemedicine.

There is no specific mention of any particular Swedish strength in this area. But a major challenge within this area is that it is difficult to establish clear cut business models that shows that the investments made are covered within a reasonable period of time by increases in efficiency or productivity. Two other important challenges identified are the need for common standards to ensure data exchange between different systems and a range of legal issues that must be explored in relation to new ways of generating and storing data on patients.

All in all there are relatively few indications on Swedens current position and ability within e-health and there are no explicit recommendation for particular forms of actions.

## ICT Nordic Foresight (Norway)

### ***Publications used***

Foresights are a relatively new phenomenon in Norway. Forward looking and future activities have been undertaken at various levels in different institutions, but up until 2002 there had been no large-scale, nationwide foresight exercises carried out in Norway (Eerola & Jørgensen 2002: 34).

One of the first initiatives aimed at promoting foresight activities in Norway was the project CREATE initiated in 2002 by the Research Council of Norway<sup>8</sup>. In their report “*Foresight in Norway 2003*” (Foresight i Norge 2003) the CREATE group identified a number of Norwegian foresights covering issues ranging from drivers of change in the Barents Sea region to an analysis of ethics and strategies in the Norwegian fishing industry. However, none of these foresights are about ICT innovation.

The recent initiatives in Norway include a mapping of private and public groups in Norway with expertise in conducting foresights, and more general reflections on how to carry out foresights. One example is the report “*Technological Foresight. Purpose, methods and the role of the Board of Technology*” (Teknologisk fremsyn. Formål, metoder og Teknologirådets rolle) published in 2004 by the Norwegian Board of Technology<sup>9</sup>.

Since 2004 five major foresights have been carried out by the Research Council of Norway. The foresights cover the following themes:

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<sup>8</sup> The Research Council of Norway is a strategic body which identifies areas of special effort, allocates research funds and evaluates the resulting research. The mandate of the Council is to promote and support basic and applied research in all areas of science, technology, medicine and the humanities. The Council is the principal research policy adviser to the government, and it acts as a meeting-place and network-builder for Norwegian research

([www.forskningsradet.no](http://www.forskningsradet.no)).

<sup>9</sup> The Norwegian Board of Technology is a public independent think tank for technology assessment

([www.teknologiradet.no](http://www.teknologiradet.no)).

<b>Theme</b>	<b>Title</b>	<b>Year of publication</b>
Aquaculture	Havbruk 2020. Grensesprengende – hvis...	2004
ICT research	UTSIKT – utviklingsmuligheter og strategivalg for IKT	2005
Biotechnology	Biotek Norge 2020	2005
Energy	Energi 2020+	2005
Advanced Materials	Avanserte Materialer Norge 2020	2005

The five foresights and the conclusions reached at a conference on research in Norway (VEIVALG 21 in May 2005) provide the basis for a synthesis report aimed at identifying the main challenges and opportunities in regard to future technologies.

ICT is – not surprisingly - at the heart of the foresight on ICT research, while the remaining four foresights only to a limited degree focus on ICT. In these four foresights ICT is typically considered to be a means to ensure product – and/or process innovation rather than a goal in its own right. Thus, out of the five foresights only the foresight on ICT research is directly relevant for this analysis.

Other sources used in this analysis include governmental strategies and reports related to the four main themes in this report: Security, health care, production economy, and experience economy. However, these publications do not address priorities and strategies in relation to ICT innovation, and no specific recommendations can be identified.

The chapter on ICT in Norway is structured as follows:

- 1) ICT research in Norway
- 2) Security
- 3) Health care
- 4) Production economy
- 5) Experience economy

## **ICT research in Norway**

### ***Definition and general perception of the area***

The ICT sector is the second largest sector in Norway when measured in annual turnover (only outmatched by the oil industry), and Norwegians are rapid adopters of new technology in general (OECD 2004: 11). However, the Norwegian economy has a slower implementation of modern ICT than other Nordic countries, and the public and private investments in ICT research are lower than in other European countries.

The importance of the ICT industry for the Norwegian economy and the importance of ICT innovation in regards to competitiveness and innovation in other industries such as the oil and fishing industry has placed ICT research on the national political agenda. As a result, ICT has been named as one of four topic areas specifically targeted in Norwegian research policy. Also, the purpose of the foresight on ICT research is to contribute with knowledge that can provide the basis for a new national long-term programme for ICT research, VERDIKT<sup>10</sup>. The programme is aimed at ensuring Norwegian leadership in the development of knowledge for innovation and interaction in an ICT-based wireless network community.

### ***ICT research in Norway***

In the foresight advanced ICT competences are considered to be vital for ICT innovation, and such competences can only be maintained and developed through investments in ICT research, closer co-operation between the industry and the research communities, and participation in international research projects.

When it comes to ICT three technological areas are of special importance:

- micro technology
- communication technology
- software

It is possible to identify competent [strong] Norwegian research communities in all of these three areas, and there is a strong tradition for close co-operation between the industry and the research communities.

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<sup>10</sup><http://www.forskningsradet.no/servlet/Satellite?cid=1092128011679&pagename=verdikt%2FPage%2FHovedSideEng>



In an international evaluation of Norwegian ICT research, a number of research groups have been rated as ‘excellent’ and ‘very good’. These groups are working with the following themes:

<b>Rating</b>	<b>Themes</b>
Excellent	Coding theory and cryptography Databases Knowledge based systems Control- and [styringsystem] (cybernetics)
Very good	[Signalbehandling] Communication systems Software development Information systems [SW engineering] [Acustics] Components and [kretsteknologi] Bioinformatics and modelling

### *Norway’s position*

The following strengths, weaknesses, opportunities and threats are identified in the foresight:

<b>Strengths</b>	Wireless products and services due to the advanced use and dissemination of wireless technologies
<b>Weaknesses</b>	Many small and vulnerable research communities; activities are only to a limited extent co-ordinated; R&D is not focused on long term development and there is a need for more funding; research communities are not sufficiently anchored at the European and international level
<b>Opportunities</b>	Content and user needs rather than technology
<b>Threats</b>	Risk that Norwegian research communities do not take part in the European division of labour within R&D; risk that research communities get too small to function (critical mass)

Norway has strong competences in areas that are relevant for the future wireless market. But there is room for improving the co-operation between universities, users and the industry.

## **Security**

### ***Definition and general perception of the area***

A national strategy for information security has been developed, and in 2005 an awareness campaign aimed at small businesses and households was launched [according to OECD 2004: 27 – not yet verified].

The national strategy “e-Norway. National strategy for information security” (e-Norge. National strategi for informasjonssikkerhet) published in 2003 by the Ministry of Defence, the Ministry of Trade and Industry and the Ministry of Justice identifies the main challenges and priorities.

- Protection of critical IT-infrastructure
- Better coordination of the initiatives in regard to IT-security
- Establishing a body for the national coordination of IT-security initiatives
- Analysing risks and vulnerability on a regular basis
- Classification of information and information systems
- Awareness
- Warning systems
- [ansvarliggjørelse] of the ICT sector and suppliers
- Protection of critical IT-systems and –infrastructure through certified security solutions
- Developing IT-security skills
- Developing an infrastructure for electronic signatures
- Participation in international activities related to IT-security

The public [indsats] in regards to information security is anchored in Centre for Information Security ([www.norsis.no](http://www.norsis.no)). This centre is charged with expanding the existing warning systems for threats to the digital infrastructure and with monitoring and analysis of threats.

### ***Norway's position***

The national strategy points out specific initiatives in response to the challenges and priorities, and especially the initiative aimed at strengthening research on IT-security could in turn result in the development of core competences (organisational, technical etc.). Furthermore, the responsible authorities and private actors are identified in relation to each initiative.

However, there are no indications of national strengths and weaknesses in regard to IT-security, and the role of ICT development in relation to IT-security is not elaborated.

## **Health Care**

### ***Definition and general perception of the area***

There are no technological foresights on health care, but a number of publications address the use of ICT in health care and in the social services.

<b>Title</b>	<b>Year</b>	<b>Published by</b>
" <i>Medicine and Health 2020</i> " (Medisin og Helse 2020)	2000	The Research Council of Norway
" <i>The Norwegian Board of Technology's scenario workshop on elderly people and ICT in health care services</i> " (Teknologirådets scenarieverksted om Eldre og omsorgsteknologi) <sup>11</sup>	2000	The Norwegian Board of Technology
"xxx" (S@mspill 2007. Elektronisk samarbeid i helse- og sosialsektoren) <sup>12</sup>	2004	The Ministry of Health Services and the Ministry of Social Affairs
" <i>e-Norway</i> " (e-Norge. Tilstandsrapport 2004) <sup>13</sup>	2004	The Ministry of Trade and Industry

<sup>11</sup> <http://www.teknologiradet.no/Articlearchive.aspx?m=49>

<sup>12</sup> [http://odin.dep.no/filarkiv/201735/ING-samspill\\_2007.pdf](http://odin.dep.no/filarkiv/201735/ING-samspill_2007.pdf)

<sup>13</sup> [http://odin.dep.no/filarkiv/211754/eNorge\\_tilstandsrapport\\_2004\\_web.pdf](http://odin.dep.no/filarkiv/211754/eNorge_tilstandsrapport_2004_web.pdf)

In “S@mspill 2007” the use of ICT is considered to be vital for quality and effectiveness in the health care sector and social services. Furthermore, according to “e-Norway” (e-norge) published by the Ministry of Trade and Industry in 2004 the benefits of using ICT in the health care sector could be substantial. In general, there seems to be a potential for innovation based on ICT in the health care sector, but there are no specific recommendations or strategy on how to realise this potential.

### *The use of ICT in the health care sector*

One of the relevant public initiatives is the ICT in Medicine and Health Care programme (IKTHELSE) from 2001-2005: The purpose of the programme was to contribute to improvements in the health care sector through the development and use of ICT-solutions and products based on existing and future user needs. Also, the programme was going to contribute to the development of competences and innovation in the Norwegian industry. The programme ended in 2005 and new health related ICT projects can be financed via the VERDIKT programme.

According to Jacob Hygen, Managing director of the Norwegian Centre for Informatics in the Health and Social Care, Norway by international comparison is quite advanced in its use of information technology in the health care sector (Hygen 2005). In this section we focus on four areas that are pointed out as important in publications on ICT in the health care sector: Electronic Health Records, Picture Archiving and Communications Systems (PACS), telemedicine and standardisation.

It is noteworthy that these four areas have been anchored in specific national research institutions, since this can be considered as a precondition for the development of core competences in the respective research areas.

#### *Electronic Health records and PACS*

With few exceptions, all GP's and private specialists in Norway have EHR systems, and 80 pct. of hospital patients are covered by EHR. Furthermore, 2/3 of the Norwegian hospitals have acquired PACS, and all the remaining hospitals are planning to implement PACS within 2005 (Hygen 2005).

According to the Programme Board of the IKTHELSE programme the electronic patient records constitute the biggest challenge in regard to the development and use of ICT in the Health Care

sector<sup>14</sup>. Thus, as a part of the IKTHELSE programme the University of Trondheim was given the assignment of establishing a centre for research on electronic health records in 2004

(<http://www.nsep.no/>).

### *Telemedicine*

Norway has a low population density and long travelling distances to hospitals or medical experts. This is one of the main reasons for Norway's focus on telemedicine. According to Hygen, operational solutions are in place in a variety of medical disciplines and care situations.

The Norwegian Centre for Telemedicine is the national resource organization for telemedicine in Norway (<http://www.telemed.no/>). The centre aims at providing research and consulting in telemedicine, and at promoting the introduction of telemedicine services in practice.

### *Standardisation*

In general, the use of IKT in the health care sector is supported and promoted by the Norwegian Centre for Informatics in Health and Social Care (KITH). This company is owned by the Ministry of Health and Care Services, the Ministry of Labour and Social Affairs, and The Norwegian Association of Local and Regional Authorities. Its main purpose is to contribute to coordinated and cost-efficient application of information technology in the Health and Social Care sector.

KITH has 5 focus areas: Codes and terminology, Electronic Information exchange, Information security, Electronic Health Record systems (EHR), and Digital imaging systems/ radiology. The centre is responsible for standardisation and coordination activities related to the five focus areas, and as an important part of its responsibilities, the centre operates a meta database, Volven, that contains coding, classifications, terminologies and definitions necessary for establishing a coherent communication infrastructure ([www.volven.no](http://www.volven.no)).

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<http://www.forskningsradet.no/servlet/ContentServer?pagename=ikthelse/Page/HovedSide&c=Page&cid=1088789296067>

## *Norway's position*

### *Electronic communication*

“xxx” (S@mspill 2007) published by The Ministry of Health Services and the Ministry of Social Affairs is a strategy focused on IT development in the national health care and social services. The key word in the strategy is electronic communication (elektronisk samarbeid), and two main priorities are to 1) consolidate existing systems of electronic communication such as electronic patient journals, and 2) increase the number of actors participating in the National Health Net (NHN) so that the net includes pharmacies and the local health and social services. The NHN is operated by Norsk Helsenett A/S ([www.norsk-helsenett.no](http://www.norsk-helsenett.no)) – a company established in 2004 and owned by the five regional health authorities (regionale helseforetak).

### *Smart house technology*

In a report from 2000, “The Norwegian Board of Technology’s scenario workshop on elderly people and ICT in health care services” (Teknologirådets scenarieverksted om Eldre og omsorgsteknologi), the increased use of ICT in the health sector can improve quality of life of elderly people and people with dementia and increase the efficiency in the delivery of health care service.

ICT in health care services is defined as integrated ICT-components (smart house technology) such as external monitoring of kitchen stoves or active and passive alarms in homes that are connected directly to health care personnel. The costs of installation and the possibility of installing the smart house technology in existing buildings is considered to be vital for an increased use of the smart house technology.

A multitude of technological, demographic, economic, political and attitudinal drivers influence the future use of smart house technology in the homes of elderly people and people with dementia.

The following technological drivers are identified:

- Profitable technology
- Increased ICT-access in private homes and public areas
- New functionalities such as voice recognition instead of keyboard

- User friendly ICT in the elder service
- Telemedicine (cost effective; improved access to health care services]

The report emphasises the need to include the users in the development of ICT solutions, the need to develop technical standards and user friendly technology, and the possibility of health care workers to use portable PCs that are connected to the administration. However, the technological aspects, focus areas and industrial potentials are not taken into consideration.

## ***Production Economy***

### ***Definition and general perception of the area***

ICT is considered to be a key input to productivity and growth, but according to the OECD Norwegian enterprises do not make sufficient use of technology to realise potential productivity gains (OECD 2003; OECD 2004). In fact, the full use of ICT in business lags, particular in broad sections of manufacturing even though the public administration in Norway is ICT intensive (OECD 2004: 18). This situation is in part a reflection of a governmental ICT strategy that seeks to use ICT up-take in the public administration as a driving force in the development of Norway's information society.

However, the need for initiatives that promote ICT-based value creation in the private sector has been recognised. One of the recent initiatives is the BIT programme managed by Innovation Norway<sup>15</sup>. The BIT programme is aimed at improving the competitiveness of SMEs and promoting innovation through the development, diffusion and effective use of ICT<sup>16</sup>. Moreover, innovation and growth in business and industry is one of the three target areas in “*e-Norway 2009 – the digital leap*” published in 2005 by the Ministry of Modernization. According to this strategy the active exploitation of information technology is an important precondition for strengthening Norway's competitive edge.

The following initiatives are mentioned in the strategy:

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<sup>15</sup> Innovation Norway promotes nationwide industrial development, and helps release the potential of different districts and regions by contributing towards innovation, internationalisation and promotion.

<sup>16</sup> [http://www1-invanor.no1.asap-asp.net/templates/TjenesteGroupPage\\_55031.aspx](http://www1-invanor.no1.asap-asp.net/templates/TjenesteGroupPage_55031.aspx) (23 January 2006).

- Developing the electronic gateway (Altinn.no) for business and industry to the public sector
- Providing new opportunities for increased use of electronic procurement and e-commerce in the public sector. An action plan for e-commerce containing initiatives aimed at strengthening the competitive edge of Norwegian business and industry will be prepared.
- Developing skills initiatives linked to e-business operations
- Developing and promoting electronic services in the transport sector (ARKTRANS)

### *Norway's position*

As mentioned in the introduction four out of the five Norwegian foresights do not explicitly address the role of ICT. However, according to the foresight on biotechnology converging technologies such as ICT and nanotechnology have to receive special attention due to the potential developments in these areas. Also, in the foresight on aquaculture it is stated that new technologies such as biotechnology, ICT, materials technology and nanotechnology may have a great impact on the further development of the industry. The foresight points to the current use of ICT in measuring biomass, logistics and in quality control as good examples of the use of advanced ICT in Norwegian aquaculture (p. 30).

In conclusion, the importance of ICT is recognized in both of the foresights, but there are neither any recommendations on how to promote the use of ICT nor any indications of the national strengths and weaknesses in relation to the use of ICT in these areas.

### *The use of ICT in the transport industry*

In the report “*ICT in the transport industry*” (Initiering af IKT-samarbeid i transportnæringen) published in 2001 by the Ministry of Transport and Communications<sup>17</sup> the implementation of ICT in the industries and the society is considered to be an opportunity for the transport industry to improve services, improve coordination and ensure cost-effective use of resources.

The development of an electronic infrastructure for the transport industry through the ARKTRANS project managed by the Research Council of Norway and SINTEF [uddyb samt link] is a precondition for the coordinated ICT-development in the transport industry. But the development

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<sup>17</sup> [http://odin.dep.no/filarkiv/147048/IKT\\_i\\_transport\\_-\\_rapport.pdf](http://odin.dep.no/filarkiv/147048/IKT_i_transport_-_rapport.pdf) (date).



has to be supported by the development of ICT skills and promoting ICT up-take in the transport industry.

In general, the transport industry has to focus on and prepare for the development of new mobile functionalities such as e-money and e-tickets (p. 26). The airline company Braathens is a good example of the successful use of ICT in the transport industry. In 2001 the company won the first prize in a global [kåring] of the best electronic solutions to the reservation of tickets via mobile phones.

## ***Experience Economy***

### ***Definition and general perception of the area***

In Norway the term 'experience economy' is usually associated with 'kulturnæringene' – the creative industries. In a report published in 2004 by Østlandsforskning on behalf of the Ministry of Trade and Industry, the creative industries are defined as industries in which the most important characteristic of a product is its communicative qualities. Thus, the creative industries include advertising, architecture, publishing (books, newspapers and magazines), design, film, photo, video, music, performing arts, television and radio, libraries and museums.

According to the report by Østlandsforskning the creative industries are characterised by:

- A significant potential for value creation
- Innovation and learning
- The ability to contribute to the attractiveness of a given location

These characteristics place the creative industries in an important position in the Norwegian economy. Furthermore, the creative industries present a significant potential for economic growth and innovation. In regard to the use of ICT the report states that new technology moves the creative industry closer to the information industry and the development of multimedia products (p. 61). But the report does not mention any potential benefits of using and developing ICT in relation to the creative industry.

Although the travel and tourism sector is not part of the creative industries as defined above, it is usually included in studies on the experience economy. In an action plan for the travel and tourism industry published in 2005 by the Ministry of Trade and Industry information technology is considered to be important to the travel and tourism industry since it enables information to be communicated swiftly and efficiently. Furthermore, IT can generate efficiency gains in all stages of production. Specific initiatives in the action plan include financial support to projects aimed at promoting the development and the utilisation of new technology in the travel and tourism industry<sup>18</sup>.

### *Norway's position*

In regard to the travel and tourism sector, the use of ICT is considered to be a means rather than a goal. There are on the other hand potential benefits of using ICT in the creative industries that are not merely related to efficiency gains. These are emphasised in the communication "*Culture and Industry*" (Kultur og Næring) published in 2005 by the Ministry of Culture and Church Affairs<sup>19</sup>. The communication emphasises ICT development as a driver for the development of new products, new ways of communicating and new methods. One example is Produksjonsnettverket for Elektronisk Kunst (PNEK) – a national network for electronic art that...[uddyb]. Also, the industry uses products and ideas originating in the cultural sector and gives it a commercial platform (p.27).

According to the communication the preservation of - and access to Norway's cultural heritage is promoting creativity and innovation. The new ways of interpreting and presenting the cultural heritage can promote the creation of creative alliances between suppliers of technology and cultural institutions that in turn develop new and original ICT-based services and products (p. 112).

However, in general the specific national strengths and weaknesses in regard to using and developing ICT in the creative industries are not identified.

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<sup>18</sup> <http://www.odin.dep.no/nhd/english/doc/plans/024151-220004/dok-bn.html> (23 January 2006)

<sup>19</sup> <http://odin.dep.no/filarkiv/241944/STM0405022-TS.pdf> (23 January 2006)

## Conclusions

- 1) ICT is considered to be the key to innovation in the health sector, the production economy and the experience economy, while the role of ICT in regard to IT-security is not elaborated.
- 2) In general, there is a lack of strategic direction in regards to the future use and development of ICT in these four sectors.
- 3) The foresight on ICT research in Norway provides a roadmap for future ICT research by identifying strengths, weaknesses, opportunities and threats. According to the foresight Norway has strong competences in research areas that are relevant for the future wireless market.

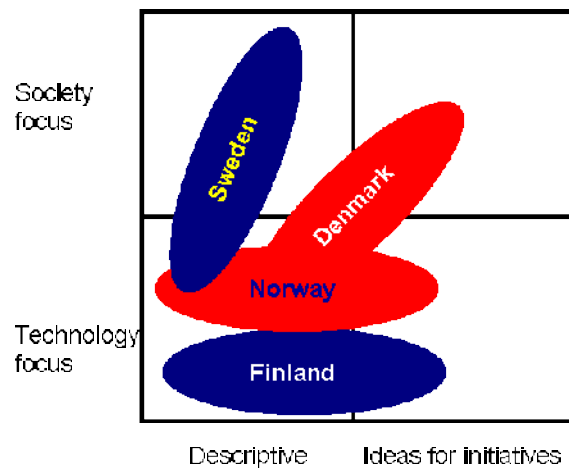
## Reflection on the Nordic position within the four areas

### ***The scope and scale of “foresighted” activities within the four Nordic countries***

The four country studies quite clearly illustrates that there are significant differences, in scope, scale and goals for foresight activities in the Nordic countries. Since foresights are the primary source of information for descriptions of the Nordic countries positions in ICT in the four focus areas, this means that clear comparisons between the different countries may be difficult. More specifically the differences in approach may be described using the following parameters.

**Society focus:** A focus on socio-ecomominal drivers of changes and challenges that are directly or indirectly linked to the opportunities of new technology.

**Technology focus:** Descriptions of key technologies and how these may develop in the future.



**Descriptive:** A focus on well defined descriptions of dilemmas and opportunities.

**Ideas for initiatives:** A report structure where lead to recommendations for political action within the innovation system

Naturally these four focus areas are not mutually exclusive, and indeed may of the publications entail all four elements. But when total amount of material available is analysed it is possible to identify the difference in approaches made by the Nordic countries and illustrate the as done in fig?

## ***Healthcare***

Reports from all four countries identify trends such as the aging society, individualisation and “user orientation” and the need to increase efficiency as important drivers for implementation of ICT in the healthcare sector. The use of ICT is therefore closely tied to a vision of a service oriented cost efficient health care system that is able to put the user in the centre.

All countries rank high on one or more areas of e-health and generally speaking both healthcare systems and ICT infrastructure is described as well developed in all four countries. This means that the structural conditions for a strong development in e-health are in place. In Finland little information available in English, but the material available indicates that Finland has a very strong focus on ICT in healthcare and that the future development of bioinformatics is a focal area for Finland.

In Denmark, the material available conveys a strong belief that the Danish healthcare sector and ICT industry are strong in the areas of ICT in medico equipment, the development of sensor technologies, and electronic health records. In Norway and Sweden telemedicine and electronic health journals are identified as the major strengths and future focus areas.

There are few concrete visions or suggestions for initiatives related directly to the suggested focus areas.

## ***The experience economy***

There is common perception that the creative industries that belong to the experience economy are important. All Nordic countries identifies strong positions in the experience economy and the underlying rationale is that these positions should be nourished since they deliver great value (economically and culturally) to society and are relatively hard to copy and/or off-shore.

Much of Finland’s focus on the experience economy is related to mobile technologies, where a range of new applications and location based and context aware services are expected to broaden

the scope and scale for the use of mobile technologies. Marketing and entertainment is identified as the most important areas.

In the Swedish and Danish material it is argued that the countries are strong in areas such as music, design, games and TV and film production and that significant synergies with ICT should be expected and pursued in these areas. On the other hand there is a fear that much of the future development of ICT and the experience economy may be located in the US, so initiatives should be cautious and well thought through in a long term perspective.

Reports from Norway also recognise the importance of the experience economy from a cultural and economic perspective and identify it as an important sector in Norway. But in the material available there are no links made between ICT and the experience economy except from the possibilities to use ICT in relation to tourism.

In a Nordic perspective then, the experience economy in itself is identified as a very important sector, but the role of ICT in relation to the sector is not analysed and discussed in the same thorough manner as the health care sector and traditional industry. One explanation for this could be due to the fact that the experience economy isn't under the same kinds of pressure for change as the health care and traditional industry. Another explanation may be that the potential benefits and new product form a lesser part of total turnover and value in the experience economy as it does in the traditional industry and the health care industry.

### ***Traditional production industry***

All the Nordic countries share the same understanding of the pressure and opportunities on their traditional industries created by globalisation and developments in ICT. And all four countries identifies ICT at the centre of their strategies to keep traditional industries competitive. Since the Historically Nordic countries are strong in different industrial areas the strengths form and industry perspectives differs mildly from country to country. But from an ICT and strategic perspective many of the insights and visions for the future are the same.

Basically the ability to combine efficiency and flexibility for complex industrial products and production processes are at the heart of the visions for the use of ICT in the traditional industry.

In relation to this vision Denmark identifies its most promising areas of ICT strengths as software for production planning and control, sensor technologies and wireless technologies.

Finland's focus is on mobile and wireless infra structure and set-up in geographically disperse production units. Sweden has a strong focus on complex production systems while Norway has a strong focus on the special challenges related to SME's.

## **Security**

IT and security may be defined and discussed in many different ways. Based on the current material two different definitions are predominant. IT security may be defined as security related to the threats related to misuse of ICT such as viruses, spam and phishing (in the following we will term this (systems security). Or IT security may be related to the use of ICT in security applications and systems ranging from home security and alarm systems to modern weapons and defence systems. Quite clearly these two definitions are very different and this is also reflected in the material available (in the following we will term this "networked security).

Material from all four countries puts Systems security high on the ICT agenda since lack of security may become a severe barrier for development of new ICT applications and markets within consumer and business segments. As such Systems security is not viewed as a strategic area of development (seen in business perspective) but rather as a prerequisite for the future development of the information society. Consequently few ICT related strengths are identified in relation to systems security, instead a range of socio-cultural factors are identified as means to strengthen citizens and business focus and understanding of the importance of ICT security.

Networked security is only explicitly addressed in material from Sweden, where it is highlighted as a very important area in which Sweden has significant strengths and opportunities due to its strong tele-industry and security and defence industry. Given the nature of the subject the fact that no material is available publicly does not necessarily mean that any other of the three Nordic countries

aren't interested in the subject and/or has companies and research communities focussing on the area.

### ***Synergies and complementary areas***

Seen from an ICT perspective mobile/wireless technologies are central in all four countries when strengths and opportunities are identified. Furthermore the wireless technologies (and sensor technologies) are deemed as important in relation to all four focal areas. The mobile/wireless would therefore seem as an obvious choice for an enhanced focus and strengthening of Nordic ambitions for development.

Of the four focus areas it seems as if there are significant synergies between the four countries initiatives within e-health and production systems. In relation to the experience economy the area as such is identified as important in all four countries but the role of ICT and opportunities related to ICT is predominantly positively reviewed in the material from Denmark and Finland. ICT systems security is identified as important in all four countries but not described as an area of strength or opportunity seen from a R&D or business perspective. Networked defence is only described in the Swedish material. Wireless/mobile and sensor technologies is central in this application area it would seem advisable to investigate the opportunities for a Nordic focus on this area further.

### ***Prioritisation of the focus areas.***

Especially in the latest round of the Swedish foresight there is a focus on the theme of strategic choices made on a holistic basis rather than a "restricted" technological and/or economical basis. The underlying line of thought is that the increasing global competition on the knowledge intensive sectors means that small countries like the Nordic countries can't allow themselves to compete in too many areas since they lack human and economic resources. On the other hand the development of knowledge and technology becomes increasingly important as low skilled work labour intensive is being off-shored or near-shored to low cost regions.



So the strategic choices are not just questions of more or less technology and research. Since it is the general model of society that is brought under pressure by globalisation and cultural and demographic trends, and it is in the light of this that opportunities and threats must be analysed and choices must be made.

In this sense choices related to national R&D strategies and use of technology is moved from a strictly technological realm to a discourse where the choices are related to societal and cultural values. This makes the choices more politicised, since the choices are linked directly to the visions of the future societal models. So, to sum up: Although there may be several interesting areas identified within the different foresights in the different Nordic countries a narrow and dedicated focus to a few areas would seem to be a better idea than a broader perspective. The actual choice of areas must be made with an understanding of their more general implications for society as such.

This line of thought is not something that is reflected much in the material from the other Nordic countries, but current work and political processes indicates that the same reflections are being made in all Nordic countries (e.g. the work of “Globalisaeringsrådet” in Denmark and the work of VEIVALG” in Norway). While the Swedish round of foresight should be recognised for this more profound and holistic approach to foresights one should also recognise the danger of this approach, which could be that the amount of information to consider makes may slow down the processes of choice and implementation significantly.

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