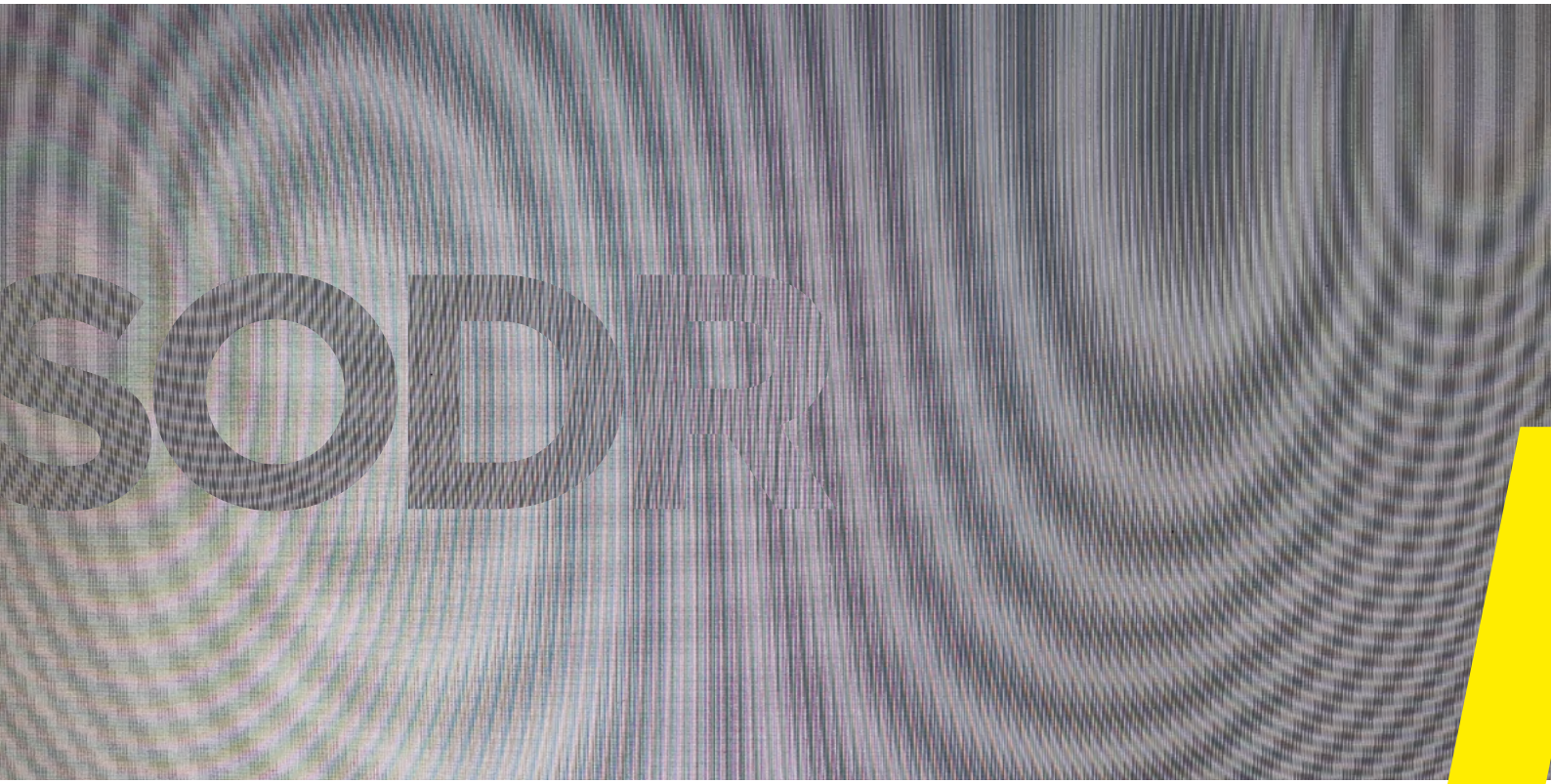
STATE OF THE DIGITAL REGION / 2015

LEVERAGING A DIGITAL BALTIC SEA REGION

Joakim Lundblad
Martin Andersson

sustainable growth innovation competitiveness
Baltic Development Forum
Microsoft
top of digital Europe



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FOREWORD

The countries in the Baltic Sea Region are among global leaders in digital solutions, digital skills, e-government and digital entrepreneurship. ICT is one of the future key growth drivers in this pioneer region within the digital economy. However, the region is facing increasing competition globally.

To promote the Baltic Sea Region as a leader in the ICT sector and facilitate dialogue on how to further fuel the digital economy, Baltic Development Forum (BDF) and Microsoft have established "Top of Digital Europe" as a neutral, non-profit ICT think tank for the Baltic Sea Region. Top of Digital Europe facilitates cross-border dialogue and public-private initiatives with the ambition to inspire increased regional cooperation as a way to implement the EU Digital Single Market.

The first think tank report, *Searching for the Micro Multinationals*, was published at the 16th BDF Summit 2014 in Turku. It is a survey on barriers and challenges to growth facing businesses in the ICT sector that want to expand to new markets. The second report, Coding the future, was introduced at the "e-Skills for Jobs" conference in Riga under Latvian EU-Presidency and published April 2015. It presents the challenge of meeting the future demand for e-skills in the Nordic-Baltic ICT hub.

This first edition of the annual State of the Digital Region report is published by Top of Digital Europe and launched at the 17th BDF Summit in Copenhagen 2015. It is inspired by BDF´s State of the Region Report, an annual analysis of the Baltic Sea Region´s economic development, published since 2004. The aim of the State of the Digital Region report is to provide businesses and policy makers with an annually updated overview of the region´s achievements and position as a global ICT hub. It will also serve as a snapshot of how the development in the region corresponds to current trends in the digital economy.

We would like to thank the authors, a research team from Lund University in Sweden: Professor Martin Andersson and PhD Candidate Joakim Lundblad. We would also like to thank our co-sponsors from Nordic Council of Ministers (NCM), the Danish Ministry of Foreign Affairs and the Danish Presidencies of the NCM and the Nordic-Baltic cooperation (NB5 + NB8). Finally, thank you to Top of Digital Europe Advisory Board for comments and ideas.

The report builds on a uniquely collected and presented data set that reflects relevant policy issues for Europe and the Baltic Sea Region. In this context, the region includes the Nordic countries Denmark, Finland and Sweden, the Baltic countries Estonia, Latvia and Lithuania as well as Poland.

It is our ambition for this annual report to highlight new thematic dimensions each year. This year's theme is the regional human capital ecosystem: How could a regional single market affect the future supply and demand of digital skills?

The report is launched together with the report A Digital Single Market: Growing the Baltic Sea Region - An Economic Impact Analysis. The two publications complement each other.

It is our hope that this report will provide new insight and knowledge about the digital economy for further inspiration for business leaders and policy makers in the Baltic Sea Region and Europe. We also hope that the report will serve as an edgy basis for policy discussions on how the region can stay in the global lead of the digital economy.

Have a good read!

Top of Digital Europe

Baltic Development Forum
Microsoft

EXECUTIVE SUMMARY

The Baltic Sea Region (BSR) includes digital forerunners in Europe and globally, as well as countries who are quick to embrace new technologies and one of Europe's largest domestic markets. Together, Sweden, Denmark, Finland, Estonia, Latvia, Lithuania and Poland comprise a market of over 65 million people who are increasingly connecting to the digital market, smartphones in hand.

The region is an excellent hotbed, or nursery, for growing and cultivating a cross-border digital market with the ambition to explore possible policy measures, to iterate and learn, and to scale up successful initiatives. Being well endowed with digital companies and human resources, and supporting policies and institutions, the BSR macro-region has unique opportunities to go further – to move beyond pockets of digital smartness and become genuinely smart in the global digital economy.

This report is an attempt to boil down and capture in a snapshot the digital state of the BSR in 2015. It assesses the potential of growing a regional digital single market, which can then expand both within Europe and globally. It is based on more than 1500 data indicators from national and international databases covering digitization and economic development.

Intuitively, there may appear to be a constant gap between these countries, with the Nordics in the lead, the Baltics on the other end of the gap, and Poland lagging behind.

However, a closer look reveals two things: (1) the size of the gap is not constant across indicators, and (2) it is not always the same countries in the lead or lagging behind.

An in-depth analysis makes a strong case for how a regionally integrated human capital ecosystem can improve the response to increasing or shifting demand for e-skills as well as advance the integration of a common digital market in the region.

Four ideas for further regional collaboration are presented: (1) to create cross-border place-based policies for human capital mobility and exchange, (2) to establish transnational testbeds for digital services, (3) to investigate how digitization is implemented in education and teacher training, (4) to establish a harmonized and border-crossing, friendly framework for open government data.

KEY OBSERVATIONS

- The gap between the Nordic and the Baltic countries in terms of digital infrastructure is not constant, and in many regards it is closing. There are still variations and each country faces its own opportunities and challenges. When it comes to digital infrastructure, they are becoming increasingly more alike than different. The BSR countries have more in common than what first meets the eye. Together they gather over 65 million people moving towards an increasingly digital economy with their cellphones, and increasingly more smartphones, in hand. Overall the digital infrastructures are well developed and companies and citizens have embraced the digital opportunities. This provides a solid **starting point for a single digital market in the BSR.**

- In terms of **digital education** it seems that the primary and secondary school systems around the BSR still have some way to go to embrace the digital economy. Generally, the availability of data is limited, giving rise for a call for better internationally comparable data on adoption of ICT in the school systems and teaching. To equip children to fully leverage the potential of the digital economy, they need to learn to understand and speak digital – as much as they need to master their mother tongue, other languages, math, etc. **Developing common systems and approaches for teaching** could be a low hanging, high yielding, fruit for macro-regional cooperation in the BSR.

- **Labour skills and needs do not currently match sufficiently** to reap the full potential of the digital economy. A regional human capital ecosystem characterized by cross-border mobility helps to realise the full potential of single digital market. The ratios between labour force and employers in each country speaks to the conclusion that the gap is more an issue of diverging specific needs for specialists and small samples of employers, and employees having a hard time coordinating and finding one another in the labour market. A digital single labour market should address this mismatch and consider the problems from a regional perspective where, for instance, Poland could readily supply the other countries with specialists in ICT-related fields.

- From a regional point of view, even if other countries appear to be ahead in some respects, the actual **impact and contribution that Poland can bring** to a larger digital market will be very important. If Poland would arrive at an entry rate similar to Finland, Sweden, and Latvia, the country would clearly be a major contributor to ICT-related businesses. Not only in the Nordic-Baltic region, but in the EU as a whole.

- **The digital markets continue to be fragmented**. Consumers tend to be much more likely to shop online in their own country. However, several opportunities are specific for the BSR. For example, Poland's comparatively low score on online cross-border B2C within the EU is troublesome, but also reflects a potential. With increasing ICT infrastructure and growing e-skills combined with continued

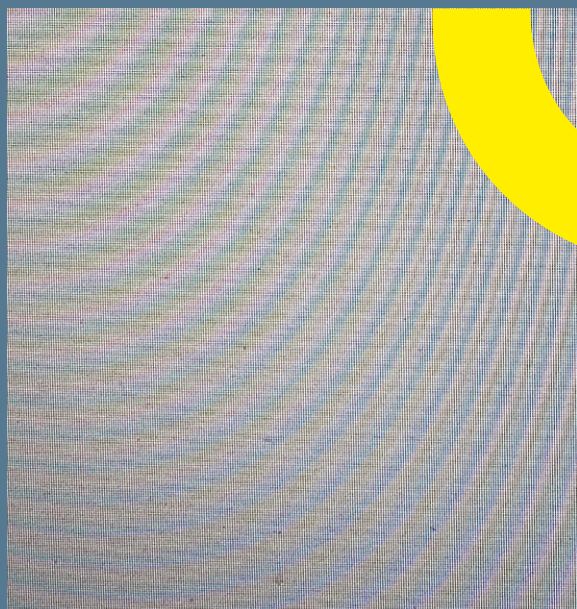
linkages across the Baltic Sea, one could expect a deepened familiarity between the countries that stimulate cross-border online purchases. Also, Latvia and Lithuania – and the entire region – would benefit if these countries caught up with Estonia in growing its cross-border interaction with other EU-countries.

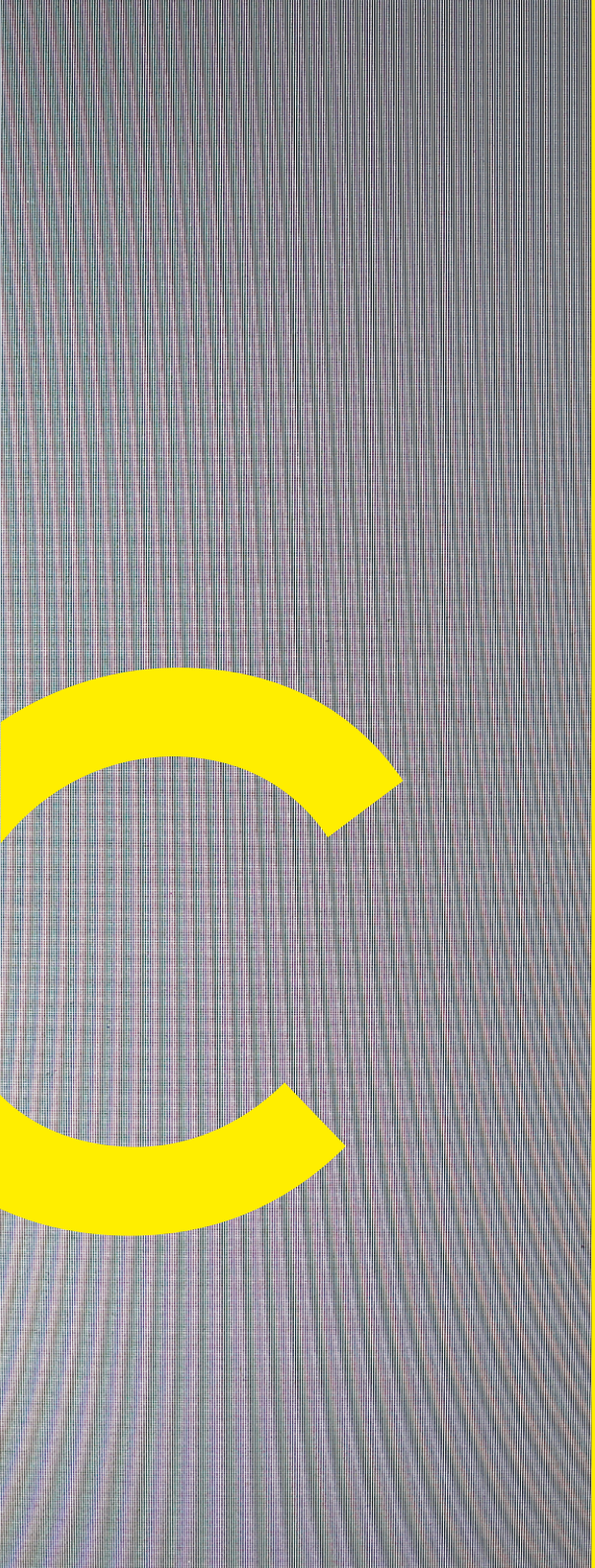
- Cross-border EU purchases tend to be high in countries with strong regional or linguistic ties to neighboring countries. National specificities as well as historical ties among certain groups of countries within the EU provide a role for policy approaches and experimentation at the regional level that can complement initiatives at the level of individual member states and EU-wide. Such **regional initiatives** provide examples that may be transferred and translated to other parts of the EU. This can be done both in terms of iterative benchmarking and learning, as well as by exporting successful methods and solutions both to neighboring countries and to other regions in the EU.

- **Public e-procurement** may play an important role in leveraging the digital economy and in creating a digital single market in the BSR. Sweden, Estonia, Latvia, Lithuania and Poland all have some form of national plan for e-procurement, and cross-border e-procurement is partly or fully enabled in Estonia, Latvia and Lithuania. Other countries in the BSR could learn from these efforts and practical experiments in order to grow a joint digital market.

- According to the Google World Map of Open Government Data, the Nordic countries all have government-led **open data initiatives**, while the Baltic countries and Poland do not. This adds to the threshold for digital entrepreneurship and innovation in these countries.

- Business and business organisations are able to take a number of initiatives leveraging internationalization of digital SMEs and the emergence of a digital single market in the BSR themselves. For example, there is an abundance of **ICT clusters** and cluster-like organisations in the region. These +30 organisations could collaborate around; e.g. exchange of peer practices and digital enterprise development support; joint research; facilitation of specialised networks with the purpose of co-creation, co-innovation, crowd funding, etc. in the digital economy.





CONTENTS

1 INTRODUCTION

In the European Commission's strategy for Europe 2020, the digital economy and a digital single market are highlighted as drivers of future innovation, competitiveness and growth. Digitization is affecting our economy in two essentially different ways. First, ICTs are enabling an unprecedented market expansion by allowing individuals and firms to match supply and demand on a potentially global scale.

This changes the basic conditions for business models and consumer behaviors alike. Second, digitization enables and promotes entirely new business models and digital goods and services, from virtual content in online video games or apps, to temporarily renting an apartment, to social network services and other types of digital platform businesses, which provide services in exchange for personal data that is used to target advertising. This is a twofold expansion of the market population and the contents being traded in the marketplace. In a not-so-distant future, the market will also include services and goods relying on the benefits of 3D-printers, sensors and the internet of things, as well as automation.

However, in order to achieve its full potential, the European Digital Market needs to be one whole rather than 28 loosely connected domestic markets. A digital single market is necessary both to fully actualize a European single market, and to leverage the opportunities associated with ICTs and technology development. It should also be considered a priority needed in order to retain and improve the EU's global competitiveness and generate smart, inclusive and sustainable growth.

The Digital Agenda for Europe is pioneering these efforts, but EU member countries are decidedly heterogeneous in terms of culture, language and informal institutions. Consequently, EU-wide policy initiatives alone will not be able to establish a truly joint single market. This provides an important scope for a complementary, regional approach to establishing a digital single market in an experimental, bottom-up manner. This is the point of departure for this report.

In this analysis, the Baltic Sea Region (BSR) covers Sweden, Denmark, Finland, Estonia, Latvia, Lithuania and Poland, leaving out Germany, Russia, Norway and Iceland. The region contains some of the digital forerunners in Europe and globally, as well as some of its quickest movers in embracing new technologies and one of its largest domestic markets. Together, they comprise a market of over 65 million people who are increasingly connecting to the digital market, smartphones in hand.

The region is an excellent hotbed, or nursery, for growing and cultivating a cross-border digital market with the ambition to explore possible policy measures, to iterate and learn, to share experiences, and to scale up successful initiatives. Intuitively, there may appear to be a constant gap between these countries, with the Nordics in the lead, the Baltics on the other end of the gap and Poland lagging behind. However, a closer look reveals two things: (1) the size of the gap is not constant across indicators, and (2) it is not always the same countries in the lead or lagging behind.

This report, i.e. the State of the Digital Region, aims to boil down and capture the state of the digital BSR. It is part of a project exploring a regional approach to a digital single market in the BSR, inspired by an idea of Andrus Ansip, former Prime Minister of Estonia and present Vice President of the European Commission (BDF and BCCA 2012). The report is published together with "A Digital Single Market: Growing the Baltic Sea Region - An Economic Impact Analysis" (Top of Digital Europe 2015) forecasting what a digital single market implies for the region. Both reports explore the same story, but from different perspectives. They complement each other and can be read together or separately.

The report is structured as follows: Chapter two presents the case for a regional perspective to a digital single market in the BSR and introduces the format for the state of the digital region. Chapter three contains the data on the state of the digital region, divided into five subsections. The analysis is based on more than 1500 data indicators collected from the most extensive and up-to-date databases covering digitization and economic development. Based on the analysis, the following chapter 4 suggests ideas

2 BACKGROUND AND MOTIVATION

for further regional collaboration that could strengthen the potential for a digital single market. Finally, chapter 5 includes theoretical motivation for a regional approach to a digital single market as well as an in-depth analysis of how a regional single market could affect human capital and the future supply and demand of digital skills.

This section starts with making the case for a regional approach to a digital single market in the BSR. Following this, the methods behind the State of the Digital Region report are presented. An overview of current research and the theoretical foundations behind the arguments presented here and later in the report are found in chapter 5.1.

2.1 THE CASE FOR A REGIONAL PERSPECTIVE

There is much to be gained by developing an integrated single digital market in Europe as a means to stimulate the ICT-driven economy and benefit EU citizens. What is also clear, however, is that Europe is a group of countries with cultural, linguistic and institutional differences, which creates specific challenges.

A truly single digital market requires more than pertinent digital technology and regulatory frameworks. Technology and regulations are institutional framework conditions that create potential. Realization of the potential relies on people and businesses truly engaging in cross-border transactions and interactions, not just globally but also regionally. This in turn requires that people and businesses have necessary skills (e-skills) to utilize the technologies, and that entrepreneurs act on the opportunities provided by the framework conditions, for example, by designing business models and developing platforms that facilitate cross-border transactions.

A further requirement is that people trust sellers and contract enforcement systems in other countries and that they overcome barriers related to culture and language. Consider, for example, a recent study by Hortacsu et al (2009) that analyzes the geography of inter-individual online transactions on eBay in the US and Mercadolibre in Latin America. Though they find that geographic distance has a much weaker effect on transactions than what has been observed in studies of non-internet commerce between firms, they do find a significant "home-bias" in online transactions. People are more likely to trade with other people in the same city.

Possible explanations of such a bias in online transactions include cultural factors and the greater possibility of direct contract enforcement in case of problems. As the authors write "…even in the absence of search costs, information asymmetries, such as uncertainty regarding the reliability of a seller, may serve as an important barrier to trade, and proximity may serve as a substitute for trust" (ibid, p.55). This means that people normally feel more secure engaging in economic transactions with people and actors they know or who are part of the same legal institutions, since they feel confident that contracts can be enforced.

The 28 EU member states are truly heterogeneous. Not only do they have different general economic preconditions and different levels of readiness with regard to e-skills and digital infrastructure; they also have different languages, cultures as well as formal and informal institutional framework conditions. Consider for example the following quote from an entrepreneur operating in Sweden quoted in the report *Searching for the micro multinationals* (Top of Digital Europe 2014, p.9): "We prefer to focus on markets that are known and understandable. The Baltic market is unknown and considered to be unsure."

One implication of this is that it is unlikely to find a one-stop-shop solution for how to make a cross-border expansion happen concurrently between EU member states, even if EU-wide regulations and infrastructure are in place. Behaviors, culture and trust play important parts in realizing integration, and these dimensions of integration are more likely to be built "bottom-up" and on a smaller scale. Even if online platforms, like eBay, can to some extent mitigate problems of information, issues remain in Europe, for example, with language barriers and gaps in e-skills and general readiness.

The prevalent national specificities as well as historical affinities between certain groups of countries within the EU thus provide a scope for policy approaches and experimentation at the regional level that can complement initiatives at the level of individual member states and the EU-wide level. Such regional initiatives within the EU can also provide examples that may be transferred and translated to other parts of the EU. This can be done both in terms of iterative benchmarking and learning, as well as by exporting successful methods and solutions both to neighboring countries and to other regions in the EU.

The BSR constitutes an interesting case for a regional approach. Sweden, Finland and Denmark are some of the digital forerunners in Europe and globally. Estonia, Latvia and Lithuania have proven to be quick in embracing new technologies. Poland is one of Europe's largest markets. Together they make up a market for 65 million people and significant potential for cross-border interactions. The region is an excellent hotbed, or nursery, for growing and cultivating a cross-border digital market with the ambition to explore possible policy measures, to iterate and learn, to share experiences and to scale up successful initiatives.

2.2 STATE OF THE DIGITAL REGION

This report takes the BSR as its case and studies available data in order to review the state of the digital region and assess the preconditions for a regional approach to an integrated digital market. There are two main aims: (1) to identify and assess gaps in, as well as opportunities to improve, the readiness with regard to the digital economy and ICTs and (2) to study the potential for, and effects of, cross-border initiatives towards a digital market in the region. The report also contains an in-depth analysis of how a regional single market could affect human capital and the future supply and demand of digital skills.

We focus on hard data. This is not because data based on surveys of people and their perceptions of the digital state in the countries are not important. A main reason for this choice is instead that perceptions are not something that can easily be treated by policy or translated between places within a country or – even less – between countries.

There are already several thorough collections of data on digitization and the information economy within the EU, and the aim of this study is not to attempt to add new data to these. Rather, the approach in this project has been to gather and mash up data from some of the largest and most up-to-date databases available. The analysis is based on data from the European Commission, OECD, World Bank, International Telecommunications Union (ITU), World Economic Forum (WEF), Eurostat and International Labour Organisation (ILO). In total the material used in this project comprises approximately 1500 different indicators. There are of course overlaps and shared data between these sources, but overall each source provides valuable input to the scope of the analysis.

3 ASSESSING THE STATE OF THE DIGITAL REGION

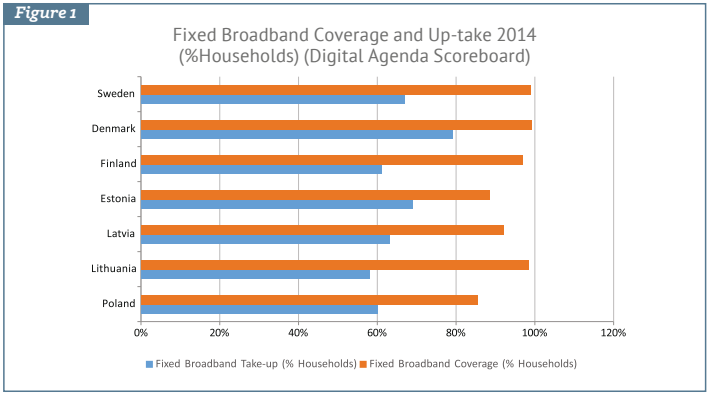
This section presents the main results of the analysis, i.e. the digital state of the BSR. It is divided into five sub-chapters: (1) Infrastructure and internet use, (2) Education, (3) Higher education and R&D, (4) Labour market and enterprise and (5) Public sector. For each part, the score of each country in the BSR is presented and discussed, as well as how the countries relate to each other.

3.1 INFRASTRUCTURE AND INTERNET USE

Both the availability and the take-up of fixed broadband is fairly even across the region according to the Digital Agenda Scoreboard, with the most noticeable gap being the one between the coverage and the actual up-take among households in each country (**Figure 1**). That is, the share of households that could have fixed broadband but don't is comparable in Sweden and Poland, with the exception that the population of Poland is more than four times larger than Sweden's. However, the share of households with some type of internet access at home has risen steadily between 2003 and 2014, and the gap between the countries is narrowing (**Figure 2**).

There has been a remarkable rise in mobile phone subscriptions according to data from ITU (**Figure 3**). Since somewhere around 2007, all seven countries have crossed the line indicating that there are more than 100 mobile phone subscriptions per 100 people, meaning that more people are getting and using multiple mobile subscriptions. Both Poland and Estonia have surpassed the Nordic countries in this regard. At the same time, fixed phone subscriptions are falling in all of the countries, indicating a shift in communication technologies **(Figure 4**).

Figure 1



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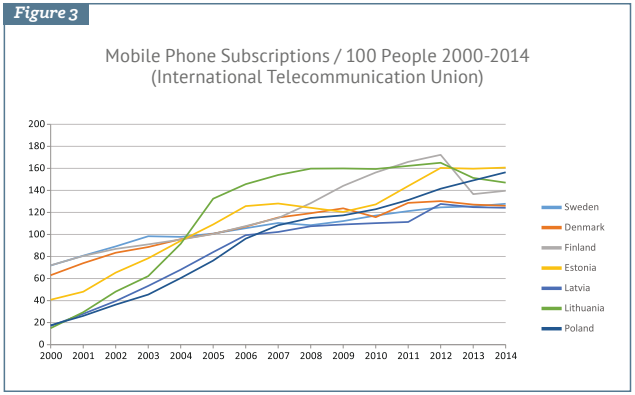

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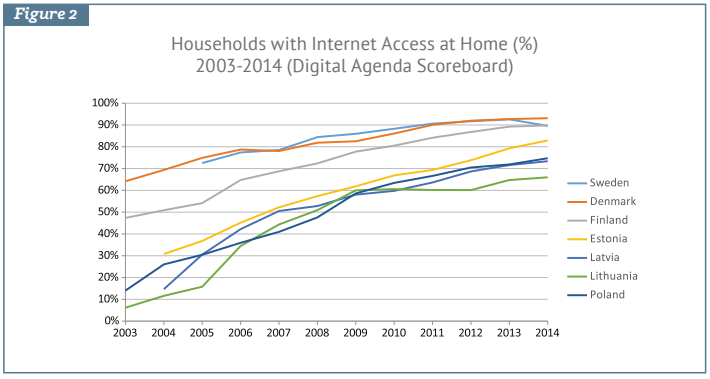

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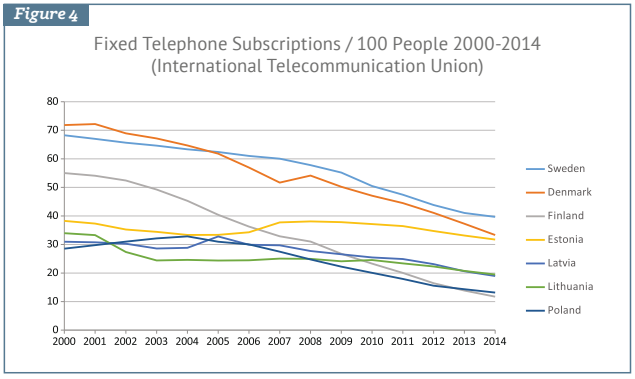
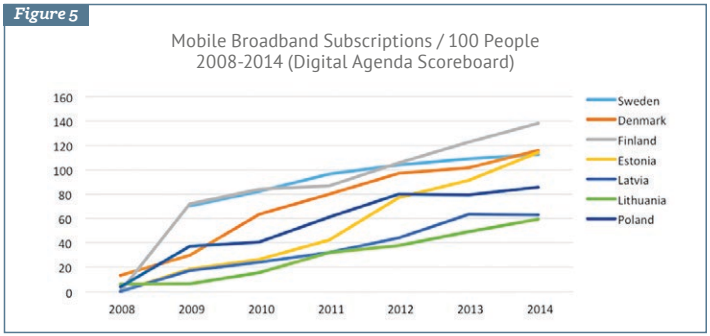


Wireless broadband connections have also grown, although not to the same level as mobile phone subscriptions yet (**Figure 5**). The penetration of fixed and wireless broadband connections indicate the increasing importance of mobile internet connections (**Figure 6**). The share of households with fixed connections is fairly even, but there is a significant difference in wireless connections. Finland, Denmark, Estonia and Sweden all had more than one wireless internet connection per person in 2014, suggesting that people use multiple connections, but also that new devices are being connected to the internet.

Figure 5



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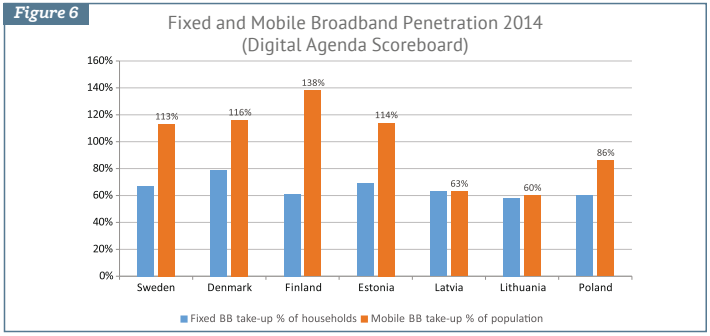
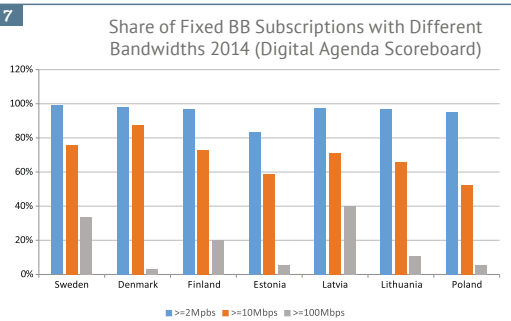


These six graphs show two things. First, the gap between the Nordic and the Baltic countries in terms of digital infrastructure is not constant, and in many regards it is closing. There are still variations, and each country faces its own opportunities and challenges, but when it comes to digital infrastructure they are becoming increasingly more alike than different. Second, these seven countries have more in common than first meets the eye. Together they gather over 65 million people and they are moving towards an increasingly digital economy with their cellphones, and increasingly more smartphones, in hand.

A closer look at fixed broadband connections reveals that there are some differences in the bandwidth and cost of connections (**Figure 7, 8, 9, 10**). With the exception of Estonia, above 90 per cent of the subscriptions in the region are associated with speeds of >2 Mbps, while the share of subscribers who get >10 Mbps varies a bit more. This correlates fairly well with the coverage of so called Next-Generation Access (NGA) broadband, which varies but is still above 70 per cent in the entire region except for Poland (53 per cent). The share of subscriptions with >100 Mbps speeds are notably fewer in most countries. Latvia, Sweden and Finland have the largest share of such high-speed subscriptions. The demand for bandwidth is likely to increase in the future as more people use streaming services and more content converges to one network.

Figure 7



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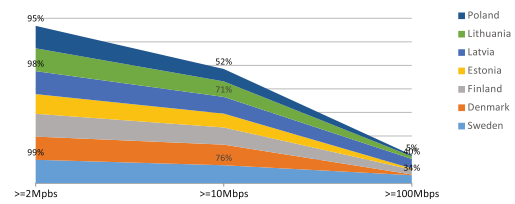

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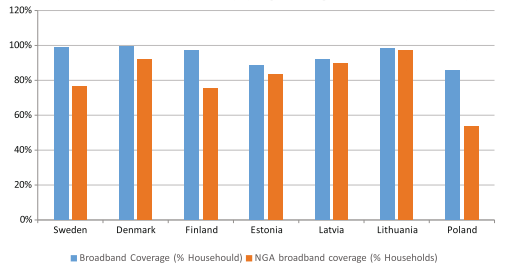
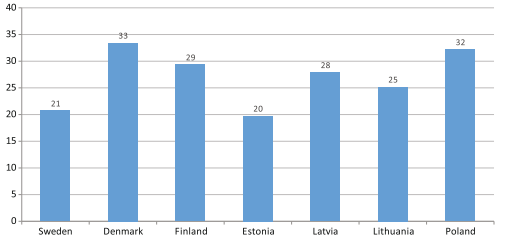


Figure 10

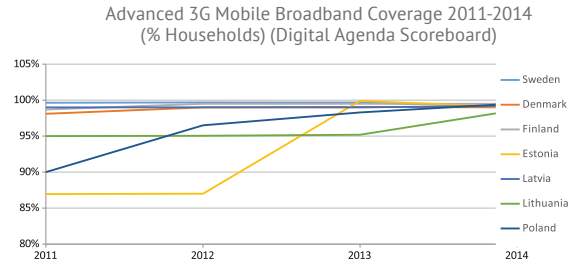


The differences in monthly prices for broadband connections varies both within the Nordic and the Baltic countries, with Estonia having the cheapest connections in the region and Denmark the most expensive.

Wireless 3G coverage is high across the region, measured by the share of households included. 4G coverage is above 90 per cent in the Nordic countries (99 per cent in Sweden and Denmark) and between 65 and 80 per cent in the other countries with Latvia at the bottom (65 per cent) (**Figure 11, 12**). Accordingly, even if there are still blind spots in the overall coverage, the wireless infrastructure is largely available and the gaps between countries are largely concentrated to the 4G network. However, there is an evident gap concerning the use of mobile phones to access the internet.

Sweden, Denmark and Finland have all experienced a sharp increase in mobile phone internet access around 2012 (**Figure 13**). The Baltic countries and Poland have seen a gradual increase, but lack this spike in mobile phone internet traffic. This development can partly be associated to network effects, e.g. more people getting smartphones and accessing the internet through them if a large enough share of their friends do it. Judging from the overall statistical picture, it is just a matter of time before Estonia, Latvia, Lithuania and Poland experience the same sharp rise, if they haven't already.

Figure 11



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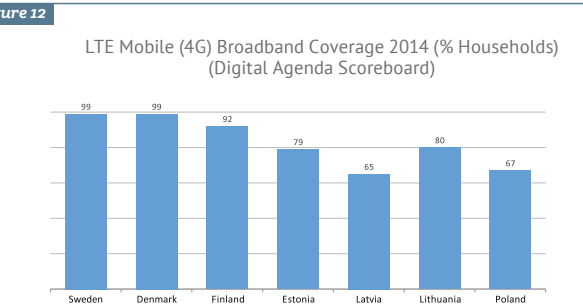

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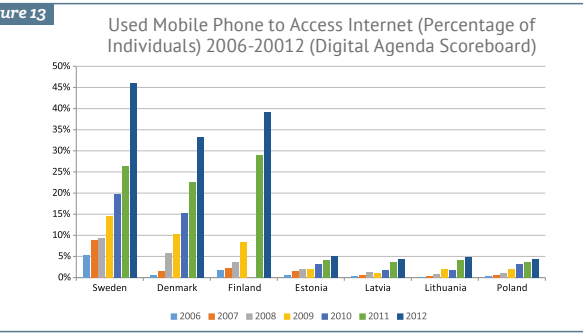


Data based on percentages and shares of businesses, households or people consistently leave out the sheer effect of size. This is evident when it comes to Poland. Although Poland lags behind on some accounts, in absolute numbers the country is going through a remarkable shift. To illustrate this, consider the development in fixed broadband connections, fixed phone connections and mobile phone subscriptions in absolute numbers (**Figure 14, 15, 16**). The other six countries are small in comparison, and Poland's size makes the shift it is going through all the more impressive. From a regional point of view, even if other countries appear to be ahead in some respects, the actual impact and contribution that Poland can bring to a larger digital market will be very important.

Figure 14

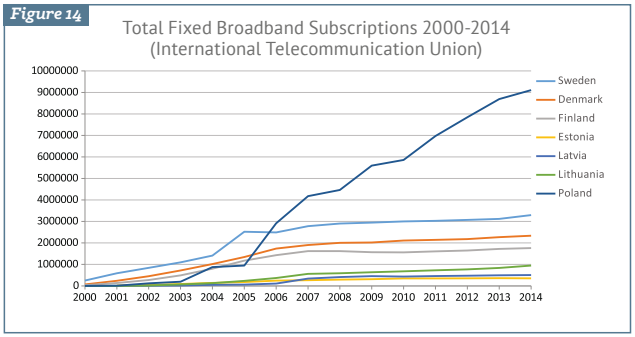


Figure 15

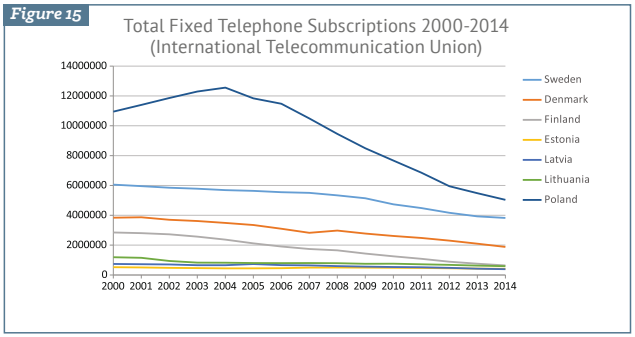
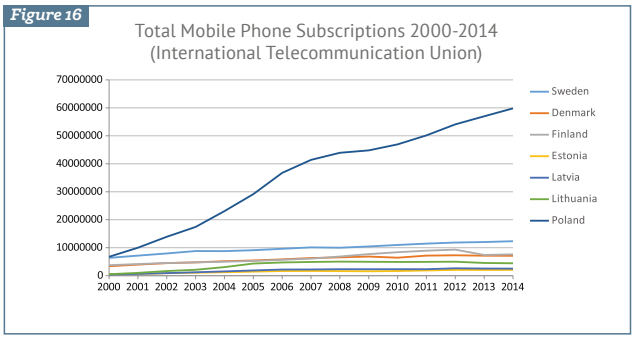


Figure 16



Having the digital infrastructure in place is necessary, but it is not sufficient to build a digital market. The development of the information economy depends on people using the technology. The overall share of internet users has grown steadily according to data from the World Bank (**Figure 17**). Comparing the share of internet users in each country in 2005 and 2013, the gap between countries is shrinking because the Baltic countries and Poland are catching up, but they still have some way to go (**Figure 18**). There are many people, especially in Latvia, Lithuania and Poland, who are not using the internet at all (**Figure 19**). In 2014, 28 per cent of the Polish population had never been online, followed by 25 per cent in Lithuania and 21 per cent in Latvia (**Figure 20**).

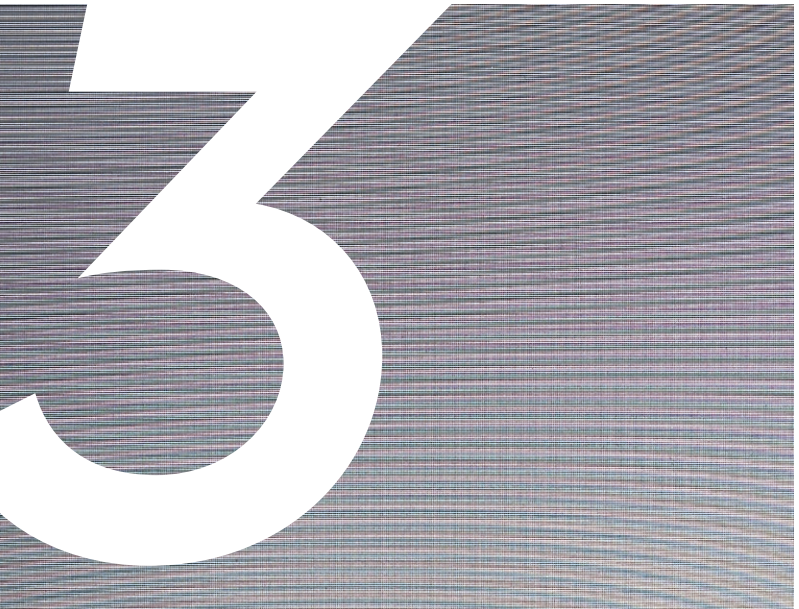


Figure 17

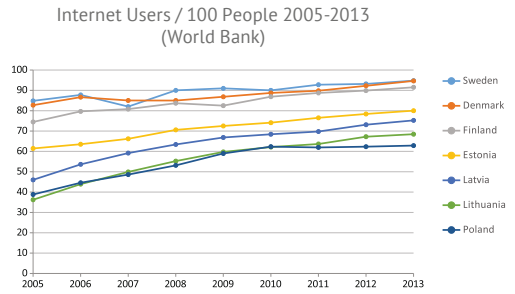


Figure 18

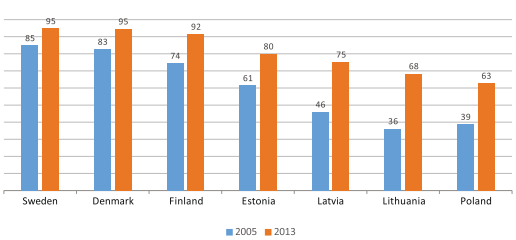


Figure 19

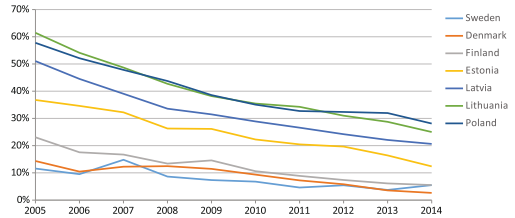
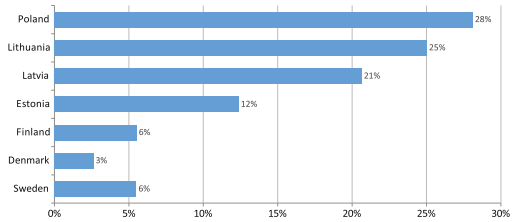


Figure 20



It appears that once people get online, they stay online and perhaps even increase their use of the technology. According to the Digital Agenda Scoreboard, the percentages of the population in each country that are either regular or frequent users are very similar, suggesting that frequent users comprise the largest part of the regular user group (**Figure 21**). [1]

Once online, what people do provides some insight into how they integrate the technology into their behavior and everyday life. It is also an important indicator of the demand in the information economy. Data from the Digital Agenda Scoreboard provide a snapshot of what online activities internet users have spent time on for a period of three months (**Figure 22**). Clearly, searching information and researching goods and services is still driving internet traffic, together with online banking and newspapers. Overall, the relative scale between different activities seems to persist fairly well between countries, and even if the total frequency varies somewhat, there is not clear gap between groups of countries. That is, even if there are differences in the share of internet users between countries, the ways people use the internet are fairly similar.

Looking specifically at activities related to the labour market, it is clear that the digital infrastructure is already playing an important role in providing information about educational programmes, as well as in actual labour market matching (**Figure 23**). Online courses have yet to see a breakthrough, but in Finland and Lithuania they have engaged 16 and 15 per cent of internet users respectively during a three-month period. In a well-functioning information economy, these functions are likely to be even more developed, not least by improved data availability, new innovations and entrepreneurs leveraging technology to provide new solutions to fundamental labour market issues.

Figure 21

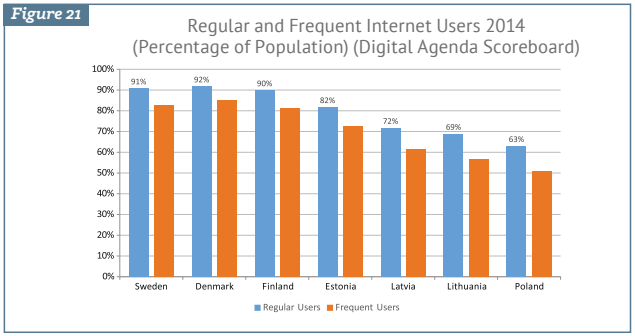


Figure 22

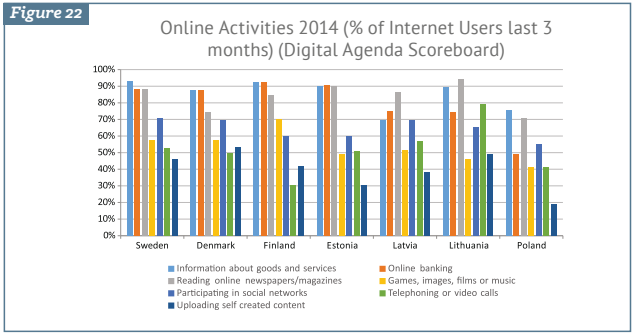
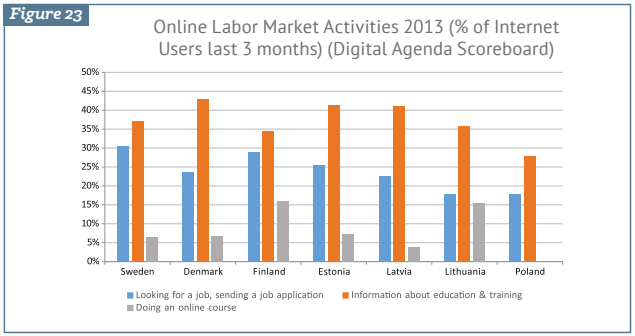


Figure 23



[1] From a technology policy point of view it is relevant to consider that the average internet user is shifting. In the 1990s it was a tech savvy "nerd", and now it is basically everyone. This observation will serve us well to remember when we consider internet governance, privacy issues, etc. Since users are changing, so is what we can expect from them and demand of them.

The share of enterprises with fixed broadband connections is also fairly high across the region, with Poland being the only country having less than 90 per cent of businesses with a fixed connection (**Figure 24**). However, Poland appears to be catching up quickly. Between 2013 and 2014, the share of firms with fixed broadband connection increased with almost 10 percentage points. Businesses also increasingly provide their employees with portable devices (**Figure 25**). This means that the way businesses operate changes, but also that more people are equipped to make better use of the digital infrastructure in the future.

Despite the share of enterprises with fixed broadband connection being high in the whole region, there are large differences in terms of the share of enterprises that use modern online services. One example is provided by Cloud Computing Services (CC). CC is an example of a recent technology category of ICT that has the potential to generate large cost-savings and flexibility for firms by providing online storage and computing capacity as a service on a pay-per-use basis. The adoption rate of such a new service is about 50 per cent in Finland and about 40 per cent in Denmark and Sweden, whereas it is substantially lower in the Baltic States and Poland (**Figure 26**).

Figure 24

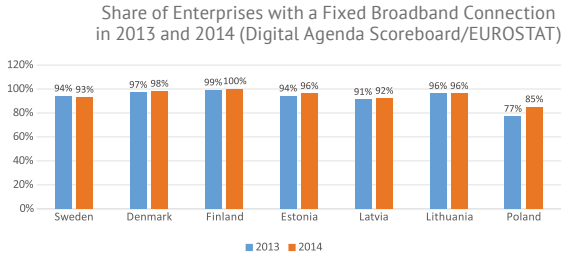


Figure 25

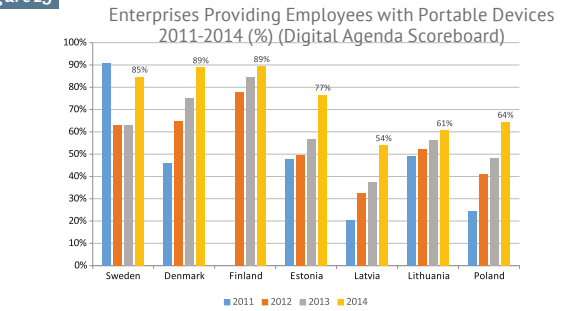
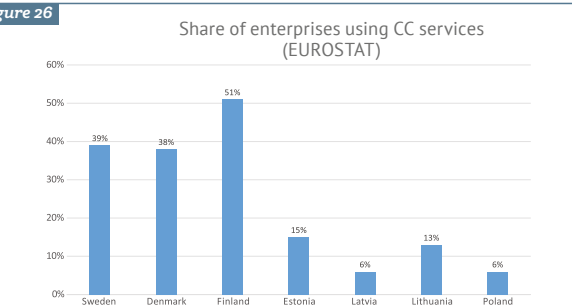


Figure 26



3.2 EDUCATION

Children growing up today are perhaps more familiar with using digital technology in everyday life than their teachers. However, this does not mean that they have all the knowledge they need to fully leverage the potential of digital technology in their working life or to develop innovations and new business models.

The educational system serves as a foundation for the knowledge and skills of the next generation of the workforce. Having a familiarity with computers, programming and software, and an understanding of their possibilities, as well as their role in society, is likely to depend to a large extent on how such tools are integrated in the teaching of standard subjects, the e-skills of teachers, as well as the teaching of programming and computing as individual subjects. The way in which ICTs are employed in the school system, at both primary and secondary levels, is crucial both for the future of education and for the development of e-skills and interest in ICT in the next generation. This fact is increasingly recognized by entrepreneurs and innovators, such as Codecademy or the technology-based start-up EDQU in Sweden[2].

Despite the importance of these issues, hard data on the actual use and teachings of ICT in primary and secondary schools in the different countries of the region are difficult to find. An overview of the curriculum from each country suggests the following:[3]

- **Basic ICT is available as a subject in both primary and secondary school in all the countries of the region. Whether it is mandatory or elective, as well as the types of ICT skills that are taught, appears to vary considerably between the countries.**

- **Programming as its own subject is available at primary school only in Latvia. In Poland, Sweden and Latvia, it is available in secondary school. Neither Finland, Denmark, Estonia nor Lithuania has programming available in either primary or secondary school.**

- **ICT is part of the education of teachers for primary and secondary school in all countries of the region.**

Given the lack of transparent, quantifiable and comparable data on these matters, it is difficult to draw clear conclusions about the state of ICT in education in the region. ICT does enter the national curriculum in all countries, and it is part of the education of teachers in all countries of the region. However, details on the content and structure of ICT education is still lacking. There is thus a clear need for better internationally comparable data on adaption as well as adoption of ICT in the school systems and teaching.

The European Schoolnet report *Computing our future* (European Schoolnet 2014) has made an ambitious attempt to provide an overview of the implementation of digital skills training in the education systems of EU member countries. According to the report, Finland and Estonia integrate programming in primary education, complementing the list above, which is focused on programming as its own subject. It may prove hard to draw the line between different initiatives to integrate ICTs and programming in education, but the issue that really needs to be highlighted and measured is how programming and digital tools are being used in school. There is a lot of potential for benchmarking and learning, both within and between countries, on these issues. A key issue in moving forward is to engage and involve school leaders and teachers in cooperation with schools and cross-border education systems.

For example, it is unclear whether ICT education for teachers focuses on "user knowledge", such as knowledge of handling computers, the internet and so forth, on the one hand, and on "implementation in teaching", such as knowledge of programming and visualization of data and how it can be used as a generic tool in teaching, on the other. As the availability of computers and fixed and wireless internet connections in households of the region increases, it is not a far-fetched conjecture that students in both primary and secondary levels have rather good user knowledge themselves when entering the school system. As a consequence, we are likely to observe a growing need to focus on implementation and direct resources related to issues of how, for instance, programming and data visualization can be not only taught as their own subjects, but also embedded in the teaching of standard subjects.

[2] https://www.codecademy.com/ and https://www.edqu.se/

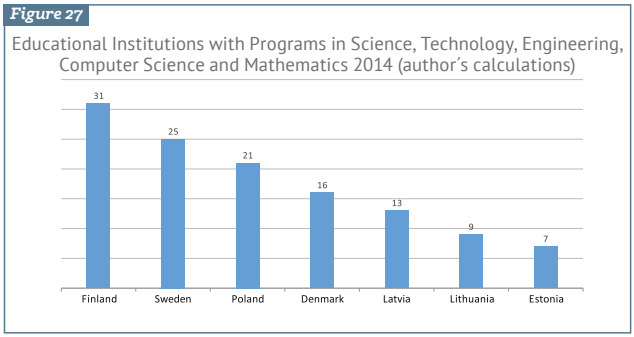
[3] **Sweden:** http://www.skolverket.se/laroplaner-amnen-och-kurser/grundskoleutbildning/grundskola/laroplan | **Denmark:** http://eng.uvm.dk/Education/Upper-Secondary-Education/Four-Upper-Secondary-Education-Programmes-in-Denmark/The-Higher-Technical-Examination-Programme-(htx) **Finland:** http://www.oph.fi/english/curricula_and_qualifications/basic_education; http://www.oph.fi/download/47678_core_curricula_upper_secondary_education.pdf; http://www.oph.fi/download/158820_national_core_curriculum_for_preparatory_education_for_general_upper_second.pdf | **Estonia:** https://www.hm.ee/en/national-curricula | **Latvia:** http://visc.gov.lv/vispizglitiba/saturs/programmas.shtml http://visc.gov.lv/vispizglitiba/saturs/programmas.shtml | **Lithuania:** http://www.smm.lt/uploads/documents/Lithuanian%20Education%20Strategy%202003-2012.pdf | **Poland:** https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/Poland%20country%20profile.pdf

3.3 HIGHER EDUCATION & R&D

There are increasing worries that the demand for ICT-related skills and skill sets will not be met in the labour market in the future. This is a complex issue, and it is not only on the size of ICT-related university education, i.e. the number of graduates produced with ICT skills, but also on how well the contents of educational programmes map to the needs of future employers. In order to improve the situation, these different factors need to be disentangled and studied separately.

An overview of university education in the region shows that there is a large variation between countries (**Figure 27**). Finland has 31 institutions that provide programmes in science, technology, engineering, mathematics or computer science, while Estonia has seven. However, in relation to their populations, the ranking looks quite different (**Figure 28**). Latvia has the highest ratio of university institutions, with 6.4 institutions per hundred thousand inhabitants, followed by Finland with 5.7 and Estonia with 5.5. Poland has 21 such institutions for higher education, but due to its population size this only amounts to 0.5 per hundred thousand inhabitants. This gives a first indication of each country's capacity to provide higher education with a strong relation to the information economy.

Figure 27



The share of university students enrolled in science, mathematics, computer science and engineering adds to the picture (**Figure 29**). Finland stands out with nearly 34 per cent of its university students in these programmes in 2012, while Latvia and Estonia have a high degree of educational institutions dedicated to these subjects, but only a fairly average share of students enrolled in their programmes. There also appears to be a slight downward trend in enrollment to programmes dedicated to science, technology and mathematics. To get a comprehensive regional perspective on the situation, it helps to look at the data in real numbers.

Figure 28

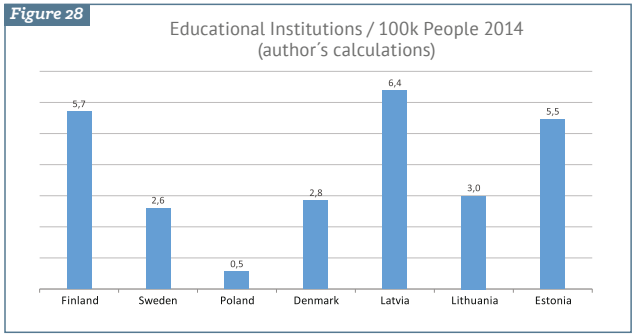
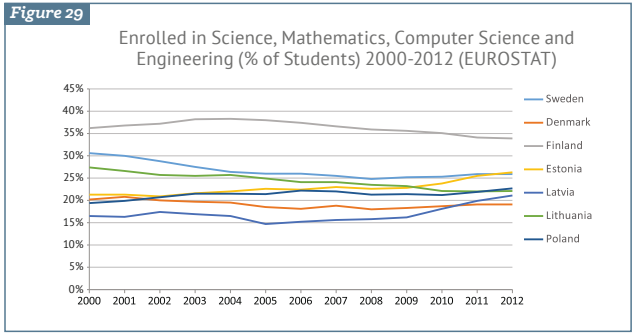


Figure 29



It is then evident that Poland is by far the largest provider of science- and technology-oriented university students (**Figure 30**). The actual enrollment of university students taken together and superpositioned provides an important overview of the future supply of these skills within the region (**Figure 31**).

Figure 30

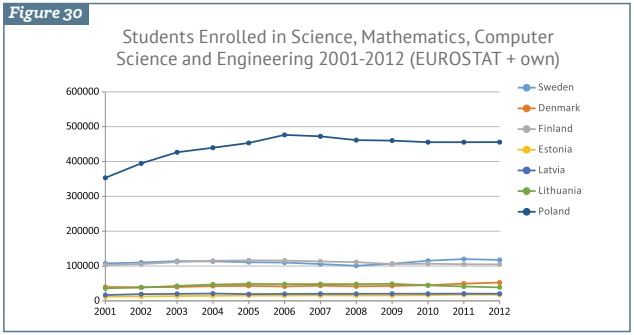
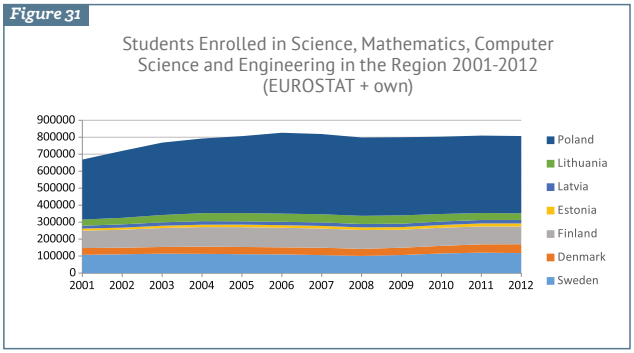


Figure 31



The number of graduates has been rising across the board from 2000 until 2012 (note that data for Latvia is missing for 2012), with some exceptions around the period of the financial crisis (**Figure 32**). Taking all the graduates together and superpositioning them in a graph provides another indication of the supply of ICT-relevant skills at a regional level (**Figure 33**). The Digital Agenda Scoreboard provides a similar measure of graduates in science, technology, engineering and mathematics (STEM) per thousand individuals aged 20-29 (**Figure 34**). In 2012, Lithuania had the highest amount of STEM graduates (23), followed by Finland (22), Denmark (19), Poland (18), Sweden (16), Latvia (14) and Estonia (13). There is no large gap between groups of countries, and Nordics and Baltics compete for the top places. However, it is worth noting that Estonia, which shows strong progress in other categories compared to the other Baltic countries, finishes last with ten graduates per thousand people less than Lithuania.

Figure 32

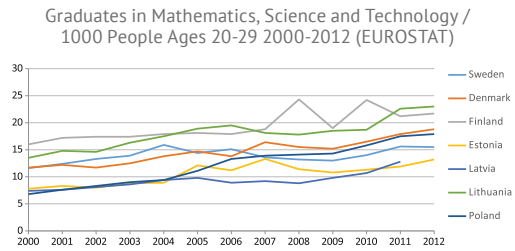


Figure 33

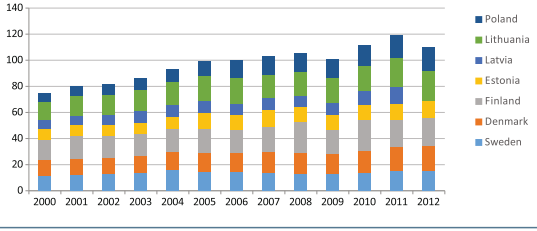
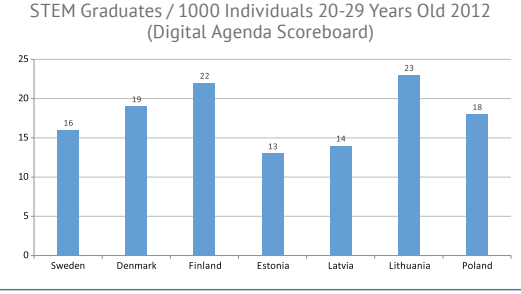


Figure 34



The share of PhD students is considerably higher in Poland, Finland and Sweden (**Figure 35**). Poland and Sweden have more PhD students in science, mathematics and computer science, while Poland and Finland outperform Sweden when it comes to more hardware-oriented subjects like engineering, manufacturing and construction (**Figure 36**). Finland and Sweden produce an impressive amount of PhD students in relation to their respective population size. These are also the countries with the largest actual number of university students in these subjects, meaning that their supply of potential doctoral students is larger. Combined, the doctoral students in science, mathematics and computer science from each country provide a supply of more than 16.5 million researchers and specialists (**Figure 37**).

Given the scale of researchers and specialists, it is tempting to draw the conclusion that this leads to future workforce quality, however it is the match between skills sought after by employers and the contents of educational programmes that will be essential. One example in this regard can be found in the report Searching for the micro-multinationals (Top of Digital Europe 2014). Based on interviews with SMEs in ICT-sectors it is concluded that there is a shortage of engineers who know not only technical and engineering issues, but also understands business development and sales.

Looking at research and development funding in science and technology, there have been significant differences between The Nordic countries and the rest of the region. Sweden has the highest private R&D funding by far, followed by Denmark and Finland on an even second and third place, and the Baltics countries as far as a factor 100 behind (**Figure 38**). However, Poland picks up by roughly a factor of 10 between the years 2002 and 2013. Measured as per cent of GDP, there is still a large gap between the Nordics and the Baltics, but the Nordics are now more even, and Estonia, rather than Poland, stands out among the rest (**Figure 39**).

Figure 35

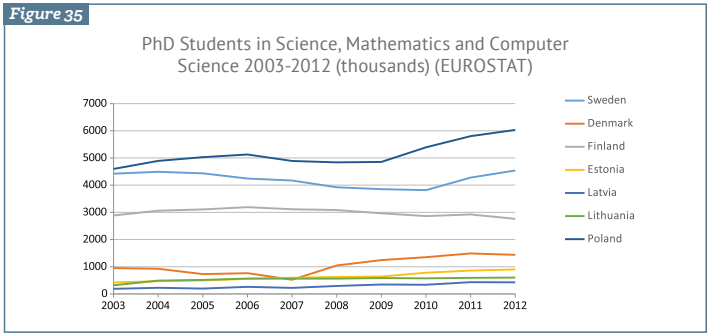


Figure 36

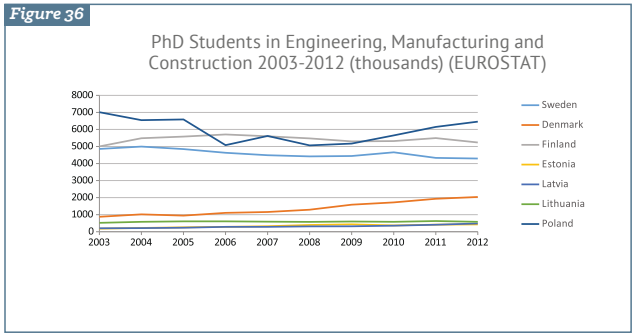


Figure 37

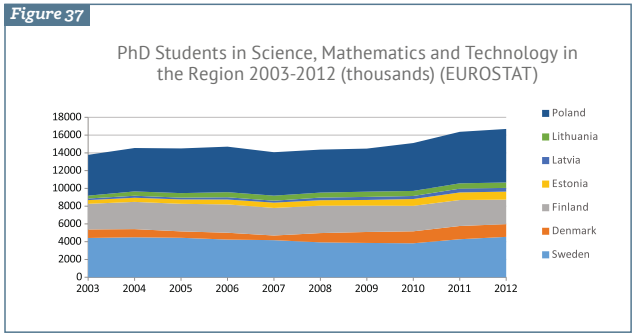


Figure 38

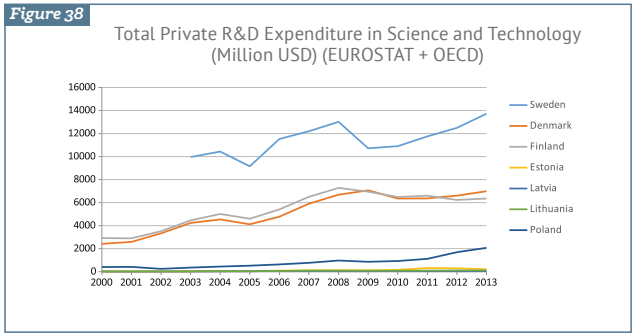
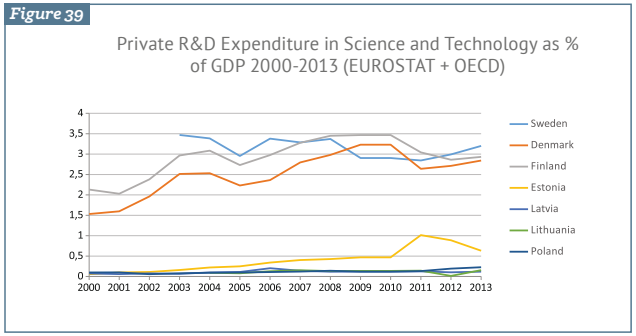


Figure 39



Public R&D funding looks somewhat different. In total amounts invested, Poland has increased substantially since 2005 and leads, followed by Finland and Sweden, who have remained in a fairly steady state for the last couple of years (**Figure 40**). Denmark has decreased its public R&D funding in science and technology, but show signs of picking up somewhat following 2011. In terms of GDP, all of the countries except Finland are converging, meaning that the Nordics are decreasing to the steady level of the Baltics (**Figure 41**). Finland stands out with 0.4 per cent in public R&D funding to science and technology in 2013, followed by Sweden at 0.1 per cent.

What this essentially means is that businesses and private interests are spending significantly less on creating new knowledge and developing goods and services within the area of science and technology in the Baltic countries. This most likely means that less money is being spent on employing ICT specialists and that the labour market demand for digital skills looks very different in the Nordics compared to the rest of the region. In terms of private funding, this is a signal that businesses are not investing in the entire region, which policy-makers should take to heart and try to change. As for public funding, although R&D in science and technology is given comparable attention as shares of GDP, Poland is the only country with small private investments that has increased its public funding over time. Accordingly, both private and public R&D funding is comparatively modest in the Baltic countries, something that may hold back or even counteract the benefits of the overall digital improvements made in these countries for the last decade.

Figure 40

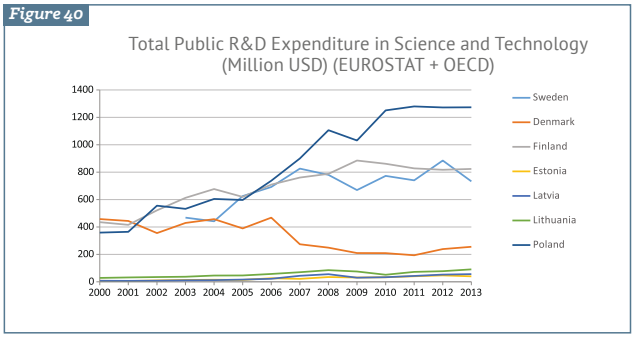
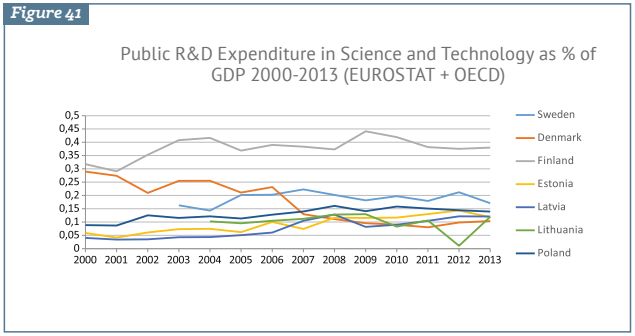


Figure 41



3.4 LABOUR MARKET AND ENTERPRISE

As the economy is being digitized and also automated, the demand for ICT-related skills will increase in the labour market. However, the data paints a more complex picture than just an increased need for classical computer engineers.

Looking at the broad sector categories of ICT manufacturing and services, there is no evidence of a large increase in share of employment in either sector during the period 2000-2010 (data from Eurostat is incomplete but provides a first impression) (**Figure 42, 43**). In fact, the share of employment in ICT manufacturing appears to have decreased in most countries, while the share employed in ICT services remains fairly steady, except in Estonia where it has increased by roughly one percentage point. Comparing the share of employment in ICT services and manufacturing in 2010, it is evident that services outweigh manufacturing by far, but also that the share of people employed in ICT services varies across different countries from 3 per cent in Denmark to 1.3 per cent in Poland (data on Sweden is not available) (**Figure 44**). Judging from this picture, digitization is not simply shifting the labour force towards engineers and occupations classically thought to be associated to ICTs.

Figure 42

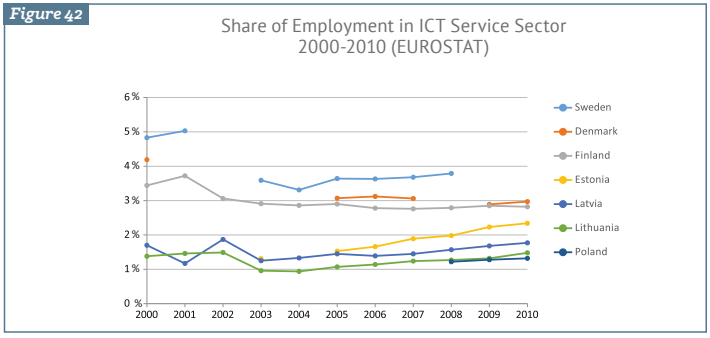


Figure 43

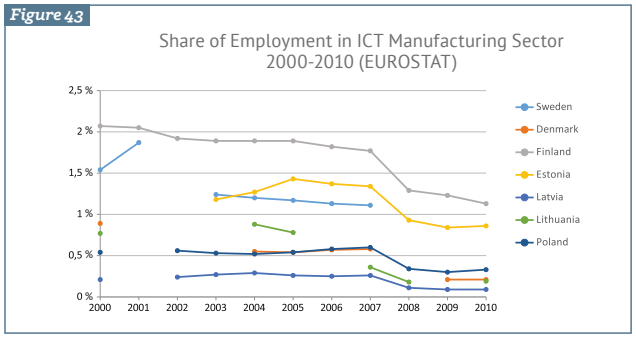
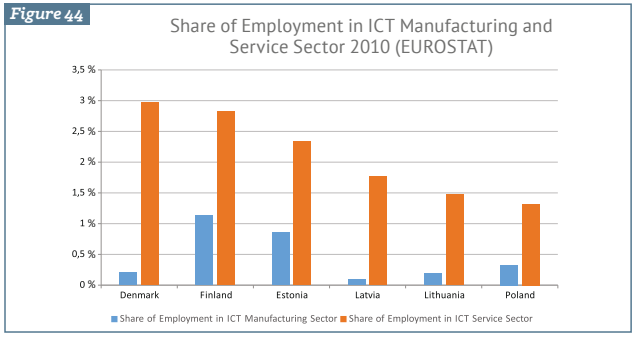


Figure 44



Another measure that could act as a proxy for employment in ICT-related areas is knowledge-intensive business services (KIBS). The share of employment in KIBS has risen in the entire region between the years 2000 and 2013, and in Poland and the Baltic countries there is a notable jump following 2007, which contributes to narrowing the gap to the Nordics (**Figure 45**). A closer look reveals that market services account for the largest part of the KIBS labour force in each country, and that information and communication is equal in size to high-technology services (**Figure 46**). Accordingly, the rise in KIBS may be related to digitization and the information economy, but it is not an increase driven solely by technological skills. In fact, the "other" category vastly outweighs all the other established categories of KIBS in Eurostat's data (**Figure 47**). This suggests that KIBS, and the information economy with it, brings about demand for skills and expertise that combine technology and other competencies in new ways that may not always fit into the historical view of the labour market and sector categorizations. This difference is important, since it is two quite different issues to demand more classical engineers, and to demand more engineers with business or marketing training (or marketers and business majors with technological know-how, for that matter).

There are a wide variety of ICT-related skills. To illustrate this, consider the following comparison between the share of employees who use a computer at their job, the share of individuals who have written a computer program, and the share of businesses that report difficulties with hiring ICT specialists (**Figure 48**). Remembering that these are shares from different wholes, there are still two aspects of this comparison that stand out.

Figure 45

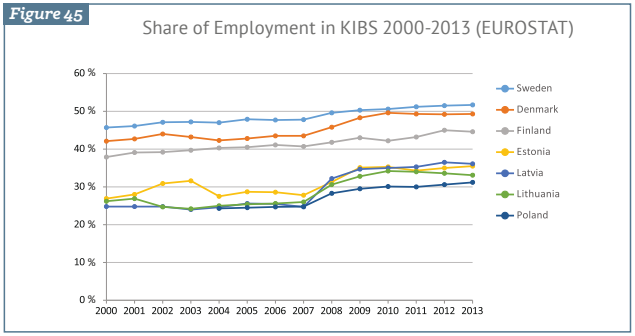


Figure 46

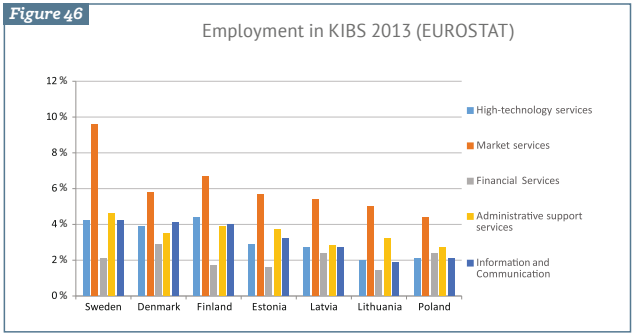


Figure 47

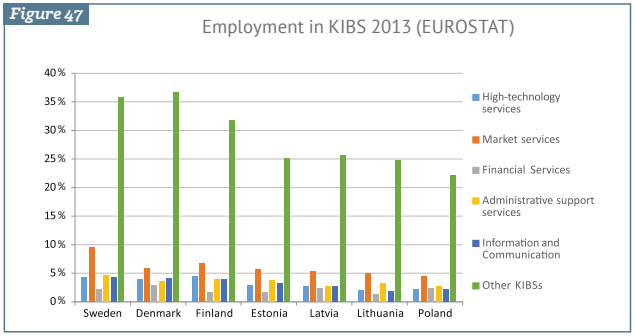
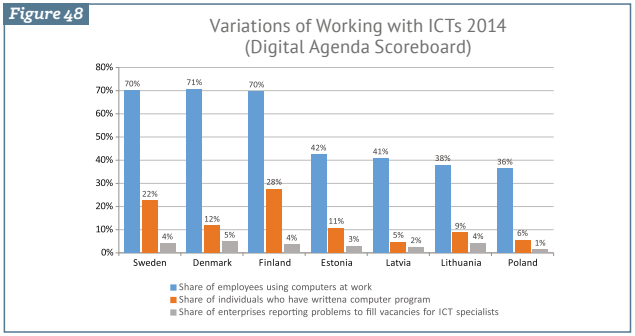


Figure 48



First, there is a considerable difference between people who need to be able to use computers in their daily work and those who have at least basic programming skills. Judging from this, most people will need to know how to use computer to get a job in the future, while employers looking for programmers may have a hard time. To add to this picture, consider that according to the Digital Agenda Scoreboard, the share of individuals with medium or high internet skills is above 50 per cent in every country except Poland (43 per cent) (**Figure 49**). However, there is also a clear gap between the Nordic countries and the rest when it comes to using computers in the workplace.

Second, the share of people who command some basic programming is consistently larger than the share of employers looking for ICT experts. Naturally, "expert" may mean a wide range of different things to these employers, but the relationship between these two categories suggests that the gap is not one between would-be employers looking for experts and employees with none of the desired skills. With the KIBS "other" category in mind, the gap may in fact be between a supply of general ICT skills (including some programming skills) and specific subject knowledge (technical expertise) or cross-disciplinary skill combinations (e.g. app programming and business planning or marketing). This issue pertains to how vocally training programmes and university programmes correspond and adapt to shifts in the labour market and society at large.

Consider this simple thought experiment. Comparing the share of businesses reporting a lack of ICT specialists in 2014 with the share of people employed who are reported to have ICT specialist skills in 2013 (**Figure 50**), it turns out that the share of specialists in the labour force (which is a bigger population in total than the employers) is larger than the share of employers having trouble hiring specialists in four of the seven countries (Sweden, Finland, Estonia and Poland).

This does not mean that there is no gap now or that there will be no gap in the future between supply and demand for ICT-related specialists. It will most likely become an increasing problem in several countries, especially if the effects of automation and outdated skill sets are also taken into consideration. However, the ratios between the labour force and employers in each country speak to the conclusion that the gap is more of an issue of diverging specific needs for specialists and small samples of employers and employees having a hard time coordinating and finding one another in the labour market. These problems should also be considered from a regional perspective where, for instance, Poland could readily supply the other countries with specialists in ICT-related fields.

Figure 49

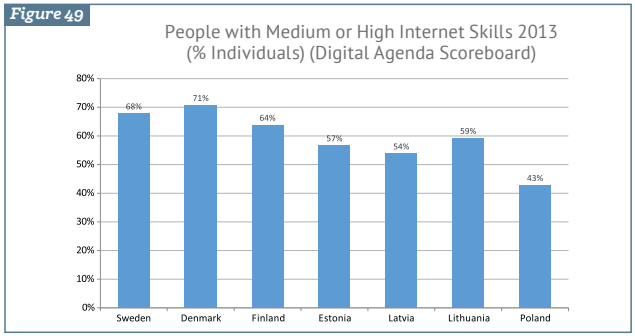
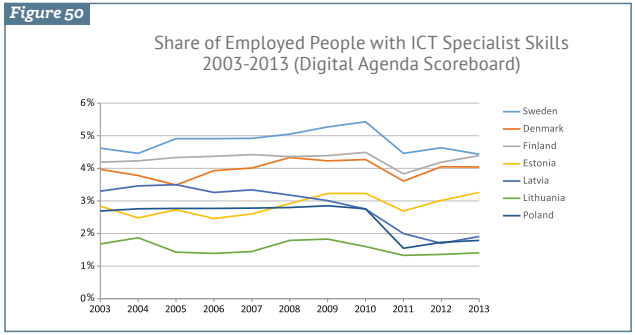


Figure 50



3

A complementary way to study labour markets for ICT skills is to study the extent to which ICT/IT specialists are employed in manufacturing and service companies (**Figure 51**). It is clear that there is a gap between the Nordic countries and the Baltic States when it comes to employment of ICT/IT specialists. Firms in manufacturing generally show a lower propensity to employ ICT/IT specialists compared to firms in information and communication services (**Figure 52**).

Figure 51

Figure 52

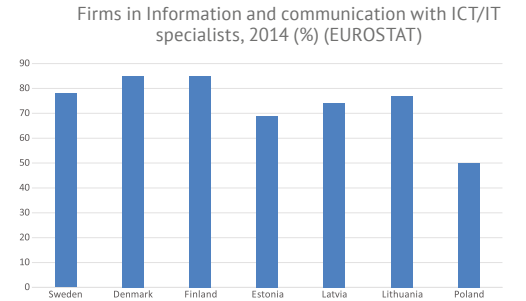


Figure 53

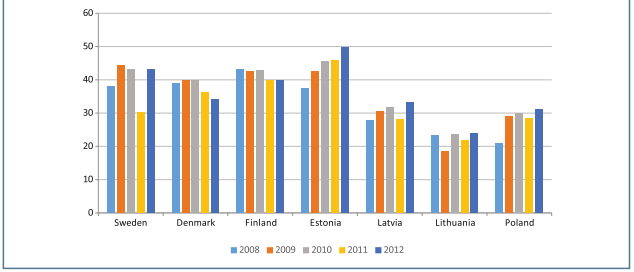


Figure 54

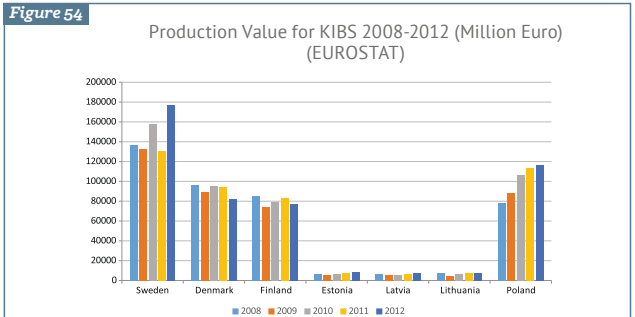
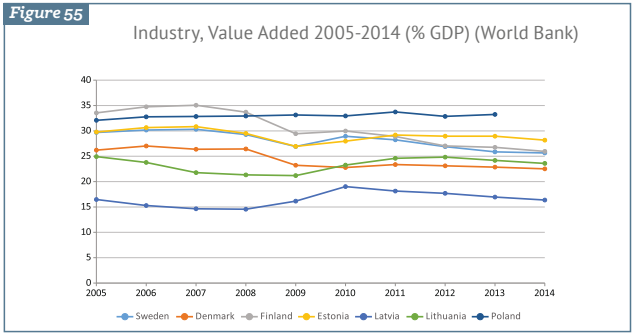


Figure 55



Looking at the economic impact of KIBS as part of the GDP for each country, Estonia and the Nordics have remained on a significantly higher level than Latvia, Poland and Lithuania (**Figure 53**). Estonia even outweighs all of the Nordics between 2010 and 2012. However, it may be sobering to consider the level of actual value-add in the KIBS sector (**Figure 54, 55**). The Baltic countries fall a factor ten behind the rest, while Poland outperforms Denmark and Finland, and Sweden takes the lead. Considering differences in size, there is still a considerable gap between the Nordic countries and the rest.

One way to study economic dynamics and growth of digital and ICT-related businesses is to study start-ups. Start-ups are also related to labour markets and availability of skills in two main ways. First, the presence of start-ups in ICT-related sectors means that there are individuals with ideas for new business opportunities in the sector and who regard starting a business as a way to capitalize on their knowledge.

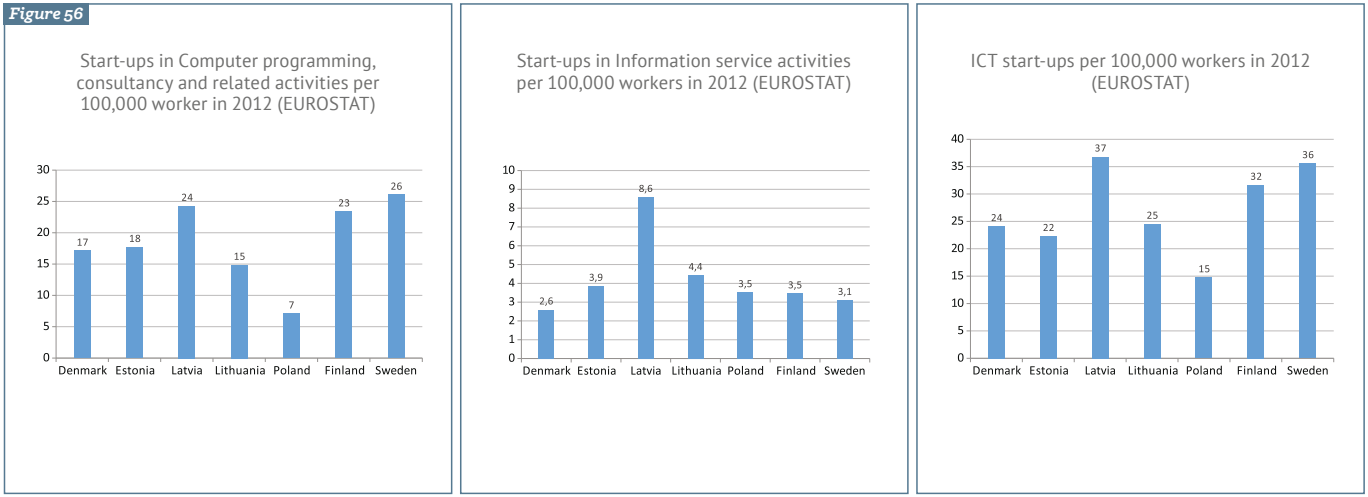
Second, it also supposedly suggests that entrepreneurs view availability of resources and employees as sufficient to run a business. As an economic phenomenon, start-up activity has a supply- and a demand-side. The supply-side refers to availability of resources such as inputs, capital, employees and knowledge. The demand-side refers to availability of demand for the services, products and technologies the start-ups bring to the market. (**Figure 56)** presents start-ups per 100,000 workers in 2012 in three sectors: (1) Computer programming, consultancy and related activities, (2) Information and service activities and (3) total ICT start-ups.

In Computer programming and consultancy, it is clear that Sweden, Finland and Latvia have a lead. The number of start-ups per employee in these countries is significantly larger than in the other countries. Denmark, Estonia and Lithuania are on a similar level, with Poland lagging behind. In information and communication services there are less pronounced differences between the countries, with the exception of Latvia, which shows a high entry rate in this sector. Looking at the total ICT sector, there are in principle three groups: Sweden, Finland and Latvia with high rates of start-ups, then Denmark, Estonia and Lithuania with a moderate entry rate, and then Poland with a lower entry rate. It is clear that Poland's weak position in the total is at least in part due to a low entry rate in computer programming, consultancy and related activities.

Again, it is still relevant to consider the underlying scale. Normalizing by employment could imply that small countries with a modest number of start-ups score high on entry rate. Looking at the absolute number of start-ups, it is clear that Poland, while lagging in terms of rates, produces a large number of start-ups. In 2012, for example, the Polish economy produced over 2,700 start-ups in ICT. This is in fact more than what Denmark, Estonia, Latvia, Lithuania and Finland produced together in the same year. Even in computer programming and consultancy, i.e. the sector in which Poland was clearly lagging behind in terms of rates, Poland shows a number of start-ups of about 1,300. The total number of start-ups in the same sector in Denmark, Estonia, Latvia, Lithuania and Finland together was about 1,700 in the same year.

These numbers also show a special position of Sweden. Despite a workforce three times smaller than the Polish workforce, Sweden alone produced over 1,800 ICT start-ups. If Poland would arrive at an entry rate similar to Finland, Sweden, and Latvia, the country would clearly be a major contributor to ICT-related businesses, not only in the Nordic-Baltic region, but also in the EU as a whole. At the same time, it is not only quantity that matters. Given the large amount of Polish start-ups, it is

Figure 56



relevant to pose the question of what percentage of the start-ups have managed to develop a brand that is recognized internationally and grows in terms of sales and employment.

In order for businesses to leverage the digital market, they also need to make transactions online. The share of enterprises making online sales in each country between 2009 and 2014 clearly shows that there is considerable unrealised potential in this area (**Figure 57**). In Sweden and Denmark, roughly a fourth of the businesses are selling online, while in Finland, the share of business with online sales is at 15 per cent. In the Baltic countries, Lithuania sticks out at just below 20 per cent, while Estonia is at 12 per cent and Latvia at seven per cent, the lowest in the region. In Poland, ten per cent of businesses have online sales. While this may be seen as a comparatively low Figure, Poland is in fact listed as a top emerging country in the most recent fact sheet on Key B2C E-commerce Data of Goods & Services[4] with a turnover of 6.6 billion EUR of business to consumer (B2C) e-commerce.

Divided by size, it is evident that large companies with 250 or more employees are more established in online sales (**Figure 58**). Looking at the share of businesses of different sizes compared to the overall share of enterprises engaging in online sales, it appears that small businesses are overwhelmingly underrepresented online. This segment includes businesses not traditionally thought of as digital, such as shops or local service providers, but this does not imply that they have nothing to gain from online transactions. A local restaurant could easily become a small-scale catering business by providing online group orders. At any rate, a challenge to every economy is to digitize a larger part of the low- and non-technical, often small, businesses.

Dividing the data by business sector shows that wholesale, manufacturing and transport, and storage and communication are the most established in online sales, although by varying degrees in the different countries (**Figure 59**). Renting, real estate and business activities are relatively small in each economy, but should be expected to grow significantly in the near future, especially driven by growing urban economies and emerging sharing economies.

Figure 57

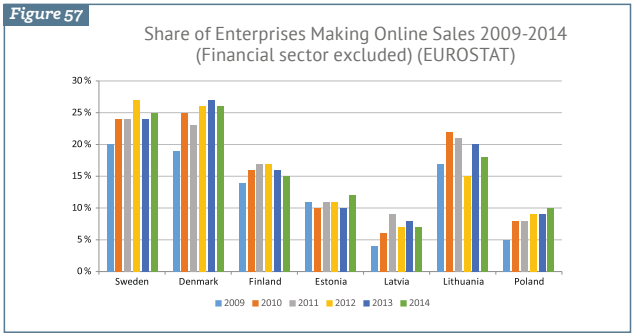


Figure 58

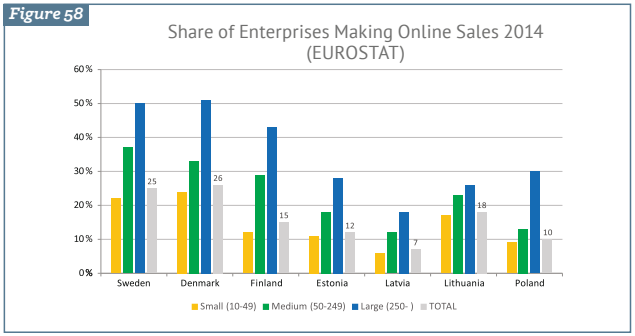
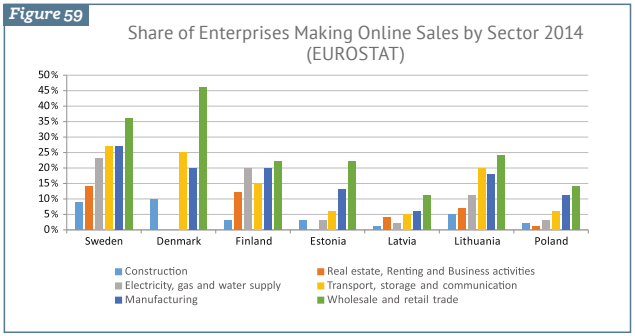


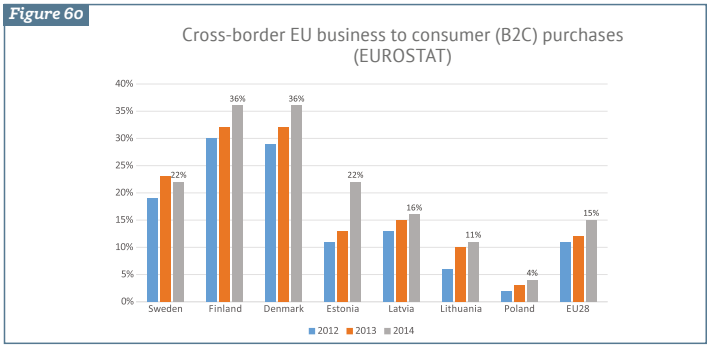
Figure 59



4 http://www.ecommerce-europe.eu/home

Another relevant issue, not least from the viewpoint of digital market integration, concerns cross-border e-commerce within Europe. In fact, cross-border online shopping in the EU is a direct measure of the realization of a cross-border digital market. To what extent do citizens in the Nordic-Baltic region purchase goods and services online from other countries in the EU? The European Commission reports that only 15 per cent of consumers bought online from other EU countries in 2014, while 44 per cent did so domestically. There are, however, sharp differences between countries (**Figure 60**). In terms of cross-border business to consumer (B2C) sales, it can first be observed that all countries in the region, just as in the EU as a whole, show a positive trend in that the fraction of citizens that purchase online from sellers in other EU countries increases. It is in fact only in Sweden where there is no significant increase between 2013 and 2014 in this regard.

Figure 60



A second observation is that Finland and Denmark are in a leading position with over 35 per cent of their citizens shopping online from other EU countries in 2014. This is more than two times larger than the average in EU28. The fact that it is Finland and Denmark that are leading the way in the Nordic-Baltic region is consistent with the general notion that cross-border EU purchases tend to be high in countries with strong regional or linguistic ties to neighboring countries (E-commerce Europe 2015). Sweden and Estonia come in second place with about 20 per cent. Estonia is a clear runner up with an exceptionally strong growth in its inhabitants that engaged in EU cross-border B2C online shopping between 2013 and 2014. Latvia, Lithuania and Poland are lagging, with the two latter countries being below the EU28 average through 2012-2014.

The European B2C e-commerce report (E-commerce Europe 2015) states that some of the primary reasons motivating consumers to engage in cross-border e-commerce are more competitive prices and a bigger variety of goods and services. Given significant differences in prices as well as variety in supply between EU countries, the growth in cross-border EU online purchases can be expected to continue to grow. There are also several opportunities that are specific for the region. Poland's comparatively low score on online cross-border B2C within the EU is troublesome, but also reflects a potential. With increasing ICT infrastructure and growing e-skills combined with continued linkages with, in particular, the Nordic countries across the Baltic Sea, one could expect a deepened familiarity between the countries that stimulates cross-border online purchases. It would also be good for the entire region if Latvia and Lithuania caught up with Estonia in growing its cross-border interaction with other EU-countries.

In any case, it is clear that the fast pace at which e-commerce grows worldwide suggests that e-commerce will become even more important for firms and households in the future. Not more than ten years ago, an e-commerce solution was a complement to any retail business, while a physical shop was essential to the business model. In the near future, the reverse will most likely be true, as having a physical shop will increasingly become a complement to online presence for a growing number of retailers.

3.5 PUBLIC SECTOR

The public sector plays a threefold key role in the emerging information economy: (1) it needs to adapt to digital technology and improve its own organisation and procedures, (2) public actors and government agencies are large and important procurers of new technology (to fulfill its role according to the previous point) and thereby promote entrepreneurship, innovation and growth, perhaps also future exports, and (3) governments hold many of the largest, most detailed and most valuable archives of data that could potentially be used to produce new knowledge, services and innovations. The other way around, digital technology can be used to improve the ability of government agencies to serve the public as well as to provide democratic engagement and participation.

The administrative work required to start a business or resolve a contract dispute provides an interesting picture of public agencies' efficiency and service towards the business community. While the number of actual procedures required to start a new business is fairly equal across the board, there is a huge gap in the number of days it takes to get the procedures done (**Figure 61**). Denmark is the fastest (6 days) followed by Estonia and Lithuania (7 days). Sweden and Poland finish last with 16 and 30 days respectively. The amount of procedures required to enforce a contract is more even across the countries, between 27 in Latvia and 35 in Estonia and Denmark (**Figure 62**).

According to the Digital Agenda Scoreboard, about 80 per cent of citizens in Sweden, Denmark and Finland used eGovernment services during a 12-month period, whereas the corresponding shares in Estonia and Latvia were roughly 50 per cent (**Figure 63**). In Lithuania and Poland, 41 and 27 per cent respectively had used some eGov service in the last 12 months. A similar pattern, although with smaller differences, appears for citizens who have submitted a form through eGov services in the last 12 months. In this area, it seems that the gap between the Nordics and the rest persists. Enterprises' use of eGov services is much more even across the region (**Figure 64**). Most businesses report both having used eGov services and having submitted forms through such services. This of course begs the question of if the administrative burden on businesses is efficient or could be further optimized, but at least it confirms a digital link between businesses and public administration.

Figure 61

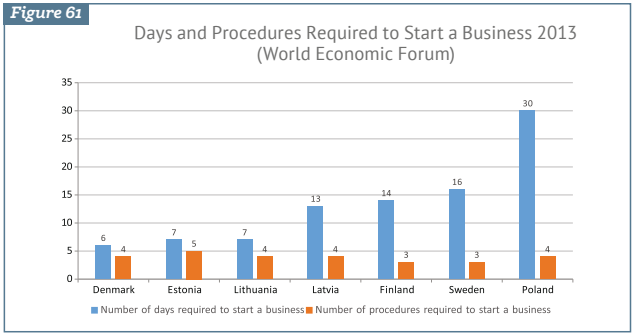


Figure 62

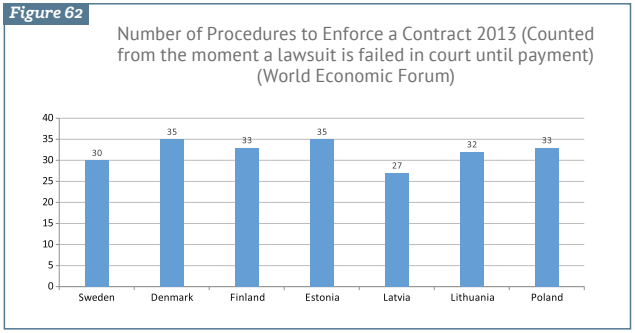


Figure 63

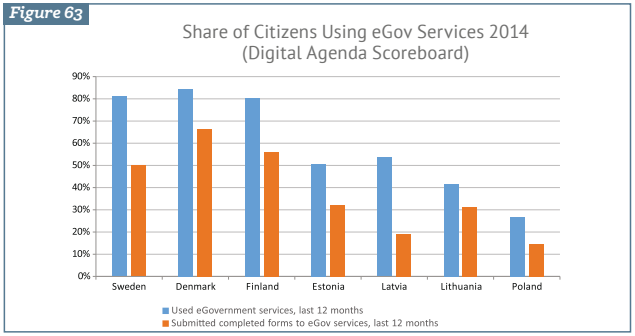
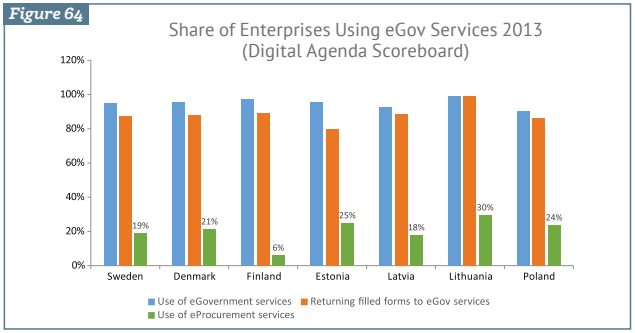


Figure 64



One eGov factor that greatly effects how people and businesses can interact and make transactions online is electronic ID, or eID. All countries except Sweden have their own national standards for eID. Sweden is in the process of getting one, but currently people are using third party standards issued primarily by banks. It is troublesome that there are so many different national standards. There are initiatives to increase the interoperability between them, for instance, to allow people from different EU member countries to access EU Commission data with their different IDs.[5] There are also various cross-border initiatives, among others from Sweden, Denmark and Latvia, and also between the Nordic countries, there is the Nordic eiD Systems. However, they are in different phases and it would prove difficult to map them all and decide on where to draw the line.

Estonia has a remarkably well developed system for electronic identification, including the e-residency, a national ID-card which also functions as an ordinary European ID card, and legal reforms to make electronic signatures equal to paper signatures.[6] The Estonian system is open to people outside Estonia who wish to become e-residents or to start an Estonian firm online. Yet, it is not cross-border in the sense that it applies in different countries. At the core of this is the issue that in many cases the way from initiative to interoperability is a long road. Ideally, an open standard for European electronic identification is the most desirable solution with the highest cross-border potential.

Electronic procurement, or *e-procurement*, has been pointed out as a strategic activity to promote the digital economy and market. However, as for ICT in education, this is an area where comparable data are difficult to find. For example, internationally comparable data on the extent to which public organisations act as procurers of new technology through e-procurement is lacking. However, data on firms' involvement in e-procurement from 2013 suggest that only a small share of businesses, roughly between two and three out of every ten businesses, are engaging in e-procurements across the region. Lithuania has the largest share of businesses engaged (30 per cent) while Finland has the smallest (6 per cent). This raises the question of how e-procurement procedures can be improved both in where they are used and how they implemented in order to engage a larger portion of the business community. Sweden, Estonia, Latvia, Lithuania and Poland all have some form of a national plan for e-procurement, while Denmark and Finland do not. There is also the issue of enabling cross-border e-procurement. This is supposed to be partly or fully enabled in Estonia, Latvia and Lithuania, but not in the Nordic countries or in Poland. This should be considered an important and attractive potential venue for regional cooperation and experimentation in order to promote a growing joint digital market.

Data has gone from being a residual of administrative work to being the raw material of the information economy and governments have, at their disposal, some of the richest of these residual archives in the world. These archives contain, for instance, demographic, geographic, historical, cultural and economic data for entire countries. Public Sector Information is increasingly being made available for re-use as open data, with the ambition to promote both innovation and transparency. However, there is no good way to quantify how much of its data a government or government agency has made available, since data is no definitive or scarce resource. It can be categorized and presented in a myriad of different ways. What can be done, on the other hand, is examine the effort to make data open and available for re-use. According to the Google World Map of Open Government Data, the Nordic countries all have government-led open data initiatives, while the Baltic countries and Poland do not. This adds to the threshold for digital entrepreneurship and innovation in these countries.

3.6 CONCLUDING REMARKS

The main conclusion from the assessment of the digital state of the BSR is that the gap is not constant. The picture is one of heterogeneity where different countries have strengths in terms of different aspects of the digital economy. It is not the case that the Nordic countries are in the lead across the different indicators or that the Baltic countries are always in a middle position. There is also large variation in terms of the size of the gap between leaders and laggards. There is thus a twofold meaning of the fact that there is no constant gap:

5 For example, http://ec.europa.eu/isa/documents/eu-activities-in-the-field-of-eid-interoperability.pdf
6 https://e-estonia.com/components/

1 The gap size between the leaders and laggards is not uniform across indicators;

2 The ranking of countries is not constant across indicators.

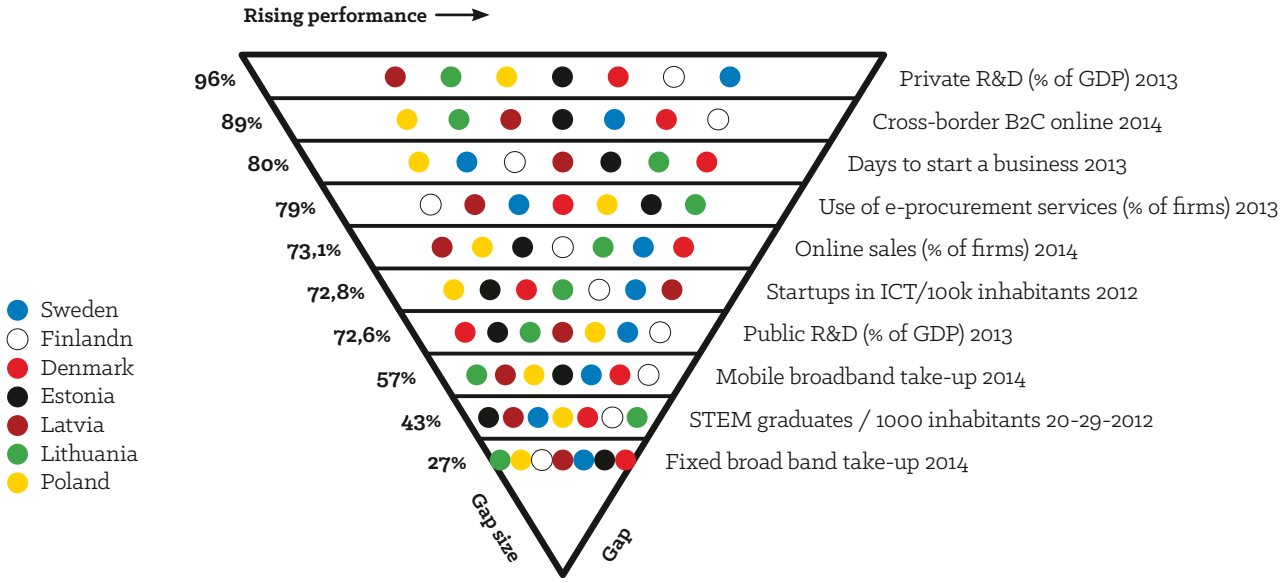
To illustrate this, **Figure 65** presents the position of each country according to representative indicators. The size of the gap in terms of the distance between the best and worst performing country is represented vertically. To illustrate the gap-size across indicators, we calculate it as a percentage of the score of the top performer. For example, if the top country scores four while the bottom country scores one, the gap-size in per cent of the top performer is 3/4=75 per cent.

For an indicator placed in the bottom part of **Figure 65**, the size of the gap is small. As a consequence, the horizontal distance between the countries is small. This means that the size of the gap between the top and bottom is small for fixed broadband take-up. If we instead look at private R&D, the gap is large. There is a significant distance between the country with highest and the country with the lowest R&D intensity.

Looking at **Figure 65**, it is evident leaders and laggards vary across indicators and they vary to a large extent. For example, Sweden lags in "days to start a business" but leads in private R&D. Latvia leads in start-ups but lags in private R&D. Lithuania leads in STEM graduates but lags in mobile broadband take-up.

There are several initiatives under way that address these gaps and issues, not least the Digital Agenda for Europe and the Digital Single Market Strategy adopted by the European Commission.[7] These provide necessary EU-wide actions that will of course also impact development on a regional level. There are also several national initiatives aimed at improving the positive impact of digitization in each country, such as the Estonian e-residency platform.[8] However, these initiatives can be complemented and supported by local and cross-border regional actions that can cater to localized challenges and opportunities, for instance improving cross-border social networks and trust.

Figure 65



7 http://ec.europa.eu/priorities/digital-single-market/docs/dsm-communication_en.pdf and https://ec.europa.eu/digital-agenda/en

8 https://e-estonia.com/e-residents/about/

4 IDEAS FOR FURTHER COLLABORATION

Many barriers to a digital single market are non-technological, and relate to how people, data and ideas move. In this section, we suggest four ideas to policy-makers, on a local and national level, that will strengthen the conditions and potential for a digital single market in the BSR. They all point to the need for a more active and dedicated cross-border regional collaboration in the digital area.

4.1 CONNECTING PLACES AND PEOPLE ACROSS BORDERS

Local policy-makers in cities should engage with and mobilize their business communities in cross-border network building cooperations between cities in the Baltic Sea Region to attract and exchange human capital. This promotes social networks and trust between cities and across borders, for instance by offering housing and office spaces to start-ups for an exchange period.

A digital single market is not limited to technology, or even to the share of cross-border e-commerce. In the end, it is about people, ideas and interaction. This is why dismantling non-digital barriers associated with language, culture and trust is essential to fully leveraging the strengths of digitization. Cross-border mobility including interactions of human capital and digital skills is a key priority to achieve this. However, people do not move between countries, so much as between places.

Exchange of digital human capital should be done primarily between cities or municipalities, rather than through broad programmes between nations. Conversely, entrepreneurs may be attracted to relocate if they are offered free housing or office space and the opportunity to test out their ideas in a new market, not only digitally, but with their "feet on the ground". Both places would benefit by adding social ties between them that can leverage the combined strengths in each place. This would also promote innovation based on differences in experience or complementary advantages. The entire region would in turn benefit by lowering social borders between countries, moving towards a more integrated economy. Sharing human capital is an excellent way to make it grow.

National governments need to continue to work together to remove institutional and regulatory barriers to the movement of human capital. The real gains are found in connecting places and people rather than systems. Local policy-makers should engage in cross-border interactions to promote exchange of human capital. There are plenty of examples of public officials networking between cities to benchmark issues of joint concern. However, there is a great potential in connecting entrepreneurs, start-ups and business leaders, rather than just the policy-makers themselves.

4.2 TRANSNATIONAL TESTBEDS

Policy-makers in each country should jointly set up open and linked testbed platforms to connect entrepreneurs and start-ups with public institutions such as education, healthcare, city planning or public administration. This would boost entrepreneurship within the region and make it an attractive testbed region internationally, as well as provide opportunities for schools, public transit and care facilities to leverage the testing and get input to learn and improve.

Local and regional economic development organisations could similarly reciprocally open their living labs and testbed initiatives to digital companies from "sister regions" – be it within local and regional digital development efforts on public administration, public transport, city planning and/or education.

Although a digital market theoretically enables supply and demand across the globe, selling to different countries still entails significant variations and differences. Large international firms who are physically present in each market have known this for a long time, but for new businesses born global and digital, i.e. micro-multinationals, new solutions are needed to overcome such barriers. One possible approach to this would be to establish transnational testbeds for new digital services.

Testing is becoming increasingly important to large and small firms alike, but it is often associated with costly and time-consuming processes, which will especially inhibit SMEs. This need not be the case. The countries in the BSR make up a joint market with high digital maturity, but also significant variations in technology adoption and use. This makes it an ideal arena for transnational testing.

By linking testbed platforms between countries, or even between specific cities, firms could be invited to test their services around the region. Examples of such platforms could include tourism, public transit, public administration, schools, or simply free Wi-Fi platforms. Within these, firms could get access to potential users, while the platform owners could benefit with the firms by getting use-cases, testing new ideas for development together with firms, or simply engaging people in the testing procedures to increase their knowledge in this area. A high school or college participating in a testbed platform could, for instance, allow students to test a service and evaluate it together with the entrepreneurs as a learning process building tangible experience with real-world problem-solving. Such platforms must ensure user privacy and a responsible treatment of data. Also they should be constructed to include harmonized open government data, which could in turn spur new innovations.

4.3 UNDERSTANDING EDUCATION FOR THE INFORMATION SOCIETY

National policy-makers and school leaders should establish cross-border cooperation in the region to improve the understanding of how to leverage digitization in education. It requires: (1) measuring and quantifying *how* technology is being used and what works, and (2) benchmarking between schools and across borders to facilitate experimentation and continuous improvement. It can accelerate the development towards a school that both makes the most of new technology in the classroom and prepares students for the future by supplying them with the necessary e-skills.

Exploring data on the digital state and developments in the BSR, it is evident that one core area of interest is underrepresented: education. Even though education policy is a high priority in every country and there is a lot of information on traditional outcomes like grades or specific test scores, there is surprisingly little data on how ICTs and digitization are introduced and used in school. Two issues should be prioritized: (1) adoption vis-a-vis adaption and (2) teacher training and skills.

It is clear that schools throughout the region are using computers in schools, and have internet access and some form of ICT knowledge in their curriculum. However, these measures relate more to adopting new technology (i.e. adding it to the existing organisational structure), than to adapting to new technology (i.e. changing organisational structures to take advantage of new technology). Should e-skills be a subject of its own in the curriculum? Should it be integrated as a set of tools in other subjects, or both? It should be expected that a teacher in chemistry, biology or mathematics in the year 2020 use programming or digital tools as part of their teaching. However, to realise this ambition, there is a lot of work to be done between now and 2020. It begins with improving our knowledge of how (not just if) digital technology is used in schools, and benchmarking this knowledge between schools and between countries.

Schools will never become better than their teachers. Teachers are the spearhead of school development. This goes for ICTs and digitization, just as for any other subject. However, if teachers are not given the necessary skills, tools and mandate to bring digitization into their classrooms, then the entire educational system will increasingly lag behind.

Data suggests that ICT-related skills are at least an optional part of teachers' education in each country in the region. However, it is unclear what this actually entails. In most cases, the students will already be more avid users of new technology than their teachers, and if teachers are just trained in general ICT use, they will always be falling behind their next

class. If, instead, teachers are trained in programming or more advanced applications of the technology, they will be better suited to leverage technology in class and able to provide their students with e-skills that they may not have attained on their own.

4.4 CROSS-BORDER-FRIENDLY DATA

National policy-makers should jointly set up a framework for providing harmonized, high-quality open government data in a cross-border-friendly way. This would promote data-driven innovation and the emergence of new online platform businesses.

Intellectual property rights and data regulation hampers the European market at large. As mentioned previously in the report, American online entertainment content providers are better poised to export a global, digital market than their European competitors. This also means that uniquely European content or potential innovative approaches to content provision are inhibited by fragmented regulations. This is a loss both to the digital market and to European culture.

It is a tall order, but policy-makers need to improve the conditions for cross-border data traffic within the EU and to the rest of the world. Intellectual property rights are of course at the core of this issue, but there are other approaches as well. One is to provide high-quality open government data in a harmonized format that is easily accessible in all of Europe. A first step in this direction would be to build this platform for the Baltic Sea region, and then to expand it. There is already plenty of knowledge and ready-to-implement open standards for providing open government data that could be used to this end.

5 THEORETICAL FOUNDATIONS AND ANALYSIS

5.1 THEORETICAL FOUNDATIONS FOR DIGITAL MARKET INTEGRATION

Many economic analysts and policy professionals argue that the parts of the economy that are driven by Information and Communications Technologies (ICTs) and data-intensive processes are becoming increasingly important for economic growth, innovation and employment (see e.g. Grajek 2012, Fransman 2012). According to the report *Lessons for ICT innovative industries* from the European Commission's joint research center (EUR 25562 EN), ICT-related sectors constitute the leading R&D-investments in the world.

This appendix provides a theoretical overview of the arguments for digital market integration and a review of relevant research. The text covers ICTs as *general purpose technologies*, the US-EU ICT gap as well as why a single digital market matters.

5.1.1 | ICT as general-purpose technologies

A major reason for the large economic impact and role of ICTs, such as cloud computing, internet of things, machine learning and 3D-printers, is that they fulfill criteria of being general purpose technologies (GPTs). This means that they enable solutions in a variety of contexts by being platforms for subsequent applications (Bresnahan and Trajtenberg 1995). Consider for example social networks. The more people that are connected to a specific social network, the larger its attraction for new members. A large number of users of the social network in turn also influences the incentives for businesses to use the social network as a platform for advertising. That is, the inherent complementarities between platforms and applications amplify the economic impact of ICTs.

"…the platform benefits from an increasing number of applications, which triggers more investment in the platform followed by more applications and so on. The total impact of a GPT in any given point in time is much greater than the direct productivity impact of its individual applications. The impact tends to grow substantially over time, eventually reshaping large parts of the whole economy" (Grajek 2012, p. 2).

One example of an area where ICT have had tremendous impact in recent decades is computer-mediated transactions. Many, if not all, modern economic transactions involve a computer or computer program. This has enabled a large set of opportunities for firms to charge payment for services and products in new ways as well as to design new business models. Varian (2010) lists four large categories of impacts that computer-mediated transactions have brought and that penetrate many different sectors and lines of businesses: (1) they facilitate new forms of contract, (2) they facilitate data extraction and analysis, (3) they facilitate controlled experimentation and (4) they facilitate personalization and customization.

Together, these four factors enable a wide variety of developments. For example, they enable a new type of start-ups that are born both digital and global. They facilitate for large companies to learn from data and form individual relations to all customers through data-driven business intelligence. They also allow individuals to demand highly personalized services and goods.

Grajek (2012) reviews estimated economic impacts of different categories of ICT technology: social networks, cloud computing, machine-to-machine communication (M2M) and data-driven organisational technology. Several of the articles in his review suggest large impacts. For example, one study estimated a productivity gain of 23-32 billion euros from cost savings through adoption of cloud computing among SMEs in Europe. Another estimated a cost savings in the order of 1.1 % of GDP due to deployment of internet business solutions as part of data-driven organisational technology.

By providing access to real-time big data, digitization is also often claimed to accelerate innovation. For example, in a new report from the OECD, *Data-driven innovation – big data for growth and wellbeing*, it is stated that:

"Close to real-time analysis of large volumes of data (big data) – generated from a myriad of transactions, production and

communication processes – is accelerating knowledge and value creation across society to unforeseen levels. Data-driven innovation (DDI) refers to significant improvement of existing, or the development of new, products, processes, organisational methods and markets emerging from this phenomenon. DDI has the potential to enhance resource efficiency and productivity, economic competitiveness, and social well-being as it begins to transform all sectors in the economy, including low-tech industries and manufacturing" OECD (2015, p. 17).

5.1.2 | The US-EU gap in ICTs

Given the importance of ICTs, an issue of major concern for the EU is that Europe lags behind the US in terms of leveraging the new technologies in the economy. Several studies and reports of the European Commission have shown that Europe has a lower specialization in ICT compared to the US, and also that the weight of the ICT sector in total R&D is much smaller (JRC 25562 EN). European ICT firms also show an overall R&D intensity that is small compared to US firms. In the European Commission's *Innovation Union Competitiveness Report 2011*, it is claimed that the US ICT R&D intensity is almost twice as high as that of the EU. A closer look at ICT-related firms in Europe also shows that Europe has a comparatively weak development of businesses that find new ways of leveraging ICTs in new business segments, for instance in terms of software- and internet-driven business models. The European economy also has blind spots when it comes to generating new, innovative firms capable of competing with world-leading US firms like Google, Apple, Facebook and Amazon, in terms of providing digital platforms and applications (Veugelers and Cincera 2010).

Veugelers (2012) argues that this gap is a problem for the European ICT-driven businesses. A main reason for this is that enterprises providing digital platforms constitute a central cog in the information economy. In recent years, the economic power has shifted from network providers and network operators towards platform providers. These firms can be described as intermediaries between businesses selling applications and consumers buying the applications. As supply increases in the digital market, so does the need for coordination in order to connect buyers and sellers. Being in charge of a platform with many users and many applications attached to it is extremely valuable since platforms are two-sided (cf. Rochet and Tirole 2003). That is, there are significant network effects on both sides of the market: the more customers, the more peers to connect to and the more incentives for other firms to provide application to the platform. Operating systems like Windows, Linux and Unix, as well as Google's Android, Apple's iPhone and Microsoft's Windows Phone are all examples of platforms. Veugelers (2012) shows that Europe has a weak position precisely in the segment comprising providers of platforms, contents and applications, i.e. the business segment capturing most value in the ICT ecosystem.

5.1.3 | A single digital market – why it matters

It is clear that a key challenge for Europe is to undertake measures to increase the conditions for a growing digital market and strengthen its position globally. The fact that Europe lacks a single integrated digital market is consistently reported as a major barrier for innovation and growth of the ICT ecosystem in Europe. Economic theory identifies a number of ways in which larger markets stimulate innovation and growth, and benefit consumers. Classic arguments concerning effects of larger integrated markets through integration include the following:

- **Increased competition, which lowers prices and increases consumer surplus;**
- **Increased productivity emanating from a reallocation of resources to more efficient producers, and adoption as well as adaption of ICT;**
- **Improved access to a variety of goods and services;**
- **Greater returns and incentives to entrepreneurship and innovation;**
- **Better access to skills and competencies and improved matching between supply and demand in the labour market.**

The unique thing with digital markets, or rather the underlying ICT platforms, is that they make it possible for people and businesses to connect to each other as well as to buy and sell goods and services all over the world. Thereby, they have a fundamental potential to promote development and growth through trade. At the same time, digital markets are, just as ordinary markets, subject to friction phenomena induced, for example, by institutional barriers.[9]

[9] As an example, the European Commission reports that there are issues with cross-border delivery costs and VAT compliance costs associated with online cross-border transactions (https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/digital_single_market_factsheet_final_20150504.pdf)

The development of online platforms that can facilitate cross-border transactions and interactions within the EU requires a common digital market that in turn puts demands on institutional adjustments y.[10] For example, the European economy has so far not provided sufficient conditions to stimulate the development of EU-wide platform providers, such as European-based globally competitive versions of eBay or Netflix, and it is not for lack of several entrepreneurs around Europe trying. The EU commission reported that only 15 per cent of consumers bought online from other EU countries in 2014, while 44 per cent bought something online from sellers in their home country. All in all, research clearly shows that there are large gains to be realised from integrating a digital market between countries. This applies equally to the BSR and the entire EU.

5.1.4 | Trade costs

There is clear evidence in the literature that online transactions reduce trade costs. Lendle *et al.* (2012) use a dataset of bilateral eBay trade between 61 countries and show that distance matters significantly less for online transactions compared to standard "offline" trade. A detailed analysis of cross-border eBay transactions show that the influence of distance on trade is about 65 per cent less compared to traditional offline trade for the same countries and similar products. This difference in distance effects is due to the online technologies reducing information and trust frictions associated with geographic distance. As argued by the authors, this suggests that digital technologies for online trade have a clear potential to make trade more efficient and "friendly".

Online platforms for cross-border transactions also enable and improve the conditions for exporting, especially for small and medium-sized businesses. Exporting in the traditional way is associated with significant costs that normally encompass incomplete information about international trading opportunities, uncertainty about contract enforcement and unfamiliarity with market characteristics (see e.g. Anderson 2000). These are costs that small entrepreneurs often have problems dealing with. For example, the EU commission reports:

"…at present, markets are largely domestic in terms of online services. Only 7% of EU small- and medium-sized businesses sell cross-border. This needs to change – putting the single market online."

These numbers are remarkably low, especially when considering how to establish a digital single market connecting all buyers and sellers to each other in the EU. It goes to show that there is still much to do.

Exporting through online platforms, like Amazon, still entails much smaller hurdles. Lendle (2013) uses data on firms selling through eBay and finds that eBay sellers are more likely to export, and they export to a larger variety of markets. These results are consistent with the idea that platforms for online cross-border transactions reduce costs associated with selling to foreign countries compared to traditional exports offline.

These studies, i.e. Lendle et al (2012) and Lendle (2013), are particularly relevant in an EU context, since the EU member states are heterogeneous with different cultures languages and informal institutions. The findings of both studies point to an important role of a large integrated EU digital market in, for example, paving the way for the development of European businesses that develop platforms for online transactions. Such systems have a clear potential to reduce issues of information and trust to a significant extent and to stimulate cross-border transactions and interaction. Another benefit of promoting such European platform businesses is that they are more likely to improve the conditions for bringing forward uniquely European niche content. This not only applies to more local niche businesses reaching an EU-wide market, but also to more European businesses reaching a global market.

To illustrate this, consider intellectual property rights where there is a huge difference between the US and the EU in terms of regulation. Online entertainment content from the US is better equipped to reach a global market than corresponding content from the European market. Because of this, the thresholds for new customers to find and enjoy American film are much lower than for accessing French or Italian films even if you happen to live in a neighboring EU country.

5.1.5 | Innovation and entrepreneurship

An integrated digital market is also likely to stimulate entrepreneurship and innovation in digital technologies and ICT sectors. Innovation activities in firms respond to incentives and expected revenues (Cohen and Klepper 1996). When institutional

[10] The European Commission has identified the completion of the Digital Single Market (DSM) as one of its 10 political priorities. A DSM is defined as a digital market in which the free movement of persons, services and capital is ensured and where the individuals and businesses can seamlessly access and exercise online activities under conditions of fair competition, and a high level of consumer and personal data protection, irrespective of their nationality or place of residence.

framework conditions are in place that, for example, enables online platforms for EU-wide cross-border transactions, the prospects for R&D projects to develop platforms and applications increase. For instance, consider a firm in Latvia having an idea for a software innovation for a niche market. Realizing this idea requires investing money in an R&D project. If the niche market in Latvia is too small to generate sales revenues that are sufficient to motivate the investments, and the institutional barriers and costs associated with reaching the same niche market in other European countries are too high, the firm might refrain from the investment. On the other hand, in a larger digital market, innovation may be easier.

A large single digital market allows for more small and or niche innovations to find a critical customer mass, since the necessary niche audience can be compiled from a larger cross-border population. That is, innovations for which a local market in Latvia, or even the entire Latvian market, would be too small may be worth investing in on an EU or global market level. This especially applies to customer goods and services that have historically been fairly divided into domestic markets. Veugelers (2012, p8) reports ***"a major problem for firms in Europe to create commercial value for their new technologies, to access early lead customers willing to take the high risk of adoption, to mass customize and successfully brand their products"***. A single digital market will clearly help in this regard as access to customers EU-wide will be improved.

5.1.6 | Adoption and adaption of ICTs

Adopting new technologies, i.e. adding them to the current organisational structure and routines, may generate benefits in terms of improved efficiency. However, there are also large benefits to be made by organisations that manage to adapt to new technologies, i.e. change their structures and routines to fully leverage new technologies in reaching their goals.

Market expansion that induces competition between firms in the EU could increase both adoption and adaption. For example, research show that increased competition stimulates adapting to data-driven organisational technology and ICT solutions. In fact, this is one of the main conclusions from Grajek's (2012) study of obstacles hampering ICT-led growth in Europe.

Following Brynjolfsson (2011, p.61) organisational technology and ICT solutions are defined as "innovative management techniques, business models, work processes, and human resource practices, which complement and amplify their [firms'] ICT investment". It is argued that it can foster innovation in firms because data stored in firms' ICT systems can enable more objective data-driven decision-making, and facilitates experimentation with new business ideas. Also, data-driven decision-making allows for a more dynamic approach to organisations themselves, much in the same manner as prototyping and agile development are changing the conditions for development projects and making them more iterative. Grajek cites several studies arguing that one of the reasons for a lower use of organisational technology and ICT solutions among firms in Europe compared to the US is weaker competition and market rigidities. His conclusion is that "rigid product and labour-market regulations and the lack of European single market, especially the digital market and the market for services, significantly hamper the deployment of data-driven organisational technology and ICT solutions" (ibid, p.8).

5.1.7 | Improved access to and variety of goods and services

Greater access to a wide variety of goods and services enabled by an integrated digital market will also have a strong and positive effect on European citizens. Brynjolfsson et al (2003) study consumer gains from online bookstores and find that (ibid, p.1580) "… the increased product variety of online bookstores enhanced consumer welfare by $731 million to $1.03 billion in the year 2000, which is at least five times as large as the consumer welfare gain from increased competition and lower prices in this market". An integrated digital market that stimulates EU-wide online platforms for cross-border transactions is likely to significantly increase the variety of goods and services available for EU consumers. This is what Marc Andreesen, internet entrepreneur and renowned venture capitalist, has referred to as "software is eating the world".

5.2 IN-DEPTH ANALYSIS: A CROSS-BORDER HUMAN CAPITAL ECOSYSTEM

Up to this point, the report has focused on the position of individual countries in the BSR, and discussed gains that can be realised from a single digital market. It is in this context important to recognize that a

truly single market also requires that other markets becomes integrated. The preconditions for an integrated, competitive and dynamic digital market are not limited to technology and ICT infrastructure; the conditions for cross-border transactions and movements are equally important. The prospects for realizing and fully leveraging a single digital market are intertwined with the conditions for a single market, also with regard to the flow of human capital, goods and services between countries.

In this chapter the focus is on human capital; a critical component of the factor market. The chapter discusses how a regional single market could affect availability of human capital and the future supply and demand of digital skills, which clearly bears on the growth potential of ICT-related businesses.

5.2.1 | The case for human capital

For good reasons, there are few (if any) firms that do not cite access to qualified employees and human capital as a critical factor for their development and success. For instance, firms operating in dynamic technology and knowledge-intensive business, such as ICT-related ones, are in a constant need to keep-up with and integrate new technologies and technical solutions, as well as to adapt goods, services and business models accordingly. To succeed with this, they need human capital.

According to OECD (2001), human capital can be understood in overall terms as "as the knowledge, skills, competencies and attributes embodied in individuals". When firms hire employees, those employees accordingly bring with them new knowledge, skills, experiences as well as ideas that can be essential for the development of their businesses. The so-called competence-based view of firms holds in principle that firms' capabilities ultimately reside in the knowledge, experiences, and skills of the people in the firms. This is not least true for new firms. For example, in a classic analysis of success factors among new high-technology firms, Cooper and Bruno (1977, p. 21) concluded that "for a new, high-technology firm, the primary assets are the knowledge and skills of the founders. Any competitive advantage the new firm achieves is likely to be based upon what the founders can do better than others."

It is thus crucial that firms, new as well as established, find the "right" type of workers for their businesses. Still, firms consistently report problems finding pertinent human capital. Moreover, qualification mismatch, that is the discrepancy between the qualifications held by workers and those required by their job, have also become an issue of growing concern for policymakers. As an example, Quintini (2011) reports that in the OECD area, about one in four workers are over-qualified and about one in five are underqualified. These are issues that to a great extent apply to ICT-related business in the BSR, as illustrated in the report *Searching for the micro multinationals* (Top of Digital Europe 2014).

5.2.2 | The role of an integrated market for human capital: Regional human capital ecosystems

An integrated market for human capital that facilitates cross-border mobility influences the long-term goal of a digital market and development of competitive ICT-related business in two main ways:

1. It influences the speed with which e-skills, availability of human capital and matching of supply and demand in the labour market is improved and adjusted
2. It fosters cross-border knowledge flow and stimulates cross-border social networks and familiarity

5.2.3 | Adjustment speed

Solving issues of access to qualified labour and matching on labour markets takes long periods of time. This is especially so when such problems are addressed from a purely inward-looking and domestic perspective in each county. Consider, for example, a case in which firms in Denmark experience lack of employees with e-skills. Looking at Denmark as an isolated island, the policy response would most likely include establishment of new educational programmes, measures to increase the attractiveness of studying certain subjects at universities and professional training. These are phenomena that change in slow process. A new educational programme developed today will mean graduates that are employable in five years at the earliest, and then they are fresh graduates without business experience.

If Denmark would be part of a larger integrated labour market, such that the incentives and possibilities to recruit employees from other countries, say Poland or Estonia, would be high, then the e-skill shortage of Danish firms could be solved much quicker. Hence, the speed with which the long-term goal of better e-skills and better efficiency by which supply and demand are matched could be improved. This argument comes close to the effect that

economists often refer to as "labour-market pooling", initially used to describe one of the benefits of a large agglomeration of firms operating in industries sharing a similar underlying knowledge base.

The above argument could also be put in perspective of the findings in this report. One finding for the BSR is that the share of specialists in the labour force is larger than the share of employers experiencing difficulty in hiring specialists in four of the seven countries (Sweden, Finland, Estonia and Poland). This clearly indicates the potential for cross-border labour mobility in alleviating issues of skill shortages.

5.2.4 | Cross-border knowledge flows, social networks and familiarity

Cross-border mobility of labour does not only influence issues associated with matching and human capital availability. It also stimulates knowledge flow and the development of cross-border social networks and familiarity. If an ICT-specialist leaves a firm in Estonia to start working in a firm in Sweden, it is obvious that she brings her knowledge, skills and accumulated experience. Thus, the receiving firm in Sweden gets an inflow of knowledge that is likely to strengthen that firm's position. However, modern research shows that the story does not end there.

Oettl and Agrawal (2008) study inter-firm cross-border flows of inventors and analyze the patterns of knowledge flows that form as a consequence of such mobility. Their focus is on unintended knowledge flow – understood as flows that are driven by cross-border mobility of inventors, but do not go through the hiring firm. They summarize their main findings as follows:

"the inventor's new country gains from her arrival above and beyond the knowledge flow benefits enjoyed by the firm that recruited her (National Learning by Immigration). Furthermore, the firm that lost the inventor also gains by receiving increased knowledge flows from that individual's new country and firm (Firm Learning from the Diaspora)."

National Learning by immigration is explained in that inventors create new social networks in the country they move to, and those networks are vehicles through which their knowledge is spread. Firm Learning from the Diaspora is explained on similar grounds. When an inventor moves to a new country she keeps her social networks to colleagues and friends in the country and firm she came from and these networks can stimulate knowledge and information flow. All of these exchanges are effects beyond the intended one, and stimulate a cross-border circulation of ideas.

To continue with the example of the ICT-specialist in Estonia moving to Sweden, the results by Oettl and Agrawal (2008) suggest that her move will not only benefit the new firm she goes to in Sweden. Her knowledge and expertise will flow to other firms in Sweden and also back to Estonia and the firm she left. The key is social networks.

Not only is knowledge and information about technologies spread through social networks, but also knowledge and understanding about behaviors, attitudes and norms in other cultures and countries. In other words, cross-border social networks are also vehicles for better cross-border familiarity and trust. For example, it is very likely that if a person in Poland has a good friend who moved to Scandinavia back in time, and who says that one can trust Scandinavians, then the person is more likely to indeed trust Scandinavians. Greater cross-border mobility implies greater cross-border social networks that can foster familiarity and trust.

This illustrates the crucial role played by mobility in stimulating the formation of cross-border social networks. Such networks are in turn important in that they pave the way for cross-border knowledge flows, familiarity and trust. As is clear from chapter 2 of this report, trust and familiarity are major hurdles not only for ordinary cross-border trade, but also for online sales cross-border. Opening up for cross-border mobility of labour will increase the speed at which hurdles relating to familiarity and trust are reduced. Greater knowledge circulation that also results from the same type of network also benefit innovation and business development as the pool of knowledge to draw on increases. A regional human capital ecosystem characterized by cross-border mobility helps to realise the full potential of a single digital market.

AUTHORS

Joakim Lundblad
is a PhD student in Economic Geography and Innovation Studies at CIRCLE, Lund University, and a senior policy analyst (on a leave of absence) at the Chamber of Industry and Commerce in Southern Sweden. His main research interests are urban economics, complex adaptive systems and technological development.

joakim.lundblad@circle.lu.se

Martin Andersson
is a professor of Innovation Studies at Lund University and a professor of Industrial economics at Blekinge Institute of Technology (BTH). His research focuses on the interplay between innovation, technology and business dynamics, as well as on cities, agglomeration economies and local labour markets.

martin.andersson@circle.lu.se

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