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Barriers to information and communcation technology adoption in small firms

Past experiences, current knowledge and policy implications

Vinit Parida, Johan Johansson, Håkan Ylinenpää and Pontus Braunerhjelm

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Foreword in Swedish

Studien har genomförts på Näringsdepartementets uppdrag för att analysera hinder för investeringar i informations- och kommunikationsteknik (IKT) i mindre företag. IKT är ett viktigt, kanske avgörande, medel för att små och medelstora företag ska klara den intensifierade konkurrens som globaliseringen förväntas leda till. Osäkerhet, bristande kunskap och ett svagt förtroende för IKT-baserade system riskerar att leda till att investeringarna i IKT inte når upp till en samhällsekonomiskt önskvärd nivå. Den mycket snäva tidsram som har omgärdat projektet har inneburit att analysen har utgått från de betydande skillnader i IKT-investeringar som föreligger mellan stora respektive mindre och medelstora företag. Utifrån den observationen och en genomgång av tidigare forskningsresultat rörande hinder för och behov av IKT i särskilt små företag, föreslås en rad åtgärder för att avveckla eller minska den ”digital divide” som präglar svenskt näringsliv.

Samtidigt bör beaktas att behovet skiljer sig inte bara mellan stora och små företag, utan också mellan olika typer av småföretag. De ekonomisk-politiska slutsatserna är därför fördelade på dels generella, dels mer specifika insatser. De senare utgår i sin tur från behovet hos olika företagstyper.

Arbetet har genom undertecknad lagts på KTH och genomförts i nära samarbete med professor Håkan Ylinenpää, Ph D Vinit Parida och Ph D Johan Johansson, samtliga från Luleå Tekniska Högskola. Rapporten, som är författad på engelska eftersom en av de deltagande forskarna (Vinit Parida) är engelskspråkig, presenterades vi ett seminarium på Näringsdepartementet den 3 september 2010. I och med överlämnadet av denna rapport är vårt arbete slutfört. De förslag och synpunkter som förs fram i rapporten, liksom eventuella felaktigheter, är naturligtvis helt och hållet författarnas ansvar.

Pontus Braunerhjelm

Professor, KTH, Vd Entreprenörskapsforum

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Barriers to information and communcation technology adoption in small firms

Vinit Parida, Johan Johansson, Håkan Ylinenpää and Pontus Braunerhjelm[1]

May 3, 2010

Executive summary in Swedish

I en internationell jämförelse ligger Sverige förhållandevis långt fram vad gäller användning av informations- och kommunikationsteknik (IKT) i såväl näringsliv som hos privatpersoner. Inte desto mindre finns det betydande skillnader mellan företag av olika storlek liksom mellan urbana miljöer och glesbygd. Mindre företag har inte kommit lika långt i att IKT-anpassa produktion, organisation och försäljning som större företag.

EU, liksom Sverige, lyfter fram de mindre företagens roll för att upprätthålla en hög sysselsättning och ett dynamiskt näringsliv. Mindre och nya företag bidrar med konkurrens, innovativa lösningar och utgör på sikt en viktig komponent för uthållig tillväxt och ett fortsatt högt välstånd. Samtidigt är de just de mindre företagen som utsätts för ett allt hårdare konkurrenstryck i ett globaliseringsskede där marknader blir öppnare och mer lätt tillgängliga. Globaliseringen öppnar visserligen för nya möjligheter men reser också betydande utmaningar när det gäller att bibehålla och utveckla konkurrenskraften. Ett medel för att klara dessa utmaningar är ett effektivt användande av IKT.

Den vikt som läggs vid mindre företag avspeglas delvis i en rad politiska initiativ på EU nivå, initiativ som också spiller över på svenska företag. EU-politiken behöver dock kompletteras med en nationell politik, vilket sker i ett flertal länder. Av de 13 medlemsländer som enligt EU har en IKT-strategi ingår dock inte Sverige.

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[1] Parida (Ph D), Johansson (Ph D) and Ylinenpää (Professor) are all affiliated with Luleå University of Technology. Pontus Braunerhjelm, professor at the Royal Institute of Technology (KTH) and managing director for Swedish Entrepreneurship Forum, is corresponding author (pontusb@abe.kth.se). Sara Wahlqvist have provided excellent assistance support. The manuscript has also benefited from comments by civil servants at the Ministry of Enterprise, Energy and Communications.

Syftet med föreliggande rapport är att dels identifiera hinder för att mindre företag ska kunna använda kostnadseffektiva och konkurrensförstärkande IKT-lösningar, dels föreslå ekonomisk-politiska åtgärder för att undanröja eller minska nuvarande hinder.

På företagsnivå är fördelarna uppenbara med en väl genomförd IKT tillämpning. Moderna IKT-lösningar möjliggör sålunda för företag att lättare nå andra marknader, uppnå lägre kostnader, förbättra intern och extern kommunikation, större enkelhet att samarbeta och koordinera produktionen med andra företag samt skapa bättre innovationsförutsättningar genom enklare access till olika former av kunskap och information. Samtidigt är hindren betydande. Bland de vanligast förekommande är en föreställning om att IKT inte är lämpligt för företaget, begränsade IKT- kunskaper hos ledningen/företagaren, standards och regelverk som är svåra för småföretag att anpassa sig till, höga utvecklingskostnader för IKT, bristande synkronisering/interoperabilitet mellan olika IKT-system, säkerhetsproblem och bristande förtroende, legala oklarheter samt bristande infrastruktur. Var och en av dessa kan innebära betydande problem för särskilt de mindre företagen.

Baserat på en genomgång av de senaste årens forskning inom området föreslås en rad olika ekonomisk-politiska åtgärder i rapporten. Dessa avser dels generella åtgärder, dels mer specifika insatser anpassade till kunskapsnivå och det upplevda behovet av IKT i olika typföretag. Bristen på relevant IKT-information och en upplevd osäkerhet kring pålitligheten i nuvarandes system gentemot såväl leverantörer som kunder, kombinerat med en otillräcklig kunskapsnivå i särskilt mindre företag, innebär att det finns en risk att investeringarna i IKT inte når en samhällsekonomisk önskvärd nivå.

Bland de generella åtgärderna märks förslag till skatteincitament under en begränsad tid för att öka IKT-investeringar liksom satsningar på forskning och utveckling. Likaså föreslås en översyn av de regleringar som finns på området med särskilt fokus på ett förenklat och IKT-baserat förfarande vid offentlig upphandling som möjliggör för mindre företag att delta. Bland mer specifika satsningar är förslagen sammanställda utifrån behoven hos olika typföretag. Olika utbildnings-, informations- och samordningsinsatser föreslås bli kombinerade med vissa riktade ekonomiska incitament som lånefaciliteter och konsultcheckar. Vår bedömning är de föreslagna ekonomisk-politiska åtgärderna bör kunna utgöra kraftfullt verktyg för att minska en nu rådande ”digital divide” bland företag av olika storlek och mellan regioner. Samtidigt vill vi betona att mot bakgrund av den tid som stått till värt förfogande – en dryg månad – ska förslagen ses som tentativa och förutsätter ytterligare bearbetning.

Analysis

Introduction

Background

Small firms have played a key role in the economies of all major industrial societies both in terms of turnover and level of employment. Small firms are often viewed as the seeds for a vital entrepreneurial economy, the majority of the European workforce is employed by small firms, and about 99 percent of the firms in the EU are small or medium sized firms (SMEs).[2] Their role as a major source of innovation and growth has also been emphasized in contemporary research (Braunerhjelm, 2008). In addition, small firms are instrumental in the renewal of the economic system since they pave the way for new ideas and businesses models, remove inefficient products and processes, which in turn lead to economic development (Schumpeter, 1934). Thus, smaller firms are needed to balance the market through increasing competition and reducing threats of monopolistic practices. Therefore, it is not surprising that supporting small firms is one of the "EU priorities for economic growth, job creation and economic and social cohesion" (European Commission, 2006, p. 5).

Although important, small firms are characterized as being vulnerable and prone to failure (Storey, 1994; Wiklund, 1998). According to ITPS (2006), more than 60 percent of small firms struggle with survival during their early years of operations. Thus, understanding more about the dynamics behind small firm competitiveness seems important as they provide great value for the economy and society. Arguably one of the most prominent challenges for small firms is to overcome the scarcity of internal resources, which reduces their ability to meet increasing competition and market fluctuations (De Toni and Nassimbeni, 2003; Madrid-Guijarro et al., 2009). This resource-based view (RBV) is consistent with the European Commission's (2006) study, which argued that small firms usually have problems with internal resources (e.g. capital and know-how) that limit the scope of their development and reduce their access to new technologies and/or innovations.

In this context, being able to effectively utilize information and communication technology (ICT) can provide small firms with a strategic advantage which can positively influence their competitiveness. Several studies suggest that adoption of ICT can provide small firms with valuable information, increase knowledge, improved relationships with customers and suppliers, deepen and maintaining collaboration with other firms, increase efficiency, offer new distribution and communication channels, reduce cost of production and better target

[2] See http://ec.europa.eu/enterprise/entrepreneurship/facts_figures.htm.

customers (Fillis et al., 2003; Karagozoglu and Lindell, 2004; Taylor and Murphy, 2004; Nieto and Fernandez, 2006).

Hence, one instrument for small firms to overcome their resource constraints implies adopting and using ICT. By using ICT they can also receive access to global markets in a more cost efficient manner. According to Clemons and Row (1991), ICT applications have a positive impact on a firm's communication with its trading partners, such as increasing the degree of vertical collaboration, which seems to be a prominent feature of the ongoing globalization. These technological communication setups can eliminate geographical barriers and facilitate the forming of (vertical) collaboration with new firms (Ozer, 2004).

These insights regarding the relevance and importance of ICT for small firms have triggered numerous EU initiatives to promote ICT adoption. Still, current statistics reveal that small firms are unable to reap the potential benefits of ICT. Larger firms tend to invest more in ICT and implement ICT in more advanced ways as compared to smaller firms, regardless of technology and area of use. Considerable differences in ICT-usage are also reported across industries in the EU as well as in Sweden. The percentage of enterprises that operates within e-commerce is highest in the industry of information and communication companies, whereas low-end service sectors employ Internet less frequent than other industries.

ICT in Swedish small firms

In an international comparison, Sweden seems to rank relatively high as regards firms' ICT usage. For instance, about 60 percent of all small firms are claimed to use e-commerce in the purchase of goods or services, while 20 percent were receiving orders via e-commerce (Statistic Sweden, 2010). E-commerce refers to orders for products or services over the Internet or other computer networks that are placed via the website or via automatic information exchanges.[3]

The Swedish enterprise sector makes substantial investments in ICT-equipments. In 2008 their procurement of software reached 18.9 billion SEK, whereof 2.1 billion refers to expenditure on software by small firms (5-49 employees). Existing commercial solutions have been claimed to be focused on large companies and therefore ill-suited for the needs of small firms. This aggravates the already higher investment threshold for many small firms due to relatively higher investments costs. More recently, judging from the development among U.S. software giants, there seems however to be an increasing interest to develop software better designed towards the need of smaller firms.

[3] According to a report by the Swedish insurance company Trygg-Hansa, comparing ICT use in small firms in the Nordic countries, about 50 percent of the Swedish small firms have a webpage, 40 percent use if for marketing purposes while 15 percent claim it is their prime sale channel (http://media.trygghansa.se/2009/02/02/fler-danska-an-svenska-foretag-har-hemsida). No considerable differences are reported between the Nordic countries.

According to Statistics Sweden (2010) the group with 1-9 employees (i.e. micro firms) holds the lowest ranking in the statistics, when it comes to use of technology and services of ICT, while companies with more than 250 employees are almost always ranked in the top. Irrespective of those differences, the statistics do however reveal that ICT is widely used among all size categories of Swedish firms. About 94 percent of the enterprises with 1-49 employees have access to the Internet and 90 percent have fixed high-speed Internet connections with a minimum of 2 Mbps. The corresponding figure for Internet access among micro firms (1-9 employees) is 83 percent and 88 percent, respectively. Regarding the firms' access to broadband, Sweden is currently ranked as number four in Europe, and the Swedish enterprises are the second most regularly users of computers at work in Europe. In the most recent broadband strategy by the Swedish government (November 2009), the objective is that 90 percent of enterprises and households in 2020 will have access to broadband of at least 100 Mbps.

Hence, these figures pinpoint that Sweden's general ICT infrastructure is advanced in an international comparison, simultaneously as there is considerable variation in the use of ICT with respect to firm size, sector and region. Large firms in metropolitan areas and firms in particular sectors are the most advanced IT-users. As stressed by The Swedish Agency for Economic and Regional Growth (Tillväxtverket)[4], such knowledge gap ("digital divide") between firms of different sizes may have repercussions for the use of ICT in enhancing and streamlining small firms businesses.

The objective

The Swedish government has pointed out the importance of ICT for stimulating economic growth, competitiveness and innovation. The rationale for such priorities is provided by a number of studies having confirmed a positive impact of IT investment on both labor productivity and total factor productivity in the Swedish manufacturing industry during the 1990s. A study by Statistics Sweden (2005) shows that total factor productivity tend to increase with the fraction of IT-users among firms' employees. The study also reports a positive and significant association between productivity and accessibility to broadband.

Taken together the statistics briefly described above suggest that small firms may not have been able to fully make use of the development potential that modern ICT offers. There is a multifold of barriers to fully exploit the advantages of ICT in smaller firms that will be discussed in some detail further below, where well-designed policies may play a critical role to overcome or reduce such obstacles. Obviously a possible reason for a sub-optimal level of ICT adoption in the case of small firms may be related to inaccurate or insufficient policy initiatives taken by governmental bodies. Thus, barriers to ICT adoption represent multiple dimensions, and therefore policy initiatives need to develop a comprehensive action plan which takes into consideration these different dimensions.

[4] Tillväxtverket (TVV), previously named Nutek, will be referred to as TVV in the report.

Based on this background, the purpose of this study is two-fold: (1) *to identify barriers to adoption of ICT in small firms,* and (2) *to develop policy implications for stimulating a higher degree of ICT adoption in this category of firms.*

The rest of the study is divided into six sections. The first one presents a definition of small firms and what is typical for them in comparison to larger firms. The second section elaborates on adoption processes of ICT in small firms. The third section discusses the potential benefits of ICT for increasing the competitiveness of small firms. The final three sections, focuses on identification of barriers to ICT adoption in small firms, describes some previous projects and policy initiatives, and suggests a number of additional policy measuers to stimulate an increasing adoption of ICT in small firms.

Specific characteristics of Small firms

According to the European Commission (EU) a small enterprise has a headcount of fewer than 50, and a turnover or balance sheet total of not more than €10 million (Recommendation 2003/361/EC). A micro enterprise has a headcount of fewer than 10, and a turnover or balance sheet total of not more than €2 million. This recommended definition is developed as a tool in the work to improve consistency and effectiveness of policies targeting small firms.

Competition is often intense for small firms. Many firms are small suppliers on competitive markets and they are often unable to influence neither price nor quantity. The standard view of competitiveness (i.e. Porter 1980) where firms compete on cost or differentiation is problematic for small firms. They are unlikely to be able to lock in customers and suppliers, build barriers to entry, or significantly lower costs (Johansson, 2008). Small firms usually have scarce resources in the form of financial resources, management and a limited in-house knowledge base. However, small firms often have processes and products that are difficult to imitate. The resource-based view argues that competitive advantage can arise when firms accumulate resources that are rare, valuable, non-substitutable and difficult to imitate (Barney, 1991, 2001), and where improved competitiveness is achieved through recognition and exploitation of the firm's core competences (Prahalad and Hamel, 1990). These competences form the basis for a business strategy. ICT can be expected to comprise an increasing part of such competencies.

Five specific characteristics can be associated with small firms which distinguishes them from larger firms. First, small firms' *organizational structure* tends to be more organic compared to the normally bureaucratic structure of larger firms. This means lack of standardized and formal working process which leads to a flat organizational structure which offers small firms the advantage of taking fast decisions due to less bureaucratic processes. Lack of complex processes facilitates a higher level of informal communication which can be seed to innovative

developments and lead to closer synergy between different activities and functions within the firm (Levy and Powell, 1998).

Second, small firms have the advantage of being *highly flexible* in their processes, strategic orientation and operations comparing to larger firms. This flexibility enhances their ability to perform in a dynamic environment and adapt to changing needs of market as they are close to the end customer (Rothwell, 1989).

Third, small firms are the *drivers for economic growth and innovation.* Profitable market opportunities increase the rate of small firms' creation. This increases the total number of small firms in a country, which increases job creation and income per capita. As people become wealthier, they will increase their consumption, which in turn will open up new market opportunities that will entice the creation of more small firms. The growth of small firms directly benefits the country, because most small firms are predominantly strictly domestic firms. This reinforcing dynamic generates economic growth (Braunerhjelm et al., 2009). Small firms are also drivers for innovation due to that when the number of small firms increases, their knowledge of their products and industries also increases. This knowledge allows them to innovate through new products or processes, which helps them to develop a competitive advantage that generates more profits. New market opportunities captured by new small firms will in turn encourage more people to establish their own company to capture such opportunities (OECD, 2004a; Kotelnikov, 2007).

Fourth, *risk taking behaviour* is usually associated with small firms because they need to compensate for their limitations through creating and exploiting new opportunities. The outcome of these risky ventures are however not always successful, since they can result in loss of revenues or even insolvency.

Finally, *liability of smallness and liability of newness* are two characteristics which inhibit small firms from higher growth potential. The first characteristic relates with lower levels of slack resources, lower levels of efficiency when using their resources and competences. Without the slack resources necessary to weather sizeable opportunities, small firms must be very careful in how they deploy their available assets. Thornhill and Amit (2003) observed the failure of small firms to be generally attributable to a lack of resources and capabilities. Therefore, several small firms form alliances and collaborations with other (large and/or small) firms in order to overcome these limitations Liability of newness is most prominent for new ventures, but small firms in general may also face similar disadvantage related to their limited bargaining power (Hajimanolis, 2000). Small firms may e.g. have significant problems with getting access to bank loans. When trying to establish new relationships, small firms may be regarded as unattractive partners as they lack sufficient reputation and goodwill.

To conclude, even if small firms have advantages due to their organisational structure and inbuilt flexibility, they are faced with several challenges to achieve competitiveness. In this

respect, adoption and utilization of ICT could serve as a strategic weapon for securing and developing competitiveness. The next section further discusses the process of ICT adoption in small firms.

Adoption of ICT in small firms

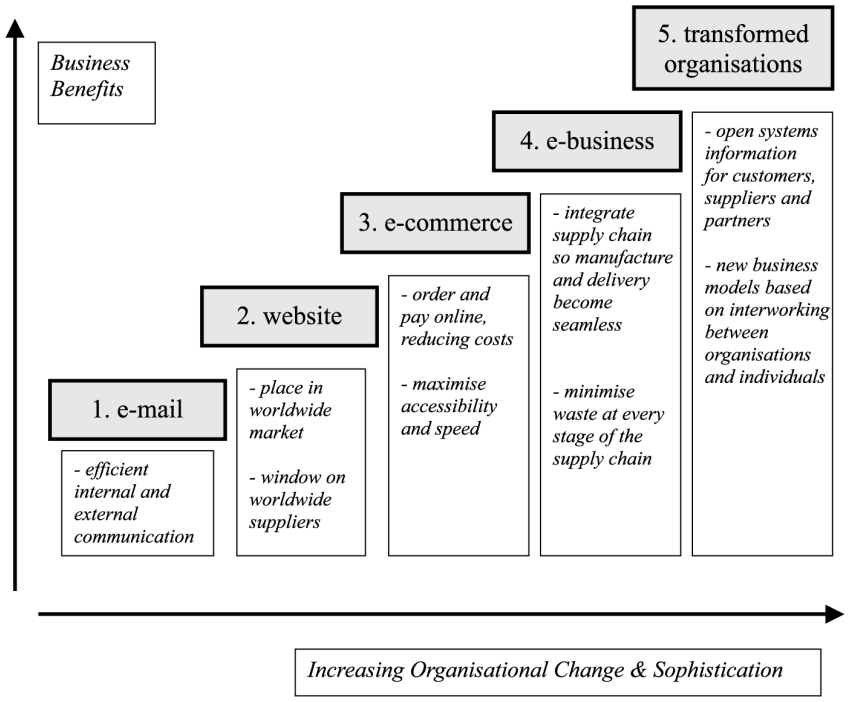
In the current knowledge economy, firms' ability to create, accumulate and disseminate knowledge represents a critical function. ICT may serve as a catalyst for effectively performing this function, as it enables firms to codify knowledge into a digital form and easily transmit it anywhere around the world. Firms with access to ICT are able to use this for transmitting and/or processing information, which includes wide array of technology, ranging from database programs to local area networks (Matlay and Addis, 2003). ICT has also speeded up the pace of globalization and increased the complexity of business practices, because firms today not only need to be familiar with their local context but also with global developments. Thus, to compete in the knowledge economy, small firms need a strong ICT-literate skills base that can innovate and adapt quickly to change.

Before moving into a discussion on potential benefits of ICT for small firms, we would like to discuss the adoption process of ICT. Adoption of ICT is namely no digital off/on-process, but according to research in the field normally a process consisting of different phases or trajectories. There are different views on the adoption process of ICT and we would like to present two of them here. The first and most easily understandable adoption process is often called the "adoption ladder approach". This adoption ladder approach has been used by the UK government's Department of Trade and Industry (DTI) for better understanding of the adoption of ICT by existing small firms (Martin and Matley, 2001). Figure 1 provides an illustration of this ICT adoption model. The main idea behind this model is that a small firm approaches ICT adoption through a series of stages, in a well planned and sequential manner. The business benefits associated with ICT drive the adoption process and results in increased organizational change and ICT sophistication at each step. Small firms' usage of ICT ranges from basic technology such as emails and fixed lines to more advanced technology such as e-commerce, and information processing systems. Using advanced ICT to improve business processes falls into the category of e-business and finally representing a transformed small firm.

However, not all small firms need to use ICT to the same degree. The first ICT tool that most small firms adopt is having basic communications with a fixed line or mobile phone, whichever is more economical or most convenient for their business. This allows the small firm to communicate with its suppliers and customers without having to pay a personal visit. After acquiring basic communication capabilities, the next ICT upgrade is usually a personal computer (PC) with basic software. Even without Internet connectivity, small firms can use PCs for basic word processing, accounting, and other business practices. With the Internet, small firms are

able to use more advanced communication capabilities such as email, file sharing, creating websites, and e-commerce. This may be sufficient for most small firms, especially those in service industries such as tourism. Small firms in manufacturing may adopt more complex ICT tools such as enterprise resource planning (ERP) software or inventory management software. It should be recognized here that this like any other models, this model depicts a simplification of reality. Therefore, it should be clarified that not all firms will start at stage one and progress linearly through further stages.

Figure 1: DTI adoption ladder approach



Source: Martin and Matlay (2001) adapted from Cisco-led Information Age Partnership study on e-commerce in small business

The advantage of this "adoption ladder" approach is that it highlights the transformation aspects of technology and the key social needs from which it emerges. However, it remains a profoundly deterministic view of change and builds on the understanding that small firms have the need and opportunity to follow one prescribed course. If they are not able to climb the top of the model, this is often understood as representing some kind of failure or unused potential. Of course this is not true, as we know that small firms have different needs and requirements in regard to use of ICT and in certain cases, over-emphasis on ICT could result in wasteful investments of resources in activities which do not generate any significant value for the firm.

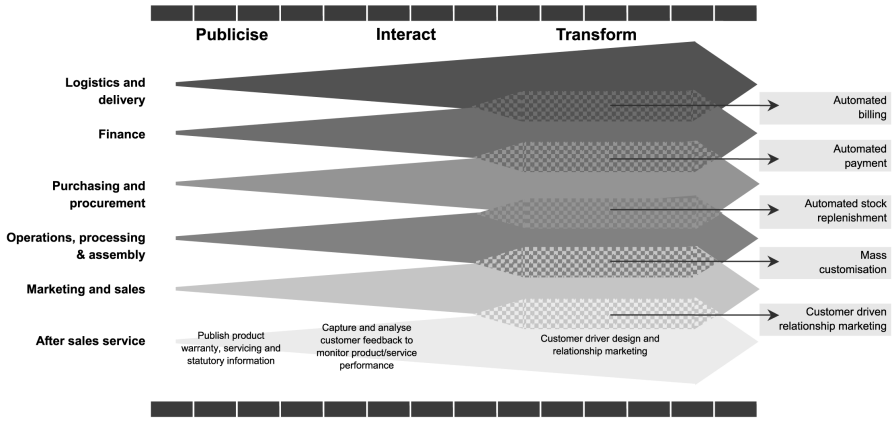
The second model regarded as PIT model represents another view on the adoption of ICT by small firms. This model is better able to illustrate the diversity of applications and adoption of ICT approaches in small firms. It has two dimensions; *first* it focuses on what functions ICT can be used for in the firm, and *second* it focuses on what activities ICT can be applied for (see figure 2). Moreover, according to the model, ICT can be used for three specific purposes in small firms.

To publish: This means using ICT tools such as a website for publishing information about products and contact details.

To interact: ICT is used for interacting with suppliers, customers and other stakeholders through automated communication systems, which are more sophisticated than simply sending e-mails. For example, using extranet for storing orders and other details

To transform: This relates with using ICT for transforming the way the business is undertaken. This can include providing specific delivery reports and real-time tracking deliveries.

Figure 2: The PITs model of ICT adoption by small firms



Source: After Foley and Ram (2002)

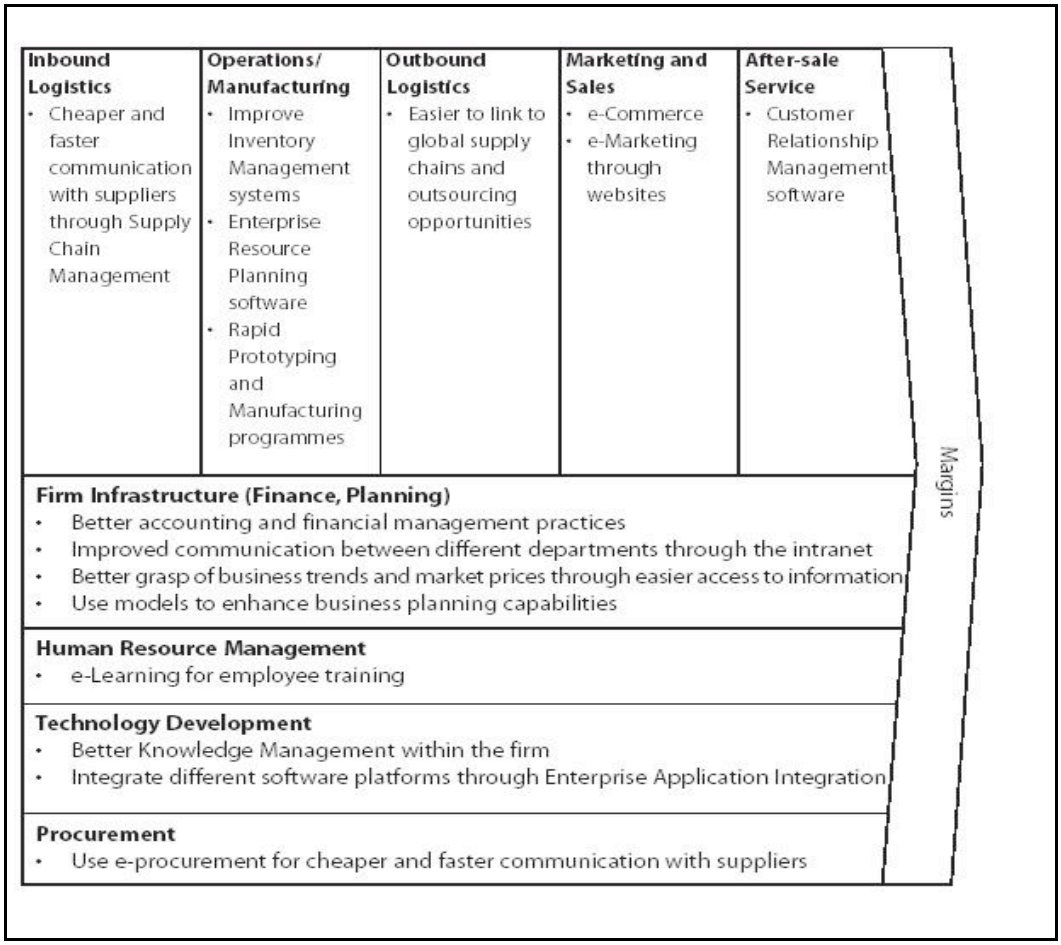
This model focuses on the different purposes and activities for which ICT can be used by small firms. According to Foley and Ram (2002), six areas are recognized as critical in this respect. They are logistics and delivery, finance, purchasing and procurement, operations, processing and assembly, marketing and sales, and after-sale services.

The above mentioned adoption model shares certain similarities as both show different levels of ICT adoption feasible by the small firms and what this would mean for performing different activities. The adoption process depends on the ability of the firm, but also could be driven by the benefits firms foresee as being associated with moving into more advanced use of ICT. However, this transformation usually is hindered by certain barriers. In the following sections, we will discuss certain advantages and barriers associated with adoption of ICT in small firms.

Potential advantages of using ICT in SMall firms

As already mentioned, ICT applications provide many benefits for performing a wide rage of important activities underpinning firm competitiveness. ICT helps small firms in creating business opportunities and combat pressures from competition. Appropriate ICT can help small firms cut costs by improving their internal processes, improving their product through faster communication with their customers, and better promoting and distributing their products through online presence. In fact, ICT has the potential to improve the core business of small firms in every step of the business process and enhance their competitive standing. Figure 3 uses Porter's value chain to summarize various ways that ICT can benefit a firm.

Figure 3: Benefits of ICT Tools Categorized under Porter's Value Chain.



Source: Kotelnikov, 2007

Based on a literature review we were able identify five critical advantages associated with the use of ICT in small firms:

1) *Access to Global Markets:* In the past decade, the world economy has become increasingly global. On one hand this means that firms have to compete with a greater number of firms and on the other hand, this means that they have the opportunity to more easily enter a global market. This activity is primarily fueled by access to Internet and the use of electronic payment systems. ICT has the potential to give small firms immediate access to global markets. Moreover, the cost of operating globally has reduced due to ICT. Thus, small firms can regardless of their location opt for developing websites which provide them global access to customers and suppliers.

2) *Achieving lower costs:* Small firms can lower their operational costs through effective utilization of ICT, e.g. by reducing the cost of production, improving document handling processes, using financial and accounting applications, etc (Levy et al., 2001; Acar et al., 2005). E-commerce can also streamline internal and external processes that can imply higher cost effectiveness for small firms. Furthermore, through ICT, small firms can effectively maintain appropriate level of inventory, access global suppliers, and present incurring costs due to errors and inefficiencies.

3) *Enhance internal and external communication*: ICT can be used for establishing and gaining from a high level of communication both within and outside firm boundaries. ICT-oriented small firms can use an intranet and an extranet for achieving a constant inflow and outflow of information, which may result in better learning opportunities (Venkatraman, 1994). An intranet provides a potentially valuable communication platform to share information, ideas and knowledge within the firm. According to Clemons and Row (1991), ICT applications have a positive impact on a firm's communication with its trading partners, such as increasing the degree of vertical collaboration. Use of extranet can enhance a firm's ability to find new partners for collaboration or maintaining close collaboration with existing partners (Nieto & Fernandez, 2006). These technological communication setups together can eliminate geographical barriers and facilitate the forming of collaborations with new firms (Ozer, 2004), making it possible for small firms to handle large pools of business relations (Karagozoglu and Lindell, 2004).

4) *Facilitating collaborations:* ICT is capable of providing collaboration opportunities with business partners. Electronic data interchange (EDI) networks and other electronic information platforms provide a stable connection with trading partners, which fosters knowledge-sharing and better customer/supplier information exchange (Zaheer and Venkatraman, 1994). With the presence of superior ICT, small firms are able to offer high value services, such as just-in-time delivery, higher quality communication, etc. According to Levy et al. (2001), such services can lead to the development of trust, satisfaction and commitment that facilitates the development of effective and efficient collaborations. The investment required for accomplishing such integration is fairly small and gives small firms a much needed advantage, such as accessing external resources (Nieto and Fernandez, 2005). Having a high level of ICT usage can also

contribute to creating recognition of small firms as an attractive business partners. This not only advances their current business, but also secures their chances of collaborating with other attractive partners in the future (Dholakia and Kshetri, 2004).

5) *Drive Innovation:* Several ICT tools such as product data management, virtual prototyping, computer-aided design, and other applications can enhance and speed up the innovation process (Thomke et al., 1998). Moreover, an effective use of ICT can facilitate generating slack resources as a result of higher asset-utilization efficiency. This can in turn allow small firms to expand their resource base and increase the likelihood of developing innovative products (Nieto and Fernandez, 2006).

Barriers to ICT adoption in small firms

There are several factors that can prevent small firms from actively adopting and using ICT in their business. These reasons can considerably vary across different sectors, countries and size groups. Based on our literature review we have been able to identity eight specific barriers to ICT adoption in small firms: ICT unsuitable for the type of business, limited level of ICT skills or competence within the firms, lack of standardized ICT-related applications, cost factors, issues with access to ICT, lack of trust, and legal uncertainties.

1) *ICT unsuitable for the type of business:* A prominent reason for small firms to not engaging in using ICT for business purposes is related to the perception that it does not suite the nature of their specific business. A EU study (2002), based on data from firms with less than 250 employees from 19 European countries, shows that 40 percent don't use the Internet for selling because they consider that Internet and e-commerce does not suit their business and/or products. This percent is slightly higher for micro firms with less than 9 employees. In industries such as construction and among small retailers, the view on Internet and e-commerce as an unsuitable medium for business is restively strong (Love et al., 2001). Most small firms in these sectors use ICT as a medium for communication rather than a medium for e-commerce activities. Another example can be found in the transportation industry were small firms using websites found it to be ineffective as most customer preferred personal or telephone contacts for business negotiations and transactions (Mehrtens et al., 2001). The view that ICT is not suitable for the business holds strong implication for small firms aiming to adopt ICT because they will not take advantage of ICT unless these benefits justify the need for establishing and maintaining a more advanced ICT-based system. Thus, such unfavorable perceptions on the use of ICT can be regarded as a justifiable reason (or barrier) for many small firms not to engage in e-business activities.

2) *Limited ICT literacy of owners and employees:* The owner or manager of a small firm has significant influence on the adoption of ICT. In Parida's (2010) in-depth study of three

technology-based small firms, it was found that the perception of the owner/manager had significant implication on how the firm viewed the role of ICT. If the small firm owner was unfamiliar with operating a computer and hold the belief that ICT is only for larger firms, they were unlikely to get involved in ICT-related activities. Thus, even when they possessed the financial resources needed to integrate ICT into their business, they often failed to recognize the need to use ICT in their company. However, also when small firm owners had a positive view on ICT, the main barrier for ICT adoption was due to lack of skilled employees. Firms that want to adopt ICT need to have employees with a reasonable amount of knowledge regarding use of technology. According to the study of Mehrtens et al (2001), ICT was comfortably adopted by those small firms that had employees which could understand and use the specific technology. These employees were not necessarily ICT professionals but rather people who were interested in using technology. Small firms lacking sufficient in-house expertise can opt for outsourcing ICT services, but with the advancement in the usage of technology (e.g. e-commerce activities), it can become dangerous if firms entirely depend on outside firms. Under such circumstances advice of professional ICT consultants can be priceless, but small firms usually have problems with accessing this expert advice due to high costs.

3) *Lack of standards and ICT related applications for small firms:* The technological tools which are used for communication with buyers and suppliers usually need to share a common platform. When firms plan to implement certain communication or procurement tools they need to make a selection from large number of different alternative service provides. Such variety can discourage participation by small firms because they may feel like committing to specific software and training before they can foresee the returns on their investment (Howarth, 2002). Moreover, it has been found that most advanced ICT tools are geared towards the needs and requirements of large firms as they are willing to pay more. These products are often to complex and to expensive for small firms. Although this seems to be changing with increasing demands from the small firms, this is still perceived as a problem and a barrier by many small firms (Nutek 2004b).

4) *Cost of developing and maintaining ICT systems:* Most small firms are unwilling to adopt ICT if they perceive the cost for developing and maintaining the technology system to be higher than the benefits it generates. This issue is central to small firms because they suffer from budget constrains. Some firms may be able to get credit or loans from a bank for ICT investments, but this is not attractive when/if they can't foresee their return on investments. Therefore, this can prohibit small firms from adopting more sophisticated ICT solutions (e.g. a website with a secure environment for credit card transactions). Most small firms therefore use more simple ICT applications such as a website with information about the firm's products.

Both simple and more advanced ICT applications however need continuous updating and maintenance. Website maintenance and upgrading are frequently undertaken in firms with a focus on online business. Over time when the cost of transaction grows, the cost of maintaining

system will also increase and generate an excessive workload for employees. This could result in a problem for small firms with few technologically skilled employees. Moreover, logistics costs (e.g. packing, delivering, etc) are also something to consider for small firms with online business. Although product information and transaction can be handled online, small firms do need to incure the cost of delivering the product to the customer. If small firms are located in remote areas and are doing business on a small scale, the logistic costs may not be reasonably priced. Moreover, small firms also need to consider the invisible or hidden cost which they have to incur as they move towards e-business which requires considerable management and organizational change.

5) *Access and interoperability:* The availability of different Internet connection and communication tools at a reasonable price is crucial for small firms. This could allow them to make the most appropriate selection of ICT devices and operators based on their needs and expectations. The most common form of communication used by small firms is still the fixed telecommunication networks for accessing Internet. Although fixed telecommunication (dial-up connections) networks are useful for basic functions, small firms that want to adopt e-commerce or even move towards e-business operations need broadband availability (DSL, fiber or high capacity broadband). Slow internet connections and data transfer can discourage small firms from adopting Internet for their business operations. The availability of theses services can also be related to the location of small firms as remotely located small firms may not enjoy a similar level of services as the ones in metropolitan areas.

The increasing use of e-commerce can lead to new challenges related to network infrastructure for small firms because they need to ensure interoperability with a range of different e-commerce systems and to have in-house ICT management and organizational skills. Studies have however shown that small firms are less confident in using technologies compared to larger firms and less sure about how to adapt different and competing e-commerce systems.

6) *Lack of security and trust:* small firms face higher barriers when they aim to sell their products online as compared to larger firms possessing stronger brand names. On-line customers often regard recognized brand names as a proxy for creditability while small firms with a weak brand image represent lower credibility for their customers. A professional website can partially improve the image of the small firm to conduct business to business (B2B) transactions. Firms can also use their websites for placing details referring to corporate information on the site and provide information about their products.

In a study involving technology-based small firms it was found that firms were more comfortable using ICT applications when they possessed a higher level of goodwill or legitimacy and their partners knew the small firms based on prior experience. Networking with other companies normally implies that ICT is extensively used for inter-organizational communication, but if firms don't have higher level of trust, adoption of ICT for collaboration may not be suitable (Parida, 2010).

With regard to a business to customer (B2C) setting, small firms are offering customers with the possibility to use credit cards for online transactions. This raises concerns regarding security and having a secure system firewall for supporting online transactions. Moreover, when small firms work in a collaborative setting with other firms, they need to maintain a high level of security as firms share sensitive information during collaboration. It is therefore not surprising that security issues are among the main barriers hindering ICT adoption in small firms.

7) *Legal uncertainties:* Most Internet and e-commerce transactions tend to be international. This means that companies need to be aware and careful regarding issues such as currency levels, differences in legal and regulatory environments etc. These issues can have effect on small firms operating in a B2C setting as there is no standard legal framework with rules pertaining to the determination of jurisdiction and applicant law that ensures the cross-boarder environment of legal rulings. Firms can hence risk being sued in multiple jurisdictions under a number of inconsistent laws. Larger firms can manage to maintain a legal department which handles such issues and provides expert advice in case of complications, while small firms may feel overburdened with handling such legal issues. Not surprising, legal uncertainties concerning contracts, terms of delivery and guarantees was mentioned as an important barrier to e-commerce purchases by 40 percent of small firms in Spain, 37 percent in Italy, and 24 percent in UK (EuroStats, 2002).

8) *ICT adoption challenges:* Barriers to the adoption of ICT are also changing over time and may vary along the adoption ladder. For some small firms, sophisticated in the use of e-commerce, the barriers mentioned above may be unimportant. But they may face other challenges as they change their management and organizational structures and restructure business processes to make better use of the ICT. One such group of smaller firms is the group of firms we often call “early adopters”.

The OECD’s Electronic commerce Business Impacts Project (EBIP) study undertook in-depth interviews with 217 firms that were early adopters of Internet and e-business strategies. This cross-country, cross-sector study showed that firms view competence factors (e.g. management attitudes, skill levels, training) as the most positive factors for them to successfully adopt e-business strategies and these factors were mostly favorable for them. Technology factors (e.g. how to ensure interoperability with different e-commerce systems, network reliability and flexibility) were also highly favorable for them and were of less concern than competence factors. Cost factors (cost of reaching customers, cost of engaging in e-commerce, telecommunication costs) were also seen as largely positive for adopting firms when compared with benefits from e-commerce and e-business. On the other hand confidence factors (e.g. brand image, transaction security, legal structures, IPR issues) were of lower concern on average but were more often seen as being negative, particularly in areas such as protection of IPRs and general legal structures (OECD, 2004a). Thus, it can be concluded that early adopter may have different views regarding the barriers to ICT than other firms which needs to be taken into

consideration for policy development. Advanced understanding early adopter firms could provides guidelines of other firms which may follow similar path to ICT adoption in future. Unfortunately, there is lack of studies addressing the issues surrounding these firms barriers ICT use.

Recent findings suggest that "ICT adoption that is no longer a choice but a must across the different types of SMEs operating in different sectors" (Tan et al 2010, p.50). This findings stress that SMEs ought to be aware that they need to be innovative not just by offering unique products and services but they also ought to be fast enough to adopt the latest technology in complementing their market offerings and strengthening their internal operations. Tan, et al (2010) observed that the SMEs seem to receive more benefits to from ICT adoption than the micro-sized firms. Many of the firms started using internet to increase their access to market information and knowledge. Their finding corroborates Adham and Ahmad (2005) where many SMEs started to use the internet for searching information and then after some time realized that ICT adoption could play a wider role in helping them to improve their efficiencies in dealing with their supply chain partners.

POLICIES

ICT usage and previous policy initiatives

ICT usage among small and large firms

Since 2000 Statistics Sweden present a survey-based annual report concerning the access and use of the Internet regarding for example e-commerce and software development.[5] The most recent survey (which refers to 2009) shows that 96 percent of all small firms (1-49 employees) use computers while the corresponding figure for micro firms (1-9 employees) are 85 percent. A fairly stable pattern can be observed over the years. Notable is that the fraction of employees using computers with non-Internet access is higher than the share of employees using computers with Internet access. This is due to that manufacturing firms use computers to control machinery and for enterprise resource planning purposes.

The most common usage of the Internet is searching information and downloading forms from governmental agencies' websites. The use of IT tends to be more advanced the larger the company is. The surveyed group with 1-9 employees holds the lowest ranking in the statistics when it comes to use of technology and services of IT, while companies with 250 employees or more are almost always ranked in the top.

Significant difference between small and large firms concerns the use of automatic information exchange (with external IT systems), the use of intranet and the use of fixed Internet

[5] See the annual report "Use of ICT in Swedish Enterprises" (Företagens användning av IT).

connections via cable or fiber instead of the telephone line (DSL). In contrast, differences between large and small firms are negligible regarding the use of full electronic case handling (transaction) in contact with governmental agencies. Likewise, no differences related to firm size have been found regarding environmental policy that supports reducing energy consumption in IT use.

Telecommute (e-work) occurs in 35 percent of all small enterprises and three out of ten micro-enterprises have employees who regularly work at a distance. This share has remained the same since first measured in 2003. It can be noted that about a quarter of all small firms have an environmental policy suggesting telephone-/video-/web conferencing instead of physical meetings if possible.

One important factor explaining these differences seems to be the level of education of the executives. In smaller firms where executives hold an education above the secondary level (gymnasium), about 70 percent use ICT. The corresponding figure for small firms with executives with higher education is 91 percent. When it comes to the strategic use of ICT for development of new products and services, this is almost twice as common in firms headed by a well-educated person.

There are also obvious regional differences in the use of ICT among small firms, where more extensive and sophisticated use of ICT occurs in metropolitan areas. The main difference in IT usage is shown between small firms in metropolitan areas on the one hand, and small firms in smaller regions dominated by public employment on the other. A statistical analysis shows that these differences are truly regional, meaning that they are not explained by differences in the industry structure.

Previous policy initiatives

Broadband access to most parts of Sweden has been one core element in promoting an extensive ICT usage. The present lack of broadband has been claimed to constitute an obstacle for business and work, leading to increased travelling and regional concentration.[6] As stressed in a report by the organization Swedish IT and Telecom Industries (2009), a clear policy on these particular issues and how to cope with the demand for increasing broadband capacity in the rural areas, is missing.

Since the early 2000s, several strategies have been implemented aiming to enhance ICT skills in small firms. In particular, The Swedish agency for economic and regional growth (TVV) has carried out three major programs in the last decade: IT.SME.se (2001-2004), Reg-IT (2002-2005) and Handlingskraft med IT (2006-2009). The aim of the first-mentioned program was to increase IT- maturity among firms and enhance the awareness of the potential strategic benefits of ICT. The initiative focused on small firms with 0-10 employees that did not systematically use IT. Reg-

[6] The project *Fiber till byn* (a collaboration between Swedish Urban Networks Association, The Federation of Swedish Farmers and KTH) analyzes the demand and market for broadband expansion in rural areas.

IT aimed at increasing ICT use in rural areas. The program focused on self employed firms and entrepreneurs who worked together in networks. Both these projects were aimed at skill development in the firm and/or to launch pilot projects in firms involved in integrated production. The most recent program, Handlingskraft med IT, aimed at increasing business opportunities and strengthening the competitiveness of small firms through the use of ICT. The program focused on e- business management where the target group was firms with relatively high ICT maturity and an understanding of e-business management. An evaluation of the last program is expected during 2010.

The evaluation of the first program (Effektutvärdering 2005) indicates that the projects in the program functioned well when they were carefully designed to suit participating firms.[7] The firms adapted programs with concrete and tangible actions, the ICT usage increased for a majority of participating firms. Courses closely related to the firms needs have received very positive feedback. "IT-utbildning för jord- och skogsbrukare i Halland" is one example where the teaching of administrative systems directly intended for farmers has been implemented (Nutek 2004c). The project was designed such that detailed consideration was taken with regard the participating firms, to ensure that they could actually participate in the program.

Self-employed had the opportunity to meet colleagues and to share experiences, participating firms formed sustainable networks. Projects that were more geographically dispersed, focusing on a particular group of firms, ran into more difficulties. Overall, according to the evaluation, local projects seem to have had greater impact than regional, particular in terms of more efficient contact between customers and suppliers.

In the recently concluded policy program referred to above (Handlingskraft med IT, TVV) a renewed IT-policy was introduced. Instead of a broad target group the efforts were aimed at motivated enterprises with high ICT maturity. These companies can then act as role models or good examples that hopefully trigger other companies to start investing in ICT.

Specific policy instruments

Subsidized consulting services have been implemented to stimulate deepened ICT usage, introduction of e-commerce and websites design (Ramböll, 2009). The subsidy provided small firms the opportunity to engage external specialist experts at a lower cost, where the regional authority contributed with 50 percent of the actual cost (maximum 50 000 SEK). The main objective with the subsidies was to streamline and strengthen the county's small firms and ultimately create new jobs.

Almost 90 percent of small firms using the subsidies to purchase consulting services for their ICT development have indicated a positive impact on competitiveness. The firms were satisfied with

[7] Following section draws on the conclusions in the report Effektutvärdering av IT.SME.se (Evaluation on IT.SME.se, Nutek 2005().

the program and considered it to have an impact on firm growth. These findings were confirmed by a systematic evaluation study showing that subsidies have had significant effect on sales growth compared to firms in the control group whom had not been supported.

The public sector is singled out as a possible role model that could take the lead and act as a catalyst in the development of ICT skills. In its role as a coordinator the public sector should get an overview and the capacity to coordinate and carry out the initiative. One such area concerns public procurement (electronic procurement), which amounts to approximately 500 billion SEK annually. In November 2008 Kammarkollegiet (The Legal, Financial and Administrative Services Agency) was commissioned by the Government to lead the work on organizing and manage a platform for electronic procurement.[8] The directive emphasizes that procurement by governmental agencies should consider quality and sustainable development and support small firms to participate in public procurement. An important aspect of e-procurement is the extent to which small firms can be involved. One argument is that the introduction of less complicated/bureaucratic procurement procedures should facilitate for smaller firms to offer bids, enabling for them to compete with larger companies. Presently, costs due to regulated procedures are considerably higher for small firms.

Lessons from the EU and the U.S.

A number of policy initiatives have been taken within the EU, at the level of Commission as well as in the individual member countries (European Commission 2007, 2009a,b). These initiatives illustrate the political awareness of ICT as a critical instrument in promoting the EU into a leading, knowledge-based, future growth economy. Even if ICT penetration and usage display an impressive increase in the last decade, this is of course not unique phenomena for the EU. In fact, there are indications that EU is lagging behind when it comes to certain aspects of ICT-led innovative development. For instance, high speed fiber technology and implementation is spearheaded by Japan and South Korea; Asia seems to take the lead in wireless broadband; US tend to dominate development of new interactive web habitat. Hence, even though Europe are well positioned in certain ways, e.g. being the world leader in broadband where 80 percent of European business are reported to have broadband connection and 93 percent of the EU25 population. On the other hand, one third of the EU inhabitants have never used broadband. Thus, the digital divide is present, and usage is dominated by the so called “digital natives” (the age cohort between 16 to 34 years of age).

Basically EU policy measures with regard to ICT are structured around three pillars: the ICT infrastructure, encouragement of ICT use and strengthening of ICT literacy, and, finally, public

[8] Swedish Agency for Growth and Policy Analysis (2009).

services. It falls however beyond the scope of this study to give a full account of these measures, rather we refer the reader to the EU document mentioned above. Of course, the Swedish government must continue its efforts at the EU level to promote a true single European information space and a harmonized ICT environment, e.g. through the standardization of laws and procedures regulating national business, trade and industry.

Turning to the U.S., which still is considered one of the leading ICT-nations, policy measures to target small enterprises are often an important and integrated part of their ICT policy. A report from the governmental authority Swedish Agency for Growth Analysis (2007) has examined success factors in promoting more of ICT in American small firms. The results can be summarized as follows:

• Training ICT skills is often an integral part of other courses, such as in marketing or accounting. This allows ICT skills to increase simultaneously as it becomes part of a broader support for small enterprises.

• Grant systems and initiatives for public support are often conducted in an open cooperation with other market players, particularly the industry and the academies. To a greater extent than in Sweden, it seems common for private actors to function in ways that more often is associated with public funding in Sweden. There seems to be a generally greater acceptance for such a type of collaboration in the U.S.

• Grant systems aimed at small businesses are often closely linked to colleges and universities. For example U.S. development center for small enterprises such as the Small Business Development Centers and Women's Business Center[9] (with a primary focus on women) is often directly available at colleges. It helps to stimulate the flow of knowledge and creating opportunities to gain access to networks in an early stage of the process.

Potential policy implication for incresing ICT adoption and use in small firms

Building on the findings reported in this study, where heterogeneity has been shown to be one conspicuous characteristics of the small firm sector, we will structure our policy recommendations in terms of general and more specific measures, We believe that there is no quick-fix recipe in alleviating potential shortcomings among small firms, rather several policy areas have to considered, where policies are carefully designed to avoid conflicting or

[9] For Swedish research regarding women and IT – see *Kvinnors delaktighet på IT- och telekomområdet – övergripande kartläggning av initiativ som främjar kvinnors delaktighet på IT- och telekomområdet* (2009).

neutralizing effects. Given the short time period for the current study, there has not been time to undertake such detailed analysis. Thus, our recommendations should be regarded as a catalogue of suggestions that needs further refinements.

Suggested general policy implication

Swedish ICT-policies have to a large extent centered at broadband expansion. The idea was that a new infrastructure would be the tool that independently created conditions for regional development, as well as contributing to reduced regional disparities.[10] We claim that a sophisticated infrastructure is a necessary condition to reap full leverage of ICT, but far from sufficient. Broadband expansion by itself is no guarantee for long-run strengthened competitiveness, nor growth and development at the regional or national level. To fully exploit the advantages of ICT broadband expansion it must be complemented by efforts to support an entrepreneurial and innovative economic environment, which implies that policies related to education, taxes, labor market, the financial sector, etc., must also be considered. Without such supporting policies, and a comprehensive view on the measures that has to be implemented, isolated broadband and ICT initiatives may turn out quite disappointing.

ICT is predominantly a technological tool to rationalize, make firms more efficient and competitive, and to facilitate access to larger and distant markets. Given the uncertainties and knowledge asymmetries (digital divide) referred to in previous sections, there is an obvious risk for market failures and underinvestment in ICT. To prevent a suboptimal investment level, and with the caveats mentioned above in mind, we propose the following four general policy initiatives:

i) A tax incentive could be motivated to overcome market failures and increase ICT-investments which are likely to render positive direct effects (reduced administrative expenditures on both the private and public side) and indirect effects (learning effects and increased absorption capacity). One way would be to allow for extended deductions for investments in ICT-equipment (soft-ware and hard-ware), where the design and extent has to be further discussed. We recommend that such initiative should be restricted in time.

ii) Alternatively, a more general R&D tax credit, including ICT, could for similar reasons be motivated in order to upgrade and develop firms ICT. This should be complemented by programs that stimulate collaboration between small firms and university/university colleges, and policies that support the development of standardized and multi-functional ICT platforms and systems developed on the basis of the needs in smaller organizations (through for instance Vinnova and TVV).

[10] Nutek, IT i *småföretag, Regionala skillnader i användningen av IT* (2004).

iii) Scrutiny the regulatory environment, stimulate interoperability and technology neutrality, and increase security and producer/consumer confidence in ICT based transactions. Both the producer and the consumer side must be considered. At the EU-level the eYou Guide has been forwarded (2009) which provides information about users right, laws on personal data, internet safety, advertising, shopping, copyright, etc. A better and standardized regulatory environment would serve to cut costs and increase confidence in ICT based system.

iv) One particular area refers to public procurement where less complicated/bureaucratic (electronic) procurement systems and procedures should be introduced, such that smaller firms can offer bids and compete with larger companies at reasonable costs. Procurement practices in government organizations should consider to require that procurement packages are divided into smaller parts (enabling for small firms to compete for orders), and/or procedures that opens the possibility to bid for only parts of a procurement package (having the same effect, but also assigning the buying organization to establish networks of suppliers contributing to a specific procurement). Using public procurement in innovative way could pave the way for smooth and less costly ICT transactions systems. Such initiatives have to be harmonized with EU regulations.

Suggested specific policy measures

As often pointed out, small firms are not a homogeneous group of companies characterised by similar strategies and capabilities. Instead the represent a broad variety of different types of firms, spanning from e.g. high-tech firms operating on a global market to small businesses serving very local service needs. For the purpose of this study we have found it functional to distinguish between companies along two major dimensions:

a) Whether they perceive a need for ICT in order to develop their business or not,

b) Whether they have the knowledge and capabilities needed for utilizing ICT in their business or not.

This simple two-dimensional distinction then constitutes the building blocks for constructing a 4x4 matrix where different policy implications may be positioned. Since close to 99 percent of Swedish firms have less than 50 employees, these recommendations can be viewed as pertaining to primarily small firms.

In the Figure below, firms positioned in square A may be understood to possess adequate ICT skills and to use these skills for e.g. communicating with partner companies or customers. Firms positioned in box B perceive no real use for ICT solutions in their companies although they possess the relevant ICT knowledge and competence, while companies in box C recognize the need for using more of ICT solutions but lack the knowledge and competence to do this. In

square D eventually we have firms neither possessing the knowledge needed nor perceiving any needs for ICT solutions.

		Need for ICT solutions: YES	Need for ICT solutions: NO
ICT Knowledge & Competence	YES	A	B
	NO	C	D

Figure 4: A simple framework for positioning suggested policy implications

The following section refers to different types of firms as categorized in the matrix above. As a first observation, which also is evident from previous research referred to above, success seems to build on defining the specific needs of the firm and point at the particular gains that can be made in each specific case. Hence, even if training includes more general competencies, they also have to be customized. Small firms are quite heterogenous as is their needs to upgrade their ICT competencies: for some increased productivity would be the prioritized objective, which could perhaps be obtained through more of production integrating ICT measures. Others are in need of strengthening their marketing knowledge, which may be a the decisive input to survive in a globalized economy, where a different set of policy measures are required.

Since the barriers, as discussed in previous sectors, frequently refers to lack of resources – financially and knowledge wise – the specific measures presented below has to be combined with the more general prescriptions that has already been discussed.

I) For small firms possessing ICT knowledge & capability and perceiving need for further ICT development

- To remove barriers that prevent or hamper small firms from investing in or utilizing more ICT for business development, for instance:
    - To introduce favourable loan systems for small firms investing in more advanced ICT systems, administered by regional actors that have knowledge about the local/regional conditions and settings (e.g., ALMI Företagspartner or other suitable organisation). Resources from Structural and Rural funds should be used and matched by other local funding (firms, local and national authorities).
    - To support small firms that in collaboration invests in broad band systems (masts, cables, etc).
    - To combine such regional initiatives with e-learning systems designed for small firms.
    - To introduce/expand consultancy support (*konsultcheckar*) for ICT development and upgrading, which used to procure private or public (universities etc.) services.
    - Initiate a Round Table discussion with relevant parties (banks, credit companies, ICT industry representatives etc) on how to develop more effective security systems for e-commerce adapted to the needs and conditions prevailing in small firms. Consider the possibility to initiate public technology procurement of equipment and software solutions as a policy-initiated measure to stimulate a more rapid development of market demand.

ii) For small firms possessing ICT knowledge & capability but perceiving no need for further ICT development

- Let regional actors (e.g. ALMI Företagspartner or other suitable organisation) proactively engage in defining the potential benefits for ICT for small firms (building e.g. on Figure 3 in this report).[11]
- Make sure that other, existing small firm support also include an ICT part when relevant.
- Stimulate network building among small firms (since networking increases ICT use and may serve as a trigger for developing the firm's in-house ICT capability)

[11] Experiences may be drawn from previous projects such as "IT-rådgivarna", initiated in 2003 and financed through TVV, EU, regional actors and others.

- To introduce/expand consultancy support (*konsultcheckar*) for ICT development and upgrading, which can be used to procure private or public (universities etc.) services.
- Combine such regional initiatives with e-learning systems designed for small firms. Organize regional platforms involving e.g. government agencies, universities, trade/industry organisations, and individual private companies to demonstrate usefulness and pay-off from ICT investments.

iii) For small firms lacking ICT knowledge & capability but perceiving need for further ICT development

- Develop ICT knowledge and skills through government-sponsored training programs for small firms, based on adequate expertise, network learning and course applications on real cases.
- Introduce/expand consultancy support (*konsultcheckar*) for ICT introduction and development.
- Support to ICT trainees – internships linked to different educational programs introducing ICT knowledge in small companies.
- Introduce (through ALMI Företagspartner or other suitable organisation) scholarships for thesis work addressing challenges and solutions related to ICT conducted on bachelor, master and Ph.D. levels
- Stimulate network building where small firms compensate for their lack of in-house ICT competence through networking.
- Introduce a specific Help Desk at for instance Post och Telestyrelsen (PTS) where small firms experiencing problems related to ICT may get assistance and problem-solving.

iv) For small firms lacking ICT knowledge & capability and perceiving no need for further ICT development

- No initiatives suggested

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Appendix. Some selected tables from Statistics Sweden (2010)

Tabell 7a. Andel företag med tillgång till Internet efter storleksklass och bransch, år 2009, 10 anställda eller fler, procent
7a. Share of enterprises with access to the Internet by size and industry, year 2009, 10 employees or more, per cent

	Andel % ± ki		
Totalt (SNI 10-82)	**95**	**±**	**1**
Storleksklasser			
10-49 anställda	94	±	1
50-249 anställda	98	±	1
250 eller fler anställda	99	±	0
Branscher			
Tillverkningsindustri (SNI 10-33)	97	±	1
Energi och återvinning (SNI 35-39)	97	±	3
Byggindustri (SNI 41-43)	95	±	3
Handel; serviceverkstäder för motorfordon (SNI 45-47)	96	±	2
Transport- och magasineringsföretag (SNI 49-53)	89	±	5
Hotell och restauranger (SNI 55-56)	84	±	5
Informations- och kommunikationsföretag (SNI 58-63)	97	±	2
Finansiell verksamhet (delmängd av SNI 64-66)	100	±	0
Fastighetsbolag och förvaltare (SNI 68)	98	±	2
Övriga företagstjänster (SNI 69-74 samt 77-82)	95	±	2

Tabell 8a. Andel av företagens sysselsatta som i arbetet regelbundet använder Internetanslutna datorer, efter storleksklass och bransch, år 2009, 10 anställda eller fler, procent
8a. Share of employees regularly using computers with Internet access in their work, by size and industry, year 2009, 10 employees or more, per cent

	Andel % ± ki		
Totalt (SNI 10-82)	**61**	**±**	**1**
Storleksklasser			
10-49 anställda	52	±	2
50-249 anställda	60	±	3
250 eller fler anställda	65	±	2
Branscher			
Tillverkningsindustri (SNI 10-33)	56	±	2
Energi och återvinning (SNI 35-39)	74	±	4
Byggindustri (SNI 41-43)	36	±	3
Handel; serviceverkstäder för motorfordon (SNI 45-47)	68	±	3
Transport- och magasineringsföretag (SNI 49-53)	47	±	4
Hotell och restauranger (SNI 55-56)	37	±	4
Informations- och kommunikationsföretag (SNI 58-63)	92	±	3
Finansiell verksamhet (delmängd av SNI 64-66)	98	±	1
Fastighetsbolag och förvaltare (SNI 68)	73	±	6
Övriga företagstjänster (SNI 69-74 samt 77-82)	63	±	5

Tabell 11a. Andel företag som använt Internet vid kontakter med myndigheter, efter storleksklass och bransch, år 2008, 10 anställda eller fler, procent
11a. Share of enterprises using the Internet for interaction with public authorities, by size and industry, year 2008, 10 employees or more, per cent

	Andel % ± ki		
Totalt (SNI 10-82)	**86**	**±**	**1**
Storleksklasser			
10-49 anställda	84	±	2
50-249 anställda	92	±	3
250 eller fler anställda	94	±	1
Branscher			
Tillverkningsindustri (SNI 10-33)	89	±	3
Energi och återvinning (SNI 35-39)	95	±	4
Byggindustri (SNI 41-43)	85	±	5
Handel; serviceverkstäder för motorfordon (SNI 45-47)	82	±	4
Transport- och magasineringsföretag (SNI 49-53)	83	±	6
Hotell och restauranger (SNI 55-56)	76	±	5
Informations- och kommunikationsföretag (SNI 58-63)	92	±	3
Finansiell verksamhet (delmängd av SNI 64-66)	94	±	3
Fastighetsbolag och förvaltare (SNI 68)	95	±	3
Övriga företagstjänster (SNI 69-74 samt 77-82)	90	±	3

Tabell 12a. Andel företag som använder Internet vid kontakter med myndigheter för olika ändamål, efter storleksklass och bransch, år 2008, 10 anställda eller fler, procent
12a. Share of enterprises using the Internet for interaction with public authorities for different purposes, by size and industry, year 2008, 10 employees or more, per cent

	Söka information			Hämta blanketter		
	Andel % ± ki			Andel % ± ki		
Totalt (SNI 10-82)	**84**	**±**	**2**	**83**	**±**	**2**
Storleksklasser						
10-49 anställda	82	±	2	81	±	2
50-249 anställda	92	±	3	89	±	3
250 eller fler anställda	93	±	1	91	±	1
Branscher						
Tillverkningsindustri (SNI 10-33)	87	±	3	86	±	3
Energi och återvinning (SNI 35-39)	92	±	4	91	±	4
Byggindustri (SNI 41-43)	84	±	5	82	±	5
Handel; serviceverkstäder för motorfordon (SNI 45-47)	79	±	4	78	±	4
Transport- och magasineringsföretag (SNI 49-53)	82	±	6	82	±	6
Hotell och restauranger (SNI 55-56)	72	±	6	74	±	5
Informations- och kommunikationsföretag (SNI 58-63)	90	±	4	89	±	4
Finansiell verksamhet (delmängd av SNI 64-66)	93	±	3	92	±	3
Fastighetsbolag och förvaltare (SNI 68)	93	±	4	93	±	4
Övriga företagstjänster (SNI 69-74 samt 77-82)	88	±	3	85	±	4

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