

THE NORDIC SHAPING OF INNOVATION IN ESTONIA: CASE STUDIES FROM MOBILE COMMUNICATIONS AND E GOVERNMENT



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ABSTRACT

The paper examines how the Nordic and Baltic *innovation activities* in ICT have become linked to each other, and what these links have meant for innovative performance in the Baltics. High-performing innovation systems can be regarded as the very core or ‘energy centre’ of any modern country with future oriented ambitions, and the relevance of studying Nordic-Baltic integration from the perspective of innovation should therefore be self-explanatory. In particular, the article focuses on Estonia’s links to Sweden and Finland, aiming to explain how these links have influenced Estonia’s innovative strength in ICT. The results presented here are generally in line with earlier research on the foreign shaping of creative innovation from a catch-up perspective. However, the Estonian case deepens our understanding of the ways in which interaction with the foreign environment influences the build-up of innovative strength.

Keywords: Systems of innovation, Nordic-Baltic relations, mobile communications, e-government

1. INTRODUCTION

Since the collapse of the Soviet Union in 1991 and the regained independence of the three Baltic states – Estonia, Latvia

and Lithuania – it has become increasingly clear that these countries are undergoing interesting processes of cross-border integration with their Nordic neighbours in a variety of dimensions. The information and communication technology (ICT)

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sector provides one of the most impressive illustrations of the overall Nordic-Baltic integration that has taken place since the early 1990s. Important cooperative projects were initiated in this field already in the late 1980s, and since then Nordic players have become important investors and trade partners of all the three Baltic countries in a variety of segments, starting with telecom operators and electronics

manufacturing and continuing with the ICT-intensive banking sector and other information intensive services.

This paper, however, goes beyond integration in terms of trade, investment and production, by asking how the Nordic and Baltic *innovation activities* in ICT have become linked to each other, and what these links have meant for innovative performance in the Baltics. High-performing innovation systems – in ICT as well as in other sectors – can be regarded as the very core or ‘energy centre’ of any modern country with future oriented ambitions, and the relevance of studying Nordic-Baltic integration from the perspective of innovation should therefore be self-explanatory. In particular, the article focuses on Estonia’s links

to Sweden and Finland, aiming to explain how these links have influenced Estonia's innovative strength in ICT.

The article is structured as follows. Section 2 defines the concepts and theoretical ideas underpinning the study. Sections 3 and 4, which form the main part of the article, elaborate on four case studies of innovation in the Estonian ICT sector. Section 5 summarises and synthesises the results, seeking to discern general patterns in the cases discussed.

2. INNOVATION, SYSTEMS OF INNOVATION AND THE IMPACT OF FOREIGN ENVIRONMENTS

Innovations, as referred to in this article, are new ways to create economic value. They may be new or improved *products* (product innovations) and *processes* (process innovations). Product innovations refer to both *goods* and *services*, while process innovations are either *technological* or *organisational* (Edquist et al., 2001: 19). 'New' does not necessarily imply only a matter of big changes; rather, innovations can be both radical and incremental, and the phenomenon of innovation is therefore quite ubiquitous in any modern economy (Lundvall, 1992: 8; Freeman, 1992: 77ff.). This is even more evident if 'new' is interpreted from the perspective of a particular firm, a country or a sector of the economy rather than from the perspective of the whole world. In its broadest sense, an innovation can therefore be said to be everything from a radical world-leading innovation to a small and non-unique adaptation in a particular firm. In this article, however, the focus is on innovations that are new to the world. Such innovations can be labelled 'creative', and should be seen in contrast to 'imitative innovations' (cf. Schumpeter, 1947: 150; Deutsch, 1949: 25f.).

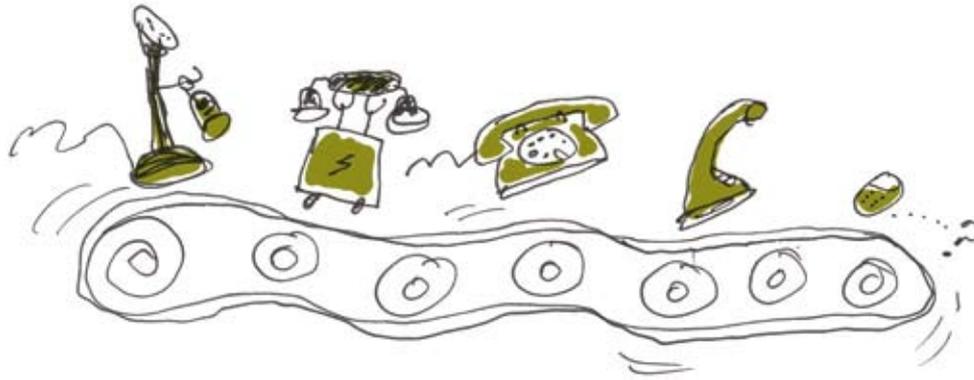
A fundamental perspective underpinning the present study is that innovation in modern societies is a *systemic process*. Systems of innovation consist of a variety of *organisations* and *institutions*, and a similar variety of *relations* among these (Edquist, 2005: 188). Organisations refer to both firms and non-firm organisations (such as universities, research institutes, government agencies, technical associations, etc.). Institutions are formal and informal rules such as laws, standards and regulations but also informal codes, routines, norms, taboos, etc. The most important relations in a system of innovation belong to those between organisations and institutions, and inter-or-



ganisational links such as cooperative, transactional and competitive relations among firms and other organisations. Since firms seldom innovate in isolation, the phenomenon of *inter-organisational networks* is of key importance in the analysis of systems of innovation.

The overall function of a system of innovation is to create, diffuse and utilise innovations (Edquist, 2005: 190). For that to happen, it is necessary that a wide array of *activities* take place in the system. It should be stressed here that these activities are much broader than mere research and development (R&D) activities; they include such diverse fields as formulation of visions, articulation of demand, creation of new knowledge, competence-building, new firm formation and market entry, adaptation of organisations, inter-organisational networking, provision of finance, consultancy and lobbying, creation and adaptation of formal institutions and policymaking (Högselius, 2005: 18ff.). A main argument of the approach proposed here is that the phenomenon of innovation is unlikely to be satisfactorily understood unless these broad activity areas are taken into account.

However, a system of innovation does not include *everything*. Like all systems, it has a boundary, implying that some components, relations and activities belong to the system while others do not. Those that do not belong to the system belong to the system's environment. The boundaries of systems of innovation may be defined through delimitations in terms of geogra-



phy, technological field, product area, etc. One may thus speak of ‘national systems of innovation’, ‘regional systems of innovation’, ‘sectoral systems of innovation’, etc. – all of which can be considered variants of the generic idea of systems of innovation (Edquist, 1997: 12). The present study focuses primarily on *national variants of sectoral systems*, i.e., systems that are both nationally and sectorally delimited.

When analysing systems in a dynamic and evolutionary perspective, Myrdal (1957: 18) once argued that the “main scientific task is [...] to analyse the causal inter-relations within the system itself as it moves under the influence of outside pushes and pulls and the momentum of its own internal processes.” In attempting to understand the Nordic shaping of the ICT innovation system in Estonia, the present article follows Myrdal’s line of thinking by focusing on the interplay between domestically-driven evolution and the interaction with foreign environments.

Central and East European countries, such as Estonia, have experienced a radical reorientation with respect to its relations to foreign systems of innovation during the past 15-20 years. Prior to about 1990, Central and East European systems of innovation were strongly linked to other socialist countries in the East, while there were much fewer links to Western capitalist economies. After 1990, this changed dramatically with the emergence of a variety of new connections between Eastern and Western countries. These new links have resulted in pushes and pulls from a ‘new’ (i.e. Western) environment.

Given Central and Eastern Europe’s deep historical and cultural relationships to the advanced economies of Western and Northern Europe, Central and East European systems of innovation may be seen to have a potential advantage as com-

pared to countries located further away from advanced systems. The background for this reasoning is the widely recognised fact that innovation involves considerable interaction and interactive learning and that such interactive learning is much easier when actors share a common or similar frame of reference, with similar habits of thought and common experiences of earlier interaction. Historically, this has been shown to be central in the innovative catch-up of regions such as Northern Europe from the late 19th century (which built on strong relations to the culturally and geographically close Germany and Britain), the Asian tiger economies in the late 20th century (building on strong relations to Japan and later South Korea) and more recently China (whose innovative catch-up builds largely on close links to Taiwan, Hong Kong and the overseas Chinese community in the United States) (e.g. Freeman, 1994; 2002; Hobday, 1995; Sigurdson, 2006).

From a somewhat different perspective, Bresnahan and his colleagues came to a similar result. They studied the recent build-up of strong ICT-related clusters in several countries, stressing the importance of connections to advanced ICT markets – in particular the US market. The highly successful clusters in Ireland, India and Taiwan are seen to “come from regions that, for one reason or another, have easier potential interaction with the US market (language, cultural connections, diaspora, etc.)” (Bresnahan et al., 2001: 843). This also related to the issue of innovation networks, which play such important roles in modern systems of innovation. For such networks to work efficiently, personal relationships of trust and confidence (and sometimes of fear and obligation) play important roles, and therefore “cultural factors such as language, educational background, national loyalties, shared ideologies and experiences and even common leisure interests continue to play an important role in networking” (Freeman, 1992: 100).

From this perspective, it would be natural to expect that Estonia's historical and cultural relations to the Nordic countries – and in particular Sweden and Finland – have the potential to stimulate innovation in post-Soviet Estonia. But is this really the case? And if so, what are the actual mechanisms by which the Nordic ICT systems of innovation can be seen to have an impact on innovation on the other side of the Baltic Sea? In the following sections, I investigate the phenomenon of interaction between the Estonian system of innovation and its foreign – in particular Nordic – environment through a series of qualitative case studies of concrete innovations that have recently taken place in the Estonian ICT system of innovation. The first two cases are taken from the field of mobile telecommunications, and the latter two are taken from the field of ICT innovation in the public sector (e government). The case studies are based on in-depth interviews with key actors in combination with substantial documentary data such as company annual reports, press-releases, branch magazines and the local and international business press.

3. NORDIC-ESTONIAN LINKS IN ESTONIAN MOBILE COMMUNICATIONS

At the turn of the millennium, mobile telecommunications was a field in which Estonia could already look back upon an interesting and dynamic past. NMT, the early, analogue mobile standard that had been developed jointly by a number of actors in the Nordic countries, was introduced in Estonia at a time when the tiny republic was still a part of the Soviet Union. To achieve this, the Soviet-era Estonian Ministry of Communications cooperated with the Swedish and Finnish state-owned public telephone operators (PTOs), which became minority shareholders in the Estonian Mobile Telephone company (EMT – the Estonian state retained 51%) as well as with Ericsson for the delivery of equipment. Technically, the Estonian NMT system was initially even *a part of the Finnish network*, and contracts with early customers were written in Finnish rather than in Estonian. During the following years, Estonia emerged as the leader among the Central and East European countries in terms of mobile penetration.

In early 1995, two Estonian operators almost simultaneously introduced the global system for mobile (GSM), the digital mobile standard. The private Finnish company Radiolinja,

known for its early introduction of GSM in Finland, entered the Estonian market and won the race against EMT in creating Estonia's first GSM network. The loss of prestige this implied for EMT, which had earlier had a *de facto* monopoly on mobile communications, seems to have stimulated the company to accelerate both its network expansion during the following years and its innovative activities in terms of introduction of new digital services. The entry of a third mobile operator, Ritabell (for which the main investor was the Swedish privately-owned Comviq) in 1997 strengthened this trend. The fierce competitive climate in Estonia was from then on unique in Central and Eastern Europe, and measured in 'operators per capita' Estonia was definitely the global leader!

In the following, two cases of creative innovation in the Estonian mobile communications sector are discussed.

3.1 MOBILE PARKING

In July 2000, EMT launched an interesting new service, which at the time did not exist anywhere else in the world; in other words, it was a truly creative, world-leading innovation. The service came to be known as 'm-parking' and offered EMT's customers the possibility of paying for parking a car using their mobile handsets. The background was the problematic situation of car parking in the Estonian capital, Tallinn, where modern pay-and-display machines for car parking had not yet been installed on any wider scale. Apart from being first in the world, the new service quickly became extremely popular in actual use. It also won a number of prizes and awards internationally, and export opportunities seemed to open up as well.

Is it possible to discern any Nordic influence on this highly interesting Estonian innovative success? At a first glance, the answer seems to be no. The m-parking service was formally the result of a joint development by the Estonian mobile operator EMT, the City of Tallinn and a local software firm, Voicocom. Informally, the development involved two additional domestic actors: the large domestic bank, Hansapank, and another small software firm, Oskando. The innovation originated from loose discussions that took place in an informal network of personal connections between EMT, Hansapank and Oskando. Hansapank hoped that the new service would yield profit for handling the payment procedure, but the service that was pro-

posed by Oskando and accepted by EMT in the end excluded the bank's participation, as it was decided that payments would be handled directly between EMT and the City of Tallinn (Kõuhkna, 2003; Haljand, 2003). Later on, Oskando was also removed from the project, as EMT decided to work with Voicecom, with which EMT already had a well-established relationship.

From this perspective it would seem reasonable to regard m-parking as a perfect example of a genuinely Estonian innovation, without any foreign involvement. However, for a more thorough understanding of the dynamics behind the creation of this innovation, we have to go a step further and ask, for example, how a small and still very poor post-socialist country actually hosted such a diversity of advanced domestic actors – from EMT and Hansapank to Oskando and Voicecom – whose competencies could be taken advantage of for the development of the innovation?

In the case of EMT, we have already seen that this firm had historically grown-up as a joint venture between the Soviet-era Estonian Ministry of Communications and the Swedish and Finnish PTOs. The very early Nordic investments and participation in the build-up of EMT as a mobile operator can hardly be under-estimated, although the firm's management quickly acquired a far-reaching independence from their foreign investors. More indirectly, EMT's technological development activities were further spurred, as already mentioned, by the tough competition from two additional mobile operators, both of whom were based on Nordic (Finnish and Swedish, respectively) capital. EMT's technological advancement was also spurred by its increasingly close relations to the Swedish equipment manufacturer Ericsson (see the next case). Last but not least, EMT's R&D department for many years had been headed by a young Estonian engineer, Tõnu Grünberg, who had graduated from Chalmers University of Technology in Sweden, which had enabled him early insights into Swedish telecommunications developments and had contributed to stimulating the build-up of a young, enthusiastic and futuristically-oriented R&D department at EMT.

The two software firms, also had interesting links to Sweden and Finland. *Oskando* was originally an electronics design firm, but diversified into IT and underwent significant changes in

2000 when it was merged with a small software firm, Interplus, which had been supplying Internet solutions to the City of Tallinn. The manager and owner of Interplus, Tarmo Kõuhkna, was an experienced Estonian entrepreneur who had recently completed an MBA in Helsinki, which had made him familiar with Finnish and Nordic business culture. His decision to invest in Oskando and merge it with Interplus was based on the fact that a Swedish car accessories wholesaler, K.G. Knutsson, which had recently established itself in Estonia, had shown interest in procuring car alarm systems with mobile communication functions, to be marketed in the Baltic states (where car theft posed a serious problem and the markets thus seemed promising). EMT had shown interest in implementing mobile phone-based car alarm services in its GSM network, and Knutsson had committed itself to procuring a substantial amount of alarms – if EMT could deliver the corresponding system. This later resulted in highly interesting creative innovations developed jointly by EMT, Oskando and the Swedish equipment manufacturer Ericsson in the field of mobile telematic services. Oskando's involvement in the m-parking service, however, failed.

Voicecom, for its part, had its origins in a Finnish firm, Univoice, which was created in the late Soviet years by an Estonian researcher from the powerful Institute of Cybernetics, Olev Künnap, who had emigrated to Finland in the early 1980s. There he gained experience from a number of projects, such as the automatic measurement of water levels in water reservoirs and its connection to computer networks. With the convergence between telecommunications and computer technology it soon became natural for Künnap to move into telecom-related IT developments. After Estonia's regained independence, he created an Estonian sister company to Univoice, which in 1993 was split into two companies, one of which was Voicecom. This firm initially made important contributions to the development of telephone banking in Estonia, and after the take-off of GSM the firm diversified into software for GSM services such as m-parking. EMT later acquired a minority stake in Voicecom.

Hansapank, which was also involved in the initial planning of the m-parking innovation, was originally a domestic bank without foreign involvement. In the end of the 1990s, this situation changed, as Föreningsparbanken from Sweden acquired first a minority post and then, in December 1999, a majority stake, transforming Hansapank into a subsidiary of

the much larger Swedish bank. One of the reasons behind Föreningsparbanken's interest in Hansapank was the latter's excellent performance in the field of ICT. In some respects the Estonian bank was probably more advanced than its Swedish investor. This technological strength of Hansapank was closely related to the unique history of its IT department. The department had originally been an independent software firm, Crebit, which was acquired by Hansapank in the early 1990s. Crebit's founders had earlier been employed in a Soviet-era Estonian electronics-related R&D institute as specialists in mathematical modelling, and around 1990 they had been working for a few years in Finland, in a firm focusing on communications solutions for conference centres and related customers. In 1991 Crebit started a close and, as it would turn out, crucial cooperation with Hansapank, which was then a newly created bank and for which Crebit's experiences from Finland – in terms of both technology and management – contributed in interesting ways to the creation of a dynamic IT department in the Estonian bank. Among other things, Hansapank would from 1996 onwards emerge as a leader in the field of Internet banking solutions, a field in which Estonia early on belonged to the world's most progressive countries (Kerem, 2003).

In summary, the case of mobile parking seems to reveal that there are at least two somewhat different ways in which we can understand the Nordic shaping of innovation in Estonia. According to the first interpretation, it may be argued that m-parking was a genuinely domestic innovation in which no foreign actors took part. According to the other interpretation, in contrast, the successful development of m-parking in Estonia can be understood as a natural result of a long-term accumulation of capital, competencies and experiences, in which foreign actors did indeed play a very important role. The Nordic countries participated in the dynamic transformation of the Estonian ICT system of innovation by providing, for example, foreign investment, high-technology exports, education and research exchange and employment abroad. Although Nordic actors were not directly involved in the concrete innovation, they can in this view be seen to have taken a highly active part in shaping Estonian opportunities for innovation.

In the following we will investigate whether these observations are coincidental, or rather correspond to a more general pattern in creative Estonian ICT innovation.

3.2 MOBILE POSITIONING

Mobile parking was a service that was developed exclusively by Estonian firms, at least to the extent that EMT and Hansapank themselves could be regarded as Estonian firms. There are good reasons to see this as being the case. As a matter of fact, although EMT was owned to 49% by Telia and Sonera, the relationships to the Nordic operators beyond ownership per se were relatively weak, and the management had been exclusively Estonian since the mid-1990s. Nordic representatives were only involved at the level of the supervisory board.

On the manufacturing side, the Estonian-Nordic links were stronger. Ericsson Eesti, the Estonian subsidiary of the large Swedish telecommunications giant, was essentially to remain a sales office for the global company's business in Estonia, and as such it had little opportunity to go its own way. The Estonian subsidiary was in no way meant to be a centre for Ericsson's innovative activities; the only exception was in implementation-related R&D, for which a number of Estonian engineers in the Tallinn office supplied radio network design services on a minor but worldwide scale (Sepp, 2001). However, this transnational integration did not prevent Ericsson Eesti from developing an increasingly local profile during the course of the 1990s, and in this sense it resembled the development of EMT. A main step was taken in this direction when the Finnish general director of Ericsson Eesti, Matti Lehtimäki, was replaced by a young, 32-year-old Estonian, Veiko Sepp, in late 1998. The latter had started his Ericsson career in 1991 in Helsinki, where Ericsson had offered the opportunity to write a telecommunications-related diploma thesis for Tallinn Technical University (Sepp, 2001). Similar to EMT, with whom Ericsson by the end of the 1990s could already look back upon a ten-year long experience of close cooperation, Ericsson Eesti now hosted a young, enthusiastic, and fully Estonian staff.

In 1999, Ericsson Eesti and EMT, both of which had recently installed new CEOs (EMT's new CEO was Peep Aaviksoo, who had earlier been the head of Norma, a car security company that was closely related to the Swedish Autoliv), jointly decided to enter an interesting project aimed at launching a new service based on Ericsson's mobile positioning system (MPS) platform, developed by Ericsson in Sweden during the preceding years. GSM-based positioning at this time was still in

its infancy and not yet commercially available. However, the new technology was attractive from the perspective of major attempts being undertaken to make it possible for *rescue agencies* to locate emergency calls made from mobile handsets. EMT sought to develop such a service.

Ericsson's headquarters in Sweden were somewhat sceptical of the idea of launching the world's first commercial MPS service in the ex-Soviet Republic of Estonia. An open issue was above all the availability of necessary complementary competencies in the tiny and economically poor country. In particular, MPS services were by necessity closely related to the field of geographical information systems (GIS), and if the new service was to be launched in Estonia, it would have to be linked to the development of local maps and Ericsson would therefore have to cooperate with local suppliers of maps and GIS.

Surprisingly, it turned out that advanced GIS suppliers did not merely *exist*, but that Ericsson had even been involved in *collaboration* with one of them a few years earlier. The firm was called Regio and was known as Estonia's main producer of maps. This was a young firm created in 1988 as a spin-off from the University of Tartu, and that had diversified into software development in connection with the digitalisation of maps. This had allowed the company to evolve swiftly along the new digital GIS trajectory. In 1997, Ericsson had collaborated with Regio in the development of a system for the Estonian police, in which it was attempted to create a solution based on Ericsson's EDACS radio communications platform. The idea, which was successfully realised, was to display the positions of police cars on a map (Jagomägi, 2003).

Ericsson remembered the fruitful cooperation with Regio, and despite the hesitation connected with Estonia's being a former Soviet republic, the Swedish multinational agreed to let EMT, Regio and Ericsson Eesti enter the new positioning project. Also involved was, of course, the local Rescue Board. In autumn 1999, EMT's R&D department announced the launch of the MPS project. During the following months the service was developed, and in May 2000 it had arrived at a stage in which EMT's CEO, the Rescue Board director and Ericsson's President Kurt Hellström could meet ceremonially in the medieval City Hall in Tallinn to sign the official memorandum preparing for the actual launch. It thereby also turned out that

the project had managed to receive financial support from the Swedish-based Baltic Sea IT Fund. From the beginning of June, it became possible to use the new service in Tallinn and the surrounding county, Harjumaa (*Mobiil. EMT Kliendileht*, 2000: 4).¹ At the international positioning conference in Rome a few months later, EMT attracted surprised attention for being one of only two operators worldwide that at the time offered working positioning services on their networks. Soon afterwards, Regio and Ericsson began marketing the new software abroad in order to further exploit the innovation.

Compared to the case of m-parking, the development story of mobile positioning in Estonia reveals both similarities and differences. Similarly to m-parking, the driving actors in the innovative activities were domestic: EMT, Ericsson Eesti and Regio were all organisations falling within the boundaries of the Estonian system of innovation. At the same time, however, a foreign actor – the Baltic Sea IT Fund – participated in the project by providing financing. Hence, this case shows a slightly stronger Nordic participation at the concrete level of the specific innovation.

As in the m-parking case, moreover, we can discern an alternative interpretation of the Nordic shaping of mobile positioning innovation in Estonia. The Nordic influence on EMT's capital and competence accumulation – both at the level of EMT as an organisational entity and at the level of key individuals within EMT – has already been discussed in relation to the previous case. Not surprisingly, Ericsson Eesti, too, was strongly influenced by Nordic actors – in particular Ericsson's headquarters in Sweden and the important subsidiary of the same company in Finland. Ericsson Finland had played a crucial role for the establishment and growth of Ericsson's activities in Estonia, starting with the establishment of business relations with EMT in connection to the creation of the Estonian NMT network in 1991. But for the mobile positioning innovation to be launched, a trustful relation with Ericsson's Swedish headquarters was, as indicated above, also necessary.

In addition, the links to the Nordic countries appear at the level of individuals, as exemplified by Veiko Sepp's research experiences in Finland in the early 1990s – experiences that later made him a natural candidate for the position of CEO at Ericsson Eesti. Sepp's experiences in Finland can be seen as

a parallel to the experiences of EMT's R&D director Tõnu Grünberg in Sweden (see above). These soft relationships to advanced neighbouring countries at the level of key individuals can hardly be over-estimated, as they both create a natural understanding for foreign innovation cultures and make cross-border personal networks considerably easier to establish.

4. NORDIC-ESTONIAN LINKS IN ESTONIAN PUBLIC SECTOR ICT INNOVATION

A field in which Estonia gained international reputation from the years around 2000 was e government. The country played a major role in the creative innovation in this field and was early on recognised as one of the world leaders in international evaluations. According to the *Global Information Technology Report* published in 2002, Estonia had already advanced to become the fifth most progressive country in the world in e government

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(Kirkman et al., 2002). This is all the more interesting from the perspective that the country was still far from Western levels of GDP and general economic development, which was still very much based on the exploitation of the low-cost economic environment. Estonia became an encouraging example for many other less-developed countries, by showing that it was indeed possible to arrive at a highly advanced e government system without the enormous financial resources available in richer countries.

4.1 E TAX BOARD

A particularly interesting government organisation significant to the further development of Internet-based public services was the Estonian Tax Board. The Tax Board had participated from an early stage in the development of public-sector data communications networks in Estonia, and towards the end of the 1990s the Board was about to complete electronic intercon-

nections between different branch tax offices throughout the country. At the same time, Internet banking was gaining popularity in Estonia. The question then arose as to why it was possible to handle all financial transactions except taxation issues via the Internet. The Tax Board sensed a clear demand for Internet services enabling the submission of income tax declarations directly over the web, and at about the same time as the internal interconnection of branch offices was completed in 1999, the Board started to think about the actual development of the new Internet services (Lapõnin, 2003).

The planned services did not exist anywhere else in the world at that time, but there was considerable expertise available in Estonia with regard to the closely related field of Internet banking solutions. The main inspiration thus came from the local Estonian banks, rather than any existing applications of tax boards in neighbouring or other foreign countries. The banks

and many local software firms had gained experience in the field of Internet banking applications since its introduction in Estonia from 1996. Towards the end of 1999, the Tax Board's IT department started to design a general scheme for what came to be called the e Tax Board, which was thus to include not merely informative services on the web, but interactive services enabling the submission of tax declarations online. For emerging security issues, the Board made good use of existing informal relationships with the domestic banks, with which it had a great deal of IT interests in common (Lapõnin, 2003).

On the software side, the Tax Board worked closely with a local computer and software firm, Abobase Systems. Abobase Systems had gained early experiences from acting on the Nordic market, and during the course of the 1990s it emerged as a leader among Estonian software firms in general and database-related software specialists in particular. The firm counted a number of telecom operators among its clients (for example,

for software related to billing systems and later the development of the mobile portal 'Airport' for EMT). From Finland, the telecommunications giant Nokia had also showed an interest in the company, looking for outsourcing partners in software for mobile devices, but Abobase had rejected this offer, as the firm was specialised in open languages rather than microcode. The company now emerged with Hansapank (in which Föreningsparbanken from Sweden was just about to get hold of the majority of shares) as the Tax Board's main partner in developing Internet-based tax declarations (Saarma, 2001).

With these joint efforts, a pilot phase of the new project was completed in early 2000, when as a first step private persons were offered the possibility of filing their income tax declarations directly over the Internet. Around 12,000 people used the new service at this early stage, making the project a clear success. The project was then extended so that people could view their social tax notices over the Internet, and in a second main phase, launched in fall 2000, the service was also opened to firms (Estonian Tax Board, 2001: 24f.). By 2003, around 50 per cent (!) of all tax declarations were filed electronically in Estonia (estimation by Lapõnin, 2003). In Sweden, a similar kind of service was launched for the first time two years later.²

While Internet banking became the main source of inspiration for the Tax Board's innovative activities, the popularity of the Tax Board in turn inspired the development of further public Internet services. One of them came to be known as 'X Road' and is discussed in detail in the following section.

4.2 XROAD

An important information technology requirement for the Tax Board was the capacity to connect to a number of very *different* databases, organised across often completely different government agencies. The Tax Board needed smooth access to, and interconnection with, databases such as the population register, the business register, the customs board, etc. When the Informatics Council elaborated the state IT budget in June 2000, it was observed by some experts – notably from the Institute of Cybernetics, which had earlier been a part of the Academy of Sciences but which after a reform in 1997 had been divided into a department within Tallinn Technical University and a private, business-oriented research organi-

sation (Cybernetica) – that the cross-use of databases in government agencies was a quite common phenomenon, and that many agencies were about to develop services based on such interconnections. For example, there were plans to develop a new visa register, which would need data from sources such as the population register, the business register, the vehicles register, the police register, etc. Around 20 such planned projects could be identified, each of which was to cost around one million Estonian kroons (app. €60,000). The idea then gained ground that it could be advantageous to develop a systematic means of interconnecting different databases, so that the specific projects would involve only minor developmental work (Kalja, 2003).

Despite potential legal problems with respect to such an explicitly systematic interconnection of various databases – a development which might lead to the interlinking of sensitive information in controversial ways – the Department of State Information Systems (RISO), a government agency, began to develop a corresponding project called X Road. The idea was to create an infrastructure for interconnecting various state databases, but it also sought to combine the project with developing new services for citizens via the Internet. Interesting prospects seemed to open up not least due to the recent adoption of the law on digital signatures (in March 2000) and the related plans to issue electronic identification (ID) cards. During winter and spring 2001, a series of seminars were organised, with a total of around one hundred participants from various branches of academia, business and the public sector. Experiences from other countries were also taken into account, but it turned out that similar systems simply did not exist elsewhere, with the exception of Iceland, where the interconnection of databases issue had been solved by placing the databases on one large server, thus eliminating the need for interconnection via data communications networks. This was not regarded as a viable solution for Estonia. What was demanded was, instead, to use the Internet to interconnect the databases. This idea had existed since some time also in other countries, but legal uncertainties appeared to have hindered the actual development of systems elsewhere in Europe corresponding to X Road.

RISO collaborated with the Ministry of Internal Affairs, which produced background material defining the most popular type of queries that were made to Estonian databases, and with Cybernetica (the privatised part of the Institute of

Cybernetics), which performed a thorough analysis of data security issues (a field that had advanced considerably in the past few years). Using these results, a public tender was then issued.

Although it is hardly possible to determine the actual extent to which these Estonian-Nordic links contributed to Estonia's innovative success in e government, there is hardly any doubt about the fact that these cross-border links have contributed greatly to the shaping of the overall environment and opportunities for innovation in Estonia.

The project went to Assert, an Estonian firm that had originally been created as a Swedish-Estonian joint venture. It had been established in December 1991 by five former employees of the Institute of Cybernetics together with the Swedish biotech-related IT consultant Bionix. Assert's area of activity was initially very broadly defined, but it soon became clear that the actual focus was to be computer hardware and software. In 1993, a first software contract was acquired with the help of Assert's Swedish contacts, focusing on programming in the form of subcontracting for a Swedish firm. In the following year, the company entered the US software market, but it soon turned out that Assert's main focus in software was to be the Nordic countries. Headed by former researchers from the Institute of Cybernetics and with strong relations to Sweden and Finland, Assert grew to become one of the dominant IT firms in Estonia, and it strengthened its position also as a software subcontractor to Nordic firms such as Ericsson. Assert's proposed architecture for X Road was based on the Unified Modelling Language (UML), which had been originally developed by Ivar Jacobsson from Ericsson, and which was now about to emerge as a world standard (Kalja, 2003).

The first version of X Road was finalised in December 2001. When the first new electronic ID cards were launched in January 2002, the system found its first use among citizens, as discussed in the preceding section. Moreover, for the various government agencies, X Road became a popular tool for the interconnection of databases (Kalja, 2003).

Compared to the cases of creative Estonian innovation in mobile communications, the creative development of public Internet services in Estonia shows both similarities and differences. A general similarity is the far-reaching absence of any direct Nordic involvement in the concrete innovation projects. In other words, there were hardly any Nordic actors that took any direct, active part in the development of Estonia's world-leading innovations in this field. On the other hand, however, we can, again, discern a more indirect – and at the same time more diverse – Nordic shaping of the Estonian system of innovation in ICT.

In the cases discussed above – e Tax Board and X Road – this Nordic influence is expressed through the Nordic-related history of actors such as Abobase Systems and Assert (later renamed Cellnetwork). At the level of government agencies (particularly RISO) and the important Institute of Cybernetics, there are also interesting Nordic links. Researchers within the latter institute had cooperated with Sweden and Finland already in the Soviet period, for example, through guest professorships, joint conferences and increasingly through Estonian contract research for various Finnish customers. RISO was in reality to a great extent populated by former researchers from the Institute of Cybernetics, and the organisation was headed since 1993 by the former CEO of Univoice, the company mentioned in the m-parking case above that was based on a Finnish firm with the same name. After 1991, there was also a great interest from Nordic IT-related government agencies to establish cooperation with their Estonian counterparts, often interpreted from the Nordic – but not from the Estonian – perspective as a form of development aid. Especially in the early years of Estonia's regained independence, Nordic organisations contributed widely to various evaluations and 'master plans' that were carried out in preparation for transforming the organisational and institutional landscape with respect to both ICT and the system of innovation in general. But also later on Nordic actors were very active in Estonian public sector developments in the field

of ICT. For example, in 1999 the Swedish IT branch organisation, Dataföreningen, collaborated with the local firm Baltic Computer Systems (BCS) in organising far-reaching ICT training programmes for public sector managers. (BCS was itself a firm that had once been created as a Swedish-Estonian joint venture.) And apart from these and other direct participation in Estonian ICT-related activities, Finland and Sweden very often served as role models for organisational and institutional developments.

Although it is hardly possible to determine the actual extent to which these Estonian-Nordic links contributed to Estonia's innovative success in e government, there is hardly any doubt about the fact that these cross-border links have contributed greatly to the shaping of the overall environment and opportunities for innovation in Estonia. In the next section, these results will be further analysed.

5. CONCLUSION

While differing from each other in a variety of dimensions, the four cases investigated in this article point at an interesting and recurring pattern regarding the Nordic influence on ICT innovation in Estonia.

On the one hand, with respect to the issue of direct involvement of Nordic actors in concrete innovation projects in Estonia, the four cases indicate a relatively insignificant – or simply missing – Nordic contribution. Instead, the driving organisations (and individuals) in all four cases were domestic. Only in the case of mobile positioning could a direct Nordic involvement be discerned, through the contribution of the Swedish Baltic Sea IT Fund to financing the innovation project and the support from Ericsson's headquarters in Sweden. But even in this case the actual vision, competencies and project management underlying the development of the innovation were Estonian.

At the same time, however, when it comes to explaining, in a more long-term perspective, how it was possible for a variety of Estonian actors to initiate and successfully launch a series of highly creative innovative projects within the field of ICT, a somewhat different picture on the Nordic shaping of innovation in Estonia emerges. This concerns, in particular, the accumulation of capital, competencies and experiences that taken

together formed a fundamental basis for innovative activities. It turns out that many of the key organisations involved in the innovative projects were crucially based on Nordic investments, that some of the innovations depended on substantial high-tech trade with the Nordic countries, that Estonian firms and other organisations had crucial prior experiences of cooperating and doing business with Nordic partners, and that key individuals within innovating Estonian organisations had lived and worked (or studied) for a longer time in Sweden or Finland.

Particularly the latter aspect repeats itself in a variety of ways in all the cases investigated. It stretches from student exchange and guest research to employment in Nordic firms and the phenomenon of returning emigrant entrepreneurs. The importance of these soft links across the Baltic Sea can hardly be overestimated, as they represent channel for building up personal social networks, for a deep and tacit understanding of Western technological and business cultures, and for cross-border cultural competencies in general. In short, such links have the potential to contribute to a variety of activities within the system of innovation, in the sense discussed in section 2 – from the formulation of visions, the articulation of demand and the creation of new knowledge to competence-building through education and training, inter-organisational networking and transformation of innovating organizations, the financing of innovation and changes in institutions.

The Nordic impact on these crucial and diverse activities in the Estonian ICT system of innovation is not necessarily visible at the level of concrete innovations. There are rarely any direct causal relations between Nordic-Baltic interaction and the creation of individual innovations in Estonia. Instead, the Nordic contribution to and shaping of Estonian innovation is based on a much more long-term participation of, on the one hand, Nordic actors as investors, trade partners, advisors, etc., in the Estonian ICT system of innovation, and, on the other hand, Estonian actors' repeated ability to interact with, learn from and be inspired by actors in the Nordic countries. Nordic-Baltic interaction in this wider sense underpins in a powerful way the build-up of innovative opportunities and a creative innovation environment in Estonia, although it is only very rarely directly visible in the form of cross-border joint innovation projects.

A striking result is also that Estonia's innovative links to the West are almost totally oriented towards the Nordic countries – and particularly Sweden and Finland. In an age of globalisation we would perhaps expect Estonia's links to foreign systems of innovation to be more diffuse and less geographically focused. However, developing creative innovations in a complex field such as ICT is very different from more simple economic activities related to trade and production. As argued in section 2, innovation requires considerable interaction and interactive learning, and such social processes are much easier when actors share a common or similar frame of reference, with similar habits of thought and common experiences of earlier interaction. From this perspective, the importance of the Nordic-Estonian links is not surprising.

The results presented here are generally in line with earlier research on the foreign shaping of creative innovation from a catch-up perspective, as referred to in section 2. However, the Estonian case deepens our understanding of the ways in which interaction with the foreign environment influences the build-up of innovative strength. By historically tracing the emergence of specific innovations, it was possible to unveil influential, but previously neglected mechanisms through which catch-up countries can accumulate innovative capabilities. Given the particularities of Estonia, it may be suggested that the results should hold also for other small, post-socialist countries in their catch-up phase. The results should also be relevant for catch-up countries outside the former communist world, although the lack of inherited competencies from the socialist era may in that case lead to differing outcomes. In the Estonian case, inherited competencies from the Soviet era, as exemplified by the powerful Institute of Cybernetics, seem to have played an important role for innovation in the post-Soviet era. Although many of the inherited organisations disappeared after the collapse of the Soviet Union, valuable competencies survived at the level of individuals, and it is likely that these competencies have contributed in crucial ways to making it possible for Estonian actors to actually exploit the opportunities opened up by interaction with the Nordic countries for ICT innovation. This points at the necessity to analyse the interaction with foreign innovation environments in close relation to other factors that shape innovative outcomes. ●

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¹ *The Baltic Sea IT Fund undertook half of the development costs, which totaled 12 million Estonian kroons (€0.9 million).*

² *That is, it was made possible in Sweden for the first time in 2002. See Ny Teknik, 30 April 2003.*