



Education Intelligence

Networking makes the Knowledge
Society strong

Final Report



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Final Report 2006

Key results

This Final Report on the Education Intelligence Project seeks to provide a vision of the future business environment, products and services, labour market and the competences required by companies operating in six industrial and construction sectors in the year 2015. At the same time, ideas are put forward for developing the Finnish educational system to meet the needs of the business life. What are the most important lessons learnt from this multi-year project?

Why should we anticipate future developments?

We are in a position to influence the future and by making the right choices, we can turn opportunities into reality. Anticipation helps maintain confidence in the future despite that fact that various threats are posed by new weapons of mass destruction making use of the latest technology, mankind is torn by conflicts of interest, and we have a tendency to stare into the rear view mirror instead of looking ahead. Steps should also be taken to fend off risks.

You get what you measure

The toughest task is questioning the existing conventional truths. We also have to re-evaluate the definitions, targets and indicators used in the efforts to anticipate future developments. When we want to foresee the necessary prerequisites for maintaining the standard of living in Finland as high as possible, the whole concept needs to be re-defined. For society, a high standard of living means a happy balance between social capital, environmental protection and economic success. For the individual, it means self-expression, advancement, human relationships, civic engagement, health, and peace of mind.

Multifaceted Finland of the future

Parallel truths are becoming increasingly common. Cultural and ethnic trends will crisscross and interact with increasing intensity. Straightforward life paths, such as long careers in the service of the same employer, will be rare. The workplace environment and

duties will become increasingly international for everybody. The qualities we are required to acquire is respect for others, knowledge of others cultures and versatile interpersonal skills to promote a genuine dialogue and argumentation.

Sustainable development of increasing importance

Concerns over climate change are steadily growing. Concepts such as sustainable development, awareness and responsibility are no longer just idealism or dissident rebellion. Successful businesses will consume less energy and other natural resources. A responsible way of doing business means assuring long-term profitability and competitiveness. Non-sustainable development will jeopardize economic growth in poor countries. At the same time, if the inequality between the rich and the poor is allowed to aggravate, the well-being of the affluent will be risked as well. Human resources will also be protected. The pressures exerted by performance objectives and related indicators will be evaluated. While stress can be beneficial, it will, if excessive, undermine productivity.

How to develop our capacity for innovation

The trend is from technological to social innovations and open innovation environments. People have a desire and opportunity to participate in their own lives and shape their living conditions, including the products and services they use. Solutions to individual needs are searched collaboratively. We need to create a culture and practices for involving an increasing number of people in the innovation process.

At the same time, innovation implies great responsibility. A strong ethical position is required as, for example, the capacity for overcoming diseases and improving qualities through genetic engineering increases, and medicines affecting the brain functions and other technological methods for improving man's performance become available (biomechanic man). The role of the central government will undergo a change as new international standards are required.

What constitutes a technology of the future?

The technology of the future will be embedded as part of our immediate environment to the extent that we do not necessarily notice it. Great hopes are pinned on what is known as the key technologies of the future: information and communications, biotechnology, materials, nanotechnology, and environmental technology. The visions of what the new technologies can ultimately achieve are breathtaking – and partly beyond comprehension in the light of what we know today. In the final analysis, however, technology is only a facilitator, not an end objective in itself.

Technology can promote economic growth and general welfare. The real challenge, however, lies in how smoothly technology can be adapted to society and man and made to respond to their customs and needs. What will be highlighted in future technologies is new materials, interaction and functionality. We will no longer use or consume technology, we will create and live with it. People want to make use of the diversity of products, services and distribution channels available. Customization will become increasingly common. Products will be left partially unfinished to allow the customer to shape them to suit his or her needs, a process that will be facilitated by IT networks and digitalization.

What will a successful cluster be like?

We are living on the threshold of the era of connectivity. We have moved on to an age where the main focus lies on man and interpersonal relations. Instead of the information society, Education Intelligence uses the concept of a conscious network society. Knowledge acquires a new meaning when it benefits mankind. There will be a trend away from specific solutions towards the perception of the big picture and continual development of processes and systems. The successful cluster of the future will engender social innovations that will alter the ways that society works and transform its structures. The cluster produces system innovations where the “product” consists of a new way of life and life-enhancing experiences, such as health-promoting products and services, smooth production processes, minimization of risk, communications, learning, and a pleasant and safe environment.

What resources will the successful cluster of the future need?

The successful clusters of the future will be built around creative people. Creativity aside, other success factors will be entrepreneurship, daring and sound self-

regard. Social entrepreneurship will increase as well. Companies will be established to offer products and services that promote sustainable development while at the same time making a profit, giving work, investing and growing.

Design, in a broad sense of the word, will play an important part in the success stories of the future. As a corporate strategic asset, design will improve process efficiency and productivity. Prime examples of this are offered by the hospital environment where careful design of the instruments and premises alleviate the fear and resistance to treatment exhibited by patients. As a result, treatment becomes more efficient and a greater number of patients can be taken care of. (Green 20 Sept 2006.)

Different roles, shared mission

Future companies will employ experts whose duties will focus on doing (implementers), applying the expertise in response to customer needs (applicers), or on developing and creating something new (seers). An improvement in the general standard of competence will make it possible to expand the range of duties, which will gradually lead to the blurring of the boundaries between individual occupational categories. The creation of new things will be based on the sharing, joint development and perfection of own competence.

Companies need to strike a happy balance between specialists and “amalgamators” who combine individual strains of competence. Even specialists will be required to have the ability to evaluate issues from a variety of angles. Amalgamators are people who fuse specific competences creatively.

Increasingly, new things are generated at the various interfaces within multidisciplinary networks. Trust between the individual parties is a necessary prerequisite for fruitful cooperation. The challenge is to find a common “language” and ways of working that can be shared by the individual experts who all perceive the world differently.

Leadership to support creativity

Of increasing importance to the success of companies will be the ability to create new products, services, operations models, organisational structures, and strategic approaches. The biggest challenge is to motivate experts to channel their creativity to serve the corporate ends. What is required is inspiring leadership and a workplace community in which people support and value one another. Creativity needs time.

Business competence manifests itself in the continual development of the company. People management is one of the core areas of business competence. It is imperative to set ambitious goals that are inspiring to experts. A top priority is to maintain people's motivation to learn and renew themselves.

Forces for change at work in the educational system

The specific dimensions of competence (knowledge, skills, values, attitudes, networks, and quality) constitute the very foundation of competitiveness and welfare. In the future, the evolution and harnessing of human resources will become far more complex than it is today. An expanding market with national and international players will evolve for developing competence. A whole range of completely new learning solutions will emerge with ubiquitous technologies supporting learning interactively at work, in the free time, and within the educational system.

Diversified network for lifelong learning

While the education system will retain its central role in supporting learning, knowledge will be acquired and competencies built up in other ways as well. Technology will be harnessed to serve the learning process in the context of learning, occupational and free-time environments that combine virtuality with personal interaction. Learning must be free from the constraints of time and space.

Profiled services to meet individual needs

Organisations that add value to learning must raise their profile locally, nationally, and internationally. A system conducive to learning will be created in collaboration between networked parties with a solid track record of performance and efficiency. For services, a framework resulting from anticipated needs of the labour market has been created but practical implementation will be carried out with due regard to individual requirements. The learner can choose the way in which the learning profile is shaped: at work, in classroom training or as a member of a virtual community bringing together participants from all over the world. Points will be accumulated in a personal competence record as proof of the qualifications gained in various ways.

New role for teachers

The educational system will continue to rely on the excellent professional qualifications of the teachers. The importance of supporting the learning process and personal guidance will be highlighted. Virtual and other IT-based tools will free the teacher's resources to individuality and creativity. The teacher can be a network partner working much like an entrepreneur. The teacher, learner and other parties adding value to the education process will together draw up the new roadmaps for learning.

Strategic competence management

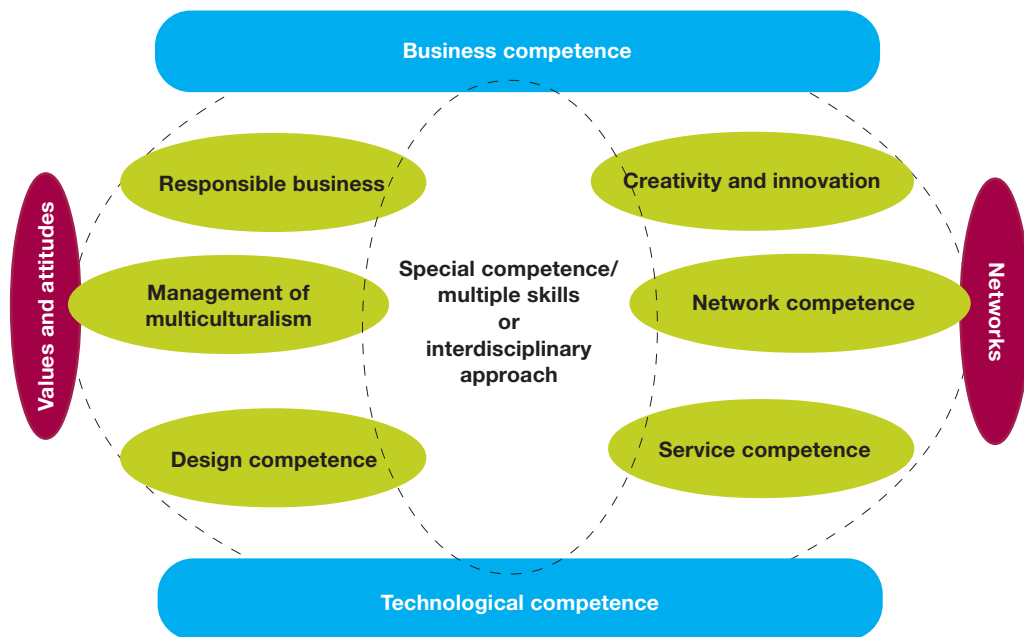
A new type of strategic management is called for to outline new learning solutions. In an intensely developing field, partner networks are indispensable for fusing existing knowledge and creating new expertise. Such networks are dynamic, evolving systems in which the roles of the players involve a certain degree of uncertainty. Trust is required. It can be generated if the network is capable of outlining a credible perception of future trends and succeeds in shaping an attractive vision and development agenda for the future. We need to think who the customers are, what the product and services are, what is the value and significance they offer to customers, and what solutions are required for fulfilling the value expectations.

How should the anticipation skills be developed?

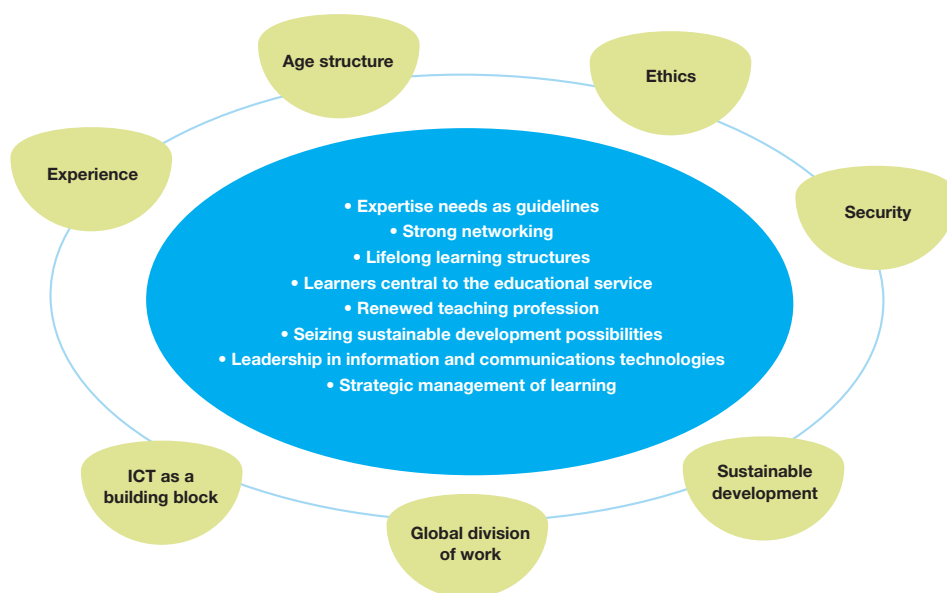
Anticipation is a communal effort to shape the future, and this effort should be as extensive as possible in order to involve citizens of all ages and to draw upon their wide range of competence. In the course of this project, a specific model called the Education Intelligence System (EIS) was created to allow more efficient use of the various indicator systems. The model needs to be tested as part of the overall anticipation framework.

The various opportunities arising in the future and their effects should be described in as unambiguous and simple terms as possible. For example, the capabilities for visualising various scenarios of the future should be enhanced. As well as artists, we also have to draw upon the knowledge of philosophers because the need to question existing truths and explore various options is so pressing. At the same time, the ability to understand diversity and accept several parallel truths is a challenge that every citizen will have face in the future.

Competences contributing to corporate competitiveness



Change drivers and the educational system



Preface

Education Intelligence is a long-term forward-looking anticipation project carried out by the Confederation of Finnish Industries EK. It seeks to anticipate the changes in the operating environment of industrial and construction-based clusters and the impact of such changes on the competence and training needs in the year 2015. The objective is to influence education policies and planning to ensure that companies will have access to qualified labour in sufficient quantities. Aside from the Confederation of Finnish Industries, funding for the project was provided by the Finnish Ministry of Education and the European Social Fund. At the same time, the input of corporate representatives and network partners in terms of time has been significant.

The pilot phase of Education Intelligence was carried out in 2001–2003, followed by a three-year follow-up project launched in August 2003. This is the final report on the follow-up project completed towards the end of 2006. The report presents views of the future labour market, companies and the required competences and makes proposals for developing training and education. Education Intelligence was implemented side by side with another anticipatory project of the Confederation of Finnish Industries EK called Services 2020, which focuses on the private service sectors.

The efforts to anticipate future developments will continue even after the completion of the Education

Intelligence and Services 2020 projects. A substantial body of data on competence needs and the development of the educational system was accumulated in the course of the projects. Based on the experiences gained in the process, it is advisable to expand the anticipatory approach to describing the changes in the business environment for industry, construction and services. An evaluation of the common interfaces between individual sectors is of increasing importance. At the same time, cooperation between the players generating data for the anticipation of future developments needs to be intensified.

The Education Intelligence project was headed by Senior Adviser Marita Aho and Project Coordinator Satu Ågren of the Confederation of Finnish Industries EK. Additionally, Ms Kirsi Juva, student of political science, was involved in writing the report. Chapter 7 of the report was authored by Professor Pirjo Ståhle.

On behalf of the Steering Group of the Education Intelligence project, I wish to extend my warmest thanks to the various advisers representing the anticipatory network as well as the numerous other experts involved in the project for their efforts to achieve the common objective.

Helsinki, 23.3.2007

Markku Koponen
Steering Group Chairman

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1 Introduction

Education Intelligence is a long-term forward-looking anticipation project carried out by the Confederation of Finnish Industries EK. It seeks to anticipate the competence and training needs of industrial and construction-based companies in the year 2015. Another objective is to promote networking between the various parties involved in the anticipation work. A third goal is to master the interactive process related to the utilisation of prediction methods and the creation of anticipatory content.

Education Intelligence – a two-phased process

Education Intelligence was launched in 2001 by initiating a pilot project. In the course of the pilot phase completed in the spring of 2003, a vision was created of Finland as a competence-intensive, dynamic and globally competitive country with well-functioning social services.

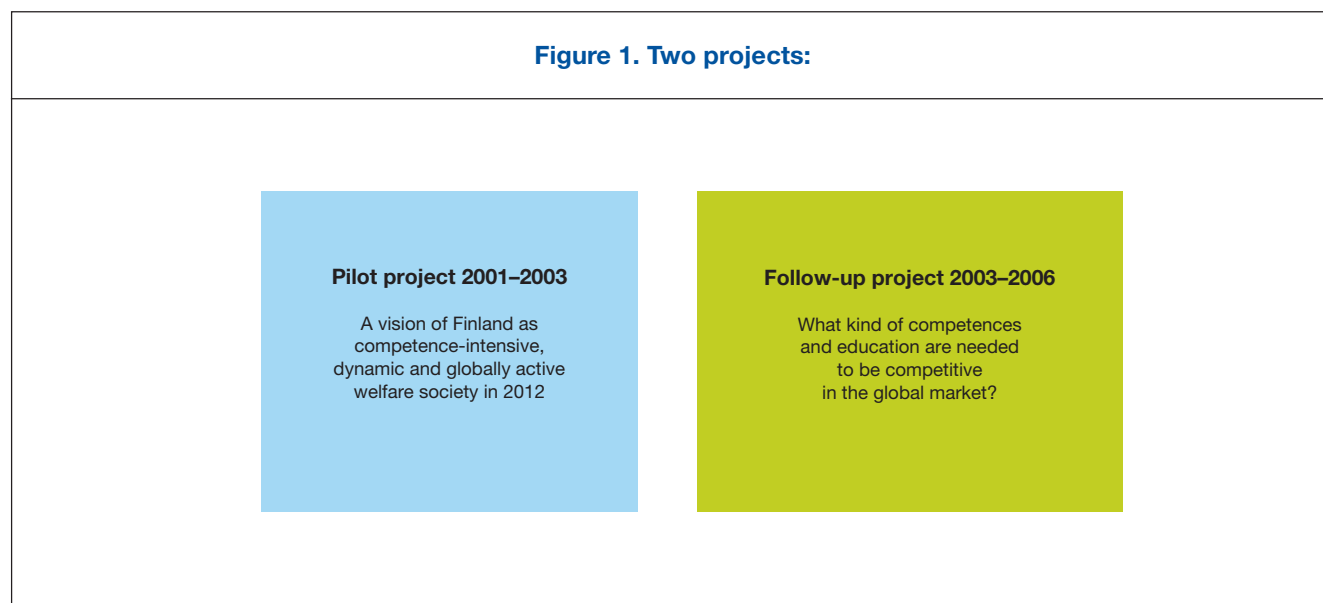
In the autumn of 2003, a three-year follow-up project was launched that focused on identifying the competences that would improve the competitiveness of companies. While competence needs were anticipated primarily from a broad business standpoint, the tool selected for the follow-up project was the

cluster approach. The following clusters were selected for evaluation: well-being, ICT, chemistry and biotechnology, forestry, construction, infrastructure and real estate, and SKIP (Service and Knowledge Intensive Products) (mechanical engineering and mechatronics branches of the Technology Industries of Finland).

Anticipatory work was based on the recognition of changes in the operating environment and identification of future opportunities. To serve as a basis for the evaluation of future competence and educational needs, ideas were generated for business, service and product concepts that Finland could introduce to the global economy. The thinking was that by correct choices and right decisions it would be possible to forge a new reality.

A cluster is understood as a pool of suppliers, producers, customers and competitors, which promotes efficiency, increases specialisation and provides a competitive advantage. A cluster is a network of networks in which competition and cooperation co-exist.

Figure 1. Two projects:



Network of advisers representing various sectors

The project to anticipate and evaluate future developments was carried out in collaboration with a network of experts representing a wide range of parties, such as companies, training and research organisations, the educational, employment, business and regional administration as well as the Confederation of Finnish Industries and its affiliated organisations.

The members of the Education Intelligence network convened regularly to work and exchange views – in short, to learn together. A number of seminars and workshops on a range of themes were held in the course of the project. One of the objectives of these events was to help the network parties to establish contacts with international partners involved in similar endeavours. To this end, field trips were made to France, the United States, and UK. Additionally, the network had access to a dedicated website for teleworking purposes.

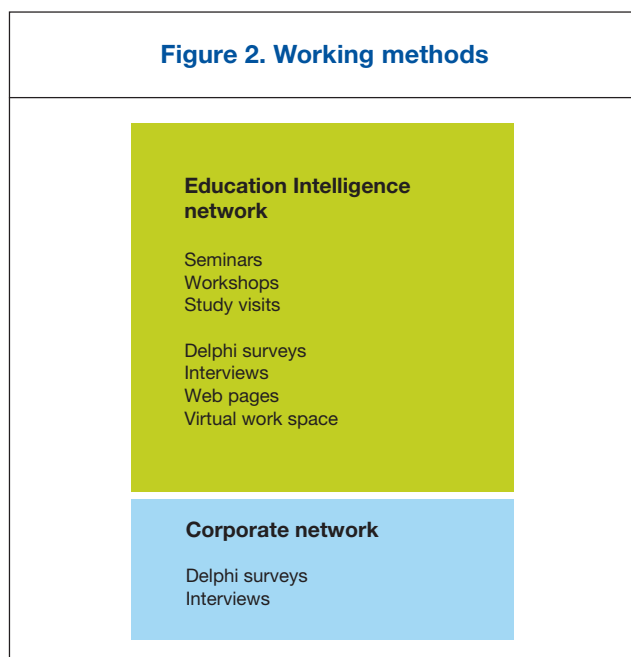
The views of the Education Intelligence network have been supplemented by corporate networks whose representatives took part in the Delphi surveys and interviews completed in the course of the project.

Four interim reports and final report

The visionary knowledge accumulated during the Education Intelligence process has been summarized in the following four interim reports and this final report:

- [Success Clusters Today and in 2015. Facts and Visions to Support Anticipating Competence \(2004\)](#) provides a description of the current status of EI clusters and seeks to foresee changes in the operating environment.
- [Technology and Innovative Business – Competence Needs Required for Success \(2005\)](#) provides a description of key future technologies and the competence needs related to the development and harnessing of technology.
- [Views on Challenges Posed by Globalization and Business Competence \(2005\)](#) provides a description of the challenges associated with globalization and business competence in connection with a study trip to the United States in the spring of 2005.
- [Education Intelligence System. Education Intelligence System \(2006\)](#) is a description of the EIS tool developed for the purpose of anticipating competence and educational needs.
- [Networking for Enhanced Competence](#) provides visions of the labour market, business activities and competence needs up to the year 2015. The report discusses ideas for developing the Finnish educational system in order to ensure that it will be able to respond to the needs of business in the increasing complex operating environment.

Figure 2. Working methods

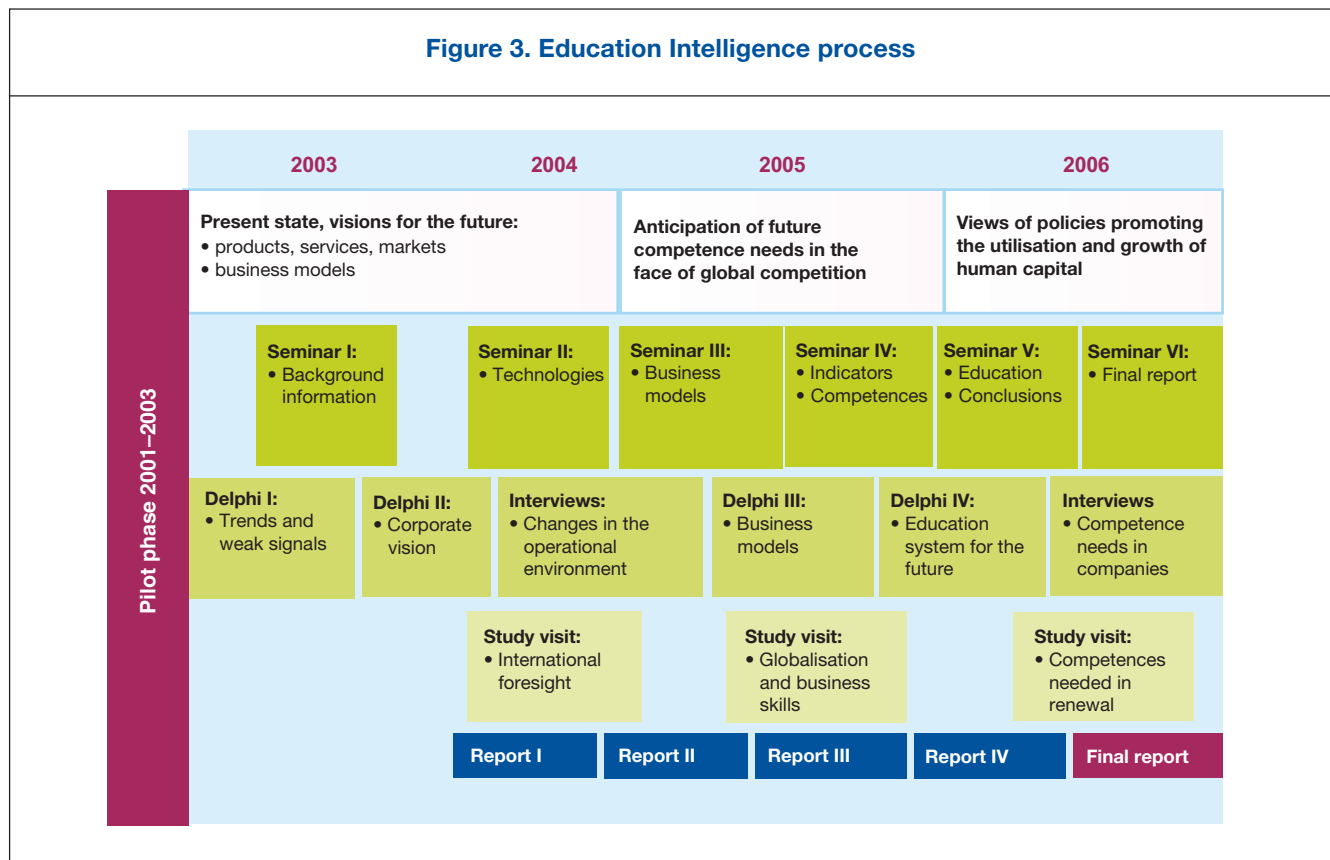


Services 2020 – anticipation of competence needs in the service sectors

Simultaneously with the Education Intelligence project, the Confederation of Finnish Industries EK is engaged in another long-term anticipatory project – Services 2020. It focuses on the following private service sectors: retail and wholesale trade, real estate services, social welfare services, health care services, accommodation and catering services, IT services, as well as financing and insurance.

The projects launched by the Confederation have been carried out in close interaction. The two projects help foresee the type of future business opportunities available to companies operating in Finland and identify the competences and education required of them to be competitive on the international market.

Figure 3. Education Intelligence process



2 Objectives, contents and methodology

This document is the final report on the three-year follow-up project included in the Education Intelligence programme. It seeks to provide visions of future labour markets and companies and the competences required by them. At the same time, ideas are put forward for developing the Finnish educational system to meet the needs of the business life. A third objective is to present a model for using statistical indicators for the purpose of anticipating the competences required in the labour market.

First, the report will give a brief overview of the clusters evaluated in the project. The introduction will be followed by the visions, created by the Education Intelligence network, as to what organisational and business models will be adopted by Finnish businesses, what the Finnish companies operating in the international market will look like, and what the employees and the labour market will be like in 2015. The visions are based on the two-phased Delphi survey and team work efforts. In the Delphi method, future developments are evaluated by selected individuals deemed to be experts in the field.

Chapter 5 discusses the critical competence needs that companies have to satisfy in order to secure competitiveness. To this end, experts representing a range of organisations were interviewed. The idea was that they would give free reign to their imagination in

an attempt to visualise the type of competences required in working life in the future. Based on the interviews, descriptions of competences were created and scenarios prepared for the individual clusters and the experts to be employed in the various occupational categories.

After the competence descriptions, the report goes on to discuss views as to how the educational system should be developed to respond to corporate needs. The ideas are based on a panel discussion held in connection with a seminar in early 2006 and the results of the Delphi survey carried out to explore the challenges facing the school system.

Finally, the report gives a presentation of a method for anticipating competence needs developed by Professor Pirjo Stähle known as the “Education Intelligence System (EIS)”.

3 Six clusters selected for evaluation

The following clusters were evaluated in the course of the Education Intelligence project:

- Well-being
- ICT
- Chemistry and biotechnology
- Forestry
- Construction, real estate and infrastructure
- Service and Knowledge Intensive Products SKIP (mechanical engineering and mechatronics branches of the Technology Industries of Finland).

This chapter will provide a brief presentation of each cluster and outline their future trends and innovation and business opportunities by means of examples.

3.1 ICT

ICT (Information and Communications Technology) includes the ICT industry, service production, content production, and data communications.

So far full use has not been made of the opportunities offered by ICT, suggesting that this technology will expand significantly in terms of usage and applications. At the same time, ICT technologies will increasingly become part of daily working life and the whole living environment. Table 1 gives a summary of the ICT cluster customers and closely related fields of activity.

Table 1. Key areas for ICT-based products and services
<ul style="list-style-type: none"> • Personal communications • Business processes, new operating methods, productivity • Expert work • System integration, electronic transactions, Information and other products • Well-being, health, culture, entertainment, learning • Embedded intelligence • Digital IPR products and services
Source: TEKES (adapted)

Table 2. ICT sector customer and related sectors and key areas for ICT-based products and services	
ICT Sector customer and related fields	
Production companies <ul style="list-style-type: none"> • Global networking, productivity • Service operations • Bio-, ICT-, metal, forest, paper industry, energy production 	Service providers <ul style="list-style-type: none"> • ICT services • Digital services • ICT as facilitator (network services, etc.) • Real estate business • Finance and insurance • Trade and logistics • Health care
Public sector <ul style="list-style-type: none"> • New public and private sector operating models • Health care, social welfare services, education, administration and research 	Individuals, groups and households <ul style="list-style-type: none"> • Health and well-being • Experiences, recreation and hobbies • Groups, entertainment and games • Safety products
Lähde: Tekes, mukaillen	

The key areas for ICT-based products and services include the following (Tekes 2005):

- Personal communications
- Business processes, new operating methods, productivity
- Expert work
- System integration, electronic transactions, information and other security products
- Well-being, health, entertainment, culture, learning
- Embedded intelligence

One of the most distinctive trends in the ICT cluster is the improved ease of use of products and services as a result of ubiquitous technologies embedded in the products and systems, speech- and voice-controlled applications and advancing wireless technologies.

Information and communications technologies will be integrated into an invisible part of the immediate environment with the applications controlled by voice and gestures. At the same time, ICT-based products and services make life simpler and improve efficiency in daily activities. For instance, sensor technologies allow automatic note-taking at meetings. With the advancement of agent technologies, agents will take over many of the routine tasks now performed by humans, such as meeting and conference room bookings, sorting of e-mail by content, online purchasing or search for user-defined information on the web. In automatic media content transmission, use will be always made of the most efficient technology available in the immediate vicinity; for example, if a person listens to music on his mobile phone when commuting, the music will immediately be transferred to the stereo set when he gets home. Advances in sensor technology will allow automatic online process control, making it possible to monitor the progress of a parcel from one location to another, etc. Similarly, the efficiency of office cleaning can be improved by means of sensor technology that, for instance, can indicate the rooms that have not been used since the previous cleaning or identify the wastepaper baskets lacking a liner.

Advanced positioning technology will make it possible to produce a wide range of focused services, such as maps or information about the nearest restaurants. Similarly, examples used in textbooks can

be customized by taking them from the location or country where the student is.

3.2 Well-being

The well-being cluster consists of the social and health care sector, related research and training, and industrial-scale business. Moreover, the cluster includes the companies offering well-being services and the construction of an infrastructure that makes it easier to cope with daily life. In the Education Intelligence project, the focus was on the industrial side of the well-being cluster. The other long-term anticipatory project launched by the Confederation of Finnish Industries, Services 2020, will offer more in-depth information about the competence and educational needs in the private social and health services sector.

The Finnish well-being sector is growing into a much wider consumer market than it is today. One of the major forces for change affecting the well-being cluster is the ageing of the population which will offer business opportunities on a global scale. Another important development is the change in consumer behaviour patterns as a result of the increasing wealth of the population. People are interested in looking after their health and well-being and willing to invest in it. An increasing percentage of people will buy the preferred well-being products and services when most convenient for them. Finland boasts a high standard of competence in medicine, preventive health care and various technologies. If these competence areas are combined, excellent opportunities can be created for developing globally competitive well-being products and services.

Thanks to future innovations, people of advanced age can live safely at home for as long as possible, move about independently and engage in various activities in their free time. With ageing population, the need for treatment and nursing will, however, increase, while at the same time the health care sector is being threatened by an imminent shortage of labour. To be able to tackle this challenge, it is necessary to focus on innovations that facilitate the work of health care personnel and improves its efficiency. Utilization of technology in public sector services makes it possible to automate simple tasks. Technology will add value without interfering with treatment as a transaction involving human interaction. (Confederation of Finnish Industries 2004.)

The senior citizens of the future will include a high percentage of people who have money, are willing to pay for services, and enjoy good health. Even so, there are few products and services for them. In the future, people of advanced age cannot be approached as a homogeneous group because they have highly diverse needs and interests.

Also, increasing demand is predicted for products and services that facilitate the daily life of the working-age population and makes it easier to reconcile careers with family responsibilities. The supply of ICT-based services will increase, diversify and improve in quality. (Confederation of Finnish Industries 2004.)

3.3 Chemistry and biotechnology

In the Education Intelligence project, the chemical and biotechnology cluster was evaluated as a whole consisting of a foundation based on the utilization and integration of competences in the fields of chemistry, chemical technology, biology, and biotechnology.

The core expertise of the Finnish chemical industry is related to forestry, agriculture, construction, electronics, food supply, and environmental products. Additionally, oil refining and plastics industry are important sub-sectors of the industry.

Biotechnology in Finland focuses on the health care sector both in research and in industrial activities. Table 2 shows a number of areas in which biotechnology can be applied.

<p>Available in 1-5 years</p> <ul style="list-style-type: none"> • Utilisation of simple and complex raw material resources • Microsensors • Structural integration of electronics • Efficient storage of electricity • Structures compliant with the principles of sustainable development 	<p>Available in 5-10 years</p> <ul style="list-style-type: none"> • Combustion, chambers for hydrogen-based energy production • Biosoluble synthetic fibres • Utilisation of naturally occurring structures • Hybrid media
<p>Source: TEKES (adapted)</p>	

<p>Medicine</p> <ul style="list-style-type: none"> • Medical research • Pharmaceutical development • Vaccines • Diagnostics 	<p>Foodstuffs</p> <ul style="list-style-type: none"> • Foods for Specified Health Use (FOSHU) • Foodstuffs and feeds production methods • Foodstuffs analysis • Foodstuffs components
<p>Forestry</p> <ul style="list-style-type: none"> • Bioprecipitate management • Fibre modification • Cellulose bleaching 	<p>Agriculture and environment</p> <ul style="list-style-type: none"> • Biofuels • Biowaste processing • Plant and animal husbandry
<p>Bioprocesses</p> <ul style="list-style-type: none"> • Chemical production • Enzyme production • Fermentation • Biocatalysis 	<p>Materials</p> <ul style="list-style-type: none"> • Medical biomaterials • Industrial biomaterials (e.g. starch, cotton)
<p>Lähde: Tekes</p>	

By combining the competences gained in the individual areas of science, such as biosciences and chemical technology, it is possible to create a basis for product and process innovations. Among other things, increasing potential is perceived in bioprocess engineering that may transform the conventional methods of chemical production and promote renewal in other conventional branches as well, such as forestry and energy production. Another major future trend and facilitator that may open up new avenues is the marriage chemistry and biosciences with nanotechnology. The products supplied by the chemical industry to other branches of industry are being developed in increasingly close cooperation with the customer. There is a marked transition away from conventional bulk production towards customized special products, technologies and services.

The traditional consumer products offered by the chemical industry, such as cosmetics, paints and detergents, will remain very much the same in terms of use. However, new properties will be introduced, for example by making use of nanotechnology. The use of consumer products is closely linked to images and local preferences.

Design is a competitive tool that the chemical and bio cluster will make use of on a greater scale than before. In the plastics industry, design has already generated a new customer base for electronic devices. Of the other sectors, design will become increasingly important in diagnostics and consumer products, such as cosmetics.

In the future, diseases can be classified according to their effects on the molecular level based on the growing wealth of genetic information enabling a better understanding of the human biology. Once the causes of illnesses are identified, treatment and prevention can be optimized. Additionally, medication can be targeted to patients who are known to benefit from it.

Genetic data has created and will create a range of new technologies that will give a new direction to further developments in diagnostics, precision therapies and new pharmaceuticals. To accomplish this, efficient use must be made of human biobanks. Genetic testing, gene therapy and stem-cell treatment will renew health care. Organs can be repaired, making it possible to heal diabetes or spinal cord injuries. By 2015, these technologies will, however, just be taking the first steps. Major medical challenges also posed by coronary diseases, diabetes, cancer, and neurodegenerative diseases such as Alzheimer's. Genetic information and related technologies may provide solutions to all these conditions.

Biomaterials can be used to replace living tissue and control tissue growth. Typical examples of such applications include biodegradable implants and the bioglasses used in dental surgery. Various medicine dispensers of ever-decreasing size will also become popular. Growing markets are predicted for biodegradable materials as new medical and cosmetic uses are found for them.

Bioinformatics is an interdisciplinary branch of biology that makes use of the methods employed in computer science, mathematics and statistics to solve biological problems. Among other things, it seeks to develop computation models and statistical methods for biological applications. There is a growing demand for

bioinformatics competence, for example in biotechnology companies that they need such competence in support of their own research.

Demand for environmentally sustainable solutions will increase. The availability of clean water may have a profound impact on global development, while the prevention of climate change calls for new production methods. Chemical and biological competence will be in great demand in all activities designed to promote sustainable development – the business potential is substantial. For example, new energy solutions are being sought worldwide in an attempt to identify viable alternatives to fossil fuels. As a result, renewable fuels will grow in importance. Here, the new competence related to the processing of biomass will be combined with the conventional processing solutions used in the chemical industry. In the plastics industry, the challenge is to develop biodegradable and recyclable materials. For example, grocery chains are increasingly using recyclable packaging materials in response to consumer demands. Information and communications technology is also being integrated into packages.

3.4 Forestry

The Finnish forest cluster includes the forestry, chemical and technology industries, communications and packaging companies, construction and energy, and transportation, including related design and specialist service companies, as well as forest owners, universities, and research institutes. Most likely, the forest cluster will in the future develop in the direction of the ICT and energy clusters. (Research Strategy for the Finnish Forest Cluster, 2006).

During the next few years, the Finnish forest cluster and its customers will feel the impact of global competition like never before. Geographically, the demand for products is shifting from Europe and North America to Asia and Eastern Europe. Therefore efficient, low-cost production capacity is being built for these markets at a fast pace. At the same time, the needs of the customers and end-users and the ways the products are used are changing. New properties and more affordable prices are required of the products while the manufacturers are expected to satisfy the increasingly stringent requirements imposed by sustainable development. (Research Strategy for the Finnish Forest Cluster, 2006).

The challenge facing the forest cluster is renewal, meaning the development of completely new

Table 5. Nanotechnology applications

	Applicable research	R&D	Initial commercial applications	Established business
Electronics	<ul style="list-style-type: none"> • New design and packaging methods in nanoelectronics 	<ul style="list-style-type: none"> • Battery technologies • New sensors • Electronic printing products • Electronic packaging 	<ul style="list-style-type: none"> • New laser technologies • New optical fibres 	<ul style="list-style-type: none"> • Lasers • Coatings • Sensors: e.g. gas • Diffractive optics
Medicine and biotechnology	<ul style="list-style-type: none"> • Nanocoatings in plastic • Biosensors 	<ul style="list-style-type: none"> • Biosensors • Nanoparticles in diagnostics • DNA chips 	<ul style="list-style-type: none"> • Diagnostic systems • Enzymes and reagents 	
Chemistry	<ul style="list-style-type: none"> • Process efficiency improvements 	<ul style="list-style-type: none"> • Nanocomposites • Cobalt and nickel nanopowders 	<ul style="list-style-type: none"> • Catalysts • UV-protection in paints 	<ul style="list-style-type: none"> • Titanium dioxide • Conducting polymers
Forest	<ul style="list-style-type: none"> • Smart packaging, sensors 	<ul style="list-style-type: none"> • Customised papers, boards • Nanofilters 	<ul style="list-style-type: none"> • Functional polymers 	
Metal	<ul style="list-style-type: none"> • Ceramic metal-substitute composites 	<ul style="list-style-type: none"> • Self-cleaning and scratch-resistant metal surfaces 	<ul style="list-style-type: none"> • Carbon surfaces 	
Other	<ul style="list-style-type: none"> • ESD-textiles 	<ul style="list-style-type: none"> • Ceramics • Nanocomposites in packaging • Nanofibres for air filters 	<ul style="list-style-type: none"> • Water purification 	<ul style="list-style-type: none"> • Nanocoatings in glass • Nanoparticles and UV-filters in cosmetics • Automotive catalytic converters

Source: TEKES (adapted)

technologies, products and procedures in order to create a new type of business. Another task is to boost the competitiveness of the companies and the forest sector. To accomplish this, it is imperative to improve efficiency in the use of the raw materials and other production factors – in particular, energy savings and utilization of bioenergy will be of growing importance. A third challenge is to fulfil the expectations concerning sustainable development. (Research Strategy for the Finnish Forest Cluster, 2006).

Paper, board, sawn timber and plywood will not

undergo any major changes over the next 10 years, even though the product properties are being continually enhanced to respond to customer needs. In contrast, the change in processed goods made from these basic products, such as packages and building materials, will be rapid and new applications will be developed in order to generate value. (Confederation of Finnish Industries 2004.) According to the objective defined in the Research Strategy for the Finnish Forest Cluster (2006), the value of the products and services offered by the Finnish forest cluster will have increased by

50% by the year 2015. One third of this value will be generated by products and services that do not yet exist today.

The rapid advancement of ICT and bio- and nanotechnology will make it possible to manufacture smart and functional wood and fibre products.

New materials and more efficient production technologies offer the potential for developing new functionalities for wood and fibre-based materials and integrating smart properties into packaging, construction and housing products and transportation vehicles. The smart label is a prime example of a product incorporating conventional forest technology along with new technologies. When controlled-atmosphere food packages become more common, it will be necessary to ensure that the packages remain leak-proof to retain the freshness of the products. Any leaking packages can be identified with oxygen-indicator labels. (Research Strategy for the Finnish Forest Cluster, 2006).

The rising oil prices, limited availability of non-renewable raw materials, the objectives established for sustainable development and the need to improve the competitiveness of the forest clusters serve as incentives to exhaust all the potential uses of wood. One of the challenges facing the industry is the need to convert the compounds obtained from biorefineries through reprocessing into materials, chemicals, and energy and to commercialise such innovations. Wood contains a huge amount of various substances that can be harnessed with new technologies, for example in functional foods and medical applications. All the potential uses of wood have not yet been exhausted: either they have not been identified or explored, or the commercial utilisation of such new uses is not yet feasible. (Research Strategy for the Finnish Forest Cluster, 2006).

Future customer solutions will be based on in-depth understanding of the customers' and consumer's needs and expectations. Aside from the product and service concepts, they are related to the technologies that make new products possible or increase the value of existing ones. For example, in order to develop print communications, it is necessary to have a new technology that reduces printing costs and improves overall efficiency; at the same time, new ways of producing attractive printed products need to be found. As far as construction and interior design are concerned, the task is to work out systems and

technologies capable of satisfying the individual needs of customers on an industrial scale while delivering a high standard of quality and efficiency. (Research Strategy for the Finnish Forest Cluster, 2006).

3.5 Construction, real estate and infrastructure

The construction, real estate¹ and infrastructure cluster is divided into building construction, infrastructure construction and maintenance, building systems, building materials industry, and the real estate sector. More in-depth information about the competence and educational needs in the real estate sector is provided in the other long-term anticipatory project launched by the Confederation of Finnish Industries, Services 2020.

Figure 7 shows the networked operations model of the construction, real estate and infrastructure cluster. An individual company no longer owns any "product" the way it used to. Customers are involved in the process right from the beginning, for example in shaping the character of a new residential area and defining the functional requirements imposed on it. Reprocessing is an activity based on cooperation between a manufacturing company on the outer perimeter of the cluster (for example a brick factory) and the development organisations working in the hub of the network (such as a housing developer) that create pleasant living environments out of the individual elements and components.

Strategic partnership is emerging as one of the key ways of expanding a company's competence and boosting its competitiveness. In the construction sector, a strategic partner may be a big land-owner with whom a historical landscape is developed with due regard to the natural assets and the principles of sustainable development. At the same time, there will always be separate, one-off customer relationships, such as individual home buyers, who want to have a dwelling of certain size in a certain district in the city.

On the one hand, 'shared information' in Figure 7 means that the needs and ideas of the consumers involved are truly heeded in the product development process – that it is not just a reactive response to the markets. On the other hand, it means timely sharing of the existing information with all consumers; for example, it could consist of conventional marketing or dissemination of information on the progress made on a regional development scheme.

In the construction, real estate and infrastructure cluster, there is an on-going transition from a

Figure 4. Level of processing defined by customer involvement



Copyright: Kuronen & Majamaa, 2006

production-oriented to a service-oriented culture and customer relationship thinking. What the consumers are looking for is a wider range of services. New business opportunities will be created as companies focus on their core activities with increasing intensity. As a result, many of them are going to give up their own real estate properties and outsource the management and maintenance services. Similarly, the increase in competitive bidding in the public sector will generate demand for the services offered by the construction, real estate and infrastructure cluster. (www.visio2010.fi.)

Extensive long-term lifecycle service models will become more common. Aside from design and construction, they will apply to services related to the operation and maintenance of buildings, etc. At the same time, there will be a growing demand for various service integrator models where operative services are acquired on behalf of the client from individual collaborative networks. The methods of individual service and mass customization will be applied beyond

the industrial production of low-rise housing to include other areas as well. (www.visio2010.fi.)

Lifecycle thinking, i.e., the concept of the total environmental impact and costs of a product over its entire service life, will increase in importance. The goal is to improve eco-efficiency, meaning that services and wealth should be generated with minimum consumption of natural resources. Greater attention is being paid in the design stage to issues such as energy and water conservation, waste reduction and sorting, and sustainable use of building materials. With the rising energy prices, energy efficiency is becoming a key component of eco-efficiency. A major challenge is to improve the energy efficiency of the existing building stock. Schemes to concentrate housing near the commute-to-work areas with carefully thought-out municipal services, low-energy houses and solutions that are easily adaptable to the needs of the users, as well as timeless design that blends in with the landscape are hallmarks of eco-efficient construction. (www.visio2010.fi.)

3.6 SKIP or Service and Knowledge Intensive Products

SKIP is an abbreviation meaning “Service and Knowledge Intensive Products”. The term refers to a service concept used in the mechanical engineering and metal products and processing industry that includes both the product and the service. Service providers and equipment manufacturers work as partners in multidisciplinary collaborative networks, having adopted an interdisciplinary approach to the use of technologies (Fig. 8).

The basis for service and product design consist of the conventional mechanical and electrical engineering know-how, which is complemented by expertise related to fields such as biology, medicine, or sociology, depending on the needs of the customer segment involved. The products become more self-directed and are integrated with the ubiquitous data network providing information about the operation of the device itself as well as the performance of the production process. Use is made of this data to develop the service concept further on an on-going basis. Technological competence is combined with other competence related to customers, services and the environment. When the service-product entity is produced in a networked environment, innovative value-generation and earnings logics determine where the optimum producer may be located and who it is in a global context. Full service agreements serving the purposes of the customer relationship process will become more common. (Salminen & Pillai, 2005.)

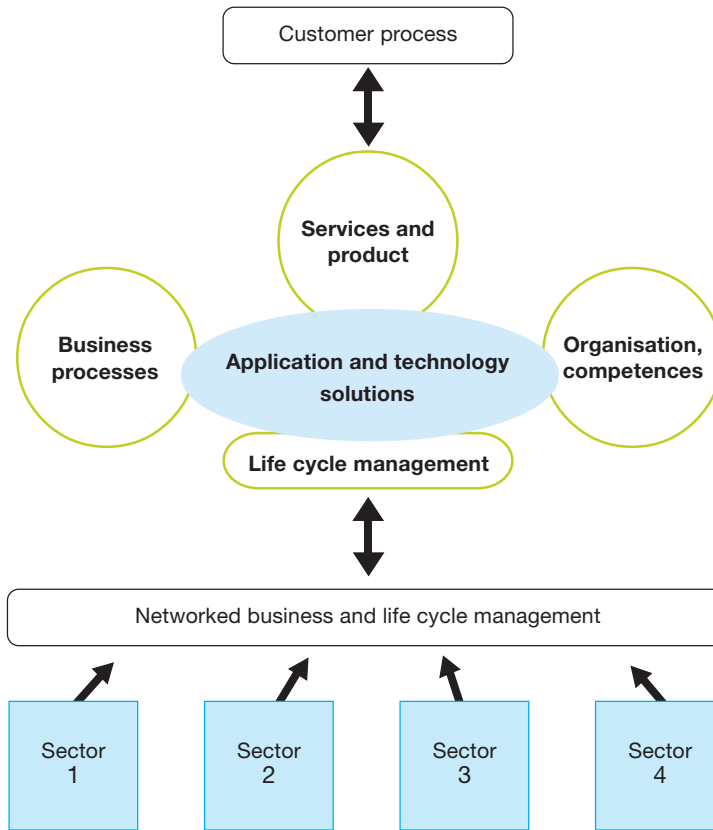
The cost pressures exerted by global competition accelerate networking in the provision of industrial services. Currently there is a trend away from product-based operation towards industrial services and businesses that generate new value to customers on a continual basis. (Salminen & Pillai, 2005.)

Competition no longer takes place between companies but between networks. In an industrial network, all the members share responsibility for the continual development of the services and competence being offered. At the same time, networking means a new type of earnings logic: the value and benefits generated for the end-customer during the life cycle of the business activity must be created together and proven to the customer’s satisfaction. With the evolution of the business environment and increasing demands for service, the only products that will be

made in the future are those that also incorporate a service (Fig. 9). Such service could consist of the customer’s feeling of satisfaction when the process runs smoothly and efficiency increases at a faster pace than with the competitors. Innovations will focus on continual improvement of the level of service. (Salminen & Pillai, 2005.)

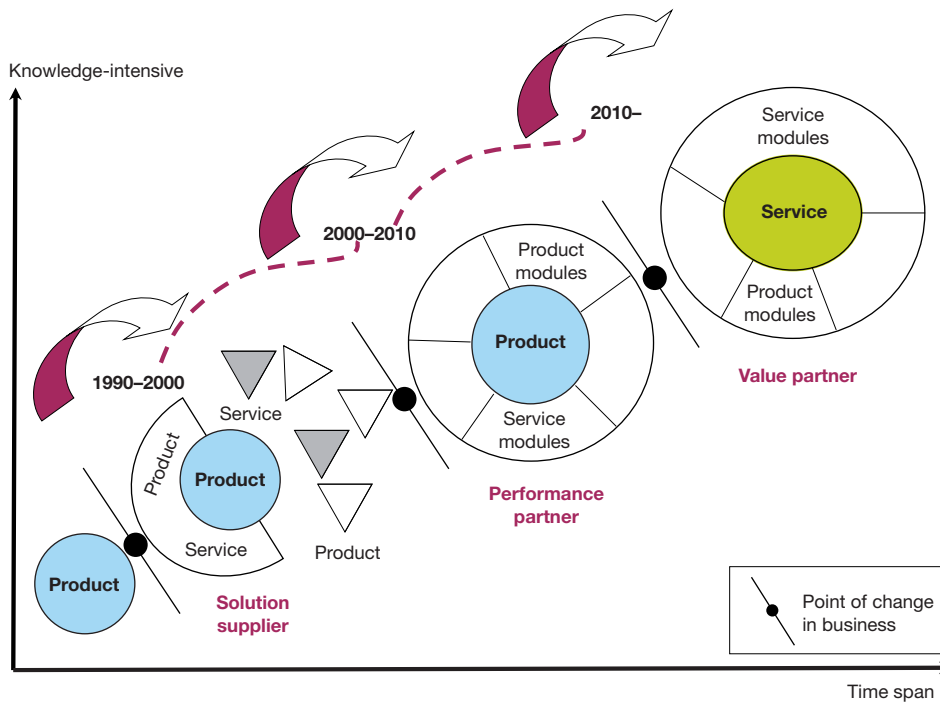
With advancing networking, system suppliers will turn into service providers. The production efficiency that the end customer can achieve depends on the key suppliers’ ability to deliver service. Consequently, the importance of interfaces and transparency is highlighted in corporate networks. Data systems will play a central part in ensuring that essential knowledge is made available to all network members. Other fundamental elements of networking are common rules, trust, a wide array of competence areas, lifecycle thinking, and continual improvement of the processes. Although networking in business, and services in particular, is only taking its first steps, expectations are running high in terms of value creation. (Salminen & Pillai, 2005.)

Figure 5. Service and knowledge-intensive products



Source: Salminen, Pelkonen, Rautainen, Kauhaniemi & Pillai, 2004

Figure 6. From machine supplier to value supplier



Copyright: Salminen, 2005

4 Education Intelligence visions up to 2015

The visions for the Education Intelligence clusters were prepared in the course of the project up to the year 2015. The process was initiated in the autumn of 2004 with the Delphi survey that focused on future business and organisational models. The respondents were the advisors representing the Education Intelligence and corporate networks.

The analysis of the Delphi survey produced five divergent visions of the future. Upon completion of the analysis, a new survey was carried out in which the EI and corporate network advisors were asked to select the most preferred of the five different views of the future.

A seminar was held in February 2005 to give the network advisers the opportunity to work in teams to prepare visions up to the year 2015 for the following:

- Organisation and business model for the Finnish business
- Finnish company operating in the international market
- Company employee
- Labour market.

The visions are based on the view of the future that received most votes in the Delphi survey as being the most preferable scenario. The visions were subsequently perfected by means of a round of interviews held in early 2006 in which a total of 56 advisors were heard.

4.1 Vision of an organisational and operations model for business

Organisational and business model of the business life:

An innovative, competent and learning network that is able to anticipate the needs of the customer in an interactive relationship. By making use of conventional and new processes, the network is capable of offering ethical and competitive solutions and create value in a global operating environment.

In 2015, the approach to business will be customer-oriented with companies providing innovative, value-added services in response to the customer's future and acute needs. Often, the solutions will be worked out in collaboration with the customer. For the customer, value may mean aesthetically pleasing or ergonomic design, a non-scratch coating, recyclability, or a sound service concept. In this process, technology is usually the facilitator, sometimes even the core of the innovation.

The corporate organisational model will consist of an amoebae-like collaborative network that renews itself continually. Work will be carried out in global and virtual teams engaged in genuine cooperation – even the members of the one and the same team may be geographically far apart from one another.

In a complex and fast-changing world, success is based on the sensitivity to understand and interpret the current views and prospects for future development. The response to the changes in the operating conditions will be quick and flexible – efforts will be made to prepare for unforeseen developments as well. As far as the staff is concerned, this calls for a high-standard of competence, excellent international interpersonal skills and the boldness to examine issues from fresh angles.

Companies will have to see to it that they comply with the same ethical standards all over the world in relation to society, the natural environment, and stakeholder groups. Enlightened ethical consumers will

impose stringent requirements on a responsible way of doing business; what the conditions are in which the products made and what sort of environmental impact they have. A good corporate image is a critical success factor that affects the customer relationships, investors, recruitment as well as the existing personnel.

4.2 Vision of a successful company

Successful company:

An international trail-blazer! Competent, confidence-inspiring, bold – the best responsible growth company in its line of business, or a strategic partner of such a company. A network-builder that attracts experts with multiple skills and supports their further development.

The model Finnish company of 2015 will operate not only in Finland but across the world. It will be part of a global value network – either in the hub of the network or in the role of a strategic partner. A network can work efficiently only if every part of it is efficient.

The company will invest in research and development in order to ensure its capacity for renewal and secure its position as a trend-setter for further advancement – and number one in its field. The most promising research projects will be initiated at various interfaces. At the same time, the company will make active use of international research findings and buy basic technology – seize the best ideas and add its own contribution to the whole from a customer-responsive point of view. The company will work in close cooperation with universities and research institutes.

It will make efficient use of information and communications technology. This enables quick and flexible operations and clearly improves the company's price competitiveness and productivity. New technologies will be employed to utilize extensive international competence networks in the development of human resources and the products and services offered by the company.

Through long-term efforts, innovative procedures and high-standard competence, the company will have succeeded in creating a strong brand. The goal is that customers will not buy a product unless it carries the label *Company plc*. Additionally, the company will find it easy to recruit the best experts from all over the world because its leadership is recognized and it has a

positive corporate image.

Competent and enthusiastic employees will be the company's most important asset and thus worth keeping. The workplace atmosphere will be open and creative and conducive to maintaining the working ability. The employees will be valued and their duties will offer them enough diverse challenges. Professional skills will be developed at work or as part of various networks, with only a small percentage of formal training. Personal coaching, genuine interaction and transfer of knowledge from seasoned employees to new recruits, projects and job rotation will be regarded as efficient forms of on-the-job learning.

4.3 Vision of the employee

The employee of 2015:

A change-maker who values himself and others and is committed to developing and sharing skills and competence.

In 2015, companies will be undergoing perpetual change. In order to maintain competitiveness, firms need to develop their processes, products and services. In a digital operating environment, information and products are transmitted online with wireless mobile communication devices. The employee will be part of a competence network that makes it possible to harness the competence of individuals around the world. There will be a wide range of employment relationships, and various corporate arrangements will be routine. For any employee, the ability to change is a basic skill comparable to literacy, given this type of operating environment,

An internal sense of security in this turbulent environment is provided by the confidence in one's competence and by skilful people management. When faced with change, the employee will have several options because he or she possesses skills that can be flexibly applied to other duties as well. To maintain the personal market value, the employee needs to assume responsibility for his or her own professional development. At the same time, a career is no longer perceived in the same way as in the past; people no

longer want life to revolve around the one and same job (Moisio, 14 Feb 2006).

While work will remain a central part of life, home, family and free time will gain in importance. Employers are expected to offer flexible arrangements in terms of content and working hours to ensure that the various aspects of life can be meaningfully reconciled. Advanced ICT solutions will alleviate the constraints of time and place and may even help strike a better balance between the individual components. Work motivation and employee commitment to the corporate goals will be affected more by the possibilities of influencing the content of one's own work and the feeling that the duties are interesting and meaningful than pay.

In a global operating environment, the employee is required to understand different cultures and be able to work with people with different cultural backgrounds. A sound sense of self and positive curiosity about new people and views help succeed in international cooperation.

In the future, people will choose jobs more and more on the basis of the values they hold .

4.4 Vision of the labour market

Labour market of the future:

Multifaceted labour market where a spearhead group of companies, working side by side with more traditional organisations, continually develop new, more competitive organisations and tasks. Both the job-seeker and the employer will be in a position to select the most suitable option from the local and global opportunities.

Finland will fare well in the structural changes of the economy, although tasks requiring only little competence, as well as a certain percentage of jobs

requiring top-notch expertise, will be relocated to countries with a lower cost of labour and closer to the markets.

Companies will have overhauled their business practices to make them more customer-responsive and networked. Competitiveness will have improved as new applications and products are introduced to complement more conventional offerings. Added value will have been created to the product and service concepts through specialization. A number of innovative companies operating at the interfaces between the clusters will have emerged in Finland.

Competition over talent will be intense because, for a long period of time, the number of those leaving the labour market in Finland will have exceeded that of the entrants by a wide margin. At the same time, the nationality of the employee will have lost all meaning: the key positions will be open for candidates from all over the world. Foreign experts move into Finland while Finnish experts leave for other countries.

5 Overview of the competences required in the year 2015

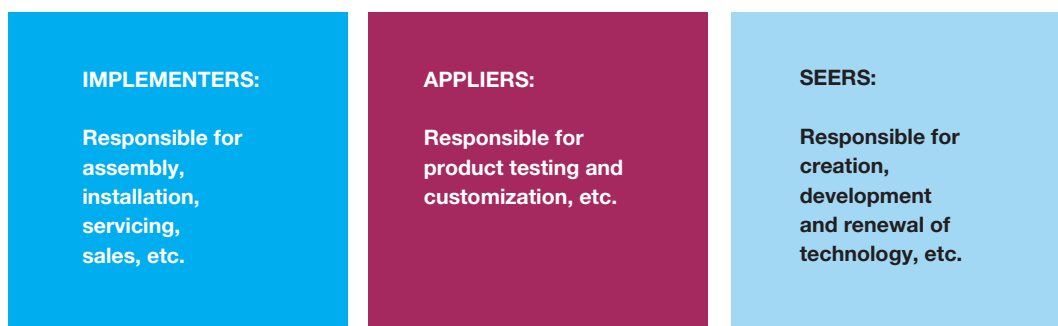
One of the objectives of the Education Intelligence project was to explore views as to the competences that will be required in industrial and construction-based companies. The future competence needs were already described in the report “Technology and Innovative Business – Competence Needs Required for Success (2005)” published in the autumn of 2005. The report sought to anticipate what sort of competences and skills will be required in companies in order to ensure that the opportunities offered by technology could be fully utilized in business. The present report provides a more in-depth analysis of these needs.

A total of six clusters have been evaluated in the Education Intelligence project: well-being, ICT; chemistry and biotechnology, forestry, construction, real estate and infrastructure, and SKIP. The competence needs of the clusters will be assessed on the basis of the following division of occupational

categories created during the pilot phase of the Education Intelligence project: implementers, appliers, and seers. The implementers will be responsible for tasks such as assembly, installation, servicing, and sales. The appliers will handle product testing, customization, etc. The seers will be responsible for creating, developing and renewing technology and business, etc. (Confederation of Finnish Industry and Employers 2002.)

Views of the competences conducive to competitiveness were invited by interviewing 56 advisors representing various organisations in early 2006. Chapter 5 provides a description of the competences required in the Education Intelligence clusters and occupational categories in 2015. Additionally, the interview data was used as a basis for creating imaginary stories about the experts of the future.

Figure 7. Occupational categories:



Dimensions of competence

The competences required by companies consists of knowledge and skills, values and attitudes, and networks. Knowledge and skills refer to the theoretical and practical capabilities acquired through training or experience necessary for coping with the work duties. Values mean the compatibility of the individual and corporate values while attitudes refer to the approach to work and the workplace community. Membership in various networks will be of growing importance in recruitment because new knowledge and skills are increasingly produced and exchanged in networks. Naturally, a high standard of competence will remain important.

Boundaries between occupational categories being blurred

The boundaries between individual occupational groups will fade and clearly defined job descriptions will disappear. One reason for this development is the general increase in the standard of competence, which will give staff member a wide range of capabilities to master more extensive duties. For example, the implementers' duties will include more planning, development and supervisory functions that have traditionally been discharged by appliers. At the same

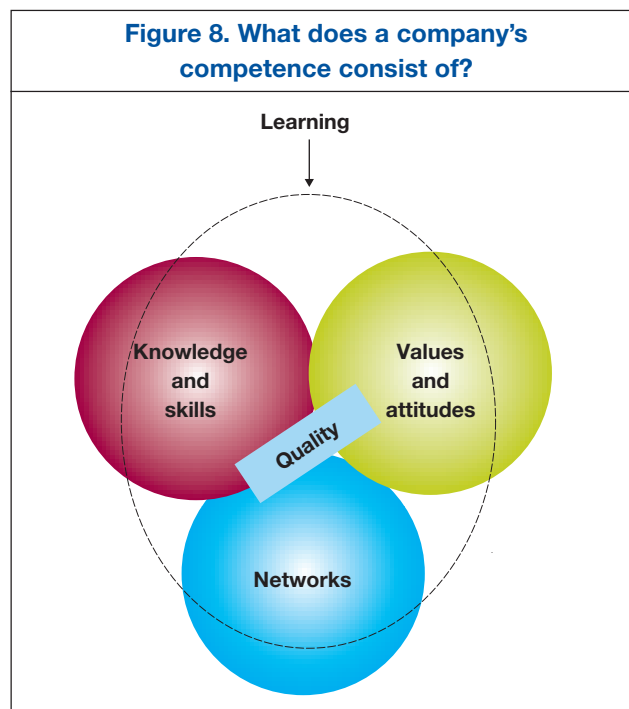
time, the representatives of all the three occupational categories are expected to be efficient and get things done. Also, the boundaries between appliers and seers will be getting harder to define.

Another reason why the division of staff into various categories and detailed job descriptions are becoming inappropriate is that such limits hinder working and cultivate the "it's not my job" thinking. Clear-cut limits may lead to a situation where part of the potential remains unused, even though top expertise is available in all groups. What will be of critical importance is that every member of the staff is aware of and understands the shared objectives, procedures and his or her own responsibility – is truly committed and does his best. Companies create the necessary preconditions for this by offering challenging duties.

The term used in Swedish to describe such employees is "medarbetare" while the Americans and British refer to them as "associates". No equivalent term is found in Finnish.

Trends in personnel structures

The number of industrial jobs is predicted to fall in the long term. With technological advancement, production will become ever more efficient and it will be relocated to countries where the cost of production is more



affordable and that are closer to the main markets. At the same time, however, completely new jobs will be created in industry and construction. But this calls for specialization in products and services that require top-level competence. According to the advisors in the Education Intelligence network, potential for developing new successful products and services could be found in the development of risk identification and evaluation capabilities, improved product lifecycle management, development of new materials, virtuality, and ubiquitous intelligence. The optional future trends are clearly interrelated. Often they are born under the pressures to promote sustainable development on the global level. (Confederation of Finnish Industries 2005.)

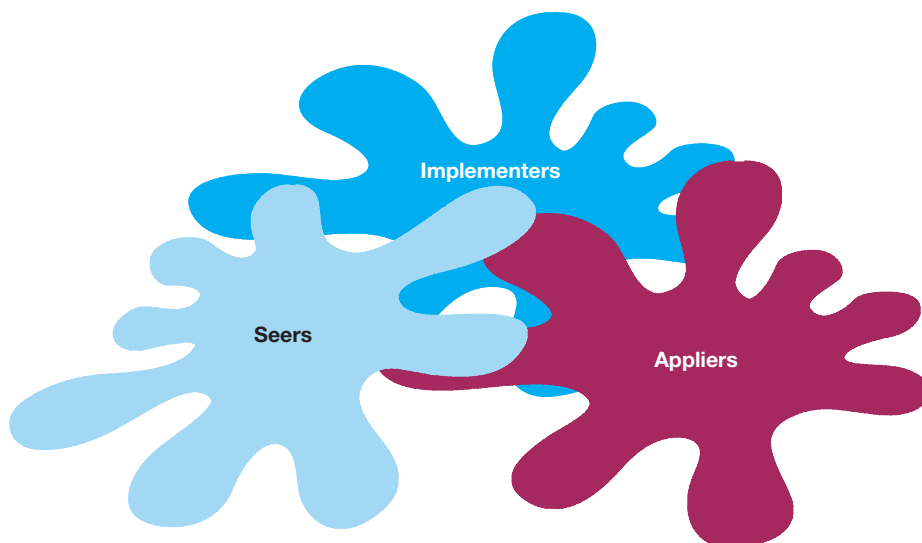
Competence challenges facing various occupational categories

The competence needs related to the improvement of competitive capabilities identified in the Education Intelligence project can be subdivided into the following eight groups:

- Creativity and innovation
- Technological competence
- Business competence
- Network competence
- Service competence
- Design competence
- Management of multiculturalism
- Responsible business

The expectations related to employee values and attitudes are discussed at the end of this chapter.

Figure 9. Boundaries between occupational categories becoming blurred



This report presents a synthesis of the competence needs of all the clusters because the challenges facing the companies are very much the same. By contrast, the relative importance of identified competence areas is different among implementers, applicers, and seers (Figs. 13, 14 and 15).

5.1 Extensive competence: multiple skills and interdisciplinarity

There is growing need in companies for people who can master the big picture. In the case of implementers, this is referred to as multiple skills whereas applicers and seers are expected to have an interdisciplinary approach.

Figure 10. What is expected of implementers?

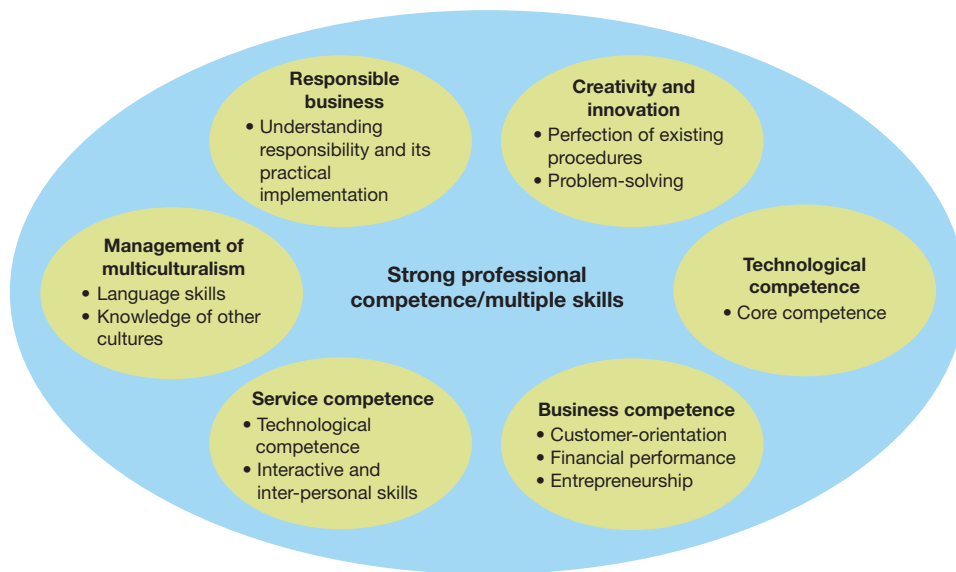
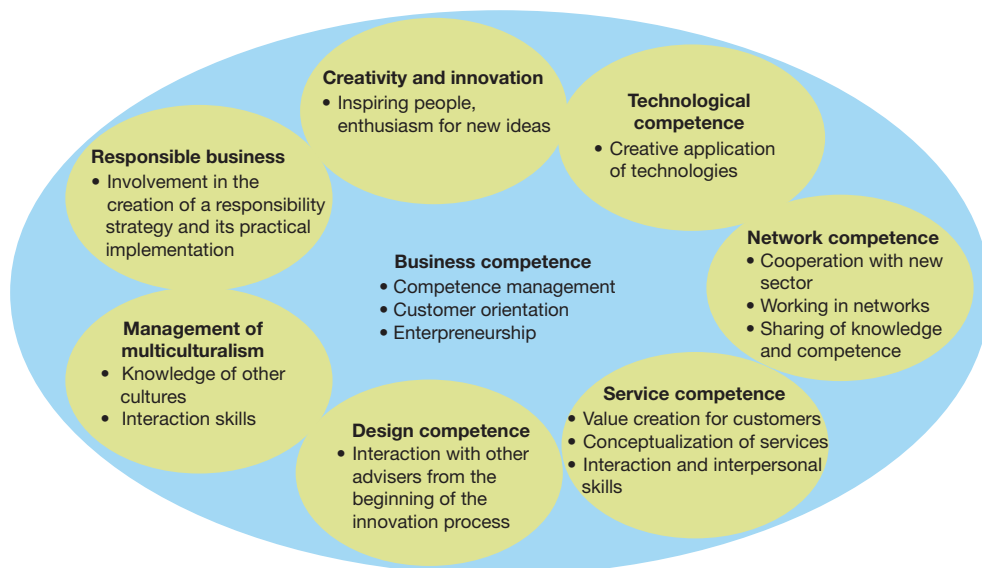


Figure 11. What is expected of applicers?



Extensive competence does not, however, mean that one person should “know it all”. In-depth mastery of a single competence area will be necessary in the future as well, but at the same time, sufficient familiarity with one or more other fields is required. Aside from a strong competence on issues, the importance of social skills at the workplace is increasing. With the increasing complexity of duties and cooperation through networks, we need sound interpersonal and teamwork skills.

The requirement for extensive competence is explained by the changes in the demand for labour due to technological development. Technological advancement will make certain jobs obsolete and a number of old trades will disappear completely. At the same time, new professions and jobs will be created elsewhere. The nature of work will also be altered thanks to technology. Practically all physically strenuous and routine work will be taken over by programmable machines. To counterbalance the effects of automation, new jobs requiring high-end competence will come about. For implementers, this will mean more planning, supervisory, control and servicing duties. Moreover, automation will no longer be limited to production; instead, it will increasingly consist of rationalization throughout the value chain.

As many traditional jobs wither away, the labour market will require multiple skills and interdisciplinary competence. Extensive competence is in the interest of both the individual and the company. An expert with

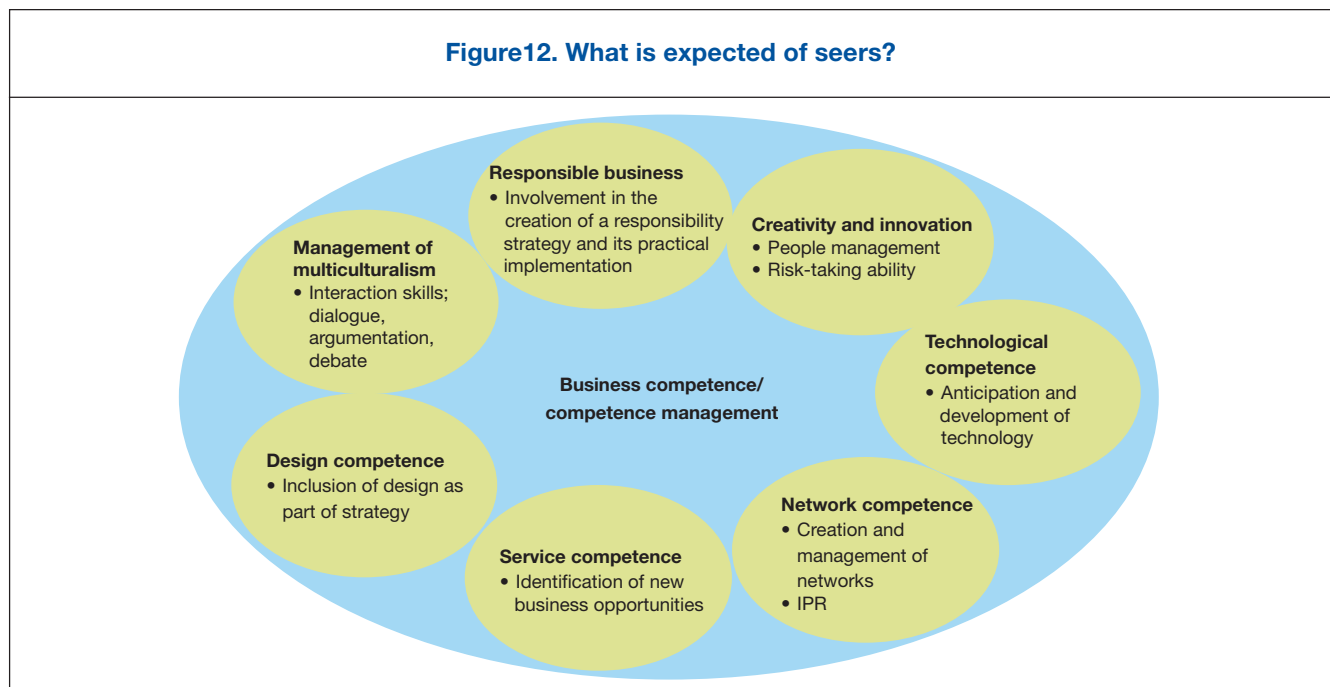
multiple skills is in a far better position to make use of horizontal and vertical mobility between and within companies than a person with a narrow skills set.

Demand for extensive competence is also related to the changing business models. Activities in the individual fields will be closely intertwined and completely new activities will be created at the interfaces between sectors that will operate in a radically different way compared with more traditional fields (Olin & Stenvall-Virtanen 2002). This trend will have a profound impact on professions and duties. Interdisciplinary degrees in which subjects are merged across the boundaries of individual sciences sometimes in highly surprising combinations – such as medicine and production economics – will become increasingly important.

Additionally, the expansion of competence means that top experts specializing in a narrow field must be able to examine issues from a variety of angles. For example, a researcher must, apart from his or her knowledge of the special field, have a understanding of business concepts, to whom the products are sold, how to increase the customer’s wealth, and at what price. For example, regulations pertaining to product development should be known.

The competence base of companies will be expanded by means of human resources planning. Within the clusters included in the Education Intelligence project, the educational structure of appliers and seers in particular will become more diversified. Customer-orientation

Figure12. What is expected of seers?



calls for in-depth understanding of how value is created for the customer or the entire cooperation network. For example, in technological applications, consumers more and more value the ease of use and appropriateness of a product or service – in short, human-scale technology. This requires not only technological competence but also inputs from

behavioural sciences and the design profession. For instance, the design of user interfaces for various devices and software are typical processes calling for interdisciplinary competence. Other aspects affecting the smoothness of man-and-machine interaction are the size of keys, display and menus, colour, design and the clarity of visual and audio messages.

Multi-skilled team of a forest company

The level of competence among the new-generation implementers in the employ of the international Forest Company Plc is high. While the company previously hired people with only elementary or comprehensive school education, the situation is now completely different. Almost without exception, those involved in production have a secondary-level technical degree from a vocational institute or polytechnic. At the same time, the company is active in training and developing the personnel.

Forest Company Plc's production facility makes use of the latest technology. Physically strenuous tasks or jobs requiring low skills have been automated. Additionally, production duties that used to be highly specialized have been combined into wider tasks. This calls for a new range of skills on the part of the people working in production; the implementers must possess special expertise, but at the same time, they need to have skills in some other area as well.

By multiple skills, Forest Company Plc means, above all, the totality of skills possessed by all the employees working in production. For example, the shifts have to be put together in a way that ensures that any problems can be solved independently. The goal is that the team is able to deal with various machine failures and other disruptions to the process without outside help. Problem-solving calls for not only technological competence but also for smooth cooperation and the ability to explain things clearly.

When Forest Company Plc recruits new implementers for production duties, the knowledge of languages is of growing importance. Production workers need to know English when communicating with customers, participating in international production development projects or at least when reading foreign-language instruction manuals. International job rotation to production facilities located in Asia, South America, etc., is possible, though still on a limited scale.

Multiple skills – a sum total of many things

In 2015, a Finnish sensor technology company operating in the global market hires the 28-year-old Marja as a product applier – to develop products in collaboration with the customer. Nearly 90 per cent of the clientele is outside Finland.

The 2010s was the golden age of technology-assisted measurement and interaction. Sensors provided various machines and devices with sensory powers. Marja's employer is a pioneer in sensor technology, particularly in the field of industrial processes. By 2010 the company had undergone an evolutionary process, typical of a Finnish company, from technology to customer orientation. Marja is one of the people contributing to this transformation.

During the past 10 years, the company has recruited experts representing fields such as physics, mathematics, wireless sensor technology, signal transmission technology, behavioural sciences, and medicine. Marja is a behavioural scientist with a post-graduate degree from the Helsinki Network University of Business Administration, Technology and Creativity. Additionally, Marja has developed her range of skills through free-time pursuits and everyday social interaction.

A decisive point in Marja's favour is an internship on the European Space Programme made possible by the excellent international contact networks of her university. She also gained valuable experience when completing a project for the China Mobile company. Her work history shows that she is capable of working on large, complex projects and with people representing a wide range of cultures. Her other assets include an outgoing personality and knowledge of Russian.

Marja has a supervisor who encourages her to study, and she also makes use of the many training opportunities offered by the company. Able to anticipate future competence needs, she acquires the new skills before they become critical. Marja takes a special interest in developing her competence in areas related to the establishment of a positive emotional relationship with the customer. She also needs to respond to ethical issues associated with bio- and nanotechnology and questions concerning the man-and-machine interface.

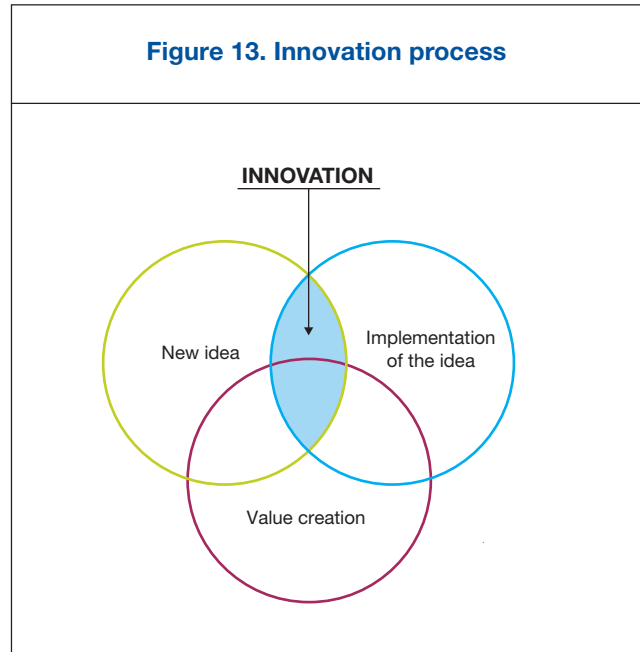
5.2 Creativity and innovation

Innovation means a reform that is valuable in competition. The innovation process involves not only the generation of a new idea, but also its execution. Some innovations mean minor progress and improvements while others include new type of technology whose introduction will have a radical impact on market structures. Innovations consist of products, services, operating models, organisational methods or strategic approaches. Social innovations mean structural changes designed to enhance society's economic and social performance and to increase the capital assets. (Stähle, Sotarauta & Pöyhönen 2004.)

The progress of an innovation from an idea to a successful product is a process that involves many phases. Innovations need to be accepted by the markets, society and technology. (Lievonen 2003.):

- **Markets:** Does the product respond to the needs of the customers?
- **Society:** Are users mature to accept the new innovation? Are they willing to learn new things?
- **Technology:** Is there true potential for the adoption and general acceptance of the innovation? For example, the introduction of new technology may require an analysis of ethical, security or regulatory issues.

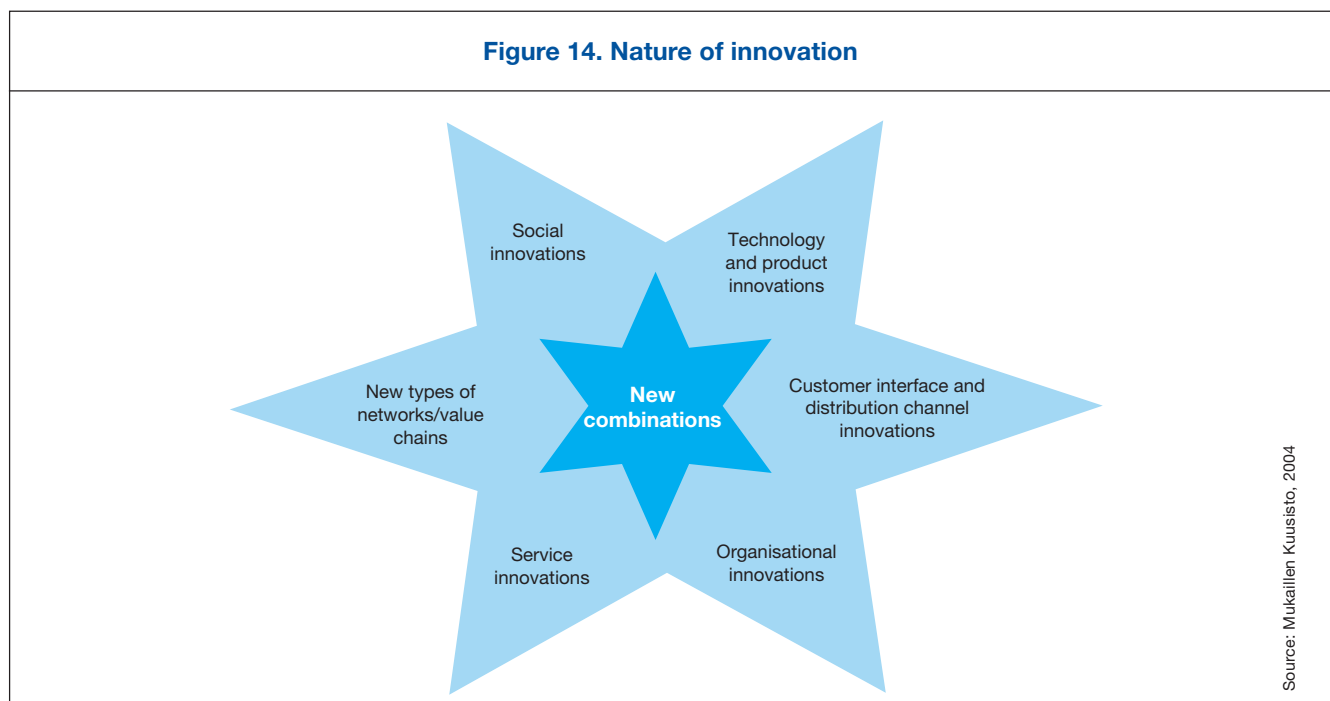
Figure 13. Innovation process



The innovation process calls for broad-based competence including marketing skills, business competence, creativity, entrepreneurship and knowledge of financing.

Creativity is a process taking place inside an individual's consciousness that is indispensable for generating any innovations. Creativity is not bound to

Figure 14. Nature of innovation



Source: Mukkailen Kuusisto, 2004

education or position. It is more of a question of how to translate man's creative potential into creative work performance. Creativity cannot be imposed by others because personal motivation is of the greatest importance as an engine of innovation. (Stähle, Sotarauta & Pöyhönen 2004.) Also, creativity needs time.

From the standpoint of corporate success, the ability to create something new is of increasingly decisive importance. All occupational groups are expected to have the capacity for critical thinking – the ability to question prevailing notions constructively.

To a great extent, it is the corporate culture and prevailing attitudes that determine the potential for creativity and innovation and what ideas are considered acceptable or new. Himanen (12 Jan 2006) employs the concept of a “community of enhancing interaction” to describe a workplace where people drive one another to better performance and get excited about the ideas put forward by colleagues. In an environment of enhancing interaction, whenever one member learns something, it is for the benefit for others as well.

In particular, the creation of favourable conditions for creativity is up to the executives – appliers and seers. A positive and secure atmosphere is important to creativity. Issues are discussed openly and people are encouraged to present ideas and proposals even if they are not yet finalized (Stähle, Sotarauta & Pöyhönen 2004). Motivation, inspiration and encouragement are the keys to bringing out creativity. Creative people enjoy working on jobs that offer enough challenge. Another important thing is that employees and their initiatives and achievements are appreciated.

One precondition for creativity is that people are allowed to make mistakes and do things that are seemingly “pointless”. Developing new things is a complex process that requires controlled risk-taking and boldness, as the final outcome can never be fully managed or predicted. Sometimes the financial investments and human efforts are wasted, sometime they lead to success stories.

Digitalization n daily life and the future

Nora and Veikko take a keen interest in the digital world and its manifestations here and now and in the future. They were hired by the company as a pair of partners to outline future trends together. The two shared a common work history having worked for the same employer in the past. “We're a bit like the two halves of the brain. We're continuously tossing ideas back and forth, and then we process and refine them together. In fact, thinking and working together creates something that's more than the sum total of the parts,” Nora says. Nora and Veikko specialize in understanding consumption patters and anticipating their changes. For them, creativity is a tool they use on a daily basis.

Anticipation of future developments and swift responses are critical competence areas for the company. “What we're trying to do through responding and anticipation is to enhance the capabilities for dealing with new and unexpected developments. Without the expertise brought by Nora and Veikko, there would a sizeable gap in product development and strategic cooperation,” the director responsible for change management says.

For a long time, Veikko considered the medical profession but the urge to be involved with arts was stronger. However, the idea of a career in health care and working with people stayed in the back of his mind. Later fate intervened. “When riding on a bus I was looking for a theme for a project using the search words “mind and action” until a friend of mine sent me a link to a brochure about cognition science. Glad he did!” Exploring the phenomena related to knowledge – perception, learning, thinking, language, and concepts – and working with the human mind soon dispelled any ideas of becoming a medical doctor. Instead, this unique possibility of combining skills surpassed everything else.

Opportunities for “brainstorming” should also be provided, at least on a limited scale: what could the product and service concepts of the future be like? The “Open source” approach will spread from the software industry to other areas as well. Under this model, all those interested will have free access to the product, service or information. They will be free to customize it for their own needs and publish any improvements to allow everybody to benefit from them.

Developing new products and services requires an increasingly diverse competence. If all the people in the workplace are just mirror images of one another, great risks are present. After all, new things emerge from the ideas of people who perceive the world differently. Differences are a pre-requisite for the creation of anything new, even if they may result in internal tensions within the organisation. It is important to make efficient use of the multifaceted character of the organisation by generating creative tensions between issues – not people.

5.3 Technological competence

Technological development and a world that is becoming increasingly networked and globalised are changing companies and their business models. The influence exerted by new technologies works two ways: technology paves the way for new operating methods while the new operating methods require new technological solutions. The second interim report on the Education Intelligence project (Confederation of Finnish Industries 2005b) provided a description of the key technologies of the future: information and communications technology, biotechnology, materials technology and nanotechnology. As these key technologies advance, they will pose a challenge to existing processes by offering a more efficient operating environment or more environment-friendly alternative (Statistics Finland 2005). The Education Intelligence clusters expect a great deal from the key technologies. They are believed to play a central role in revamping the traditional Finnish industry and to offer

potential for creating a completely new type of business. Naturally, conventional technologies will continue to develop side by side with the key technologies.

- **Information and communications technologies** offer new possibilities in communications, data transmission, data acquisition and processing. The information and communications technologies are important production technologies that can be harnessed to achieve greater efficiency and productivity. Their use will also affect business models. (Statistics Finland 2005)
- **Biotechnology** means the application of science and technology to living organisms, as well as parts, products and models thereof. The objective is to alter living or non-living materials for the production of knowledge, goods and services. ”
- **Materials technology** is concerned with the methods for manufacturing, processing and working materials. Additionally, it covers the design bases for products and production methods as well as the use, disposal and recycling of products from a material-specific point of view.
- **Nanotechnology** refers to a science and technology operating at the atomic and molecular level on the nanometric scale. Nanoscale changes in the molecular structure of a material can significantly improve its physical and chemical properties observed on a larger scale. In nanotechnology, physics, chemistry, biology and materials sciences are fused into one.
- **Environmental technology** is a technology that enables sustainable development that can solve or alleviate the problems associated with the living environment. The objective is to achieve a standard of quality of life that allows society, economy, the environment and social development to thrive.

5.4 Business competences

The report “Business Competence – What Will Change?” published by the Confederation of Finnish Industries in 2006 includes the following statement: *“Business competence means the ability of the executive management to position the company’s business activities within the context of the operating environment proactively by anticipating future developments. At the same time, it means the ability to develop a management system and earnings logic that generates a competitive edge in this operating environment based on the company’s strategic strengths. What is also required is the capacity to create and manage networks and processes together with partners.”* To put it a nutshell, business competence means all the knowledge and expertise required for successful operations.

In reality, business competence manifests itself as continuous change, development and renewal. Table 3 lists a number of challenges concerning business competence based on the “Innovaatiosta hyvinvointia” (Innovation and Welfare) report (2005) published by the Finnish Technology Agency Tekes. The relative importance of the individual aspects of business competence varies according to the organisation involved. The manifestations of competence in various contexts is illustrated in Fig. 18 (Kettunen et al 2003).

Business competence manifests itself in the ability to anticipate and understand changes in the operating environment, lifestyles and consumption patterns. At the same time, it is necessary to be able to respond to unforeseen and even surprising developments.

Business competence means the ability to develop product and service concepts that meet the customers’ expectations and needs, apparent or latent. A major challenge is to respond to the highly individual needs of specific customer groups while at the same time maintaining sound financial performance. Applied competence will be of growing importance.

People management skills will be highlighted. With baby boomers going into retirement, competition over qualified and productive employees will intensify. Instead of being simply hired, the best experts will be in a position to select the employers and managers they prefer. However, qualified staff alone will not create value. Business competence means the ability to make use of this expertise and knowledge. (Järnstedt 2005.)

Table 6. Challenges in developing business competence

Management of innovation activity

- Interdisciplinary cooperation right from the start of the innovation process
- Inclusion of business vision and strategic foresight in innovation activity
- Faster product development and commercialisation cycles
- Broad understanding of innovation activity (not limited to production innovations)

Customer orientation

- All-round evaluation of company offerings:
 - tangible products
 - services
 - brand
 - image
 - design
- In-depth understanding of the customer
- Management of long-term customer relationships
- Customer-responsive product and service development
- Service customization competence
- Familiarity with the target market
- Anticipation of changing procedures and behaviour patterns
- Service competence

Management: strategic management, network management, partnership management

- Management of core competence
- Creation of new business models
- Strategic positioning in the value network
- Creation and management of global networks
- Administration and management of networks in a multicultural environment

Management and development competence

- Competence management
- Competence related to the organisation and the culture of the its network partners
- Promotion of creativity

Source: Tekes 2005, adaptation

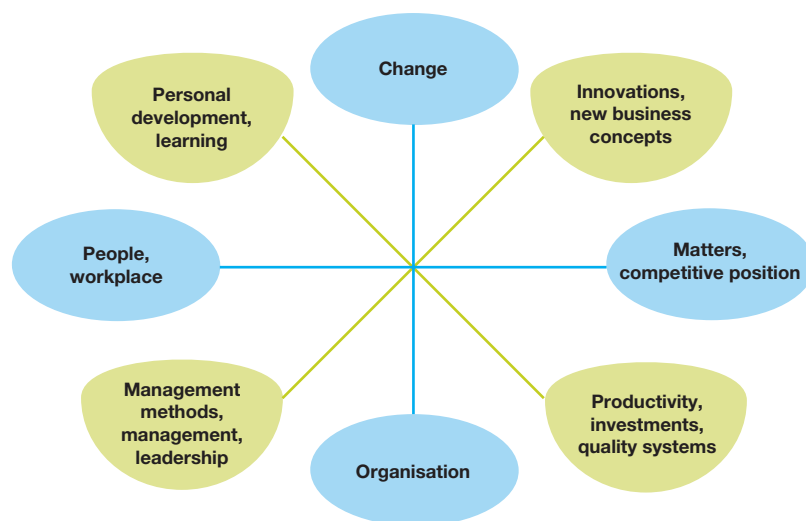
The task is to inspire people to channel their competence and creativity to serve corporate purposes. The important thing is to keep the experts active: to support people's willingness to learn and renew themselves and to promote insights and their practical application. It is necessary to set ambitious goals that generate passion and create potential for success (Himanen 12 January 2006).

Good people management will be highlighted as the rate of change increases even further. When major changes take place, for example when companies and different organisational cultures are merged, special attention needs to be paid to the well-being and sense of security of the staff as well as the related social implications. An efficient work culture is based on trust, the creation of a rewarding workplace community and creativity. If trust is lost, people tend to perceive

one another as threats and concentrate on securing their own position instead of focusing on creative risk-taking. (Himanen 12 January 2006.)

An additional challenge associated with people management is posed by the digital operating environment. A growing percentage of executives lead networked global organisations where people are managed mainly through a network. As a result, decision-making powers are inevitable distributed and the self-direction of individuals and groups gain in importance. This will create growing supervision problems that can be alleviated by training and communications. (Lehti 2006.) Even a virtual operating environment calls for the ability to express emotions; for example, giving feedback requires special skills. This is particularly important in the context of cooperation where the parties seldom meet face to face.

Figure 15. Dimensions of business competences



Source: Kettunen et al., 2003

5.5 Network competence

The success stories of the future will increasingly be created as a result of developments taking place at various interfaces, for example between sciences, technologies and/or arts. To make full use of the potential offered by interfaces, it is necessary for the experts in the individual fields to form networks. Interaction between sectors that have not previously worked together is essential to the creation of anything that is genuinely new. What is imperative is to identify opportunities in areas that are at the edge of the in-house sphere of experience or even outside it.

Networking means a process by which the partners' knowledge, competence and values are combined to generate value-adding activities (Confederation of Finnish Industries 2001b). For the clusters evaluated in the Education Intelligence project, networking competence – the ability to join, create, manage and develop functional networks – is one of the major competence challenges of the future.

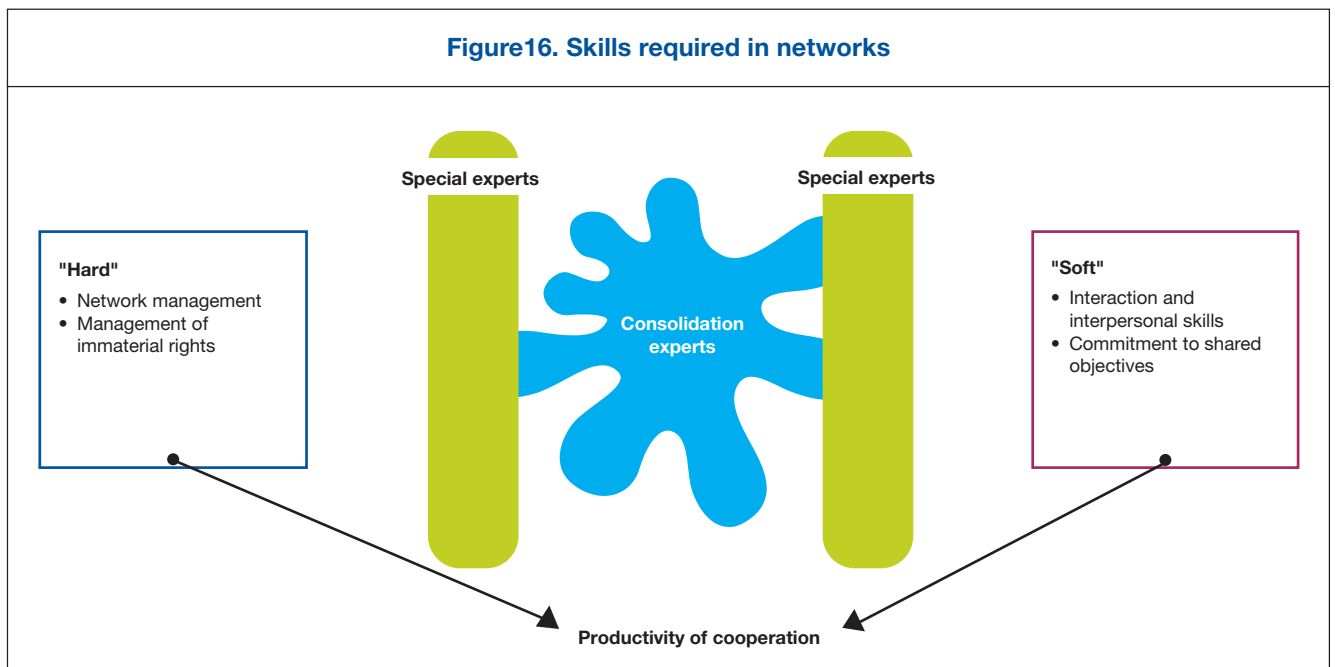
Within the networks, the real means of exchange are competence and knowledge. For the promotion of innovations, it is important that there is a happy balance between specialists and “competence amalgamators” or mixes of the two within the network. Specialists possess in-depth theoretical and practical knowledge of a narrow field. For example, developing the properties of the plastic film used for coating the mobile phone display requires a specialist who understands what type

of plastic is good for the eye while at the same time inexpensive to produce.

Competence amalgamators serve as “bridges” between the specialists in individual fields. They know how to reprocess knowledge into an understandable form and combine various fields creatively. At the same time, they have the ability to examine things from a wider perspective; for example, they may have insight into market trends, understand customer expectations and needs and be able to make the right choices.

When people try to get something done together, be it in a network or at a regular workplace, it is important to have good interpersonal and interactive skills. The key to successful cooperation is mutual trust. It increases interaction between people, helps make a commitment to common goals and resolve conflicts constructively. Also, trust is the necessary prerequisite for open and reciprocal sharing of competence. What is also required is the ability to share visions and to have an unbiased attitude towards new ideas and people – in short, out of box thinking.

In network cooperation, the efficient management and protection of intellectual property rights (IPR) are critical skills. IPR refers to rights related to patents, utility models, copyrights, trademarks, marks of origin, etc. The intellectual property rights provide various degrees of protection for inventions, works, visual or verbal symbols and models (www.tekes.fi).



Multiskilled teams in a biotech company

Biobio Pharma Ltd is a successful company, not least because of its skilfully constructed team of researchers. Anne, the 42-year-old team leader, has invited top experts of different ages and background, to join the group in which every one of them has a specific role.

Konsta, a Finnish expert in bioinformatics, works in close cooperation with Swedish, American, and Polish biochemists. All the four have taken PhDs in their native countries but before joining Biobio Pharma Ltd they had met at several pharmaceutical conferences. Konsta's professional qualifications are based on interdisciplinarity. Bioinformatics allows Konsta to make full use of his talent for experimental natural sciences as well as for his skills in applying mathematics and knowledge of data processing for the purpose of modelling natural phenomena. He develops computational models and data processing procedures for Biobio Pharma Ltd's needs while serving as a link to the biochemists.

Over the years, the number of experts in business administration in the team has been increasing steadily. Service competence as well as sales and marketing skills play a central role at Biobio Pharma Ltd. Strategic marketing has helped understand customer needs, particularly as more and more of the work is being carried out in collaboration with the customer. Simo, a psychologist with a master's degree in cultural anthropology, is also a member of the team. Operating as it is on the global market and working with multinational customers, the company regards Simo's role as irreplaceable: in an expert organisation, knowledge of people and cultures is of critical importance.

Another key member of the team is Sofia. Being a lawyer, she takes care of licensing and patents but at the same time she underlines that the understanding of legal matters is not solely her domain. At her initiative, the team members are being constantly trained to give due consideration to the legislation essential to the company's operations. At the same time, Sofia undergoes in-house training in order to gain a better insight into on-going research projects and the special features of the field.

Sofia's competence profile complements that of Aune, who is responsible for lobbying: addressing regulatory issues and communicating with the authorities. A medical doctor and social scientist by education, Aune used to serve as an EU coordinator for humanitarian aid. As a result, her special strengths are familiarity with the EU structures and extensive experience of working with the authorities.

Called a people manager by the other team members, Aune is also regarded as a seer and strategist at Biobio Pharma Ltd, but when the objectives for the future are outlined, all the team members are present. Around her, she has a team that is forward-looking and possesses a wide range of skills.

5.6 Service competences

Industry, construction and the service sectors will converge. The service business has become an important part of industry and construction and its role will continue to grow. Extensive automation of services is foreseen, as a result of which knowledge-intensive service work will diverge into self-service, tasks handled through servers and terminal devices, and related maintenance and support functions performed in the background. Thanks to global data networks, the background work can be carried out anywhere in the world, meaning that jobs will migrate to countries with a lower cost of labour. (Lehti 2006; Confederation of Finnish Industries EK 2005a.)

At the same time, the very concept of service and its

content are expanding. It is no longer just face-to-face interaction between people. The service business can be divided into product or production-related services, new services enabled by technology, and competence-intensive business services.

At the companies included in the Education Intelligence clusters, some of the services will be used in-house while others will be incorporated in the industrial products sold. Instead of having a customer buy a device and start using it, the unit will be delivered to the site, installed and set up ready for operation. Additionally, services such as training, maintenance and financing will be provided. Service will be based on expertise in which technological competence plays an important role. Working with

customers calls for interpersonal and interactive skills - being face-to-face with people requires sensitivity, the right attitude, and a vision. Figure 20 illustrates what sort of services can be built around a technological product. Figure 21, in turn, shows some real estate solutions and services that can be offered to customers.

One way of expanding existing markets is to develop services around industrial products. While a product produces a single transaction, services generate a steady flow of earnings. This is what makes it extremely important to cherish long-term customer relationships. Additional demand is created by the customers' concentration on their core expertise and the ever-increasing adoption of technology in all spheres of life. (Confederation of Finnish Industries 2004.)

New technology-enabled services mean the development of innovative service concepts by making use of information and communications technology. In the provision of any service, it is important to understand how productivity and competitiveness can be improved by means of technology. The task is to create internationally competitive digital service concepts that can be implemented in Finland instead of some other country with low labour costs.

Knowledge-intensive business services (KIBS) are business-to-business services in which expertise plays a key role. Prime examples include software and new media, information, research and development services, legal services, consultation and human resources services. Knowledge-intensive business services are vital to the creation and commercialisation of new

products, services and processes. (Toivonen 2001, 2004; Confederation of Finnish Industries 2005a.) A major challenge in knowledge-intensive services is co-production. It means that services are produced together, with both the customer and the service provider adding value as partners.

Figure 22 shows a number of challenges faced by the Education Intelligence clusters:

- **Customer service:** While many services are no longer taking place close to people, human interaction will still play an important part, being pronounced in services that are difficult to automate completely, such as various expert services.
- **Technological competence:** In services, technology plays an enabling and facilitating role.
- **Networking:** Developing a service process that gives due consideration to the customer's needs and requirements calls for interdisciplinary cooperation that transcends sectoral boundaries.
- **Creativity and innovation:** There must be enough enterprising spirit to develop and offer services for which there is currently no demand on the market or the need for which has not yet been voiced in public (www.vision2010.fi).
- **Commercialisation:** One of the major challenges is to convert services into marketable products. Companies must be able to produce a set of commercialized model solutions of which customers can select the preferred option subject to certain boundary conditions (www.visio2010.fi)

Figure 17. Services to be created are around a technologic product

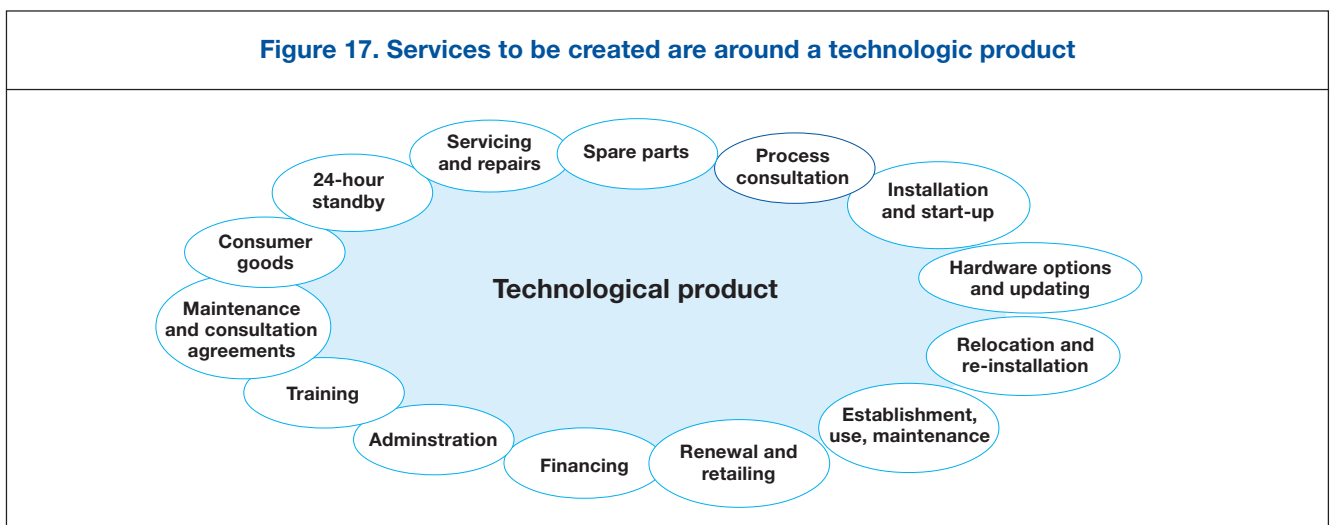
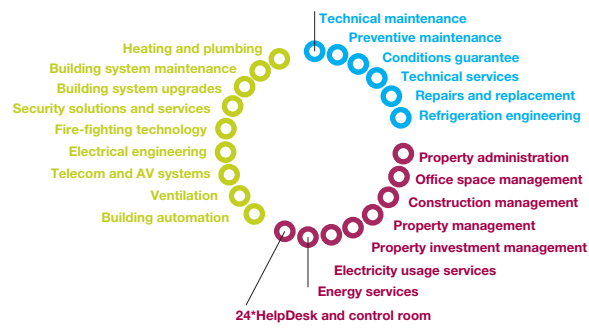


Figure 18. Building engineering solutions and services

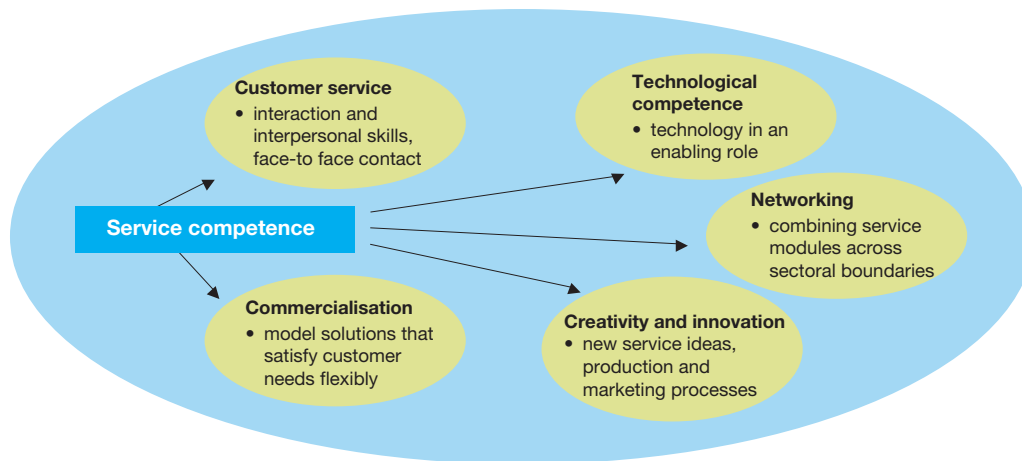


Source: YIT

- Building systems
- Property management
- Property and building engineering services

Figure 19. Elements of service competence in the education intelligence clusters

Customer-oriented business competence required right from process start



Motto: I've got what it takes

The 2015 trade championships are held in Riga, Latvia. Ossi, 20, is Finland's representative in the carpenter category. For him, participation represents no departure from the motto he lives by in his day-to-day work: I've got what it takes. The judging panel agrees with him on that point, 100 per cent.

The following summer after the competition, Ossi had an opportunity to give evidence of his skills at a Finnish construction company named SolutionBuilding Ltd. It is a service company offering sustainable solutions for added comfort and style. Solution-Building serves as an adviser helping the customer make choices and see the big picture. Ideas are tossed back and forth with the customer and action is taken after the final decision is arrived at.

During the summer, Ossi's motto acquires a new dimension. I've got more than it takes, Ossi says while studying the virtual model of a building. At SolutionBuilding, information and skills are passed between senior professionals and apprentices, but Ossi says that the master of masters is Vitor whose special skill is seeing the whole. "I've never had the feeling that I'm just pottering about, it's more like everything I do is part of a bigger thing".

Ossi will graduate in the spring of 2016, something that people at SolutionBuilding are looking forward to. His studies include modules related to general critical skills, working with customers, interaction, self-direction, and assumption of responsibility. Ossi's strengths include a keen interest in environmental issues, command of English, and elementary knowledge of Russian. The kind of competence represented by Ossi is in great demand.

5.7 Design competence

Design will play an increasingly important role in the companies representing the Education Intelligence clusters. One of the reasons for this is the shift in emphasis towards a customer-oriented business model, meaning product development based on the needs, wishes and values of the customers.

Attributes that offer added value for customers are, among others, individuality, usability, reliability, security, ergonomics, aesthetic value, ecology, and experience. For many customers, the price of the product will continue to be the primary selection. (Confederation of Finnish Industries 2004; 2005.) All these properties of products and services can be influenced by design.

Design can be utilized in products, services, communications, environment and in strengthening the identity of companies and associations. Outward appearance is important particularly in consumer products because design is a central element of the brand. Luxury products are a prime example of how pricing can be influenced by means of a desirable image. Top design competence is also found at companies manufacturing products such as paper machines and marine engines. Design can be used for building the corporate image and facilitating inter-company business by planning the activities from the standpoint of total communications; the products and devices used also communicate the values represented by the company. (Lindström, Nyberg & Ylä-Anttila 2006; Confederation of Finnish Industries 2005b).

Industrial design is an on-going decision-making process in which ideas are converted into products and services as a result of exploration and experimentation. Design competence calls for the ability to examine things from a wide variety of angles within the framework of certain initial conditions. Design is a process that includes several components (Lindström, Nyberg & Ylä-Anttila 2006.):

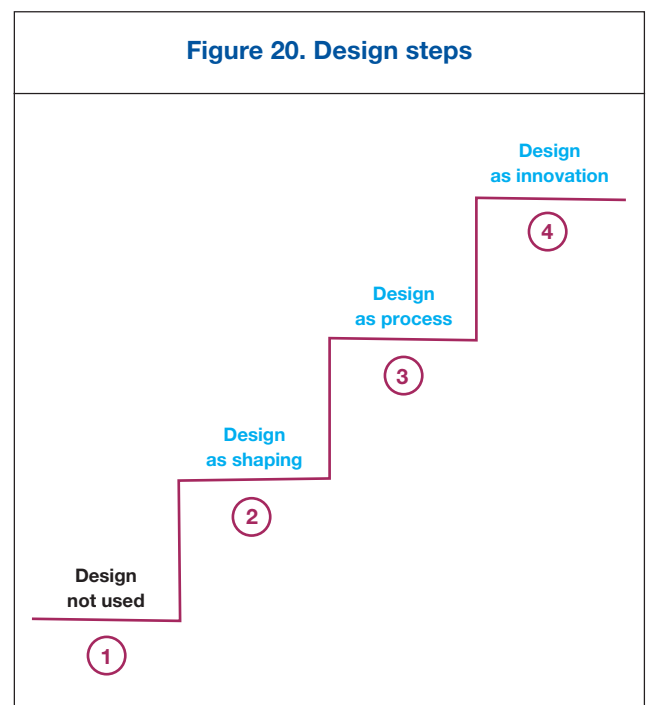
- **Market research:** An attempt to analyse in advance what commodities or services consumers will demand.
- **Concept development:** How are consumer preferences transformed into commodities and services?
- **Concept evaluation:** How does the new product answer to these preferences, competitive products and production **factors**?
- **Design solution:** Prototype testing and improvements with due regard to things such as

the product's suitability for intended use, its aesthetic values, and industrial rights.

- **Commercialisation:** Maximisation of reliability in production and minimisation of production costs.
- **Communication:** Product marketing and branding.

There is a positive correlation between investments in design, growth in sales, and export share. Of course, design does not guarantee success for a company – what is essential is the way design is used. Figure 23 shows how companies can make use of the potential offered by design. Companies at the lowest step make little use of design. On the second step, design is used for designing the outward appearance, while on the third level design is part of everything right from the beginning of the product development process. On the highest step, design is part of the corporate strategy. Studies show that the more companies make use of design, the better they succeed relative to competition. (Lindström, Nyberg & Ylä-Anttila 2006.)

Figure 20. Design steps



Network expert, partner and project team - welcome to Customise Ltd!

Customise Ltd is an expanding Finnish logistics centre that offers high-end processes, work performances and solutions arrived at in close consultation with the customer. To strengthen our staff of 300 people in Finland, we are looking for...

...Network expert

Your responsibility is to focus on customer relationships. You are an CRM professional who will handle contacts with the partner network and between the units located in different countries. You have excellent personal networking skills and the will to promote a dialogue between individual partners and to strengthen synergy. As we want to be the best possible partner for our customers, we expect you to have in-depth understanding of their business and a genuine commitment to further their interests.

...Team of two

We are looking for top expertise that can be provided by a team of two. You will assume responsibility for the technological development of solutions and related design. You are expected to have the ability to transcend boundaries - to establish connections with unconventional partners and to help combine technology with creativity. A shared work history will be considered an asset.

**Please send your application in English by Tuesday 5 February 2015 to www.customise.com/joinus.
A video clip presentation will be plus.**

5.8 Management of multiculturalism

The representatives of all occupational categories – seers, appliers and implementers alike – will in the future have more and more face-to-face contacts with people of different nationalities. With growing immigration and international recruitment, Finland and Finnish workplaces will become increasingly multicultural. At the same time, open-mindedness will turn into a major competitive tool: an easy-going atmosphere will attract people who think differently or have a different work history, including people with different cultural backgrounds (Himanen 2004).

Of the three occupational categories, the biggest change in job descriptions compared with the current situation will take place with implementers. Among other things, they will be required to handle contacts with global suppliers and customers. Job rotation will keep them moving from one country to another. Implementers will also take part in international development projects. For example, they may participate in project groups that seek to develop the production process. At a later date, a decision is made to introduce a similar process at the company's plant in China, meaning that a Finnish implementer who was involved in the project will be dispatched to the country to assist the local implementers in commissioning. Internationalisation will be reflected in the implementer's professional skills even if the duties will be mostly local tied to the location where the work is carried out. If not otherwise, the working environment will become more international at least in the form of documents and manuals that will be in English.

English is by far the most common language used in international communications. In spite of its dominant role, knowledge of other languages will also be vital in 2015. Few jobs, however, will require complete mastery of a foreign language. Oral language skills must be sufficient for active interaction and cooperation: what is required is the ability to express ideas clearly and convincingly, arouse interest and create an atmosphere of trust. At the same time, good writing skills will become more important as Finnish will increasingly be replaced by some other language in reporting.

Also, an understanding of the partner's culture is important; familiarity with the values, customs, religion, gender roles and social norms promotes open-mindedness and efficient cooperation. In-depth knowledge of the Finnish culture gives tools for greater

appreciation of other cultures as well. Familiarity with other cultures is indispensable, particularly when products are designed for the global consumer market.

Special challenges facing the appliers and seers are interpersonal skills in a demanding international environment, the ability to engage in a dialogue and argumentation, and debating skills (Fig. 25).

5.9 Responsible business

Important elements of any responsible business, also known as corporate citizenship, are economic and social responsibility and protection of the environment.

- Economic responsibility means primarily fulfilling the owners' profit expectations. Sound financial performance generates well-being in society at large.
- Social responsibility means transparency and compliance with good practices in all relations with stakeholder groups as well as a range of civic activities,
- Environmental responsibility means sustainable use of natural resources and protection of the environment.

A responsible way of doing business means that companies voluntarily incorporate social and environmental responsibility in their activities and stakeholder relations. What such social responsibility requires in reality is something that every company has to evaluate in the light of its values and objectives. (Fagernäs 2006; Lovio 2006.)

The individual elements of responsibility are inseparably intertwined. Sound financial performance provides the basis for fulfilling the social obligations and assuming responsibility for the environment. For a company to succeed, it must look after its staff and maintain its skills and competence while at the same time acting responsibly with regard to the environment and stakeholder groups.

Responsible business is growing in importance, for example in areas such as reputation management and the enhancement of the corporate and product image. A good reputation is an invaluable tool in maintaining the respect and appreciation of the staff, investors, consumers, suppliers, service providers, governments, non-governmental organisations and the media.

At its best, responsible business secures long-term profitability and competitiveness. To a great extent, the connection between responsibility and profitability depends, however, on how innovative and skilful the

Figure 21. Challenges in developing interaction skills

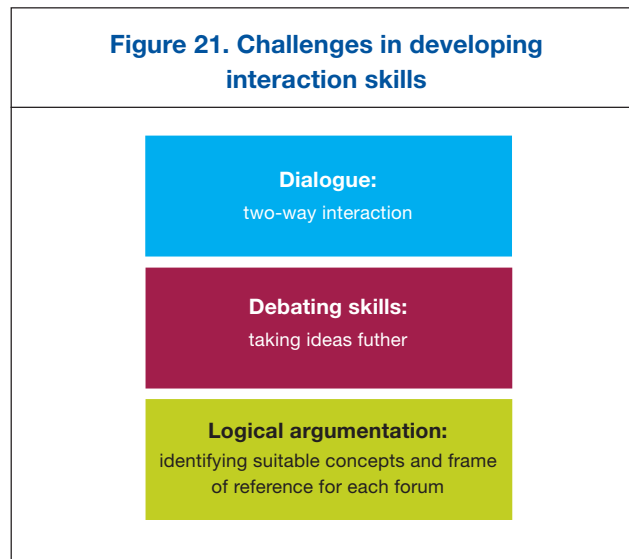


Figure 22. Multicultural skills

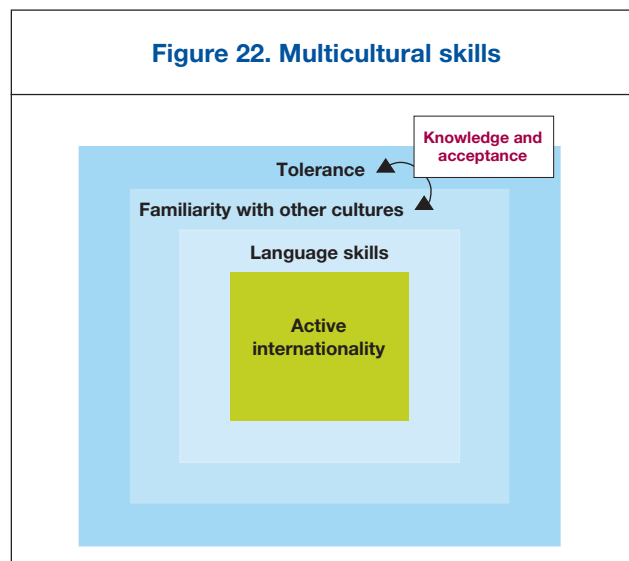


Figure 23. Three pillars of responsible business



company is in implementing its responsibility strategy. Nobody stands to gain if a company develops a highly “responsible” product and a business model geared to social responsibility but the customers are unwilling to pay for this. Then again, irresponsible business practices are bound to damage the corporate image and have an adverse impact on competitiveness both in the short term and the long term. Sound business competence is required to ensure that the responsible way of doing business is also profitable. (Lovio 2006.)

Responsible business calls for an extensive range of skills and competence in a number of areas: business administration, human resources, health, safety and environmental issues, as well as research and development. Also, the field is very demanding in terms of communications; how to convey the message about the company’s sense of responsibility in a way that is credible and understandable. Competence in the area of customer, investor and social relations is also required. Companies have to be familiar with and know how to apply a range of procedures. These include value processes, preparation of policies and instructions, management systems, and reporting procedures. Similarly, familiarity with the international operating environment and different cultures is important because a global company should be able to create values and principles that can be applied to all business environments and circumstances. As responsible business affects all aspects of corporate activities, it should be part of the professional skills of all occupational categories. (Fagernäs 2006.)

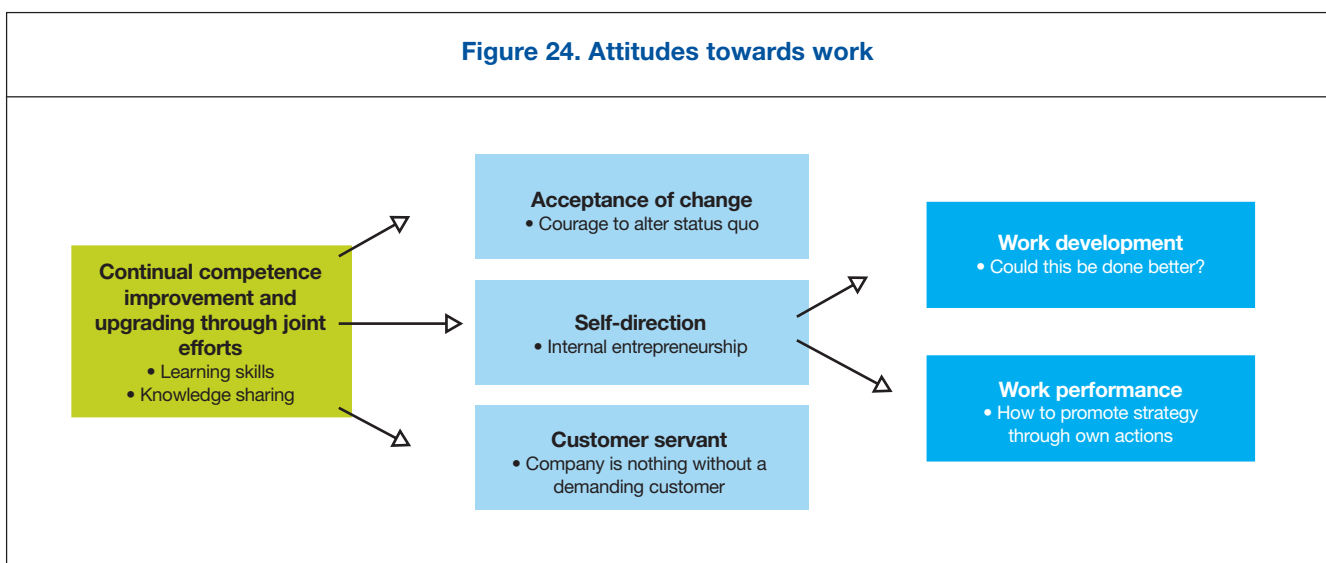
5.10 Attitudes

In an increasingly complex operating environment, qualified staff is the most important asset a company can have. Employees will be required to have better and more varied skills. Education and training will grow in importance while the employment prospects of people with little education will greatly deteriorate. Employees will be expected to have a positive attitude towards on-going maintenance, updating and development of their professional competence. Of increasing importance will be the ability to create new knowledge in collaboration with colleagues or in a wider network. This also requires a willingness to share one’s own expertise.

Living with change, uncertainty and conflicts is unavoidable but it must be supported by sound management, strategy and vision. What is critical to any acceptance of changes is the ability to get other people to realise the need for it. An employee who is good at his or her job finds it easy to embrace change as they can rest secure in the knowledge that there is always demand for their skills.

Coping with work duties requires a self-directed approach to work. Employees are expected to make a commitment to work as if they were entrepreneurs within the company. Internal entrepreneurship calls for a responsible attitude towards work and its development as well as the willingness to use one’s creativity, innovativeness and competence for the good of the company. Commitment to an entrepreneurial attitude requires transparency. Every employee must be

Figure 24. Attitudes towards work



aware of the company's strategy, objectives and current status. Additionally, they need information about how the strategy can be promoted through individual action and how everybody's input is connected to the whole.

Every individual working for any company must be service-minded. In particular, the importance of the standard of service and attitudes towards customers is highlighted when the same service is provided by two similar companies with similar products. Then, the differences consists of intangible things – the quality of service as perceived by the customer. A demanding customer relationship needs to be seen as a positive challenge as it creates pressures for the business to develop and renew itself.

5.11 Values

Values are ideas of what is worth striving for and how people should behave. Values include a strong element of evaluation and an emotional charge and are highly permanent in nature. Corporate values determine the way the firm acts. They can be used to set forth the key principles that employees are expected to comply with. Usually, the true meaning of the values inherent in the corporate culture is revealed to the individual with time. Corporate and individual values are not always identical. Individual employees cannot, however, operate in a company in accordance with their own views; instead, they have to accept the common position as the basis for action. (Raitavuo 2005.)

Personal values will increasingly determine the type of work people are looking for. They seek employment with firms whose values they see as being identical with their own. For young people, the main criteria for the selection of a workplace include the company's responsible and humane attitude towards the staff, career opportunities, the ability to influence the contents of one's work, and the extent of consideration given to the life situation of the individual. At the same time, a secure and permanent job still remains desirable goal (Moisio 14 Feb 2006).

6 Evolving educational system

6.1 Educational system is facing change

In order to succeed, all organisations must learn and renew themselves at least at the same pace as their operating environment is transformed. For the educational system, the challenge is even greater than that: you have to be ahead of the pack. Education is expected to steer future developments in a positive direction.

Some training organisations operate commercially, and so they are affected by the same forces for change as other enterprises. Other organisations are mostly funded by the taxpayers. Even so, they will be affected by change as well.

<p>Ageing population</p>	<ul style="list-style-type: none"> • Competition for top experts increases • Public funding for education more limited • Lifelong learning highlighted • Need for cooperation between providers of education increases as age groups get smaller
<p>Change in the global division of labour and increased mobility</p>	<ul style="list-style-type: none"> • Low-skill jobs relocate to countries with low labour costs; increasing quality requirements imposed on education • Competition in competence-intensive fields increases, education to promote innovativeness and creativity • Support for top competence • International benchmarking of education • Creation of high-performance multicultural learning environments • Social and cultural diversity perceived as an asset • Immigrants' own educational needs • Intense international networking of education • Fiscal uncertainty reflected in the financing of education • Mobility increases the need for diverse learning environments and flexibility in the provision of education • International markets for education
<p>Sustainable development</p>	<ul style="list-style-type: none"> • Sustainable development to play an increasingly important role in the content and provision of education
<p>Technological development</p>	<ul style="list-style-type: none"> • More efficient and varied use Information and communications technology in education • Media literacy • Understanding of the learning process • Convergence of technologies and applications increase interdisciplinary network cooperation in education • Cooperation with business Development and maintenance of the technological competence base in all population segments, including lifelong learning • Internal flexibility of the educational system • Interdisciplinarity and sectoral cooperation • Basic skills must be mastered before anything new can be created
<p>Social change, new values</p> <p>Ethics Experiences Individuality World citizenship</p>	<ul style="list-style-type: none"> • Ethical policies and content will gain in importance in education • Experience-based learning • Versatility of the new applications and environments of learning • Strong international networking, especially virtually • Understanding of the students' reference groups • Social learning and individuality side by side • Entrepreneurship training
<p>Continually changing operating environment</p>	<ul style="list-style-type: none"> • Anticipation • Capacity for structural changes • Quick feedback systems and structures facilitating response to feedback

6.2 Humane development as the fundamental point of departure

The educational system must be developed as part of society. It is imperative to identify the economic, ideological and international drivers for change and anticipate their combined effects (Kanninen 10 May 2005; Confederation of Finnish Industries 2005c). At the same time, we need to ensure that the educational system itself has capacity for renewal. Adequate resources and favourable conditions have to be created for education to allow it to lead the positive development.

Economic competitiveness and growth provide the basis for social welfare. The educational system must be overhauled to support economic growth more effectively than in the past, with due regard to the structure and quality of such advancement. It is imperative to proceed on the terms dictated by humane development. This holds true on a global scale because in the future, contacts between countries and continents will be more intense than today (Ghosh & Ugaz, Confederation of Finnish Industry 2005c).

Humane development does not eliminate the need for major structural reforms, quite the contrary. Therefore a new direction must be identified for the school system in full awareness of its strengths, weaknesses, threats and opportunities.

6.3 Diverse ways, technologies and environments of learning

The Education Intelligence project seeks to anticipate the era of the conscious network society (Fig. 30). While the education system will retain its central role in supporting learning, knowledge will be acquired and competencies built up in other ways as well. Technology will be harnessed to serve the learning process in a framework of learning, occupational and free-time environments that combine virtuality with personal interaction.

The citizens of the future are required to possess strong capacity for ethical evaluation when the following methods are made commonly available (Glenn 13 May 2005; Confederation of Finnish Industries 2005c):

- Cures for illnesses and improvement of human qualities through genetic engineering
- Intelligence-enhancing drugs that affect memory and brain functions
- Other medical and technological methods for improving man (the biomechanic man).

More than before, learning will be a permanent part of daily life. Learning at work, in the free time, and within the educational system will be supported by human and material resources (Glenn 13 May; Confederation of Finnish Industries 2005c).

Figure 25. Human approach to development

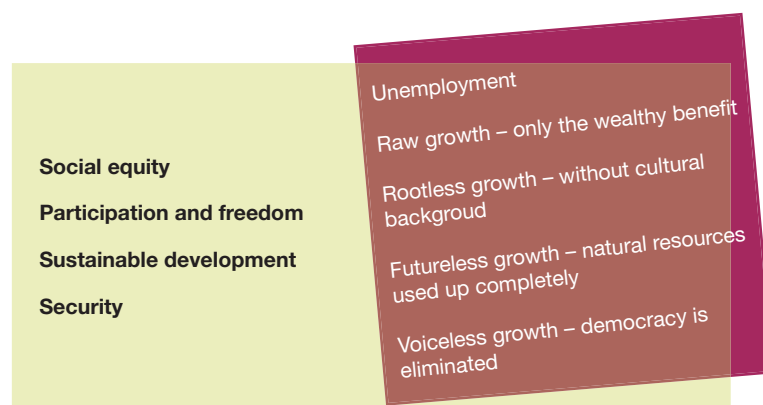
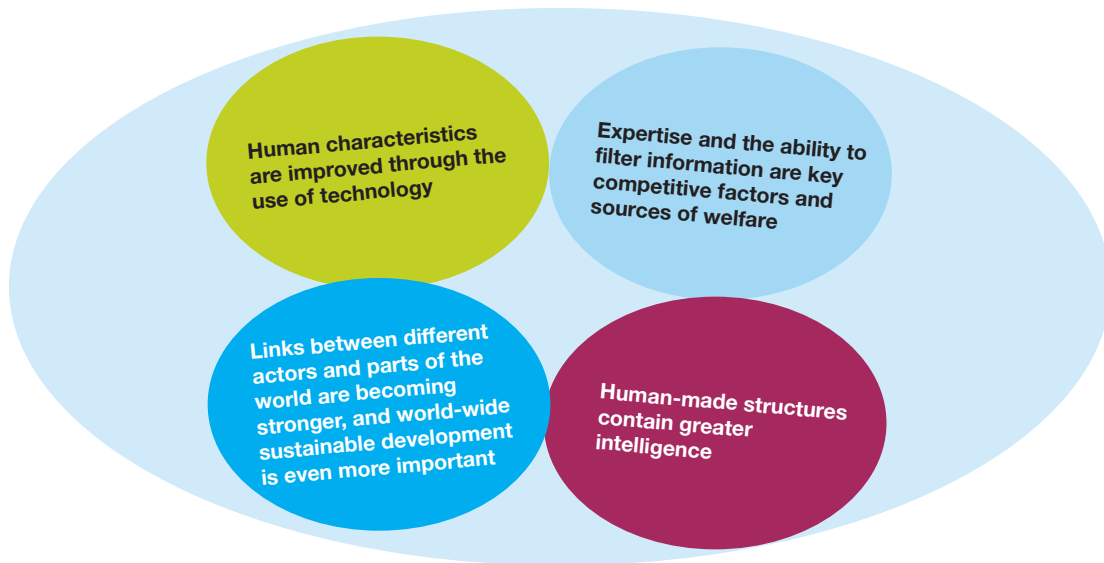


Figure 26. Conscious network society



A Human resources

- Love, caring (feelings affect learning!)
- Controlled shaping and cherishing of memes (for example: mathematics is sexy)
- Autosuggestion, becoming convinced of one's own potential
- Association with and guidance by intelligent and skilful people (teachers in a new role)
- Association with and guidance by intelligent and skilful people (teachers in a new role)
- Intelligent games
- Making use of the subconscious
- Management of the flood of information
- Promotion and utilization of the comprehensive view: understanding and exploitation of the nature of complexity, chaos and evolution; refinement of the right/wrong and true/untrue positions by combining a wealth of information and ways of thinking and accepting several parallel truths.
- Physical exercises
- Progression from a zero sum game to the limitless potential offered by knowledge and competence
- Forward-looking orientation and anticipation of future developments

B Material resources

- Diverse, intensely interactive learning, occupational and free-time environments that make use of the latest technology.

* A meme refers to a unit of cultural information that propagates itself in the same ways a genes in biological evolution. Memes are units that exist only in the brain or in objects created by means of brains, such as computers or books (Wikipedia).

* A zero sum game is a game of two players in which one player's winnings equal the other player's losses.

6.4 Views as to how to develop education

Close interaction is required between the educational system and other preconditions for learning. The Intelligence Education project proposes eight measures to achieve this goal.

Competence needs as a guideline

Competence needs are reflected in education as follows:

- The education provided responds to current and future needs.
- New applications and environments support growing competence.
 - Values
 - Attitudes
 - Culture
 - Atmosphere
 - Community and partner networks
 - Technology
 - Working methods
- Learning should be phenomenon-focused: interdisciplinary boundaries should be lowered.

The Education Intelligence project seeks to explore the attitudes, values, knowledge and skills that will be required in the future. For example, responsible corporate citizenship is critical to the renewal of Finnish business and future competitiveness. The needs of companies should be taken into consideration and reflected in the content of education, which should provide critical basic qualifications and support competence-building in the course of the professional career. Part of the skills are acquired as a matter-of-course thanks to the advanced learning methods and environments. For one thing, innovation and creativity should be promoted and encouraged by a culture conducive to learning, a positive atmosphere and by bringing different people together, physically or otherwise.

Intense networking

In practice, networking means the following things:

- A quality system based on the impact and performance of the educational system
- Utilisation of new technologies
- Cooperation on the local level
- Nationwide specialisation
- Genuine cooperation between international learning networks and various service providers
- Private-public partnerships promote growth, entrepreneurship and well-being.
- Entrepreneurship promoted throughout society.
- Trust-building.

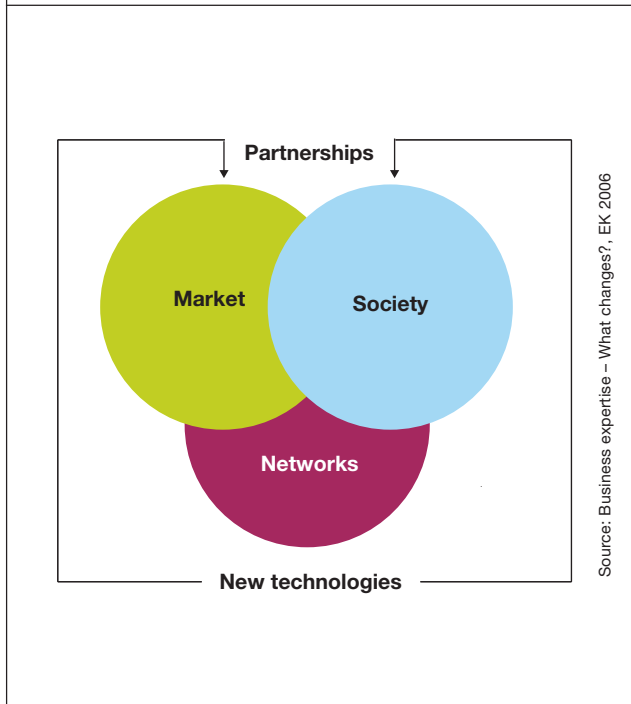
In the future, learning must be perceived broadly: education should be closely linked to the other prerequisites of learning. For this purpose, versatile activities centres should be created in which learning, play, the pursuit of various hobbies and rest would constitute an integrated school day.

Networking is also something that Finland's position in the international community calls for: we need to be able to generate products, service, business models and organisations that are truly innovative. Often, the innovations are interdisciplinary and require cooperation between several fields in order to be implemented. This is nothing new: during the LUMA project carried out in 1996-2002, research data was gathered on, and operating models developed for, interdisciplinary cooperation that transcends the boundaries between various fields; the other themes included the multiplicity of learning environments and procedures and advanced evaluation in the field of mathematics and natural sciences. The networking model should be deepened and expanded.

Learners should be able to adopt various contents flexibly according to their individual needs. At the same time, efficiency in the use of resources should be improved. How to solve this equation? Educational institutes should develop highly individual identities while at the same time cooperation should be initiated. A quality system based on the impact and performance of the educational system should be created.

The on-going IT revolution will lead to the convergence of technologies and applications. Networks involving several fields of activity will be created. In the future, educational services will increasingly be provided through cooperation between the players in the communications, entertainment, knowledge and education

Figure 27. Partnerships enhancing human capital, economic growth and welfare



industries. More and more private companies will be involved in education along with public-sector organisations. New information technologies will make it easier to build and manage cooperative networks.

The educational system will network with other service providers and stakeholder groups, such as business life. This type of cooperation calls for reformers with an entrepreneurial frame of mind in administration, education and society at large. One of the most important tasks is to promote entrepreneurship.

Conscious efforts should be made to build up confidence in a new mode of operation. Confidence grows from the conviction that the people belonging to a network are aware of their responsibilities. What is needed is common goals that can only be reached through cooperation. At the same time, opportunities for taking action and getting results are needed. (Glenn 13 May 2005; Confederation of Finnish Industries 2005c). For instance, universally accepted rules are required for the resolution of copyright issues.

Structures for life-long learning

What is needed in Finland in the future are strong professional skills as well as all-round competence focusing on building networks concentrating on

development, research and added value. All-round education is the basis on which the competence required in the working life will be built upon. Learning will not stop when school is finished. Lifelong learning will become increasingly important because society is undergoing constant change. The skills and knowledge acquired at any time will inevitably be outdated.

New structures supporting lifelong learning have to be created for education.

In practice, lifelong learning means the following things:

- The various sections of the educational system will specialise in specific fields.
- Cooperation within the educational system will be intense.
- Training modules and other forms of learning will offer individual training paths based on the needs of the labour market.
- A number of ways will be available to show proof of one's qualifications, which in turn will make it possible to advance in the chosen career or switch to another training path.
- A personal skills record will be introduced to show the skills profile.
- A range of degrees will have been put in place requiring specific skills profiles.
- The educational system is responsive to anticipated labour market needs in terms of required degrees and qualifications.
- The required training paths will be publicly funded based on performance and results.
- Administration and criteria for public funding will be coordinated.
- Public funding may be supplemented by private funding.
- Individuals will be in a position to have a say in the practical implementation of training.

To chart the potential avenues for the Finnish educational system, a Delphi survey was carried out during the winter of 2006. The preferred properties were defined based on a "40-year qualification model" (Kuosa 2006). As the working life is constantly changing, the one-off degree earned in one's youth no longer provides credible competence to last for the rest of the professional career. Lifelong learning is vital, something that was found in the pilot phase of the Education Intelligence project during 2001-2003

(Confederation of Finnish Industries 2003).

All future educational systems must have distinct profiles and a clear-cut division of duties but flexibility is required: it must be possible to relocate within the system and combine various contents. Study modules, contents and admissions should be capable of being concatenated to constitute a lifelong learning process. As a result, the competence of the individual is accumulated, updated, expanded and deepened in a planned way. Several methods will be employed to learn: at work, in formal and informal learning contexts by making use of a global syllabus, during one's free time, using distance learning, in Internet study groups, through apprenticeship and work samples, by teaching others what one has learnt, and through job rotation and overseas assignments. As the working life changes and careers are made, employees will need to master new modules that supplement earlier learning and provide competence at levels of increasing complexity. (Kuosa 2006.)

The range of courses offered by the educational network will be compiled into rational modules. The skills acquired on courses and otherwise will be demonstrated. A study manual will be introduced in which personal skills profiles are shown. A system will be created in which expertise and skills acquired through the years can be defined in terms of competence profiles in which the various degrees and qualifications will be accumulated. A special system for professional qualifications will be created focusing on practical skills along with more theoretical studies. The education system will be responsive to the anticipated needs of the labour market. (Kuosa 2006.)

Adequate public resources must be made available to education in a way that ensures the equality of opportunities. Public funding will be channelled for various training paths by coordinating the administrative and other benefits based on performance and results. Private funding is possible. Also, the citizens will have to assume responsibility for their own development.

Learners in the hub of learning

The lot of students must be improved for the following reasons:

- To highlight the importance of lifelong learning
- To personalise training in order to respond to new values and customs
- To improve learning results
- To reduce the drop-out rate
- To make better use of the resources.

What personalisation requires:

- The individual role of each learner involved in the process is defined
- Citizens manage the learning process and what it requires
- Instructors with the required qualifications are available in sufficient numbers
- Career counselling and tutoring will be developed to make it a more interactive process based on active involvement on the part of the learner
- Individual training paths tailored for the needs of the labour market will be available
- Every learner will be given the chance of doing his or her best
- Multifaceted learning will become routine
- A range of information technologies will support learning
- Methods for the evaluation of learning and its impact will be developed.

Mass education has long historical roots. It has served society well for example in teaching societal values but less so in providing capabilities for the independent acquisition of knowledge and information and efficient utilisation of talent (OECD 2006).

The growing needs for lifelong learning and individual training paths were discussed earlier. Children, too, have to be encouraged to do their best. Gifted students should be supported by offering them the opportunity for accelerated learning and giving them greater challenges. Theoretical studies will be supported using various experiments, projects, on-the-job learning, simulations and other IT tools. When training is provided for people in ways that suit them best under the prevailing circumstances, the drop-out rate will be reduced.

Personalisation is also necessary because all organisations will have to improve their productivity. First-rate services can be produced with limited resources only if the learners' own role in planning and implementing the training paths, etc., is expanded. In the future network society, the users of various services want to be able to modify contents, and this trend will become more prominent in education as well.

It should be possible to evaluate the learning results and the quality and effectiveness of training more personally than hitherto, for example by means of teacher-to-learner and student-to-student dialogues and self-evaluation. Additionally, use should be made of information technology in order to secure on-going

feedback. It is extremely important that learners of all ages receive sufficient instruction in building a training path and making progress according to the plan. Co-operation with the business community is indispensable.

New role for teachers

Technological innovations have the potential of revolutionising education. It is advisable to be prepared for this by collecting research data and thinking about the rules for the playing field. The teaching profession will, however, remain important in the network society as well. In future, the job will be understood in broad terms: teachers may evolve into network partners who work as entrepreneurs. Teaching may also be part of some other profession. The training paths include teachers acting several roles, all with their own qualification requirements. At the same time, the teaching profession will be internationalised.

The effectiveness of training and learning results will be core issues in all future training paths. While the learners will bear their share of the responsibility for quality, the teachers will be required to possess superior qualifications. Adequate public funding must be made available to the basic and supplementary training of teachers and people who support the learning process. The business life will make its own contributions by anticipating and interpreting future competence needs and services in its capacity as an expert on working life. The teacher can himself be an entrepreneur or be employed by a school's partner company.

The main qualifications of a teacher include the following:

- Support for growth as a human being
- Familiarity with core competence areas according to the task involved
- Familiarity with the future challenges and competence requirements presented by working life and personal mastery of practices
- Face-to-face contacts with people, encouragement for learning and inspiration on a personal level
- Ability to share visions with others, receptive to new ideas and people, operation in national and international partner networks
- Skills necessary for looking up, using and reprocessing information and creation of new knowledge
- Continual updating of own skills.
- Teaching creativity, personal innovation, continual development of the learning processes

In the future, we will have to consider the following issues:

- What would be the ideal length of the school day, or will it any longer be specified and if so, by whom (student, school, district, central government, international network)?
- How will the content of lessons be grouped; will there be individual subjects, themes, learning through projects?
- Will there be a syllabus and if so, what will it be like?
- What will be groups and networks be like in which learning takes place and what sort of partnerships will learning require?
- How will we respond to the individual needs of the learners (e.g. people of different ages, people with different work histories or cultural backgrounds)?

How will the learning results be evaluated? The learning process is increasingly being defined at school and in interaction with different stakeholder groups. What needs to be done is to create a culture and procedures and to provide the material and intellectual resources that make it possible to set up societies for the promotion of learning. (Hargreaves 2003.) Future virtual and other IT based tools will free the teacher's resources to personalised teaching and creativity. Use will be made of technology in learning and related interaction and administration.

Pioneering information and communications technologies

Training is to provide capabilities for meeting the requirements imposed by the conscious network society (Fig. 31, page 49). A new term is the ubiquitous society in which information technologies become an integrated part of daily life. The information and communications technology has already revolutionized people's behaviour (Harald 28 March 2006).

- One billion people, many of them free from the constraints of time and place, are already looking up information on the Internet from a total of 600 billion pages, also when on the move.
- Two billion searches per month are carried using the popular Google search engine.
- One million e-mail messages are being sent every second.
- Worldwide there are already 50 million electronic blogs while a new one is being created every two seconds.
- In 2004, cars worth \$ 11 billion dollars were bought on the eBay web site.

The various information and communications technologies will become increasingly compatible. Thanks to converging technologies, the television, Internet, search services, blogs, and e-mail can be used and various digital content created using a single terminal. Applications serving the user in the best possible way will be developed for a range of situations. This will bring about a great change in learning: every citizen can develop and produce learning content irrespective of time and place.

Information technology can be used in learning as follows:

- Virtual learning communities will be created.
- Digital content will be created.
- Content can be created in the context of a community or individually.
- Learning will be supported through multiple channels free from the constraints of time and place.
- The training and learning processes will be revamped and their efficiency improved.

The customers of the educational system of the future will act completely differently from today's students. Therefore new procedures need to be developed to respond to the new habits. For example, the sense of unity will no longer be sought within the borders of the nation-state but with "kindred spirits" all over the world who share similar values (Meristö 2005). Future information technologies will make it increasingly easy to establish virtual communities that will create learning content more and more independently. The challenge facing the training services is to identify the various "tribes" and find ways of motivating and supporting them in their learning efforts. With new IT tools and new teaching roles, this can be accomplished.

Efforts should be made to bridge the gap between official school education and more informal training, for example by making use of new mobile technologies.

At the same time, social learning become more common: ideas, insights and competences will be shared and honed together irrespective of time and place and by making versatile use of technology. Communications may be based on hearing, vision or movement even if the participants are located in different parts of the world.

Sharing and refinement of knowledge made more efficient with wireless technology

Kaisa works for an international company. She is responsible for retailer training in North Germany. Colleagues throughout the world help Kaisa improve her skills. This is possible even though Kaisa's work consists mostly of meetings with customers. Competence-sharing works smoothly because she can talk to all team members using voice-based info-nuggets. The voice-controlled system simulates face-to-face situations as if all the colleagues were present. Kaisa records her questions and ideas in the system. A little later a colleague in China listens to the message and gives his or her own comments. Another co-worker in Finland reacts to this message by asking further questions. Thus, Kaisa has access to the ideas of many of her colleagues even when she is travelling. The information is stored in the system for use by others as well.

Educational and learning processes can be made more efficient by means of new information and communications technology. Some processes may be completely automated.

General information-society skills, such as evaluation of information sources, must be included in all education and training.

Seizing the opportunities offered by sustainable development

Sustainable development will be reflected in education and training as follows:

- Sustainable development will be at the core of society.
- Sustainable development will be central to learning and action.
- Our educational competence will promote sustainable development.

Sustainable development must become essential part of content and procedures in all training.

Investments in emerging economies will create wealth, which, in turn, will expand the new middle class and generate purchasing power for various products and services. If proper use is made of the information and communications technology, they can be produced in Finland. It will be possible to create internationally competitive activities and contribute to job creation in Finland.

Finland enjoys the reputation of offering high-standard educational services. Therefore the educational competence should be actively marketed to meet the needs of emerging markets.

Strategic competence management

Work duties will be profoundly transformed in all professions. It will be increasingly difficult to respond to the needs of the labour market by providing systematic education whose content and objectives are clearly defined. Still, competence remains our most important competitive tool. Educational policy planning and monitoring of the results should be overhauled to develop a comprehensive strategic competence management system.

Strategic competence management must be forward-looking and future-oriented. Visions must be generated to explore options:

- What could career-long learning based on modules mean in real terms?
- What will the versatile applications and environments applied in the future conscious network society to support learning be like and what sort of technologies could they incorporate?
- What will the international learning networks be like and what will be the position of Finnish organisations therein?

Strategic competence management

- Competence is perceived broadly as a factor that contributes to welfare and is supported through political cooperation (policies on education, information society, labour, taxation and social security).
- Public (formal) education to be linked to informal learning.
Existing truths and beliefs are questioned in an attempt to develop completely differently options, supported by argumentation and debates.
- Future developments are anticipated.
- Activities are positioned by means of a value-creation model for organisations and partner networks that produce superior learning results:
 - What value is added?
 - What systems are used to create this value?
 - What processes are employed to generate value?
 - How will the activity be financed?
 - How will the activity be managed?
- Networks and processes to be planned in collaboration with partners.
- Effectiveness and performance will be evaluated.

(Adaptation of Neillimo 2006, Laamanen et al. 2005)

Anticipation of future developments is required over different time spans. Long-term global and educational trends will be evaluated under the direction of the OECD. Finland must take part in these efforts and build its own learning strategy as part of the global community. At the same time, the type of anticipation activity changes when we move to a local, practical and individual level. While the time span will be shortened, radical incipient innovations with a long-term effect may be born. New “manuscripts” will be written for the ways in which services are produced and their content and the roles of those participating in this process. Aside from educational services, this approach can be applied to health care and nursing services (Leadbetter 2005). A system should be put in place that would be able to pick out the incipient innovations created in various parts of the country for inclusion in the decision-making system.

As part of the present project, a specific model – the Education Intelligence System (EIS) – was developed for the purpose of anticipating educational and competence needs. The model providing a description of the use of the various indicators could be part of overall strategic competence management.

7 Education Intelligence System

One of the objectives of the Education Intelligence project was to develop a tool for anticipating competence and educational needs based on statistical indicators. For this purpose, a concept known as the “Education Intelligence System EIS” was worked out under the leadership of Professor Pirjo Stähle. A skeleton anticipatory system based mainly on statistical indicators, EIS also takes into account theoretical premises and gives pointers for the application of the system to expert anticipation processes.

The EIS identifies the global trends providing as reliable as possible an idea of developments over the following 10 to 20 years while at the same time combining them with short-term trends in the marketplace and society. The theoretical bases for the model was developed by analyzing and linking the frames of reference for competitiveness and intellectual capital. A more detailed description of the EIS complete including examples of its applications are given in the publication ”Osaamistarpeen ennakointijärjestelmä – EIS – Education Intelligence System” (Stähle & Stähle 2006).

7.1 Indicators and trends analyses serving as the basis of the system

The project was launched by first identifying the leading national and international organisations that produce indicators or basic statistics suitable for anticipation purposes and trends analysis. When the time spans and reliability of forecasts and trends are compared with the timeframes and verification requirements associated with the development of an educational system, the indicators, as such, are relatively useless. Another drawback is that the indicators measuring both economic growth and trends lack a uniform theoretical basis.

Although international organisations do not generate forecasts specifically for the purpose of predicting the future content or structure of education, all the indicators for developed countries identify the following conditions are being conducive to success:

- infrastructure performance
- national and international networking

- investments in product development
- social stability and equality.

Using the indicators, individual countries can position themselves relative to other countries and existing competition. While statistics, trends or indicators provide limited direct guidelines, they provide information in support of decision-making.

In trend analyses, it is important to identify threats associated with the trends as well as the weak signals suggesting new opportunities. The Early Warning System (EWS) is a monitoring and warning system tailored to the individual cluster or field of activity. It is an analysis scheme designed to identify any new threats affecting the cluster or lines of business as early as possible. Sensitivity to Weak Signals (SWS) is an analysis method related to an emerging technology, key technology or global trend.

In the EIS model, global trends, national competitiveness and intellectual capital are elements that can be captured by means of statistical variables. When combined with the EWS and SWS analyses, they constitute a mass of statistical data that makes it possible to anticipate future developments in a given cluster or field of activity.

7.2 Theoretical frames of reference

When indicators are to be used for anticipating educational needs, the critical issue is the selection of the relevant indicators. In the EIS model, the choice is based on the frames of reference related to national competitiveness and intellectual capital. For the evaluation of competitiveness, use is made of indicators published by the most important international sources (WEF, IMD, EU). With intellectual capital, the National Intellectual Capital Index (NICI) and the Dynamic Intellectual Capital theory are used.

There is no uniform theory underlying competitive comparisons that would explain the pre-conditions for the success of countries or predict the growth or competitiveness of an individual cluster. The competitiveness indicators (such as those produced by WEF and IMD) differ in terms of their premises and

the selection of the statistics used, and so they also yield conflicting results. Even so, all indicators for national competitiveness have a number of features in common:

- Well-functioning basic structures and extensive infrastructure
- Networking of activities, regional and global integration and interaction with the environment and stakeholder organisations
- Development of activities, structure and efficiency of innovation activity.

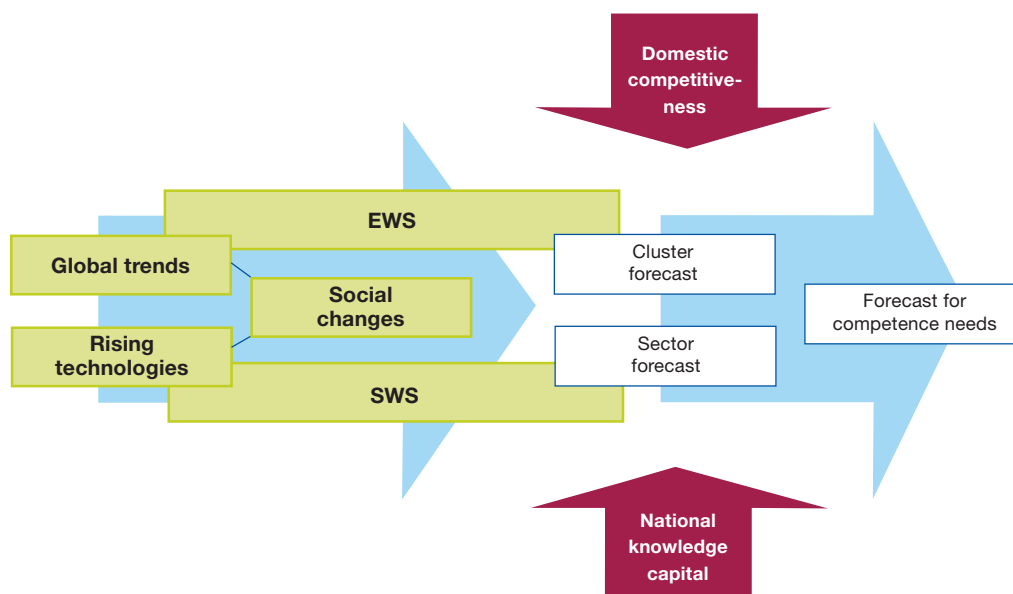
Intellectual capital has also been defined in a variety of ways. A broad consensus has, however, been reached on the view that intellectual capital is about exploiting knowledge and competence for the creation of financial value. National wealth consists of financial and knowledge-based capital. Intellectual capital represents the sum total of individual skills and the standard of performance of the social structures. They, in turn, can be divided into the operation of the markets and organisations while organisational capital can be further subdivided into process performance and the organisation’s capacity for renewal. On this basis, Nick

Bontis has created the National Intellectual Capital Index NICI which one of the frames of reference used in the EIS model.

The intellectual capital and competitiveness frames of reference include a couple of weaknesses that must be taken into account in the anticipation model. The way these frames of reference are perceived is mostly static: the individual variables have been described mainly as indicators, or groups and classes of indicators. Neither is capable of effectively capturing the dynamic or systemic elements that ultimately determine whether a nation is able to operate efficiently as an entity and whether it possesses capacity for renewal in a changing, global operating environment. For this reason, the EIS model also applies the Dynamic Intellectual Capital frame of reference postulating that a sustainable competitive edge consists of the combined effect of three operating and knowledge environments. According to the theory, capacity for renewal calls for

- production and cost-efficiency
- adaptive development and collective learning
- innovativeness and proactiveness.

Figure 28. Components of anticipation of competence needs



Source: Competence needs anticipation system. Education Intelligence System

In the EIS anticipation model, statistical data is classified and analyzed in terms of the criteria based on these three operating environments. This will help uncover strengths, weaknesses, opportunities and threats that could not be captured by using non-classified indicator data.

7.3 Implementation of the EIS model based on adviser analysis

The EIS model can be applied fairly simply if the indicator-based analysis is accompanied by expert knowledge. To accomplish this, two groups, for example, could be formed to serve as the core of the anticipation project.

The first group would consist of national decision-makers and/or representatives of individual sectors who understand the on-going international trends or forces at work within each cluster. This group would be supplied with data on global trends provided by the EIS analysis. The members reprocess the data either through a discussion forum or the Delphi survey, or both. This will flesh out the statistical data with the examination of the underlying causes and effects and provide information about the ways the experts and decision-makers are thinking and how they interpret the developments. The group is tasked to explore the

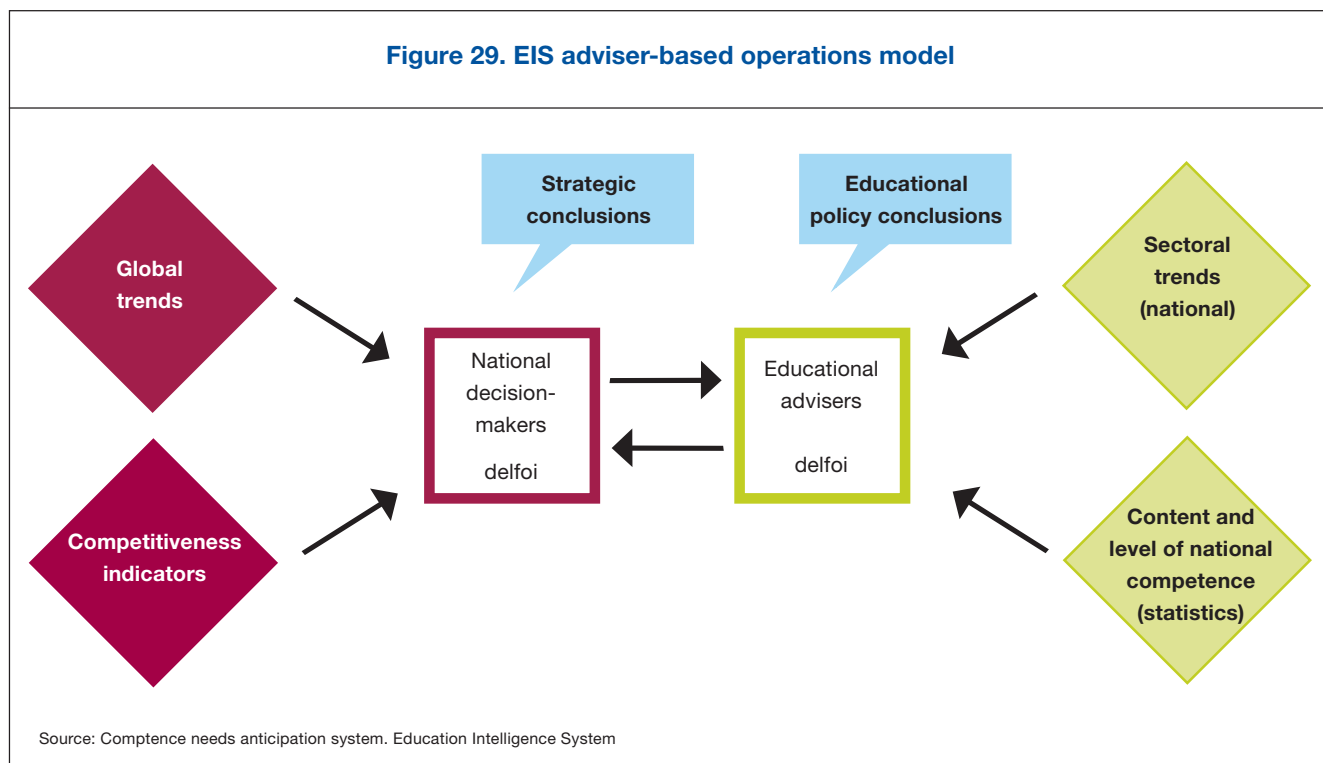
strategic significance of the trend-related and statistical data and draw strategic conclusions.

The second group consists of education experts and decision-makers. For background data, they are given the results of the EIS analysis and the strategic conclusions arrived at by the national opinion-leaders. Additionally, they are provided with forecasts for, and analyses of, the individual sectors to serve as a basis for discussions. The outcomes can be summarized either in the context of various discussion fora and/or the Delphi surveys.

The expert groups are essential in terms of strategic and operative conclusions. While the EIS model is based on trend and indicator data, their impact on how we in Finland recognise the strategic position of the nation and are able to link up to the international information and capital flows calls for interaction between experts and decision-makers.

Even if the EIS model would be further developed in the direction of systematic statistical analysis, it would still be advisable to complement and interpret the results based on real-life data sources drawing upon accumulated experience. As always, the importance of discussions and the hidden knowledge possessed by experts remains high in the efforts to anticipate future developments.

Figure 29. EIS adviser-based operations model



Persons interviewed for the final reports

President, CEO Martti Ala-Vainio
Enmac Group

Vice President, Human Resources Päivi Castrén,
Wärtsilä Corporation

Executive Vice President, SES Dan Colliander,
VTI Technologies Oy

Senior Research Scientist Annele Eerola,
VTT

Project Manager Matti Evola,
Finpro

Vice President, Personnel and Safety, Sirkka Hagman,
Nokian Tyres Group

Senior Manager, Technology Strategy Harri Hansén,
Nokia Research Center

Research and Development Director Joni Hautojärvi,
OMG Kokkola Chemicals Oy

Vice President, Finance & Administration Lasse Heinonen,
Santen Oy

Senior Technology Adviser Mari Isbom,
National Technology Agency
Tekes

Rector Matti Jakobsson,
University of Vaasa

CEO Auvo Kaikkonen,
Inion

Vice President, Market Intelligence Tero Kaleva,
M-real Corporation

Rector Markku Kantonen,
Edupoli

Senior Vice President, Human Resources, Anneli Karhula,
Oy Metsä-Botnia Ab

Programme Manager Saira Karvinen,
Academy of Finland

Chief Executive Officer Pekka Ketonen,
Vaisala Group

Development Director Pekka Kiuru,
NCC Construction Ltd

Professor Hilikka Knuuttila,
University of Joensuu, Faculty of Science,
Department of Chemistry

CEO Kauko Kurkela,
Vivoxid Ltd

Senior HR Specialist Matti Laaksonen,
Orion Oyj Orion Pharma

Human Resources Director Markku Lehti,
Huurre Group

Human Resources Director Pekka Lehtinen,
UPM North Europe

Vice President, Human Resources, Päivi Leskinen,
ABB Service Oy

Human Resources Director Marko Makkonen,
YIT Group

Senior Adviser Hannu Martikainen,
Consolis Oy Ab

Director of Research Pekka Meriläinen,
GE Healthcare Finland Oy

Director, HR, Maria Neovius,
Lemminkäinen Corporation

Professor and Technology Advisor Yrjö Neuvo,
Nokia Corporation

Chief Executive Officer Marko Niskanen,
Tiivituote Oy

Senior Manager,
Quality and Continuous Improvement Tapio Paananen,
OMG Kokkola Chemicals Oy

Senior Vice President, Human Resources & Management Systems
Mika Paljakka,
Finnforest Corporation

Program Director Tuula Palmén,
Culminatum Ltd Oy,
Centre of Expertise for Medical and Welfare Technologies

Director, Quality and Business Intelligence, Jari Partanen,
Elektrobit Group Plc.

Development Director Pekka Piironen,
Danisco

Chief Executive Officer Tapio Pitkänen,
Lujabetoni

Marjo Raitavuo Chairman of the Board of Ensto Oy

Executive Director Riikka Rahikainen
Tampere Business Campus TBC ry

Executive Vice President Heikki Rehakka Tamfelt Oyj Abp

Chief Executive Officer, President Juha-Matti Savola
Oy Juvantia Pharma Ltd

Senior Vice President, Human Resource Management
Taina Sopenlehti, Metso Corporation

Serve - Innovative Services Technology Programme Communication Manager, Senior Technology Adviser Minna Suutari,
National Technology Agency
Tekes

Executive Director Tuomas Särkilahti
Skanska Talonrakennus ry

Human Resources Vice President,
Competence Development Helena Terho
KONE Corporation

Chief Executive Officer Hilikka Tervaskari,
Finnish Wellbeing Center Finland Oy

Executive Vice President, R&D and Technology
Hannu J. Toivonen,
Kemira Oyj

Technology Director, Professor Jussi Tuovinen,
VTT (Technical Research Centre of Finland)

Research and Development Director Manager Harri Turpeinen
Neste Oil Oyj

CEO, Managing Director Ilkka Turunen
Next Wave Ltd

Chief Executive Officer Samuli Vanhala
Tracker Oy

Principal Petri Vasara
Pöyry Forest Industry Consulting

Managing Director Rauno Vaulamo (ret. 31 March 2006)
Finnsementti Oy

Human Resources Manager Virpi Virtanen
Elcoteq SE

Erja Virtasalo, Head of Technology Development Department, National Technology Agency Tekes

Executive Director Hannu Yrjölä
Helsinki University of Technology, BIT Research Centre

Managing Director Helena Åhman, Hunting Minds Oy

Technology workshop advisers

WELL-BEING

Juhani Honka, Häme Polytechnic

Risto Hynynen, University of Oulu

Tarja Immonen, Häme Centre of Expertise

Tuomo Kuosa, Finland Future Research Centre

Hillevi Lönn, Ministry of Labour

Jouni Marttinen, Employment and Economic Development Centre for Southwest Finland

Tarja Römer-Paakkanen, Haaga Polytechnic

Matti Sihto, Ministry of Labour

Project Researcher Henni Timonen

ICT

Hanna-Leena Hemming, Finnish Parliament

Martti Hyry, University of Oulu

Jarmo Immonen, Confederation of Finnish Industries EK

Ari Kalmari, Lahti Science and Business Park IT Centre

Mervi Karikorpi, Technology Industries of Finland

Anneli Manninen, Technology Industries of Finland

Jarmo Matilainen, Enfo Solutions Oy

Jouko Nieminen, Employment and Economic Development Centre for Uusimaa

Pirkko Oilinki-Nenonen, Employment and Economic Development Centre for Northern Ostrobothnia

Erkki Peltola, Pohto

Riikka Rahikainen, Tampere Business Campus

Riitta Vänskä, Nokia Corporation

Satu Ågren, Nokia Corporation

CHEMISTRY AND BIOTECHNOLOGY

Pasi Ahde, Chemical Industry Federation of Finland

Jorma Hanhiala, Confederation of Finnish Industries EK

Ilpo Hanhijoki, Finnish National Board of Education

Saara Hassinen, Finnish Bioindustries

Riitta Juvonen, Chemical Industry Federation of Finland

Pirjo Kyläkoski, National Technology Agency Tekes

Matti Laaksonen, Orion Pharma

Tapio Paananen, OMG Kokkola Chemicals

Pekka Tiainen, Ministry of Labour

FORESTRY

Eija Ahola, National Technology Agency Tekes
Miika Kajanus, Savonia Polytechnic
Päivi Luoma, Finnish Forest Industries
Simo Pinomaa, Confederation of Finnish Industries EK
Heikki Rannikko, Finnish Employers' Management Development Institute
Jorma Sinkkonen, Industrial Learning Space Ltd.
Mika Sipi, UPM Research Center

CONSTRUCTION, REAL ESTATE AND INFRASTRUCTURE

Hannu Heino, NCC Construction Finland
Keijo Kaivanto, The Real Estate Education and Training Institute
Pertti Kokki, RATEKO Institute
Jukka Lauttamäki, Economic Information Office
Jukka Lehtinen, Ministry of Education
Marko Makkonen, YIT Group
Maria Neovius, Lemminkäinen Corporation
Jukka Pekkanen, Confederation of Finnish Construction Industries RT
Heli Peltonen, Adato Energia Oy
Jouko Viitala, Confederation of Finnish Construction Industries RT
Aira Virta, Confederation of Finnish Industries EK

SKIP

Marita Aho, Confederation of Finnish Industries EK
Sakari Heikkilä, Centre for Technical Training
Petri Honkanen, Ministry of Trade and Industry
Yrjö Hämäläinen, Hyvinkään TechVilla Oy
Minna Jokinen, Technology Industries of Finland
Päivi Leskinen, ABB Oy
Päivi Myllykangas,
Confederation of Finnish Industries EK
Vesa Nieminen,
Confederation of Finnish Industries EK
Mikko Salminen, Jyväskylä Polytechnic
Vesa Salminen, Lappeenranta University of Technology
Lena Siikaniemi, Lahti Region Educational Consortium
Liisa Tenhunen-Ruotsalainen, Economic Information Office

Steering Group of the Education Intelligence

Chairman of the Steering Group, Director of Education and Training Markku Koponen, Confederation of Finnish Industries
Adivers Marita Aho, Confederation of Finnish Industries
Tutkimuspäällikkö Eija Ahola, National Technology Agency Tekes
Johtaja Juha Kaskinen, Finland Futures Research Centre
Teollisuusneuvos Alpo Kuparinen, Ministry of Trade and Industry
Ylitarkastaja Jukka Lehtinen, Ministry of Education
Manager Päivi Luoma, Finnish Forest Industries
Counsellor Hillevi Lönn, Ministry of Labour
Development Director Anneli Manninen, Central Uusimaa Region Educational Consortium
Researcher Jouni Marttinen, Employment and Economic Development Centre for Southwest Finland
Project Researcher Henni Timonen, Confederation of Finnish Industries
Adviser Satu Ågren, Confederation of Finnish Industries Tulevaisuusluotain-verkoston asiantuntijat

Confederation of Finnish Industries

P.O. Box 30, (Eteläranta 10), FI-00131 Helsinki
Tel. +358 9 420 20 • Fax +358 9 4202 2299 • www.ek.fi

Report on the Internet:

www.ek.fi/julkaisut

More information:

Senior Adviser
Marita Aho
Tel. +358 9 4202 2336
marita.aho@ek.fi

Advisor
Satu Ågren
Tel. +358 9 4202 2313
satu.agren@ek.fi