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Denmark at the Forefront of Information and Communications Technology (ICT) Competencies

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Denmark is, like most western countries, experiencing a constantly increasing need for engineers in the Information and Communications Technology (ICT) field. The article describes some of the challenges for industry and universities in order to secure a high knowledge base and a competitive industry. It argues that the new network society requires that the curricula for ICT-engineers have to be redefined in order to ensure that candidates have broader skills, such as those needed to match industry needs.

INTRODUCTION

The business and trade environment is undergoing radical changes throughout the world. This has led to profound changes in markets, business relationships and even the fundamental concepts of transactions and customer interactions. Furthermore, this does not just affect businesses in the new economy.

The new economy is the same economy that has always been around, but is now changing faster than ever before. Still, it does not alter the fact that the ability to adapt, to transform and to act is the greatest challenge for industry since the industrialisation era.

The degree of turbulence definitely differs from market to market. Doing business in a rapidly changing market with fierce competition requires the ability to exploit small windows of opportunities. Even though it might be possible to retard change for a given time period, it will come about and the criteria for success is to move on, develop and learn new methods – even to instigate change by moving first. Working against change has always been found to be counterproductive [1].

Maintaining competitiveness has become increasingly dependent upon the company's ability to efficiently use Information Technology (IT), knowledge-based production, the creation and exploitation of transnational networks and a highly educated workforce. However, this can only be achieved if the required knowledge base is at hand.

Strong competences in Information and Communications Technology (ICT) and Nordic collaboration is the reason for the strong current position within wireless communication in the Nordic countries. When mobile communication was in its infancy and a cellular phone weighed a few kilograms, the development and adoption of standards was fragmented and inconsistent. However, the governments wanted mobile telecommunication in the Nordic countries to be based on the same standard and to enable cross-border roaming.

The first generation analogue Nordic mobile telephony standard was the technical fundament for probably the best analogue cellular system in the world. In 1981, the Nordic region became one of the first areas in the world to establish cellular services. The roaming possibilities across borders was unique for the Nordic countries. This early move into cellular communication, along with a common standard and a coherent set of roaming agreements, showed high penetration rates.

When the GSM standard was designed, it also had the goal of transnational roaming. The advantage of moving first in roaming technologies in the Nordic region certainly paid off. This example serves to illustrate that Denmark can set the agenda and may even be able to do something like that again if technical science is given the attention it deserves.

Denmark can show several clusters of excellence with ICT. Some are a result of national IT and science policies, while others have grown out from

strong science positions at universities or companies, such as the NorCom Cluster around Aalborg University, Aalborg, which is situated in the northern part of Jutland and consists of several Danish and international wireless telecommunication enterprises [2].

Common for all of them is that their success is a result of cross-fertilisation between companies, research and development and universities. It is still the best way to continually generate new innovations. These clusters are therefore attracting foreign high tech companies and innovators in general.

Denmark has a well-developed educational system, offering extensive supplementary training and educational activities. However, the large investments in training and education are not sufficient to meet the requirements of the network society – either in structure or in content. A level of reorganisation is necessary.

Denmark is faced with a massive task: society must be converted rapidly from an industrial society into a network society in which technological development, globalisation and the digital economy are setting an agenda. Every day, foreign companies are utilising new technologies to rationalise their chains of production. Every day, new foreign suppliers are opening homepages with offers to consumers and every day, more and more citizens are buying goods and services over the Internet for ever increasing amounts of money.

Unfortunately, there are significant bottlenecks in the labour market. The tremendous lack of highly educated technical personnel is probably the biggest challenge industry faces today, and it still takes five or more years to educate an engineer. This is a barrier for the development and competitiveness of the high tech areas in Europe in general. ICT already accounts for more than 6.3% of Gross Domestic Product (GDP) in Europe. However, Europe does not have enough skilled ICT people; this gap is widening with a potential shortfall of 1.6 million jobs expected to be unfilled by 2004 [3].

The shortage of people with specific skills in the commercial job market also reduces the numbers entering the academic professions. This will have an effect both at the level of postgraduate students and research assistants. This imbalance threatens science and the supply of those able to teach at the higher levels.

We all have a common obligation to fight these bottlenecks through information, extended postgraduate education and substitution from other occupations. Initiatives have been taken nationally by establishing IT-universities. These universities are a result of joint ventures between existing universities. Danish IT-universities, for instance, allow all kinds of Bachelor graduates to take up an IT-related Master degree.

Universities have a key role to play, not just to educate, but also to collaborate. In an economy where capital is mobile, technology can transfer quickly and goods can be made cheaply abroad and shipped to developed markets swiftly. Our ability to compete successfully depends on our ability to create an economy that is genuinely knowledge-driven.

This is why universities must be at the heart of our productive capacity: they are powerful drivers of technological, cultural and structural changes. They generate new knowledge and import it from diverse sources. Universities also apply knowledge in a range of different environments and they are the seedbed for new industries, products and services. Furthermore, they are the centres of the industrial clusters of the knowledge economy, although this takes engineers with broader competencies.

A NEW ICT CURRICULUM

The Career Space consortium suggests that the way in which engineering and computer science students are educated should change to meet the needs of the ICT industry in the 21st Century [4]. Career Space is a consortium of major ICT companies, as well as the European Information and Communications Technology Industry Association (EICTA). It works in partnership with the European Commission to encourage and enable more people to join and benefit from a dynamic and exciting e-Europe and to narrow the current skills gap that threatens Europe's prosperity.

According to Career Space, ICT graduates need a solid foundation in technical skills from both the engineering and informatics cultures, with a particular emphasis on a broad systems perspective. They need training in teamwork, with real experience in team projects where several activities are undertaken in parallel. They also need a basic understanding of economics, market and business issues. In addition, graduates should have good interpersonal skills, such as problem-solving abilities and an understanding of the needs of customers and colleagues.

The Career Space consortium recommends that ICT curricula should consist of the following core elements:

- A scientific base of 30%.
- A technology base of 30%.
- An application base and systems thinking of 25%.

- A personal and business skills element of up to 15%.

The profile of the ICT industry's needs for degree qualifications is illustrated in Figure 1 and depicts new curricula that combine elements of traditional engineering and informatics programmes.

The Career Space consortium recommends closer cooperation and mobility of staff between academia and the ICT industry. Practical experience gained from working in the ICT industry, consisting of at least three months (ideally longer), should be an integral part of ICT curricula.

For its part, the ICT industry will release personnel from other duties to perform guest lecturing and other teaching at universities as appropriate. The ICT industry will also seek to involve locally-based university staff in its research projects.

In March 2002, the Trade Association of IT, Telecommunications, Electronics and Communication Enterprises (*Branchefællesskab for IT, Tele-, Elektronik- og Kommunikationsvirksomheder* - ITEK) of Denmark invited representatives from all of the relevant universities in Denmark to discuss the Career Space recommendations [6]. The participants were satisfied with industry taking an active part in developing a new curriculum.

Both Aalborg University and the Technical University Denmark (DTU), Copenhagen, have already begun combining elements of traditional engineering and the informatics programme in their study programmes. This illustrates that Danish universities are, indeed, grasping the challenges of tomorrow.

THE WAY AHEAD

There is no doubt that the technological opportunities will continue to grow exponentially. What is more important is the pace at which the new technological breakthroughs can be transformed into commercial activities. The time ahead has, of course, its obstacles.

Those countries that are among the ones that are quick to establish suitable conditions and those that are the smartest will have a share of the growth in the network society. However, those countries that do not adapt quickly enough will suffer a loss of earnings and jobs.

We are heading towards a network society in which incredibly rapid technological development makes it difficult for even the best technicians to see as little as three years ahead. Developments in globalisation are breaking down the boundaries of interhuman communication, and the digital economy, with its e-trade and new electronic procedures, is changing our views as to how money can be earned.

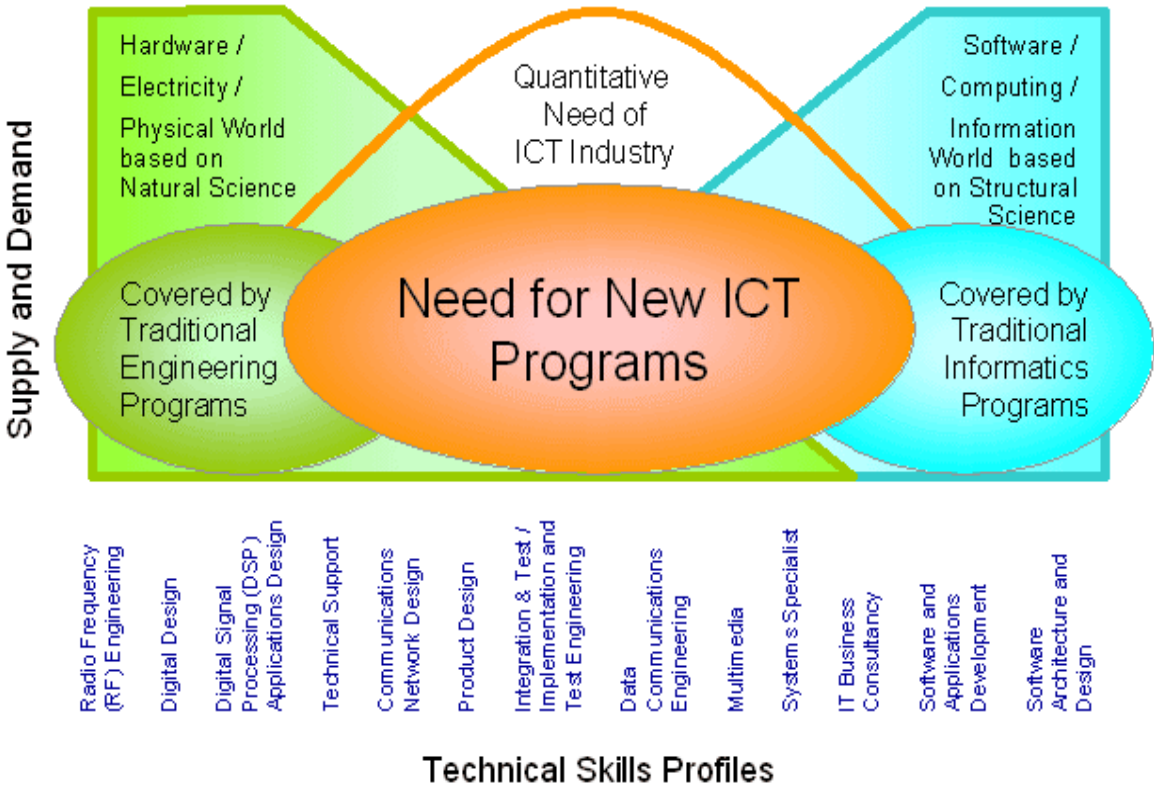

Figure 1: The upgraded profile of engineering and informatics programmes to meet industry requirements [5].

In the future, it is expected that the IT, biotech, material science and energy technologies will merge together in one form or another. This can already be seen with chip technology, where the demand for smaller and smaller components only can be fulfilled by nanotechnology and biochips. The further development of speech recognition, intelligent agents and broadband will enable communication between machines and terminals; the physical infrastructure will, in other words, become intelligent.

CONCLUSION

Denmark has a strong position to be a driving force in the network economy. Nevertheless, there is an urgent need to redirect young people to become engineers through a joint effort from both government and industry. The new mantra could be: *the best way of being a part of designing and creating the new network society is as an ICT engineer*.

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BIOGRAPHY

Tom Togsverd holds a PhD in mathematical statistics and operations research from the Technical University of Denmark, Copenhagen, Denmark. He has worked for 17 years in the Danish Ministry of Finance in areas such as energy policy, IT and telecommunications, other public enterprises, privatisations, plus others. From 1994, he served as Senior Vice-President in Tele Danmark, the Danish incumbent telecom operator, with the responsibility for governmental and public affairs. Since 1999, he has been the Director of ITEK, Copenhagen, Denmark, which is a comprehensive trade association for IT, telecom, electronics and new media within the Confederation of Danish Industries, DI.