EUROPEAN COMMISSION

e-Business W@tch

# The European e-Business Report 2008

## The impact of ICT and e-business on firms, sectors and the economy

*6th Synthesis Report of the Sectoral e-Business Watch*

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## The Sectoral e-Business Watch

The "Sectoral e-Business Watch" (SeBW) studies the adoption, implications and impact of electronic business practices in different sectors of the economy. It continues activities of the preceding "e-Business W@tch" which was launched by the European Commission, DG Enterprise and Industry, in late 2001, to support industrial policy, notably in the fields of competitiveness and innovation. The SeBW is based on a Framework Contract between DG Enterprise and Industry and empirica GmbH, running until the end of 2010.

In ICT-related fields, DG Enterprise and Industry has a twofold mission: to enhance the competitiveness of the ICT sector, and to facilitate the efficient uptake of ICT for European enterprises in general. The services of the SeBW contribute to achieving these goals, by supporting informed policy decision-making in these fields.

In 2007/08, ten studies on sectors and specific ICT issues have been conducted. This report summarises the main results. The full study reports, and further resources such as brochures, case studies and table reports with more detailed survey data, can be downloaded from the programme's website (***www.ebusiness-watch.org***).

## Disclaimer



## Imprint

This report has been prepared by empirica Gesellschaft für Kommunikations- und Technologieforschung mbH on behalf of the European Commission, Enterprise and Industry Directorate General, in cooperation with Altran Group, Databank spa, DIW Berlin, IDC EMEA, Ipsos, GOPA-Cartermill and Rambøll Management.

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Copies can be requested, free of charge, from ***info@ebusiness-watch.org***.
The report is also available in electronic format and can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).

A great deal of additional information on the European Union is available on the internet.
It can be accessed through the Europa server (***http://ec.europa.eu***).

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# Foreword

The European Commission has long emphasized the importance of information and communication technologies (ICT) for a thriving European economy. The effective use of ICT by companies is a critical success factor for innovation, competitiveness and growth. A thorough analysis of its strategic potential for enabling new business models, influencing value chains, and increasing process efficiency is therefore required. The effects of globalisation mean that business today is changing. Large companies are moving to exploit the advantages offered by ICT and e-business; smaller companies will have to follow suit, or risk being excluded from digital supply chains. It is clear that ICT and e-business are relevant to a broad range of policy areas, including innovation, standardisation, competitiveness, SME policy and industrial policy.

The results of the Sectoral e-Business Watch studies of 2008 are an impressive demonstration of the dynamic developments in ICT adoption and e-business activity. A comparison of the results of the latest survey with those of 2003 shows that in most industries companies generally have a more advanced ICT infrastructure and make more use of e-business. We are pleased to see that the ICT infrastructure of European companies is improving and that many companies are making advanced use of e-business to stay competitive in the international marketplace. The substantial efforts made by government and industry to raise awareness of the importance of ICT seem to be bearing fruit. If this positive momentum can be maintained, Europe has good chances of further closing the productivity gap with the US and strengthen its international competitiveness. However, the study also points out new challenges that need to be addressed; namely the widening "e-skills" gap, and the persistent "digital divide" between large companies and SMEs. Resolving both issues is crucial to ensure that European SMEs – a backbone of the European economy – can be part of the emerging digital value chains.

A topic of increasing consequence, both for policy makers and for industry, is the exploration of the environmental potential of ICT, for example the improvement of energy efficiency in production processes. Industry needs to adapt to the challenges posed by climate change and to grasp the opportunities of new low energy and resource-saving processes and products. To acquire better evidence of the role which ICT can play in sustainable industrial development, we have directed the Sectoral e-Business Watch to focus specifically on ICT usage in energy-intensive sectors and to analyse the links between ICT and energy consumption. We are encouraging the Sectoral e-Business Watch to continue and deepen its analytical work in this area and to deliver further empirical evidence on the impact of ICT in different sectors. We are already looking forward to the new studies that will be presented in 2009.

**Jean-Noel Durvy**
*Director, Innovation Policy*
*Enterprise and Industry Directorate-General*
*European Commission*

# Executive summary

# On a fast track towards "e-Business 3.0" – the digital integration of value networks

Basic ICT infrastructure, such as simple computer networks and access to the internet, has become a commodity for a majority of enterprises in all sectors. These technologies have become so widely used that they are now essential in daily business (see Exhibit Ex-1). Besides the basic role of ICT, its strategic potential for enabling new business models, influencing value chains and increasing process efficiency are presented in the Sectoral e-Business Watch studies. This extensive report show the critical role in tomorrow's economy for the advanced information infrastructures, services and the value creating activities which are made possible by computer networks and access to the internet. However, e-business[1] is not primarily about systems and technology. It is about optimally **managing relationships** with customers, suppliers and business partners in a complex and often global competitive environment. Furthermore, e-business is not just about accomplishing electronic transactions such as procurement and sales. It is about accessing, providing and sharing **information** in business networks. Ultimately, it is about doing business in the advancing **digital economy**. The way business is done is changing rapidly, mainly due to globalisation. Large companies are moving rapidly to exploit the advantages offered by ICT for their business strategies (see Exhibit Ex-2). Smaller companies will have to follow suit, or risk being excluded from digital supply chains.

The trend towards digitally integrated value systems connected through ICT can be seen as a new lifecycle of e-business. We refer to the period between 1995 and 2000, over which internet based trade emerged, as "e-Business 1.0". During this time, companies connected to the internet and were quickly lured into buying all sorts of immature technology. After the shake-out of several failed business models, e-business between 2001 and 2005 focused on cutting costs. We refer to this more conservative attitude towards ICT as "e-Business 2.0". However, companies are growing more "e-friendly" again. The underlying information infrastructures have matured and today no one doubts their importance for modern business. A new era appears to have emerged, "e-Business 3.0".

*Exhibit Ex-1: Basic ICT infrastructure has become a commodity*

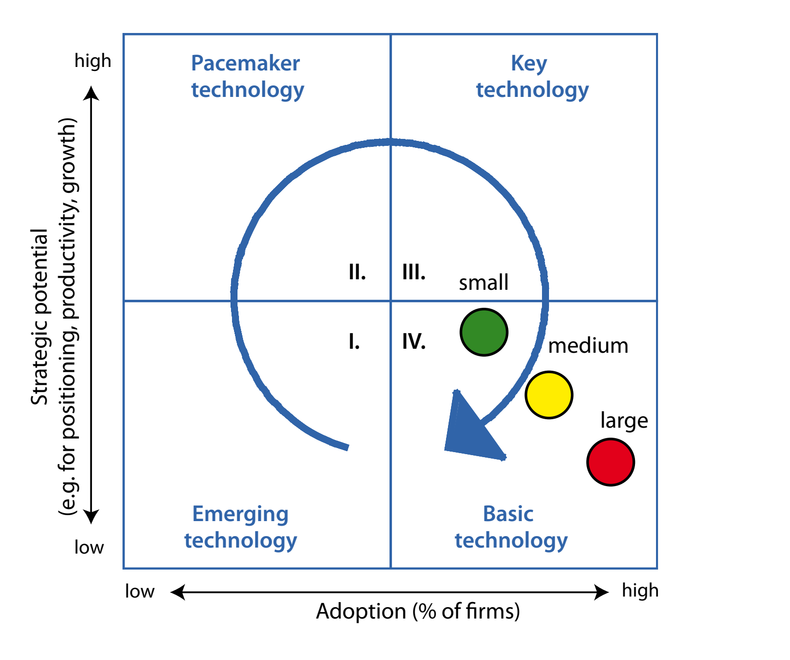
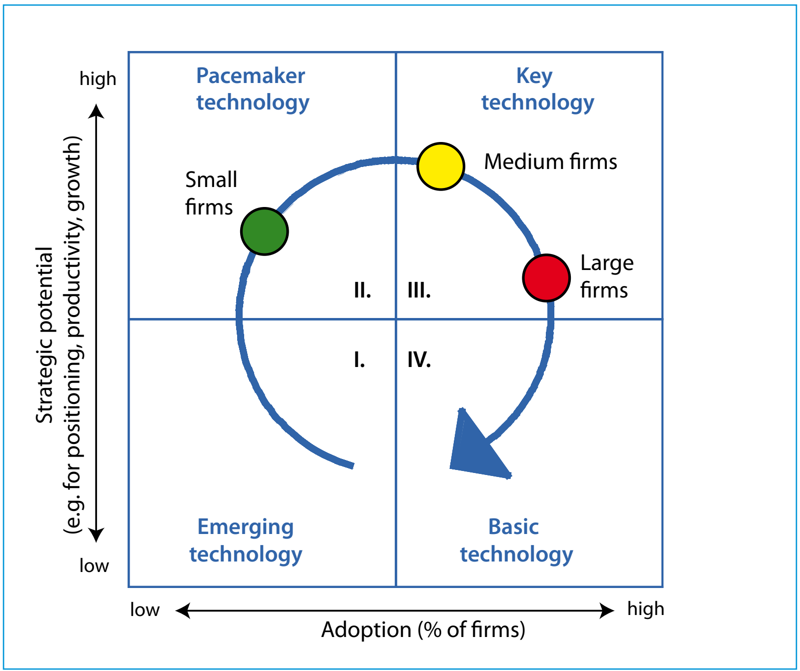



*Exhibit Ex-2: Advanced e-business activity still holds strategic potential for companies*




1. The Sectoral e-Business Watch defines e-business as «automated business processes (both intra-and inter-firm) over computer mediated networks», following a definition proposed by the OECD. Automation means that formerly manual, paper-based processes or exchanges are partly or fully replaced by digitally processing or exchanging the same data.

## ICT as a tool for innovation and growth

This development implies a change of focus. Although firms continue to use ICT to improve process efficiency (mainly conceived as ICT for cost-cutting), ICT are increasingly recognised as an important tool for **innovation** and **increasing revenues** by enabling new services and new ways of working within value networks. Globalisation and the evolution of value networks are forcing firms to cooperate and compete in new ways. New challenges include the emergence of specialised intermediaries, and the greater importance of **knowledge-intensive activities** within both the manufacturing and services sector. Companies are increasingly focusing on their core competences. ICT enhances this process by improving the transparency of information flows. It facilitates the outsourcing of non-core business processes, and offers new forms of cooperation within networks. ICT is no longer merely the key to internal process innovation - it is also vital for external process innovation.

**ICT & e-business trends observed in 2007/8**

- **Improved e-maturity.** The quality of companies' ICT infrastructure has significantly improved in the past 3-4 years, in particular among SMEs. This can be seen in the studies on the chemicals and retail sectors by comparing the Sectoral e-Business Watch data on ICT adoption from 2003 and 2007. Companies are better prepared for more advanced forms of e-business.
- **From transactions to service provision.** Companies, including those in manufacturing sectors, are increasingly devoting attention to using e-business for better service to their customers, with the goal of creating sustained relationships with them. This trend has already been observed in the previous report (2006 edition) but it has since gained considerable momentum. It highlights the fact that e-business goes far beyond concluding transactions.
- **ICT for information management and transparency of processes.** Notwithstanding the trend towards focusing on customer services, increasing the efficiency of internal processes remains an important objective for ICT. Many case studies show that a major potential of ICT in this context is to improve the transparency of processes and information management, which facilitates planning and decision-making processes.
- **Outsourcing and e-intermediaries.** ICT and e-business open up new opportunities for outsourcing specific business processes. Outsourcing promises to boost company productivity. Specialised "e-intermediaries" support data exchanges between companies, for instance by ensuring the compatibility of document formats. Electronic invoicing is a good example of a B2B service that can be outsourced.

**W@tch out: emerging trends**

- **ICT for sustainable industrial development.** ICT's potential to help companies reduce the amount of energy they use, or at least improve their energy efficiency, is not yet well understood. The issue ranks high on the agenda of businesses and policy due to rising energy costs and environmental challenges. A great effort will be made to promote further innovation in this area, for instance by implementing new energy management systems. The Sectoral e-Business Watch has started to explore links between ICT adoption and energy consumption (see Section 3.3).
- **e-Business implications for business models.** If "e-Business 3.0" matches its promise, it is likely that many companies will revise or change their business models in line with their e-strategy. This includes decisions on which parts of the value chain to cover, on product portfolios, distribution channels and cooperation strategies. Business models, in turn, are driven by market developments and competitive demands.
- **ICT and innovation are becoming inseparable.** The new series of sector studies confirms once again the critical role of ICT for introducing new business processes, such as organisational and process innovation in companies. The borderlines between implementing new ICT-based systems and introducing process innovation are getting blurred. Even the difference between a "product" and "process" innovation may become obsolete as products and services are combined in new ways.

# The economic impact of ICT and e-business it is more than a "productivity story"

The interest of policy in the economic impact of ICT was mainly triggered by the productivity growth resurgence in the USA and a simultaneous diffusion of ICT products in the 1990s. It was assumed that a significant part of this increased productivity growth was attributable to increased ICT investments. In response, a lot of research has been conducted to better understand the importance of ICT for competitiveness, productivity and growth. Unsurprisingly for such a complex topic, the research results cannot easily be summarised into simple conclusions. Studies revealed that only some countries and specific sectors (notably services and the ICT industry itself) have seen a clear surge in productivity resulting from ICT investment.

The Sectoral e-Business Watch aims to contribute to this debate mainly in two ways. Taking a **holistic view**, it will offer a combination of **micro-data** with **macro-data** based evidence in an integrated way. At the same time, it will focus on **sectoral specificities** in ICT adoption, usage and impact. Unfortunately, even this broad approach affords no simple, straight forward conclusion in the end. The Sectoral e-Business Watch studies of 2007/08 find a range of evidence in their assessment of ICT impacts. While micro-data evidence clearly underlines the strategic importance of e-business for individual companies, macro-economic analysis at industry level finds only moderate direct effects of ICT capital on productivity and industry growth (see summary of main results in Exhibit Ex-3).

These diverse results imply that the "**productivity paradox**"[2] is still valid. Despite ICT being pervasively used in all sectors and business functions, it is difficult to track the direct impact on productivity and growth. A differentiated analysis can bridge the (apparent) gap between the micro and macro perspectives. This may have implications for future research approaches. Issues to be considered include:

- **Physical infrastructure vs. business processes**: The case studies demonstrate that e-business is mainly about optimally organising information flows, work and production processes, by exchanging and processing data electronically. This requires ICT, but investments in the technology part can be insignificant compared to the "investments" in implementing the organisational changes.
- "**Embedded ICT**": The important role of embedded ICT, for example technical components in plants or in other technical equipment used in production, may not be fully accounted for in data on "ICT capital", which typically covers investments in computer hardware, software and telecommunication services.
- **Effects of outsourcing**: Not all the ICT-based activities of a company are necessarily accounted for in figures on ICT capital / ICT investments, as many companies (notably SMEs) outsource ICT activities to external service providers. The study on ICT, innovation and firm performance (see Section 1.3) concludes that outsourcing is probably a key factor for growth in labour productivity. ICT has a double role to play in this context. A good ICT infrastructure facilitates the outsourcing of business processes, while parts of the ICT infrastructure and maintenance itself can be outsourced.
- **More than a productivity story**: The arguments for ICT-related policies have focused on closing the productivity gap. However, this is only one aspect of company performance that ICT can contribute to. A good e-business strategy can be crucially important for companies' presence in global markets, without necessarily increasing their productivity. Furthermore, the use of ICT may identify problems by increasing transparency or result in a better quality of products and services, rather than in productivity gains.

From a methodological point of view, these observations illustrate why company growth can be a poor indicator of the impact of ICT and ultimately of e-business. Without questioning the merits of this method, a strong point can be made that a combination of different analytical approaches delivers a more balanced evidence base from which informed policy decisions can be taken.

2. «Computers are everywhere but in the productivity numbers.» (Robert Solow, 1987). The «productivity paradox» (or «Solow computer paradox») refers to the discrepancy between measures of IT investment and measures of output, in studies using growth accounting methods to explain the contribution of different inputs. The paradox was common in studies of the late 1980s and early 1990s, while later studies found more evidence of ICT-induced productivity effects.

*Exhibit Ex-3: The impact of ICT and e-business – micro and macro evidence from Sectoral e-Business Watch studies of 2007/08*

| **Micro-data evidence: increasing strategic importance of e-business** | **Sector-level analysis: only modest impact of ICT capital on productivity and industry growth** |
|---|---|
| Micro-data evidence from the firm surveys (see Section 1.1) and the case studies (see Section 1.2) conducted in 2007/08 point towards a dynamic development of e-business in all of the sectors studied.<br><br>■ **Case studies:** Microanalysis data show that ICT have become a general purpose technology – they are widely used in all business functions. For many companies, e-business has become an important instrument with which to implement strategy. The specific e-business objectives and applications, however, differ widely depending on the business model of a company, its size, and the market in which it operates.<br><br>■ **The companies' view:** 55-70% of companies in all sectors expect that ICT will have a high or medium impact on their business. This is true across practically all areas, including primary functions (such as production, marketing and logistics) and support functions (such as controlling, human resources and accounting).<br><br>■ **Data analysis:** A regression analysis based on data from the e-Business Survey 2007 finds that ICT use is positively linked with an increase in turnover in all sectors studied. For firms from the chemical, retailing and transport & logistics sectors, there is evidence of a positive impact of ICT use on market shares. This points towards positive effects on firm performance. | At the sector level, the direct contribution of ICT capital to productivity growth and industry growth is less pronounced. An econometric analysis for the sectors studied shows ICT having only moderate effects (see Section 1.3).<br><br>■ **ICT & value added growth:** Growth accounting (using data from the EU KLEMS Productivity and Growth Accounts[3]) does not deliver convincing evidence for growth effects of ICT capital in most of the sectors analysed. The sector in which ICT plays the greatest role is banking. The most significant contributor to value added growth throughout the analysed periods was non-ICT capital.<br><br>■ **ICT & labour productivity growth:** An analysis based on EU KLEMS panel data from 1995 until 2004 finds only a modest impact of ICT capital on labour productivity. Instead, the key driver for labour productivity growth (measured as gross production value per working hours) was intermediate inputs intensity. This indicates that outsourcing has been key to increasing labour productivity. The strongest evidence in this respect was found for the retailing, chemical and steel sectors, and to a lesser extent for transport and banking.<br><br>■ **ICT & energy:** An econometric pilot study by the Sectoral e-Business Watch on the impact of ICT on energy consumption (for three sectors) finds that electricity intensity is reduced by the use of communications devices, but is increased by IT (computers and software). |

3. The EU KLEMS Growth and Productivity Accounts are the result of a research project financed by the European Commission to analyse productivity in the European Union at the industry level. See ***www.euklems.org***

# Sectoral differences in ICT adoption and e-business focus

Companies from all sectors use ICT and e-business. The sector studies of 2008 provide evidence for a dynamic process of adoption. But e-business can cover a wide range of activities. The objectives and the focus of ICT use differ widely between sectors. Variations depend in particular on the types of products and services which companies offer, the scale of the markets in which they operate and on their marketing strategy, including the choice of distribution channels. In manufacturing sectors, the e-business strategies of companies focus on supporting procurement, optimising supply chain management, integrating with retail and distribution, and increasingly on providing the best possible service to customers. In retail, supply chain management is also a key aspect of e-business. Whether and how retailers use e-commerce to sell their goods depends on their business model. In the logistics industry, internal operations are largely based on highly complex ICT systems. In banking, the internet has transformed the whole sector and become a critical element in the business strategy of banks (see Exhibit Ex-4).

## *ICT and e-business in manufacturing sectors*

The large companies of the **chemical, rubber and plastics products industry** are advanced users of ICT and e-business in all business areas. They are increasingly replacing paper-based, manual processes by electronic exchanges (see Section 2.1). In 2007, three in four companies with at least 10 employees said that at least some of their processes were conducted electronically. The industry has developed the "Chem eStandards", its own technical standard for data exchange related to buying, selling and delivering chemical products. These are based on XML and were developed as a cooperative effort of more than 20 chemical companies in late 2000. Since 2001, CIDX (a non-profit organization) coordinates the development of Chem eStandards. However, smaller companies in the sector are less advanced. Bridging the "e-gap" between the large and small firms will be important in the years to come to exploit the full synergies of e-business at an industry-wide level.

In the **steel industry**, the main impact of ICT is on process efficiency along the value chain. However, the prospects for using e-business in direct e-commerce transactions, such as procurement and sales, are limited. Iron and steel companies prefer to procure raw materials in long-term offline relationships, due to an oligopolistic market structure (see Section 2.2). Nevertheless, e-business solutions are used to enhance communication with customers, including for example product specification, scheduling, and invoicing. Moreover, the use of ICT for internal operations can significantly enhance workflows and business processes and thus increase productivity and reduce costs in steel enterprises. The main driving forces for further e-business developments are the continued cost pressure and ongoing industry consolidation. As long as the price of raw materials remains high and competition between steel companies remains fierce, the pressure to reduce process costs will continue.

*Exhibit Ex-4: The relevance of ICT and e-business for various business functions (overall assessment based on survey results, case studies and desk research)*

| Application Sector | Sourcing & procurement | Design & production | Logistics / distribution | Marketing & sales | Customer service |
|---|---|---|---|---|---|
| Chemical, rubber & pl. | ●●● | ●●○ | ●●● | ●●● | ●●○ |
| Steel | ●●● | ●●●● | ●●● | ●● | ●●● |
| Furniture | ●●● | ●●●○ | ●● | ●● | ●● |
| Retail | ●● | n.a. | ●●○○ | ●●○○ | ●○○ |
| Transport & logistics | ●○ | n.a. | ●●●○ | ●●○ | ●●○ |
| Banking | ● | n.a. | n.a. | ●●●● | ●●●● |

● = low; ●● = average; ●●● = high; ●●●● = very high; ○ = applies only to some sub-sectors / types of firms

The European **furniture industry** is confronted with a quickly changing and highly competitive market environment. Product innovation and reduced lead times are essential for businesses to remain competitive. In this context, ICT can play an important role. It can for example support product design (see Section 2.3). CAD (Computer Aided Design) software and 3D tools are used by companies of all sizes not only to facilitate the product's design process, but also to enhance the customer's experience at the point of sale. 3D tools enable a virtual presentation of products. Ultimately, this triggers customer-driven production and innovation processes. For e-business, a decisive characteristic of this sector is the large number and diversity of business players in the value chain, including handcraft companies and professionals. The resulting diversity of ICT systems and e-skills levels is a major hurdle to integration through e-business. In particular, e-business integration is still underdeveloped between manufacturers and independent distributors. This is due to the characteristics of furniture distribution networks and the complexity of industrial categorisation and coding. e-Marketing and e-sales activities towards final customers are still limited in this sector. Those that exist are aimed at providing technical and commercial information rather than actual e-commerce functions.

## ICT and e-business in retail and service sectors

In **retail**, e-business can be used to facilitate upstream supply chain management (SCM) processes as well as for marketing and sales purposes (see Section 2.4). The purpose of SCM is to design and manage the processes, information and material flows between retailers and their suppliers. Case studies demonstrate that ICT have significant potential in this context, not only to cut costs, but also to improve service levels for customers. However, companies have to balance availability with inventory levels and associated costs. Advanced SCM software systems are still not widely used, but adoption has been dynamic among large retail companies (from 7% of companies in 2003 to 35% in 2007). Downstream, retailers representing 38% of the industry's employment stated that they use e-commerce: that is, they sell at least some of their goods online. Pure e-retailers are still the exception. In many cases, online sales are marginal compared to shop sales. Case studies in the report include examples where companies make about 1% of their total sales through e-commerce. US retailers were found to make more use of e-marketing and e-commerce than European retailers.

The **transport and logistics services industry** is characterised by a pronounced digital divide between small and large companies. Large transport and logistics companies use highly sophisticated ICT systems, such as fleet control systems, to manage their logistics. In contrast, small companies, particularly in freight transport, often run their operations in much more traditional ways (see Section 2.5). "e-Business" can mean different things in this sector. In passenger transport, it can mean "e-ticketing", enabling customers to order and receive their ticket online. In freight transport and logistics, e-business mainly means a system that initiates, tracks, and acknowledges shipments online. In both cases, paperless trade eliminates the operational costs related to manual paper processing and increases the transparency of the supply chain and information exchange between trading partners. Case studies in the report demonstrate the potential of ICT for companies in these fields. They include examples of e-ticketing systems as well as track and trace solutions for cargo handling.

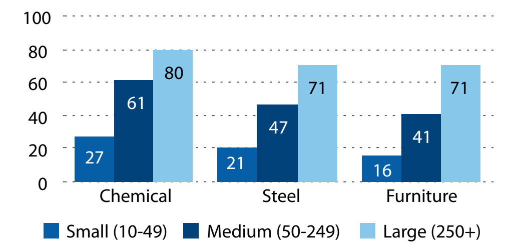
The introduction of ICT in the European **banking industry** has had a significant impact on banks operating with physical branches. Most importantly, the internet has made it possible for banks to cut costs by offering online banking. The study shows that ICT use is positively correlated with firm restructuring activities (see Section 2.6). ICT enables companies to redefine the boundaries of their organisations and possibly gain a competitive advantage. e-Banking is nowadays supported by advanced ICT solutions which enable most everyday banking services to be conducted online. This has led to a prevalent change in the strategy of banks and in branch structure: dual combination banking. In this model, most of the traditional manual banking services are performed by customers online, while more sophisticated services are still performed in the branch bank. The customer takes advantage of the low-cost nature of e-banking and the face-to-face advisory services of the branch bank.

# e-Business for SMEs – opportunities and challenges

ICT implications are ambivalent for small and medium-sized businesses. On the one hand, large enterprises can gain a disproportionate advantage from e-business by exploiting **economies of scale**. Their operations have critical mass to make use of advanced ICT systems. The 2007 survey confirms a linear increase according to firm size for the diffusion of ICT systems for internal and external process integration such as ERP systems (see Exhibit Ex-5). Many smaller companies, by contrast, still struggle with the requirements of **getting digitally connected** with their suppliers and customers. If they cannot cope with the requirements of the digital economy, however, they risk being eliminated from the value systems that tend to be orchestrated by large firms.

On the other hand, smaller companies do not necessarily need the same powerful solutions as large firms in order to achieve the same benefits, because their organisational structure is less complex. Many case studies demonstrate that SMEs successfully use ICT and e-business, whether in response to customer requirements or proactively to stay competitive and to support growth strategies.

***Exhibit Ex-5: % of companies with an ERP system (by sector and size, 2007)***




Base (100%) = companies using computers from 7 EU countries.

N = 811 (chemical) / 349 (steel) / 661 (furniture).

Source: e-Business Surveys 2007

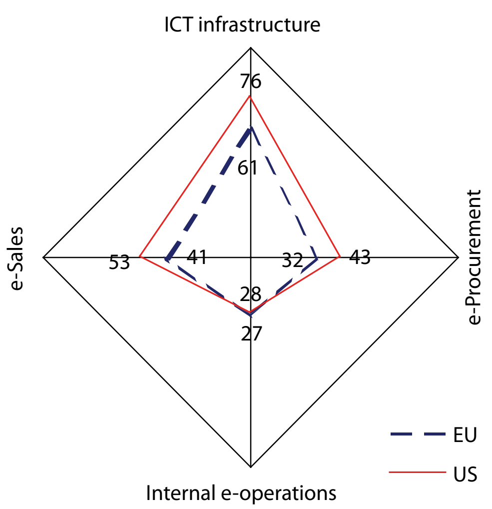
| e-Business opportunities for small firms | e-Business challenges for small firms |
|---|---|
| ■ **Access to international markets.** e-Commerce is an opportunity (if not the only way) for many smaller companies to do expand their market area.<br><br>■ **ICT usage facilitates cooperation.** SMEs need to cooperate, for example by building networks. ICT usage facilitates cooperation in many ways (e.g. through project management tools, or online collaboration tools for design).<br><br>■ **Affordable ICT solutions.** ICT vendors have developed more and better solutions which are targeted to the needs of SMEs in recent years, for example smaller-sized ERP and CRM software packages. Costs are no longer the main barrier.<br><br>■ **Support from large firms.** The economic impact of any communication technology depends critically on the number of users connected. Large companies therefore have a strong incentive to connect with their smaller trading partners in order to reap the full benefits of e-business. | ■ **Lack of ICT and e-business skills**. Smaller firms often lack a coherent ICT investment strategy or the related skills - partly because most SMEs cannot afford to employ ICT practitioners. ICT strategy and implementation critically depends on the respective skills of the management. The speed of developments in this field adds to the challenge.<br><br>■ **Complying with different ICT requirements**. Although large companies tend to be supportive (see "opportunities" in the column on the left), they can use their power to impose ICT standards and systems upon small supply companies. In B2B exchanges, small firms may therefore be forced to comply with different systems in parallel.<br><br>■ **Rising customer expectations**. In the internet era, customers increasingly expect to be offered a wide range of information and services online. It can be a challenge for smaller companies to meet these service levels. |

## e-Business adoption in Europe and the US

In 2007, the e-Business Survey included for the first time companies from outside the EU - companies from the US. The objective was to open up the analysis of ICT and e-business use to a wider international context. Information about differences between EU and US companies in e-business use may be insightful for companies and policy makers in the EU because the US is a benchmark for ICT and e-business use. However, while the US is a serious competitor on global markets, the principal competitors for industries included in the 2007/8 study period may also come from other countries, notably from Asia.

The e-Business Survey 2007 revealed that EU-7 companies in the five industries included in the survey generally use ICT and e-business less than their US counterparts. In order to compare ICT and e-business performance of EU and US companies on an aggregate level, average values were calculated for 16 indicators in the area of infrastructure, e-procurement, internal e-operations and e-sales.[4]

*Exhibit Ex-6: EU versus US firms in e-business use*




Figures indicate average values of four indicators each for infrastructure, e-procurement, internal e-operations and e-sales. The highest possible value for each domain is 100.

Source: e-Business Survey 2007

EU companies were found to lag 11 to 15 percentage points behind in terms of infrastructure, e-procurement and e-sales – see Exhibit Ex-6. The overall use of internal e-operations was found to be very similar in EU and US companies. This is mainly due to the larger level of ERP use in the EU-7.

This general trend of less ICT use in Europe, with similar internal e-operations, applies with small differences to all five industries studied. The European chemicals, rubber and plastics industry was found to have a considerably lower level of e-sales (42% versus 60%) but to perform much better than US firms in internal e-operations (38% versus 28%). The furniture industry was found to have a similar level of e-business use except a lower level in infrastructure (61% in the EU versus 78% in the US).

The lags may indicate higher potential for competitiveness, productivity and growth among US companies – to the extent that ICT actually determines these parameters in an industry or market segment. However, it is worth looking more closely at the competitive situation in the industries. For example, the European steel industry was found to lag the furthest behind. The average e-procurement indicator in the EU-7 steel industry was 27%. This is roughly half the US value of 52%. Nevertheless, according to the SeBW Advisory Board, European steel enterprises are more competitive than US ones. US steel firms are bound to tight shareholder value requirements which restrict their ability to invest in ICT. In particular, EU steel firms are better equipped with ICT in production facilities. Although this contributes to the companies' competitiveness, it is not monitored in detail in the e-Business Survey.

All in all, the sector studies indicate no clear competitive disadvantage caused by lower ICT and e-business use in EU companies in comparison with the US.

4. The following indicators were used: (1) ICT infrastructure: internet access, broadband internet access, W-LAN, remote access to company's computer network. (2) e-procurement: ordering electronically, ordering more than 50% of goods electronically, SCM, receiving e-invoices. (3) internal e-operations: ERP, CRM, RFID, CAM (retail and transport: warehouse management system). (4) e-sales: having a website, selling electronically, offering with e-catalogue (retail and transport: online advertising), sending e-invoices.

# Standards and interoperability are key to promoting e-business

According to the e-Business Survey 2007, EDI-based standards are still the most commonly used family of standards for electronic data exchange. Many large manufacturing and retail companies maintain EDI connections with business partners. Proprietary standards are also popular (CRP 31%, steel 22%, furniture 34%). Fewer than a quarter of the companies in each industry reported using standards based on extended mark-up language (XML) (CRP 16%, steel 22%, furniture 16%) and fewer still on other standards. In all industries, the use of standards was found to be much more prevalent in large companies than in SMEs. However, the actual deployment of standards may be higher than these figures indicate, as standards are often embedded in software.

## *ICT standards in the health sector: lack of widely used standards*

A special study carried out in 2008 by the Sectoral e-Business Watch on e-standards in the health sector found that there was a lack of widely used standards and problems of interoperability. Many of the conflicting standards are proprietary. There is also a lack of the "right" e-health standards. The health sector is in need of effective standards developed specifically for particular applications and concrete cases. For health service providers, this may imply that computerised systems remain stand-alone and unable to exchange data with each other in-house or externally. In particular, solutions for electronic health records are often isolated without data exchange and interoperability.

In November 2007, empirica conducted an online survey of e-health experts from the ICT industry, user organisations, public authorities, universities and research institutions, standards development organisations (SDOs), and consultants. 94 experts responded and the majority agreed that all seven e-health SDOs mentioned (ISO, CEN, IHTSDO, HL7, IHE, DICOM, openEHR) should be important in the future. Nearly all interviewees agreed that there is a lack of widely used e-health standards. They also believed that e-health standards are not sufficiently developed, that, they would benefit from more harmonisation, and that there are too many conflicting standards. Nearly three quarters of the respondents felt that within a single health service provider, the standards currently used are supportive. The majority found however that the situation was unsupportive for cross-border care provision. The respondents favoured a stronger involvement in e-health standardisation processes from many different organisations, including above all ICT user organisations and national governments, but also national competence centres, the EC and ICT industry. One of the barriers to adopting international e-health standards in hospitals is that hospital IT managers place internal process functionality as a higher priority than commonly used standards. The respondents also agreed that the managers have no financial incentive to exchange information electronically.

***Exhibit Ex-7: ICT standards adoption in industries covered by the e-Business Survey 2007***

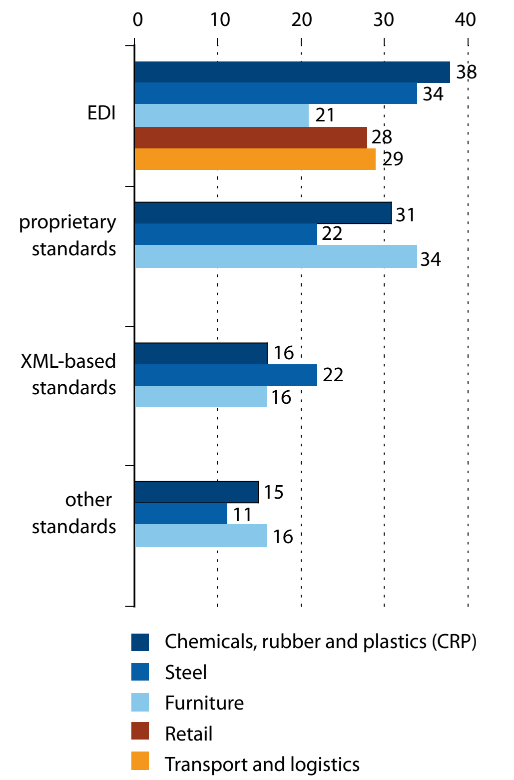



Exhibit includes data for 7 EU Member States (DE, FR, IT, ES, PL, SE, UK).

Base (100%) in manufacturing = companies with at least ten employees using software packages for internal operations.

N EU-7: Chemicals 811, Steel 349, Furniture 661. In service industries = companies of all size classes using software packages for internal operations. N EU-7: Retail 751, Transport and Logistics 475.

Figures are weighted by employment ("firms representing x% of employment in the sector / country".

Source: e-Business Survey 2007

## e-Business case studies

In 2007/8, the Sectoral e-Business Watch conducted a total of 89 case studies in 38 countries, of which 23 countries were in the European Union. 55 case studies relate to large companies and 34 to SMEs. The objective is to complement the quantitative picture of e-business adoption from the e-Business Survey 2007 and the econometric analyses. Case studies provide a very valuable source of evidence on a wide variety of e-business practices, benefits, challenges and impacts.

The majority of case studies clearly illustrate the benefits of e-business for companies. They demonstrate enhanced workflows, increases in productivity, cost reductions, service improvements, and increased numbers of customers. These benefits are closely related to the many reasons for implementing or enhancing a particular e-business solution. The overarching theme of the case studies is to sustain or expand business in a competitive environment. Many case studies also highlight barriers to implement or expand e-business solutions. Some focus on resistance from associate companies in a group, and others on the reluctance of employees to take on more responsibilities.

The case studies illustrate the benefits of e-business along the whole value chain. They cover procurement, in-house operations and co-operation with business partners, marketing, sales and distribution. Benefits include for example reduced costs, improved workflows, increased productivity and enhanced customer service. Regarding procurement, case studies demonstrate tangible cost saving opportunities. Internal systems such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) have the potential to improve the transparency of processes throughout the company's value chain. Case studies focus on interactions with customers, including transactions, but also support sales, marketing and distribution.

Some of the emerging themes that these studies highlighted include the increasing importance of intermediaries that carry out standardised and outsourced tasks, the importance of business models for e-business use, the provision of comprehensive e-solutions going beyond e-transactions, and the use of ICT to reduce energy consumption. Prevailing themes include the need to invest not only in ICT hard- and software but also in training and management changes, and examples of how to integrate SMEs into value systems.

### *Exemplary case studies*

| Company | Profile | Key issues and lessons learned |
|---|---|---|
| **BASF (Chemicals, Germany)** | One of the world's leading chemicals companies, 95,000 employees worldwide.<br>Product portfolio includes chemicals and chemical products, plastics, performance products and agricultural products. | ■ Demonstrates the pervasive importance of e-business for global operations of large players.<br>■ Focus is no longer on accomplishing transactions, but on providing business solutions ("e-solutions"): online information and service ("24/7").<br>■ Importance of leading companies as leverage to accelerate e-business adoption within their network of customers and suppliers. |
| **ArcelorMittal Gent (Steel, Belgium)** | Subsidiary of the world's leading steel company. 5,680 employees.<br>Production of flat carbon steel for automotive, construction and household appliances industries. | ■ Example of a web-based solution for electronically managing goods in warehouses dispersed across Europe<br>■ A simple e-solution can facilitate processes in case (small) business partners are not ready to invest heavily in ICT (e.g. Electronic Data Interchange). |
| **Webmobili, (Furniture, Italy)** | Spin-off from Federmobili, the Italian Association of Furniture Retailers, catering for the Italian market. 12 employees. | ■ Marketing and communication service for independent retailers and manufacturers: search engine for consumers about national furniture offers.<br>■ Huge effort in standardising product coding.<br>■ Important role of industry associations in supporting SMEs' visibility and market reach. |

# Policy implications of e-business

## *Rationale for political activity in the field of ICT and e-business*

The e-Business Watch derives its suggestions for policy actions from study findings and related analyses. A caveat should be made about the balance between industry policies and ICT policies. In some industries, the key competitive battles are not around ICT. Nevertheless, without improving productivity and customer service through e-business, companies in these industries may have serious problems beating or even keeping up with the competition. They therefore still need to foster effective use of ICT. All in all, there are solid arguments for policy makers to promote ICT and e-business adoption, but their policies should carefully consider the industry context and the specific role of ICT for competitiveness in different industries.

Three policy areas were identified as playing a particularly important role: ICT standardisation policy, ICT skills policy, and promoting industry value chains and SMEs. Policy makers should also pay special attention to the potential for ICT to reduce energy consumption and to the prospects offered by the EU's common markets. These issues are not new to the policy agenda and they are likely to remain important because they constitute essential and evolving issues.

## *Promoting the adoption of ICT standards*

The e-Business Survey 2007 found that the adoption of ICT standards is slow, leading to interoperability problems. However, the survey may underestimate the use of standards because the interviewees are not aware that certain standards are implemented in purchased software.

With regard to the steel industry, the EC could support projects to develop and implement the European Steel Industry Data Exchange Language (ESIDEL). ESIDEL is currently used by only a tiny share of European steel firms, but there is evidence about the standard's benefits. In the chemicals industry, the Chem eStandards developed by CIDX, the Chemical Industry Data Exchange, are widely used so that no particular efforts appear to be necessary to promote their use. In the furniture industry the majority of large firms rely on proprietary standards. Policy measures should now aim at fostering faster and wider implementation of standards both at sector and at cross-sector level.

In transport and logistics, public bodies might support the standardisation process by fostering co-operation between private companies involved in standards definition, seeking to ensure that the interests of SMEs are adequately considered. The banking industry can do more to implement SEPA, which implies important standardisation issues, as it requires substantial ICT investments. The EC could support cooperation between banks in ICT development projects to implement SEPA work processes. Interoperability is still a key barrier to Radio Frequency Identification (RFID) adoption. Policy makers should define a regulatory roadmap that goes beyond ten years, thus effectively supporting enterprises in safeguarding RFID investments.

As regards e-health standards, the EC and the Member States may be well advised to develop a common strategy and roadmap for e-health standards development. The collaboration initiative of ISO, CEN and HL7 which started in August 2007 should be strengthened. The large-scale pilots for patient summaries and e-prescribing that are starting in Member States should be extended to other key applications.

## *Promoting ICT skills*

The importance of ICT skills – i.e. professional skills, user skills and e-business skills – for the competitiveness and growth of the European economy has been confirmed in several high-level documents and initiatives of the European Commission. However, in the EC there are persistent concerns about the availability of ICT skills. The e-Business Watch studies of 2007/8 show consistently that successfully implementing ICT needs to go hand-in-hand with adapting related skills. The e-Business Survey 2007 found that large companies in particular are facing difficulties in filling vacancies for skilled ICT personnel. The e-Business Survey also found that e-business has an impact on skills requirements.

Developing e-skills has three principal facets: educating ICT professionals, educating ICT users, and providing adequate information about ICT and e-business to managers. e-Skills shortages are a horizontal issue which concerns practically all sectors. However, there may nevertheless be a need for industry-specific approaches. As regards ICT user skills, it may be helpful if university curricula of departments that do not primarily teach ICT subjects also include training elements about ICT. As regards management skills, information supply to SME managers may take place most effectively through industry-specific, tailor-made and personalised information channels such as industry associations.

## Fostering ICT value chains

The principal items of a company's value chain are procurement, production, marketing, sales, and distribution. Effective management of value chains is essential for competitive advantage. Findings from the SeBW 2007/8 show that a high proportion of companies use ICT and e-business to enhance their value chains, but the findings also show much scope for improvement. Barriers to adopting e-business are often related to hampered network effects: in all sectors of the e-Business Survey 2007, "suppliers and customers not being ready for e-business" was mentioned as the most important reason for not applying e-business more intensely.

The EC and Member States may launch or strengthen initiatives to facilitate e-business in industry supply chains. A sectoral focus facilitates the involvement of experts and associations with sectoral background and reputation. However, the most innovative policies will also recognise cross-sectoral aspects since smaller firms typically deal with customers from different industries. Activities to foster supply chains could pay particular attention to those supplier or customer industries which are important customers but which have a low level of e-business applications.

## Policy implications from special studies

Findings from the study of ICT and energy consumption suggest that it is worth promoting the diffusion of communication technologies regarding electricity intensity of production and productivity. The promotion of Energy Monitoring and Management Systems and energy consumer education would lead to a decrease in energy intensity of production.

Despite the fact that climate change and increasing energy prices are leading to a mentality change, policy-makers can still provide the right incentives by adapting the regulatory framework to reward and coordinate energy efficiency measures at EU level. An improved data basis for energy intensity is needed to be able to undertake further empirical econometric studies, both in terms of countries covered and disaggregation by capital input factors. EU-KLEMS and Eurostat data can be improved and disaggregated to study the relationship between ICT and energy consumption at industry level.

### *Summary of suggested policy action lines*

| | ICT standards adoption | ICT skills | ICT value systems |
|---|---|---|---|
| **Rationale** | Low level of ICT standards adoption, frequent use of proprietary standards<br>→ interoperability problems | Difficulties in filling vacancies for ICT professionals, lack of development of ICT user skills and e-business skills | Lack of readiness of suppliers and customers the most important reason for not applying e-business more intensely;<br>Large firms in particular report difficulties in convincing SMEs about e-business benefits |
| **Objectives** | Promoting industry-specific standards if they are not widely used but offer proven benefits | Develop, promote and implement a European e-competence framework and national e-skills strategies; support multi-stakeholder initiatives<br>Enhance distribution of e-business knowledge for managers | Support industry-specific e-business networks, particularly including SMEs |
| **Links with DG ENTR policy** | General standardisation policy<br>Europe INNOVA standardisation networks | European e-Skills Forum<br>Industry-specific e-skills projects | eBSN activities to promote SME best practices |

# The structure of this report

The report is structured in four main sections, reflecting the overall structure of the Sectoral e-Business Watch programme. In 2007/08, 10 ICT and e-business studies on specific sectors and applications were conducted. The main results of these studies are presented in summaries (of about 15 pages length each) in Parts 2 and 3 of the report. Part 1 is a synopsis of these studies, highlighting common trends in ICT adoption and e-business activity across sectors, an economic assessment of the impact of these developments, and the main implications arising for policy. Finally, Part 4 presents 18 short contributions from distinguished professionals and experts with whom the Sectoral e-Business Watch has been cooperating in 2007/08, notably through the various Advisory Boards (see list of members in Annex IV).

**Executive summary**

**PART 1**

**Synopsys of main results**

- Trends in ICT and e-business adoption (**2.1**)
- e-Business case studies (**2.2**)
- ICT, innovation and firm performance (**2.3**)
- Policy implications (**2.4**)

**PART 2**

**Summaries of 6 sector studies**

| 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 |
|---|---|---|---|---|---|
| Chemical, rubber, plastics | Steel | Furniture | Retail | Transport, logistics | Banking |

**PART 3**

**Summaries of 4 studies on specific ICT applications**

| 3.1 | 3.2 | 3.3 | 3.4 |
|---|---|---|---|
| RFID | IPR for ICT-SMEs | ICT and energy | ICT standards in health |

**PART 4**

**Contributions by invited authors**

- e-Business policy initiatives (**4.1**)
- Industry perspectives (**4.2**)
- Research perspectives (**4.1**)

**PART 5**

| Annex 1 | Annex 2 | Annex 3 | Annex 4 | Annex 5 |
|---|---|---|---|---|
| Glossary | Survey '07 | Econometric methodology | Activity report | Key concepts |

PART 1

# e-Business in 2008 – synopsis of main findings

## 1.1 Trends in ICT and e-business adoption

### 1.1.1 *ICT for supply chain integration and process efficiency*

THE DIGITISATION OF BUSINESS PROCESSES

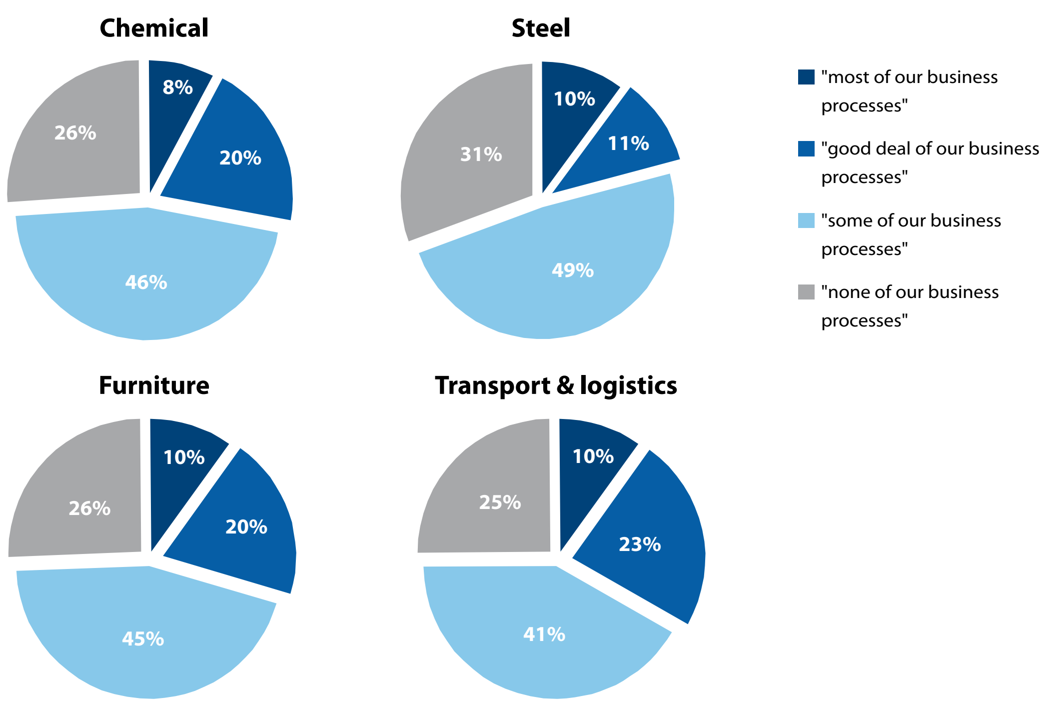
Improving the efficiency of supply chain processes is an important objective of companies in many sectors, including manufacturing, the retail industry and logistics. Depending on the segment and size of their operations, companies have chosen different approaches to building their supply chain, linking to suppliers such as raw material providers (upstream) and to customers, including those within the same sector as well as in other sectors. To realise supply chain efficiency gains, companies aim to automate processes as much as possible by use of ICT, which means replacing formerly paper-based document exchanges and their manual processing through electronic exchanges.

A simple, direct measurement of the degree to which a company has digitised its business processes is not possible. But companies can at least be asked to assess the share of their processes that are conducted electronically, and the results are surprisingly similar across different sectors (see Exhibit 1.1-1). In total, 20-35% of companies say that already "most" or a "good deal" of their processes are conducted electronically (these companies can be regarded as pioneers in e-business), and close to half of all companies say that at least "some" of their processes are. About a quarter of all companies in the sectors surveyed in 2007 apparently do not practice any e-business. The objective of replacing paper-based processes is relevant not just for exchanges between businesses (supply chain optimisation), but also for company-internal processes. Case studies show that many firms start digitisation by using a "mixed mode", i.e. using digital information from existing IT systems while keeping extensive paper files in parallel. However, this is often not a satisfactory solution, as it reduces the potential for savings.

ELECTRONIC INVOICING PAVES
THE WAY FOR E-BUSINESS

A good example of an activity where formerly paper-based processes can be digitised is invoicing. It is widely recognised that e-invoicing promises rather easy-to-achieve **cost savings** for both parties involved (i.e. the invoicing and receiving entity), because processing invoices in a standardised, electronic format can be accomplished much faster com-

***Exhibit 1.1-1: The digitisation of business processes: % of companies saying they conduct most / a good deal / some / none of their processes electronically (different sectors, 2007)***




Weighted by employment (read: «companies representing x% of employment in the sector say that …»).

Base: companies (in chemical, steel and furniture: with at least 10 employees) using computers

Source: e-Business Watch Survey (2007)

**Sector-specific trends in supply chain management**

*Meeting the challenges of downstream supply chain management is changing the character of trading in the* ***steel industry****. Intermediaries are becoming ever more important. A wide variety of business models has emerged for stockholding and customer service. Steel suppliers face a challenge as customers restrict their own stocks, either to minimise storage costs, or because of insufficient space. In this context, traders often hold stock for customers at warehouses and make deliveries just in time in response to demand - for which e-business applications are of great importance.*

*In the* ***furniture industry****, the complex supply chain involves separate activities that are increasingly organised in integrated production networks. Integration is key to speeding up processes and to allowing instant visibility into orders, shipments, and inventory status. Inter-enterprise integration, facilitated by SCM systems, is strongly related with and dependent upon the effective implementation of intra-enterprise integration (mainly supported by ERP systems).*

*In the* ***retail industry****, supply chain management is of utmost importance, as it can represent 40-70% of a retailer's operating costs (Accenture, 2004). The use of ICT-based systems for supply chain management increases the transparency of processes and information flows, which enables retailers to carry less stock without any impact on sales levels, thus reducing costs and increasing profitability. Furthermore, case studies show that relationships with suppliers can improve as a result of e-business.*

pared to the often cumbersome handling of printed invoices. The potential savings obviously depend on the number of invoices to be processed, and companies and sectors differ widely in this respect. In recent years, digitisation of e-invoicing has therefore attracted much attention not only within the business community, but also in e-business policy making. Regional and even cross-border initiatives to **promote adoption** have been launched in several countries, for example in Finland and Slovenia; furthermore, the European e-Business Support Network (eBSN) has e-invoicing as one of its priorities, in particular to solve cross-border problems.

There are **different technical ways** of delivering an invoice electronically, and different views on which of these ways actually constitutes an "e-invoice". Notably, there is disagreement whether an invoice sent as a **PDF document** (typically a scan from a paper invoice) by e-mail is an "e-invoice" - since the document is normally not machine-readable, and data therefore have to be keyed in manually into the receiver's system. In other words, it is only sent electronically, but not processed electronically, and savings are therefore significantly reduced. "Real" e-invoicing can be accomplished either in a **web-based** environment, or through processes integrated with the **ERP system** of a company. ERP-based systems (which are used in B2B exchanges) promise the highest cost-saving potential for companies.

The survey results confirm the **dynamic adoption** of e-invoicing in the past few years, including the more advanced forms. In the three manufacturing sectors surveyed, firms representing 20-30% of employment said that they send e-invoices directly from their computer system, and 15-20% said they were capable of receiving invoices in this way (2007). This most advanced form of e-invoicing is still a domain of the larger firms. It can be expected, though, that the large companies will make substantial efforts to eliminate paper-based invoices as much as possible. This requires that their SME trading partners are capable of sending / receiving invoices electronically, and, in fact, they are exerting pressure on smaller companies to support this move, as concrete business examples demonstrate. Sending invoices as PDF documents by e-mail is still the most common practice. 40-50% of companies (by employment) said that they sent some of their invoices this way, and about the same share of firms (both in the EU and the USA) said they receive PDF invoices. This method is sometimes called "the e-invoice of the small company".

INCREASED USE OF ADVANCED ICT SYSTEMS

In e-invoicing as well as in other processes, data that are exchanged between businesses should ideally be **machine-to-machine readable**, that is they go directly into a company's ICT system without having to be re-keyed into the system manually. Important ICT software systems in this context are ERP (enterprise resource planning) and SCM (supply chain management). Enterprise Resource Planning (**ERP**) systems are software systems that help to integrate and cover all major business activities within a company, including product planning, parts purchasing, inventory management, order tracking, human resources, projects management, and finance. Ideally, they link business processes electronically across different business functions and thus help to improve efficiency of operations. In addition, ERP systems can play an important role in supporting connectivity between enterprises. For manufacturing companies, ERP systems are an important "hub" for much of their e-business activities with other companies. Supply chain management (**SCM**) software help companies to match supply and demand through integrated and collaborative interaction tools. SCM provides an oversight of the flows of products/materials, information and finances, as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer.

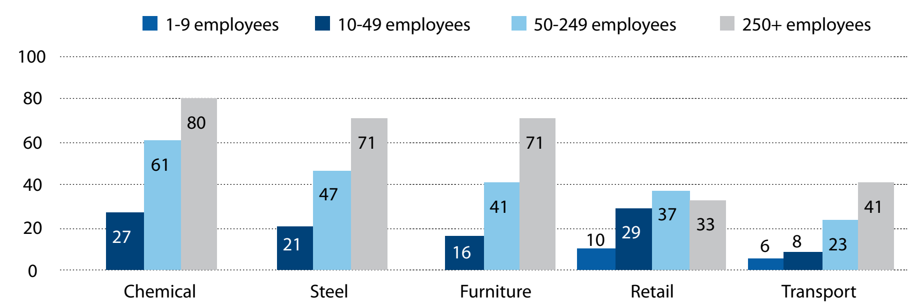
The use of ERP systems is common (if not a "must have") among large companies in most manufacturing sectors; typically, more than 70% of large manufacturing companies have an ERP system (see Exhibit 1.1-2). The deployment of ERP systems has significantly increased in the past few years. For the chemical industry, the Sectoral e-Business Watch finds that ERP adoption has almost doubled among small enterprises from 2003 to 2007 and increased by about 20 percentage points in medium-sized and large firms. The implementation of an ERP system is a complex venture and critical milestone for any company. It inevitably requires a critical review of existing business processes and the introduction of necessary changes. Thus, ERP implementation is closely linked with process innovation and possibly organisational changes, as many of the case studies conducted demonstrate.

### *1.1.2 Online procurement*

Efficient management of procurement is a fundamental activity in many sectors, notably in manufacturing, and here particularly in sectors where upstream supply chains are complex and fragmented. Procurement covers the purchase of direct supply goods (e.g. raw materials or parts of a product which a company produces) and MRO goods (maintenance, repair, and operating supplies, which includes office supplies and machinery). The larger the number of transactions, the more that improvements –even slight– save costs in this domain. **Online procurement** can be carried out simply by placing orders via a supplier's website, which is often a first step towards a more comprehensive use of ICT in business processes. In more sophisticated processes, the systems of the purchasing and the supplying company are integrated.

Many large companies operate their own electronic sourcing platforms to streamline procurement processes and reduce costs; potential suppliers may have to register on the platforms and strictly comply with the procedures. For very large compa-

***Exhibit 1.1-2: % of companies with an ERP system (by sector and size, 2007)***

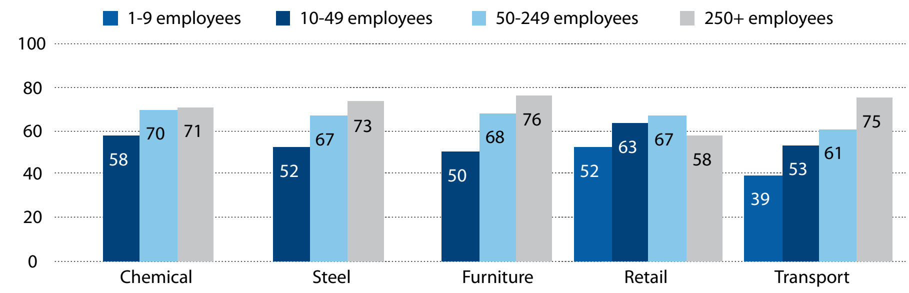



Base (100%) = companies using computers from 7 EU countries.

N = 811 (chemical) / 349 (steel) / 661 (furniture) / 1026 (retail) / 997 (transport)

Source: e-Business Surveys 2007

***Exhibit 1.1-3: % of companies ordering supply goods / services online (by sector and size, 2007)***




Base (100%) = companies using computers from 7 EU countries.

N = 811 (chemical) / 349 (steel) / 661 (furniture) / 1026 (retail) / 997 (transport)

Source: e-Business Surveys 2007

nies, such e-procurement strategies can amount to savings of two-digit millions of euros within eighteen months (see sector study on the steel industry, Section 2.2). In all sectors studied, about 60-70% of the companies ordered at least some of their supplies online in 2007 (see Exhibit 1.1-3). For the chemical and the retail industry, a comparison with an earlier survey of 2003 shows that the figure has significantly increased. Furthermore, survey results indicate that the intensity of e-procurement activity has increased: the average percentage of supply goods ordered online (as % of total supplies) is higher, according to the companies' estimates. In the chemical industry, for instance, the average share of supplies procured electronically increased from about 5% in 2003 to 12% in 2007.

### 1.1.3 ICT for marketing, e-commerce and customer service

#### THE PROFOUND IMPACT OF THE INTERNET ON BUSINESS MODELS

ICT, and in particular the internet, tend to have a profound impact on marketing activities, including the way companies communicate with customers, in how they offer and sell their products and provide related services. In some sectors, the approach towards e-commerce has become a critical factor determining a company's **business model** (e.g. in retail and banking).

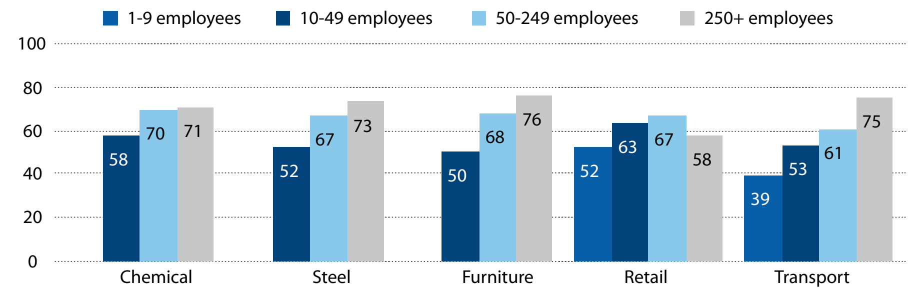
In the **retail industry**, the rise of the internet has changed the shopping behaviour and expectations of consumers. Retailers have adopted different business models in response. Pure online retailers are still the exception, and concentrated in specific segments such as electronics or media. Many smaller retailers use the internet to extend their sales beyond the regional focus to national markets. Cross-border e-commerce is not yet common; 97% of the retailers offering e-commerce say that online orders are "mainly from regional or national customers" (see Section 2.4).

In the **passenger transport** sector, "e-commerce" is mainly associated with offering electronic ticketing services. e-Ticketing enables companies to reduce administrative costs while improving service levels. In the scheduled passenger transport sector in particular (whether by rail or bus), buying tickets in advance on the internet becomes increasingly popular among travellers. In the **freight transport and logistics** sector, e-commerce basically means enabling customers to initiate, track, and acknowledge shipments online. Providing such services requires integrated supply-chain processes and their automation, based on sophisticated specific ICT solutions. Large logistics companies are highly advanced users of ICT (see Section 2.5).

In the **chemical industry**, the increasing importance of e-business applications for providing optimal customer service is one of the main trends found in the study. Companies use the web as a cost-efficient channel for information provision; these can be extranets where customers can log in and have access to a wide range of order-related information, for example about the order status and about products they have purchased. Enabling client access to such up-to-date information can have a wider impact on work and production processes in a company (see Section 2.1).

In **banking**, ICT and the internet have had a profound impact on banks' interaction with their customers

*Exhibit 1.1-4: % of companies enabling customers to order goods / services online*

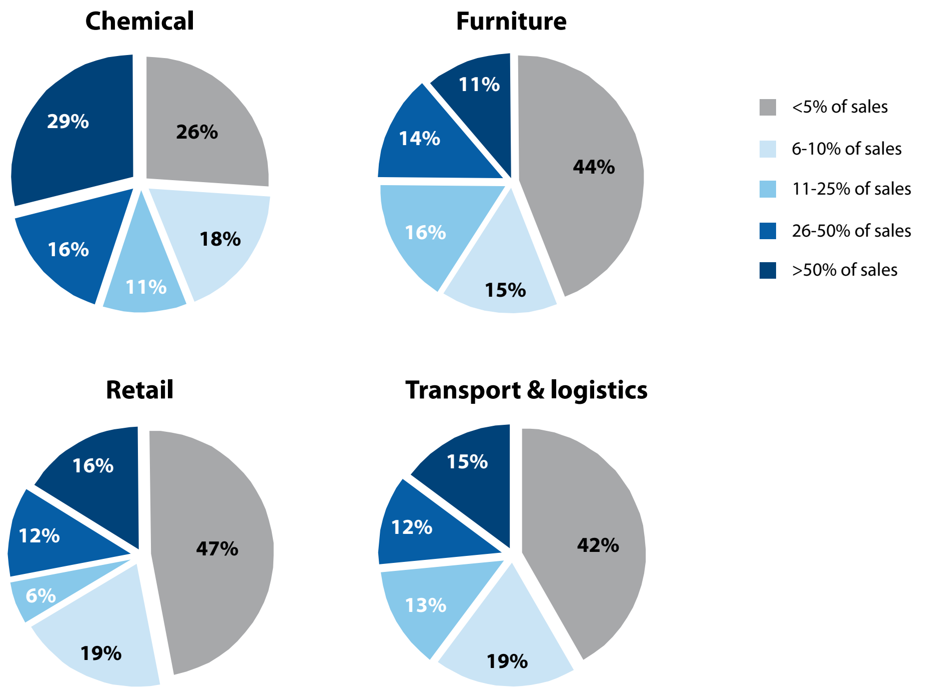



Base (100%) = companies using computers from 7 EU countries.

N = 811 (chemical) / 349 (steel) / 661 (furniture) / 1026 (retail) / 997 (transport)

Source: e-Business Surveys 2007

*Exhibit 1.1-5 : e-Commerce intensity: % of companies estimating that they receive … % of their orders online (by sector, 2007)*




Weighted by employment (read: «companies representing x% of employment in the sector say that …»).

Base: companies (in chemical and furniture: with at least 10 employees) receiving orders from customers online

and triggered a branch renewal process. The internet and mobile terminals, along with ATM and payment card networks, have made it possible to reduce the number of bank branches. Different business models have emerged, including internet-only banks and a dual-banking model, covering both e-banking and branch banks. In this model, traditional manual banking services can now be performed online while the more sophisticated banking services are still performed in the branch bank. The internet-only banks, despite a lower cost structure than branch banks, are faced with challenges in terms of customer confidence (see Section 2.6).

## INCREASE IN E-COMMERCE

In most sectors, about a third of all companies enabled customers to order their products or services online in 2007 (see Exhibit 1.1-4). This can be accomplished through different technical channels, including the company's own website, third party trading platforms on the internet (such as eBay), through extranets, and via EDI connections. Their respective importance differs between sectors, depending for instance on the nature of goods traded and on the trading partners involved (B2B or B2C e-commerce).

As for e-procurement, a comparison with earlier survey results (of 2003) shows that e-commerce activity has significantly increased. Not only have more companies started to offer their products and services online, but the average share of orders that are actually received online has also increased. Back in 2003, many of the companies that sold online said that online sales accounted for only a marginal proportion of their total sales, typically up to 5%. The significance of e-commerce has increased since (see Exhibit 1.1-5). Patterns are comparable across different sectors; in the chemical industry, the average share of sales stemming from e-commerce appears to be highest among the sectors studied. A simple computation of the companies' estimates suggests that online orders account for 15-30% of total sales (by those companies that actually sell online) in these sectors in 2007. Counting all companies, including those that do not accept orders online, the total share of e-commerce (as % of total sales) can be estimated at about 5-10% in the sectors shown in Exhibit 1.1-5.

### CUSTOMER REQUIREMENTS AS A KEY DRIVER OF E-BUSINESS ADOPTION

The dynamic increase in e-commerce activity is in part a response to rising customer requirements. In a market environment which is characterised by intense international competition for many companies, the rivalry in the market and the negotiation power of customers will also increase. In turn, companies can be expected to be more attentive and responsive to their customers' requirements. In B2B oriented sectors, a typical situation is that large buyers aim at improving their supply chain processes and, to this end, urge their suppliers that they must comply with their own data exchange formats and processes. Many customers in a wide range of business fields expect that the products or services they are interested in are available online, including consumer goods, financial services, tickets for download, or supplies they need for their business. This drives e-commerce uptake. Many companies have confirmed in the survey that they have experienced pressure from customers to adapt their ICT solutions or data exchange formats (in most sectors 40-50% of companies), and most of them have met their customers' requests.

## 1.2 e-Business case studies – the overall picture

**Key messages**

***89 case studies illustrate e-business issues:*** *In 2007/8, the Sectoral e-Business Watch conducted altogether 89 case studies from 38 countries. 55 case studies are about large companies, 34 about SMEs. They document the experience of firms on a wide variety of e-business practices, benefits, challenges and impacts.*

***Drivers and barriers:*** *The case studies illustrate a variety of driving forces behind e-business investment, all related to sustain or expand business operations in a competitive environment. They also provide evidence on barriers to the use of e-business, such as employee resistance and consumer reservations.*

***e-Business offers benefits along the value chain:*** *The case studies illustrate the benefits of e-business along the whole value chain. They address procurement, in-house operations and co-operation with business partners, marketing, sales and distribution. Benefits include reduced costs, improved workflows, increased productivity and enhanced customer service.*

***Emerging and prevailing themes:*** *The case studies highlight several emerging themes. Intermediaries that fulfil standardised and outsourced tasks are increasingly important. The same is true of business models for e-business use, the provision of comprehensive e-solutions going beyond e-transactions, and ICT use to reduce energy consumption. Prevailing themes include the need to invest not only in ICT hard- and software but also in training and management changes. This is necessary to deal with strategic problems such as how to integrate SMEs into value systems.*

### *1.2.1 Introduction to case studies conducted in 2007/8*

#### OVERVIEW OF CASE STUDIES AND THEIR OBJECTIVES

In 2007 and 2008, the Sectoral e-Business Watch collected 89 case studies. These studies included examples from all sectors and topics covered in the e-Business Watch Survey. They looked into the work of firms in nearly all EU Member States, as well as from other European countries and other continents. Case studies are examples of real-life e-business activity. They were included to complement the quantitative picture of e-business adoption from the e-Business Survey 2007 and the econometric analyses. They also illustrate the kind of impact e-business activity can have on enterprises. Case studies are based on personal interviews with company representatives and on desk research. The cases are published in the ten studies of 2007/8 and on the e-Business Watch website. This section presents a synopsis of the main results.

#### SELECTION OF CASE STUDIES

Cases were selected mainly on the basis of their relevance to the e-business issues analysed in the ten studies. They were picked to validate, illustrate and contextualise the study's assessment and findings. Different types of cases were included:

- **Matching key topics:** Primarily, the selection of case studies reflected the main issues of a study.
- **Good practice:** Some cases are considered to represent good e-business practice within their respective industry sector. Sometimes, however, insightful examples of failed e-business investment were chosen.
- **Innovative approach:** Some cases represent innovative approaches and methods of e-business, particularly where some insight is offered into future developments in the sector.
- **Typical example:** Some cases represent typical e-business activity in the respective sector.
- **SME dimension:** A number of cases focused on SMEs, as the Sectoral e-Business Watch also considers the implications of ICT for smaller companies.

*Exhibit 1.2-1: e-Business case studies conducted in 2007/8 by industry and size class*

| Sector / topic | Case studies of firms with up to 250 employees | Case studies of large companies (250+ employees) |
|---|---|---|
| **Chemicals, rubber and plastics** | OB10 (UK), Elemica (US), Medikémia (Hungary), Unicorn (UK) Zandleven (Netherlands) | Acordis (UK), BASF (Germany), Michelin Reifenwerke (Germany), Probos (Portugal), Toly Products (Malta), Zachem (Poland) |
| **Steel** | Patina foundry (HU) | Arcelor-Mittal Gent (Belgium), Baosteel (China), CMC Coil Steels (Australia), Corus IJmuiden (Netherlands), e-Arbed.com (Luxembourg), Farwest Steel (US), Srem (Poland), Tenaris (Italy), Thyssen-Krupp (Germany) |
| **Furniture** | RobinWood (Austria), Web mobile (Italy), Iwofurn (Germany), Homebase (Denmark), Quatuor (Belgium), Micuna (Spain), Stokke (Norway) | Scavolini (Italy) Profim (Poland) Danona (Spain) |
| **Retail** | AMJG (Portugal), 4Fitness (Germany), Fleria (Greece), Smart Supermarket (Malta), Cyprus-PC.com (Cyprus) | Mercator (Slovenia), Globus (Germany), Brookland (Netherlands), Casino (France), EMPiK (Poland) |
| **Transport and logistics services** | AIT (France) Cammack & Son (UK) Trafikanten (Norway) Varmlandstrafik (Sweden) | SNCF Fret (France), GEODIS (Belgium), Hupac (Switzerland), Cemat (Italy), CFR Calatori (Romania), ALSA (Spain), Saima (Italy), AISA (Spain) |
| **Banking** | ICA Banken (Sweden), Skandiabanken (Norway) | Hansabank (Estonia), Tapiola Bank (Finland), National Irish Bank (Ireland), Nova Ljubljanska Banka (Slovenia), Egg (UK), Eurobank EFG (Greece), Glitnir Bank (Iceland), Soc. Générale (France) |
| **RFID** | Euro Pool System Benelux (France) | Metro Group (Germany) Hewlett Packard (Brazil) Hong Kong Airport (Hong Kong) Land Rover (UK), Istituto dei Tumori (Italy), Futura Systems (Spain) New Look (UK), Schuitema (Netherlands), Fakultní nemocnice v Motole (Czech Rep.) |
| **Intellectual property rights** | Imatix Benelux (Belgium), Eurotech (Italy), Vierling (Germany), Net insight (Sweden) Sensitive Objects (France), Array Technologies (Denmark), Fluendo (Spain), DXO Labs (France), Comsys Mobile (Israel) | |
| **ICT & energy saving** | | Jacob Fruit Field (Ireland), Coop (Switzerland), Eregli (Turkey) |
| **Drivers and impacts of ICT** | | Zabka (Poland), Dan Steel AS (Denmark), Financial Service Provider (Switzerland), Forte Furniture Factories (Poland), FAT meble / Mebin (Poland) |

All case studies include sections about the lessons learned and the impacts of ICT and e-business. These sections were intended to be the most important elements of the case studies.

### DISTRIBUTION OF CASE STUDIES BY FIRM SIZE AND COUNTRIES

Of the 89 case studies conducted in 2007/8, 34 (or just over a third) of them cover e-business initiatives of small and medium-sized firms with up to 250 employees. The remaining 55 examine activities of larger firms – see Exhibit 1.2-1. The SME case studies break down into two studies (or 2% of all case studies) on micro firms, 15 (or 17%) on small firms, and 17 (or 19%) on medium-sized firms.

The case studies were chosen to cover EU Member States and other European countries. The majority were conducted in Germany, France, Italy, Spain, the UK and Poland, countries covered by the Sectoral e-Business Watch survey. These case studies were focused so as to reflect the economic importance of the larger European countries. The chapter also includes case studies from countries that the survey did not cover, balancing 45 case studies from countries covered by the survey with 46 case studies from countries that were not.

Each study sets out to identify exemplary business evidence from several countries. No country was meant to be represented more than twice per study. In order to reflect increasing globalisation of production processes, some case studies refer to companies in other continents. Altogether, 89 case studies from 38 countries were collected. They include 74 cases (83%) from the 27 EU Member States, eight (9%) from other European countries, three (3%) from each the Americas and Asia, and one (1%) from Australia.

### METHODOLOGICAL ISSUES

The systematic collection of these case studies again proved an **indispensable source of information** for the Sectoral e-Business Watch. The studies help to better understand, substantiate and contextualise results from the surveys and the econometric analyses. Some of the lessons learned may be of interest to companies carrying out similar initiatives. Broader issues such as the need for change management and user involvement in the course of e-business implementation go beyond specific experiences and can be taken as general recommendations.

Although case studies clearly highlight the benefits of ICT investments, it was not always possible to assess their outcome in terms of **quantitative figures**. The

***Exhibit 1.2-2: Numbers of SeBW case studies 2007/8 by country***

| European Union | # | EU (continued) | # | Other Europe | # |
|---|---|---|---|---|---|
| Germany | 8 | Ireland | 2 | Norway | 3 |
| France | 7 | Malta | 2 | Switzerland | 3 |
| Italy | 7 | Portugal | 2 | Turkey | 1 |
| Poland | 7 | Slovenia | 2 | Iceland | 1 |
| Spain | 6 | Austria | 1 | America | |
| United Kingdom | 6 | Cyprus | 1 | USA | 2 |
| Netherlands | 4 | Czech Republic | 1 | Brazil | 1 |
| Belgium | 4 | Estonia | 1 | Asia | |
| Denmark | 3 | Finland | 1 | Israel | 1 |
| Sweden | 3 | Luxembourg | 1 | Hong Kong | 1 |
| Greece | 2 | Romania | 1 | China | 1 |
| Hungary | 2 | | | Australia | 1 |
| | | | | Total | 89 |

studies do not express the "% increase in sales" or the "costs saved in % of total costs". For several reasons, many companies cannot – or do not want to – provide such figures. When ICT systems have recently been implemented, it may be too early for a valid assessment of the quantitative impact. There are also causality issues, since output changes may be attributed to several factors, including changes in the market environment.

### 1.2.2 Synopsis of key findings

E-BUSINESS: DRIVERS AND BARRIERS

Most case studies illustrate the benefits of e-business for companies. They show how ICT can enhance workflows, increase productivity, reduce costs, improve service, and reach new customers. The manner in which ICT benefits a company is closely related to the reason the company wants to implement or enhance e-business solutions. In the vast majority of case studies, the motivation is to sustain or expand business in a competitive environment. This may involve meeting the requirements from customers, as has been the case with **Tenaris** in the steel industry and **Profim** in the furniture retail sector. It may be used to relieve pressure from competitors. There may be a strategic gain in business growth and increasing market shares, as was the case with **Baosteel.** There may also be a need to integrate suppliers into the value chain as occurred with **ArcelorMittal Gent**, a steel industry, representative and **Webmobili**, that sells furniture. Investments in new e-business applications may be absolutely necessary in situations that require process integration, such as rapid growth, mergers (as has been the case for **National Irish Bank**) or acquisition of other companies (as for **DanSteel**). Government regulation has played little or no role as a driving force towards e-business.

Many case studies also highlight barriers to implementing or expanding e-business solutions. There may be resistance from other companies in a group. This happened to **ThyssenKrupp** in the steel industry. Its partners believed there was no need for e-business. In some cases, like that of **Eurobank,** the resistance came from employees who were initially reluctant to use the new system. In other cases - such as the **Srem** steel foundry - customers did not want to take on more responsibilities. In retail companies difficulties arise in reaching customers through e-sales systems because of concerns over security. Many customers are also inclined towards the traditional shopping culture and lack affinity to using computers and the internet. **Empik** in Poland and **Fleria** in Greece offer good examples of this and suggest how such difficulties may occur on a European scale.

More details on the benefits, drivers and barriers to investment in ICT and e-business will be elaborated in the following chapter. The studies will also look at the companies' value chain functions. The examples mentioned are a selection of the most insightful case studies.

VALUE CHAIN SOLUTIONS

Many case studies conducted for the topic report on Radio-Frequency Identification (RFID) systems present solutions that improve the entire value chain of a company. They were found to boost productivity and improve business intelligence capabilities. The improvements took place within a relatively short timeframe, in comparison for instance with ERP adoption. While being an innovative solution itself, RFID triggered further innovation in processes, products and services as well as business models.

The **Metro** Group in Germany implemented RFID across its supply chain operations and retail functions. By doing so, the Group increased process efficiencies, reduced losses of goods, enhanced customer service and optimised space planning for shops and warehouses. **Hewlett-Packard** printer operations in Brazil implemented an RFID solution for the whole supply chain, spanning manufacturing, distribution, repair, reverse logistics, and recycling. The main benefits of the system include greater visibility and automation of manufacturing and supply chain processes. Production cycle times were reduced by 20-25% and inventory amounts by 28%.

E-PROCUREMENT

The first element in a company's value chain is procurement. **ThyssenKrupp**, a German company working in the steel sector, has demonstrated tangible cost savings opportunities from electronic procurement. Within one and a half years of implementing an online sourcing platform, the company saved over €10 million with reduced procurement prices and automated processes. A large part of the savings came simply from avoiding the manual transcription of incoming offers into the company's computer system. The procurement unit of the company learned that the process *"also works electronically, it works even better, quicker and at lower cost, and it works with all types of goods"*.

**Globus**, a retail company in Germany, implemented an e-procurement system which has streamlined the entire process of procuring indirect goods. The system has enabled the firm to procure strategically by pooling demands of single departments within the various stores and setting up framework contracts with preferred suppliers. In order to achieve this, the company had to re-organise its business processes and secure the full support of its management and end-users.

### IN-HOUSE E-OPERATIONS

A large variety of internal systems exist within companies, including most importantly systems for Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Customer Relationship Management (CRM). A great variety of case studies dealt with such internal systems. The actions of **Toly Products**, a chemicals company with 400 employees, illustrate how business processes can be integrated by standardising information flows, in this case via CRM. ICT has the potential to improve the transparency of processes throughout the company's value chain, from order to delivery. It shows how reformed internal processes improve the service provided to customers, for instance, by effectively processing customer complaints. It also illustrates the potential of e-business for medium-sized companies with international operations.

**Profim**, a company in Poland operating in the furniture sector, replaced a fragmented ICT system by an ERP system to customise production and make logistics more efficient. The new system had a significant impact on the company's production volume, logistics and relationships with clients. It led to shorter delivery times, lower costs, and less overstocking. Due to implemented Customer Relationship Management modules, customer service has also improved with the new system.

At **Eurobank**, introducing ICT-based business process management has allowed the bank to cut costs. Efficiency has risen and routine tasks have been automated. ICT was used to ensure a smooth merger between the **National Irish Bank** and the Danske Bank. Moreover, ICT is indispensable to the cross-border cooperation of the two banks. The savings from synergy effect are estimated at €45 million in the first two years.

The Fondazione IRCCS **Istituto Nazionale dei Tumori** in Milan implemented RFID at its blood bank. Its experience may offer a good model for other hospitals. The RFID system eliminated transfusion errors completely, improved the traceability of vital transfusions, and therefore increased patient safety, saved the time usually spent on tracking blood bags, and enhanced compliance with auditing processes.

### CUSTOMER-FACING ACTIVITIES: SALES, MARKETING AND DISTRIBUTION

Case studies about customer-facing activities focused on more than electronic sales. In addition to transactions, support sales, marketing and distribution, there are numerous e-business applications that deal with sales. The case of **Danona,** a furniture manufacturer in Spain, describes how the company uses a Computer Aided Design system that generates three-dimensional models of products, designed individually for each customer at the point of sale. The system improved customer service and satisfaction, reduced delivery times and is also a successful marketing tool for Danona's sales representatives. At the **National Irish Bank**, updated ICT systems provided new services for the Irish market. They digitised routine tasks that can now be performed directly by customers, saving costs.

The case studies from the retail and banking sectors are particularly valuable illustrations of the co-existence of non-electronic and electronic channels. The banking industry continues to combine "the best of both worlds", marrying financial advice and competitive interest rates from low cost online banking with high-value services in branches. For example, the **Tapiola** bank uses ICT to offer electronic services at a competitive price. The bank combines its branch infrastructure with e-banking. Similar achievements are observed in the retail sector. **Empik**, the largest bookseller in Poland, implemented an e-sales solution that, in addition to selling books online, helped the company to realise and understand market developments. e-Commerce now provides the firm with extended information about its customers gathered from e-mail correspondence and messages left on the company's website. Empik provides an innovative example of combining business in traditional bricks-and-mortar retail outlets with electronic channels. Its shops are equipped with info-points from which customers can access the company's e-sales functions.

**ALSA**, a Spanish road passenger transport company, implemented an online ticketing system, allowing customers to purchase tickets via the internet and mobile phones. The new sales channels increased customer satisfaction, fostered intelligent bus seat management, generated cost advantages and globally increased the competitiveness of the company.

Regarding distribution, **ArcelorMittal Gent** provides an example of a web-based solution for electronically managing goods in warehouses dispersed over Europe. The new system provides an overview of goods to be shipped to warehouses, in store at warehouses, and to be shipped to customers. It is used by Arcelor-Mittal, its warehouses, and its customers. Another example of the benefits e-business can offer to distribution and logistics can be seen in **Brookland**, a retailer in the Netherlands. The company uses supply chain management software since 1995 to support its warehouse and distribution processes. By doing so, it gains logistics productivity and reduces its supply chain management costs.

### 1.2.3 Prevailing and emerging themes of e-business use and impacts

#### OVERVIEW OF THEMES

In addition to describing the benefits and challenges of e-business along the value chain, the case studies also reveal a number of prevailing and emerging themes in the use and impacts of e-business. New themes include:

- a shift from e-transactions to e-solutions in e-business operations,
- standardised operations are increasingly outsourced to intermediaries,
- new uses of ICT and e-business that reflect particular business models,
- the use of ICT to reduce energy consumption.

Furthermore, there are themes that have already been important in the past and will remain important in the future. They include e-skills and promoting e-business in SMEs (see Section 1.4 about policy implications). These emerging and prevailing themes will be elaborated along with their corresponding case studies in the following chapter.

#### FROM E-TRANSACTIONS TO E-SOLUTIONS

Advanced concepts of e-business are no longer focused on accomplishing transactions in the narrow sense. They now aim to provide their customers with integrated business solutions that will facilitate and enhance trade. These include services such as enhanced access to order-related information, for example, on the products or on the status of an order. **BASF**, a leading chemical company in Germany, is a pioneer of this e-business approach and has coined the term "e-solutions" to describe it. BASF argues that e-business is all about "business solutions" rather than IT solutions. The company therefore uses a multi-channel approach consisting of different e-solutions. A central element in this concept is "WorldAccount", a globally integrated extranet platform for sellers and buyers based on the latest XML technology. WorldAccount handles more than 60% of BASF's e-business.

**Corus Ijmuiden**, a Dutch company in the steel sector, provides a similar example. The company implemented a solution named YMOnline that allows customers to monitor their orders around the clock. Corus does not use the platform to sell products. The company and its customers appreciate the solution uniquely because it reduces the need for time-consuming phone calls, faxes and paper mail. The furniture company **Home Base** implemented a Windows™-based ICT solution that allows to efficiently manage information flows with customers, suppliers (representing some 700 contractors), warehouses and logistic contractors. Communication is based on Extended Mark-up Language (XML) to ensure interoperability between different applications.

#### THE INCREASING IMPORTANCE OF INTERMEDIARIES

Several case studies illustrate the critical role of "e-intermediaries", companies that provide e-business services between suppliers and customers. These players are typically involved in invoices. Instead of processing invoices from suppliers within the company, the task is passed on to a specialised external intermediary, processing the invoices electronically and saving costs. Financial services are often particularly well suited to outsourcing tasks to intermediaries because they can relatively easily be standardised. The case study about **Acordis and OB10** in the chemicals industry offers an example of the opportunities of outsourcing specific business processes to an intermediary by using ICT. The company found that its invoicing was particularly well suited to being outsourced to specialised service providers. However, there may be downsides for suppliers if their customers work with different intermediaries. Another example is the case study about **Stokke**, a Norwegian company in the furniture sector, which adopted an e-business strategy towards sourced warehousing and logistics. In the furniture sector, warehousing and logistic operations are typically outsourced to specialised intermediaries.

Intermediaries may take the role of "B2B connectivity hubs". The Single European Payment Area may in due course play an important role in these developments by triggering massive outsourcing of commodity products and services such as money transfers.[5]

### BUSINESS MODELS DETERMINE THE ROLE OF ICT

Several case studies show that the company's business model determines the role ICT can play within it. This role will depend on factors such as whether the company sells customised products or commodities, whether it sells on local, national or global markets, and whether it focuses on B2B or B2C sales operations. Business models, in turn, are driven by market developments and competitive demands. In the furniture industry, for example, companies currently tend to concentrate their ICT investments in design and production. Even large furniture firms tend to adopt a step-by-step approach. For instance, they automate one business area after the other.

**BASF** is a good example of the pervasive importance of e-business for the global operations of large industry players. The company uses a multi-channel approach to sell its goods. Because of the customer expectations this is raising, SMEs will gradually be forced to adapt their way of doing business accordingly. In this respect leading companies lever the adoption of e-business in their sector.

**Zabka**, a Polish retail company, combines the convenience of small neighbourhood stores with the scale effects of a large chain. Its business model is based on franchising and combining information flows between a large network of small stores and a distribution centre. ICT-based innovative supply chain management gives Zabka a competitive advantage. This case shows that new business models can alter even highly competitive markets such as retailing.

After being acquired by a new owner, **DanSteel** (Denmark) had to restructure production, shifting its business model from in-house operations to outsourcing and networking. In order to effectively realise the new business model, DanSteel invested in an off-the-shelf supply chain management system, the Steel Planner. The system provides complex control of all the processes along the supply chain allowing increased efficiency at reduced costs.

The case of **Medikémia**, a chemicals company in Hungary, illustrates the close links between a company's distribution strategy (and the preferences of the various customer segments) and its use of e-business. Medikémia maintains EDI (Electronic Data Interchange) connections with almost all its multinational retailers located in Hungary, such as Metro or Tesco. It does so because these retail chains tend to prefer using web-based EDI for exchanging data with their suppliers, in particular to keep track of their stock. The company says that EDI has proven much more efficient and time-saving than any other data exchange system the company has used so far. Medikémia notes that, in contrast to the retail chains, its wholesale trading partners prefer to make their orders by telephone rather than using EDI or other e-business tools.

The case studies for the report about intellectual property rights (IPRs) for ICT-producing SMEs highlight the importance of business models from a different angle. The use of IPR depends largely on the companies' business models. Four types of business models were identified: business start-ups based on IPR, new technology-based firms based on IPR, companies relying on open innovation or open source software, and companies basing their innovation and IPR protection activities on co-operation with other companies. For instance, **Sensitive Object**, a start-up in France, holds an IPR portfolio that includes patent applications and trademarks. IPR have been the basis for its venture capital funding and all its revenues come from protected applications. The com-

5. See the contribution from Barry O'Mahoney in Section 4.2.8 of this report.

pany uses IPR to ensure a return for investors and provide security in using the products.

### ICT USE FOR REDUCING ENERGY CONSUMPTION

Several case studies were conducted for a special report about the use of ICT to reduce energy consumption. This is a fairly new theme on the agendas of companies, and of the European Commission and Member States. The case studies highlight the benefits of energy management systems which are partly based on ICT. These systems provide information on energy consumption patterns that in turn allows companies to optimise production processes and invest in energy-efficient technologies. The reductions this affords in energy intensity lead to heavy cost savings.

The **Erdemir** steel plant in Turkey created an ICT infrastructure with a Plant Information System and a graphical interface. For 2008, modern ICT control mechanisms and models of the entire system are planned to minimise gas emissions and energy costs. The company reported energy savings of 3-5% since optimising its ICT applications. This translates to cost savings of approximately US$10 million per year.

The **Coop** company in Switzerland is internationally recognised as a pioneer in innovative and largely standardised energy management of its supermarkets and food production facilities. The energy management system consists of a variety of ICT-supported organisational and equipment changes, including standardisation of buildings, a time-of-use management system for lighting and temperature, as well as monitoring the use of waste and heat. Due to these measures, the heat consumption of new retail outlets is 50% lower than the average for supermarkets.

### A NEED FOR INVESTMENT INTO ICT SKILLS AND MANAGEMENT CHANGES

The SeBW 2007/8 predicted that investment in ICT hard- and software is not sufficient; training and management changes are also necessary. Several case studies substantiate this conclusion. When an ERP system was introduced at the **Srem** steel foundry in Poland, workshop employees were reluctant to take on the extra responsibilities it required. Training programmes and management changes were needed before the full benefits of the system could be exploited. **Farwest Steel**, in the United States, experienced similar challenges with their ERP system. At **Profim**, in Poland, comprehensive training schemes had to be conducted in the course of implementing an ERP system, because the production floor workers had never used a computer.

More generally, many firms report that success in adopting e-business depends heavily on the people involved. These include managers, day-to-day users and technology experts. But this relationship does not end with the system's adoption. The interaction between people and technology is what shapes the place the technology takes within the company. On its own, the technology has little effect; it must constantly be used and adapted by people to produce its full impact.

### FOSTERING E-BUSINESS IN SMES

A recurring theme in the Sectoral e-Business Watch case studies is the integration of SMEs into an industry's value system. A good example is **Webmobili**, a marketing and communication service for independent retailers and manufacturers in Italy. Webmobili offers a search engine for consumers for national furniture offers. It is a spin-off from Federmobili, the Italian Association of Furniture Retailers. Before launching the search engine, Federmobili made huge efforts to standardise its product coding. Today the benefits are clear. Webmobili has supported SMEs' visibility and market reach, bridging the information gap between supply and demand.

A key lesson in the case of **ArcelorMittal Gent** (see above) is how to integrate SMEs into the value chain. A simple e-solution can facilitate this process in situations where business partners, in particular smaller business partners, are not prepared to invest heavily in ICT, for example because of the complex technical challenges in Electronic Data Interchange.

However, there are also cases that suggest there is no need to foster e-business just because a small company does well with basic ICT such as computers, management software and internet access. An example is the **Patina** foundry in Hungary that operates in a business environment with low competition. A case study of **FAT meble** and **Mebin**, two small Polish furniture producers, illustrates why the companies decided not to invest in ICT solutions. The main reasons were the system's costs, difficulties in finding funding for it, its uncertain future benefits, and the dependency it would create on employees with the skills needed to operate it. These case studies revealed no visible impact of SME-promoting policies.

# 1.3 ICT, innovation and firm performance – an economic assessment

This analysis was conducted by DIW Berlin (***www.diw.de***).
A more comprehensive study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).

**Key findings**

***"Readiness" – factors influencing ICT adoption and use.*** *The results provide modest evidence that increasing competition levels (rivalry) between companies induce companies to use ICT. In particular, companies in the transport and logistics sector as well as retailing companies seem to use ICT in order to cut costs and to seek more innovative ways of conducting business. For all other sectors there is no significant relation between competition levels and ICT adoption. The analysis also finds that large companies across all sectors are significantly more likely to use ICT than small and medium size enterprises.*

***"Activity" – ICT-enabled innovation.*** *For all sectors analysed in this report the empirical analysis demonstrates that once a company has started to use ICT, the intensive use of electronic information exchange systems such as SCM systems as well as employee skills increase the likelihood that a company achieves ICT-enabled innovations. Intensive ICT users are also more likely to change their organisational structure and to outsource non-core activities.*

***"Impact" – ICT and firm / industry performance.*** *The results clearly demonstrate that ICT use increases the turnover of companies in all sectors. There is also some evidence for a positive impact of ICT use on market shares. At the sector level, these results are much less pronounced. Nevertheless, the combination of company- and sector-level results suggests that ICT capital does have an indirect impact on labour productivity through increased outsourcing.*

This section summarises the results of an economic study on the adoption of ICT and its impact on innovation and performance. As a conceptual framework, the study used a stylised "ICT value chain" consisting of three segments: ICT adoption and use ("readiness"), ICT-enabled innovation ("activity"), and implications for firm and industry performance ("ICT impact").

## *1.3.1 Methodological approach*

This study offers an economic assessment of the causes underlying the adoption, use and diffusion of ICT, its impact on innovations and the related effects on economic performance. The study focuses on three manufacturing industries (chemicals, steel and furniture) and three service sectors (retailing, transport and logistics and banking). The assessment is based on empirical analyses at the company and sector level, recent literature, expert interviews, and case studies. It follows up on an interim report on "Economic Drivers and Impacts of ICT Adoption and Diffusion" and partly draws on *e-Business W@tch* (2006), a previous study on the impact of ICT on corporate performance, productivity and employment dynamics.

CONCEPTUAL FRAMEWORK – THE ICT VALUE CHAIN

The starting point of the analysis is the premise that ICT is an enabler of innovation and productivity advances, which in turn impacts on economic performance. Conceptually, the analysis proceeds along an ICT value chain, which structures the ICT-induced value added process into three main steps:

1. **"Readiness" (adoption)**: ICT adoption and use and its relation with specific market and company characteristics such as the degree of competition that a company faces, or the nature of contractual relations of a company with its suppliers and buyers.
2. **"Activity" (innovation)**: As a second step, it is intended to demonstrate whether and to what

extent companies are able to convert their ICT investments into ICT-enabled innovations. It is expected that this depends on factors such as the availability of specific labour skills, the use of e-business software systems (e.g. ERP and SCM), the possibilities to outsource non-core activities, and the structural characteristics of the company.

3. **"Impact" (performance)**: Finally, ICT-induced changes on company performance are assumed to be the combined outcome of ICT-enabled innovation and organisational change. Indicators for company performance are turnover and market shares (at the company level) and value added and productivity levels (at the sector level).

For each of the three steps, a number of hypotheses was specified, based on a review of recent literature (see Exhibit 1.3-1). These hypotheses were then empirically tested for six sectors (banking, retailing, chemicals, transport and logistics, metals and furniture producers).

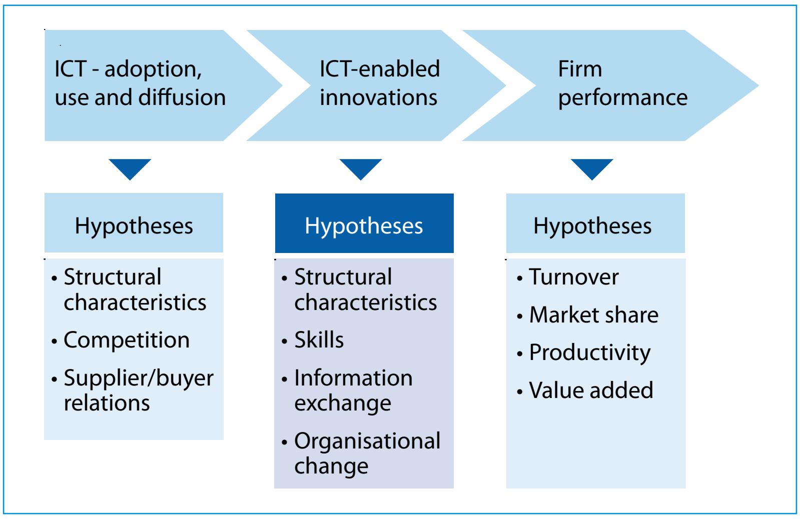
### DATA SOURCES

The empirical analysis to confirm or reject those hypotheses is based on two different data sets:

- At the **company level**, we use information from the **e-Business Survey 2007**, where decision-makers from five industry sectors in nine EU countries and the USA were interviewed in order to collect data relating to the use of ICT and e-business in European enterprises.
- At the **sector level**, we use the **EU KLEMS Growth and Productivity Accounts**, a new and detailed database which reports data on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards.[6]

Through the combined use of both data sets, we are able to test hypothesis at the level of individual companies as well as in a sector-wide perspective.

*Exhibit 1.3-1: The ICT value chain*




### LITERATURE REVIEW

The ongoing diffusion of ICT and e-business technologies and services among companies is a striking example of the possible dynamics of technological change and economic development (Koellinger, 2006). Economic theory (Breshnahan and Trajtenberg, 1995, Helpman, 1998) suggests that the adoption and diffusion of new technologies can be spurred by many factors and can have far reaching consequences. Virtually all economic spheres can be affected by technologically induced changes, including innovation dynamics, productivity and growth, the development of market structures, and the composition of labour demand.

While it is generally accepted that ICT affects company performance and characteristics as well as the environment in which companies operate, different companies in different sectors exhibit varying payoffs despite similar investments in ICT (Dhar and Sundararajan, 2004). Therefore, the starting point of our analysis is to develop a better understanding of why companies adopt ICT, what they do with it and how this affects their performance. Our fundamental proposition is that ICT impacts on a company's performance by triggering innovative processes, which in turn depend on the company's internal and external characteristics. These characteristics, including available and required skills, distribution channels, and corporate culture, vary from sector to sector and from company to company. They are also influenced by the price elasticity of demand, the type of innovation that ICT can enable, and the timing of the innovation in relation to other innovations in the market.

6. For more information see ***www.euklems.net*** or Timmer et al. (2007).

This study discusses the implications of several of such internal and external characteristics on ICT adoption and the resulting innovation processes. The starting point of this analysis is the premise that ICT is an enabler of innovation (Koellinger, 2005). In other words, the adoption and use of ICT ***per se*** does not automatically induce innovations. However, ICT can contribute indirectly to company performance by permitting improved labour productivity, rethinking of processes and the development of new products.

A standard conceptual framework in economic literature which illustrates how structural characteristics of companies and markets determine a company's conduct and performance is the Structure-Conduct-Performance (SCP) paradigm (Bain, 1951; 1956, Mason, 1939). Originally, it was designed as an illustration of how industry structure determines a company's conduct (including production, pricing and innovative strategies) and how this in turn affects company performance.

In the context of the present study, the SCP paradigm could be used as basic framework for explaining the impact of structural characteristics on the process of ICT adoption, the conduct of companies that use ICT and the performance results which they achieve. However, the SCP paradigm has been subject to severe criticism, in particular with respect to the uni-directional flow of causalities and relationships (Scherer, 1980). Critics such as Fauchart et al (2002) or Delorme et al. (2002) suggest that instead of uni-directional relationships there are various interactions between structural elements and market outcomes such as feedback effects from changes in performance on both structure and conduct parameters. To relax the strict causality assumptions of the SCP paradigm, the "ICT value chain" was used as a less restrictive framework. This makes it possible to study ICT impacts as an evolution of ICT from system adoption via innovation to performance change.

### 1.3.2 Factors influencing ICT adoption decisions

In the first step of the analyses, factors that possibly impact on ICT adoption by companies are discussed and the relationships between structural developments and ICT use and diffusion in companies or markets are assessed.

#### COMPETITION LEVELS

Increasing rivalry in the market might be an important factor that drives the adoption of new technologies and innovation, as companies search for new opportunities to cut costs by improving process efficiency or develop new products. Therefore, the first hypothesis is:

**Hypothesis A.1:**
Increasing rivalry in the market determines the adoption of ICT.

This relationship is analysed by using econometric regressions on company-level data. The results suggest that an increase in the perceived level of rivalry across service providers in retailing or transport and logistics is likely to stimulate the use of innovative technologies in order to cut costs and to seek more innovative ways of conducting business. For manufacturing and industrial companies in chemical, steel and furniture such a correlation cannot be observed. These results, however, should not be understood as

**Case Study: ICT use to strengthen competitiveness**

*Since its foundation in 1992 FORTE Furniture Factories has become the leading producer on the rapidly growing Polish furniture market as well as an exporter to Western and Eastern Europe with increasing sales volumes. ICT usage has supported the company in realising this position. In particular, the introduction of an Electronic Data Interchange System has enabled the company to cut costs resulting from errors in data exchange, to develop and deepen relationships with business partners, and to alter its work organisation.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case Study: Barriers to ICT use for small companies**

*The example of FAT meble and MEBIN, two small Polish furniture producers, demonstrates that small- and medium-sized companies are facing significant barriers to the adoption of ICT. The most significant obstacles are financing ICT projects, which often compete with non-ICT investments, uncertainty with respect to the future impact of ICT on company performance, a strong managing focus on operational business that leaves little room for strategic planning, and the need to recruit new personnel with ICT-specific skills - which imposes new risks on the company.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

evidence for a unidirectional relationship between competition and ICT adoption. While it seems obvious that increasing levels of competition can push companies to adopt and use ICT, the opposite might well also be the case. In fact, ICT and the usage of the internet have drastically impacted on certain sectors such as banking and reshaped the competitive scenario.

For all companies we find strong evidence that size is significantly and negatively correlated with ICT-usage. This evidence clearly underlines that large-scale companies are more likely than small ones to adopt ICT-technology.

SUPPLIER-BUYER RELATIONS

Supplier-buyer relations are a second important value chain characteristic which is likely to influence the diffusion of ICT applications. The second hypothesis is therefore:

**Hypothesis A.2 :** Companies maintaining long-term relationships with suppliers and customers are more likely to use technologies supporting inter-company collaboration, in comparison with their peer-group in the same sector.

The empirical test of this hypothesis is based on descriptive statistics. In the e-Business Survey 2007, companies were asked about the use of collaborative applications and practices such as SCM, software to collaborate with business partners in the design of new products or services and sharing information on inventory levels or production plans electronically with business partners. Furthermore, they were asked to define whether they interact with a regular or changing supplier and customer base. We then analysed whether companies with a regular supplier and/or customer base are more likely to use technologies that support inter-company collaboration. The results of this analysis permit only limited conclusions. In particular, we find that the proportion of users of SCM applications, e-sharing of information or e-collaboration for product design is small compared to the proportion of non-users. We find this to be independent of whether the company has regular or changing suppliers and/or customers. Hence, based on this evidence we cannot confirm that companies which maintain long-term relationships with suppliers and customers are more likely to use technologies that support inter-company collaboration than other companies in the same sector. However, these results do not imply that relations with business partners are ***per se*** not important for this decision to use such technologies. Instead, the need to harmonise and standardise supply chain and quality management as well as information exchange across companies can even be key reasons for using ICT-based systems.

### 1.3.3 ICT-enabled innovation

The second step of the assessment analyses a company's ability to use ICT for innovating products, services and business processes. Particular emphasise is given to the role of a company's internal capacities such as knowledge stock and skills, as well as to the collaboration within and between companies. We also analyse whether ICT use affects a company's decisions to outsource non-key activities and how ICT diffusion is correlated with organisational changes.

INTERNAL CAPACITY

As empirical studies have shown, ICT is most productive when combined with complementary investments in working practices, human capital, and company restructuring (Brynjolfsson and Hitt, 2000). In fact, knowledge stock and skills influence a company's absorptive capacity to adopt new technologies (Cohen and Levinthal, 1989). This, in turn, has a positive impact on a company's innovation performance. Thus, in order to develop marketable products or feasible production processes based on ICT, a company needs to build up the relevant complementary assets such as knowledge stock and expertise.

The most obvious examples of investments in complementary assets include investments in training and organisational transformations to accompany ICT investments. Consequently, companies that combine high levels of ICT capital with a high-skilled workforce should be better positioned to develop ICT-enabled innovations. Thus, we formulate the following hypothesis:

**Hypothesis I.1:** Companies characterised by a higher share of employees with a university degree are more likely to conduct ICT-enabled innovations, in comparison with their peer-group in the same sector.

This relationship is analysed by means of econometric regressions on company-level data. The main findings are that high-skilled employees are relevant for ICT-related product- and service innovations. More than for higher university education, we find this to be relevant for IT-practitioners with very specific skills that seem to be of crucial importance. This is consistent with the observation that the success of the ICT-driven innovation processes relies on the availability and quality of complementary assets such as labour.

### INTRA AND INTER-COMPANY COLLABORATION

ICT has a direct impact on process innovation in an organisational setting by facilitating inter-organisational links (Lee, 2000). ICT-enabled inter-organisational integration and collaboration enhances the innovation capabilities of companies by providing opportunities for shared learning, transfer of technical knowledge and resource exchange.

The most obvious benefit of information integration with the help of ICT is the optimisation of the value chain in order to eliminate the so-called bullwhip effect[7], a key challenge in supply chain management. Other, less obvious consequences for companies' innovativeness include creating communication infrastructures which facilitate production networks or enable partners to align the incentives of multiple players by creating joint business units or teams managing the same tasks (McAfee, 2006).

Rather than e-commerce, it is the use of electronic networks that leads to a higher probability of companies collaborating in innovative activities and increases collaborative relations (European Commission, 2004). This leads to the following hypothesis:

**Hypothesis I.2:** Companies that use ICT applications to exchange information or collaborate with business partners are more likely to introduce ICT-enabled innovations compared with their peer-group in the same sector.

This relation is analysed by using econometric regressions at the company level. The main findings indicate a close link between ICT-enabled innovations and the extent to which companies exchange information electronically. However, the different means that companies use (SCM systems, applications to collaborate with business partners in the design of new products or services, electronic exchange of information on inventory levels or production plans with business partners) are found to be of different importance for the six sectors that we analysed.

### ORGANISATIONAL CHANGES

ICT diffusion may also impact on a company's internal organisation, i.e. the structure of and the relationships between departments within an enterprise. Organisational changes may relate to a rearrangement of functions, workflows and importance of departments and employees working in them.

ICT transforms the process of replicating business innovations across organisations (Brynjolfsson et al., 2006). Traditionally, deploying business innovation on a larger scale took time and required considerable involvement of resources and employees. Today, ICT allows companies to embed business innovations and then implement them across the organisation at a much lower cost, without compromising on qual-

7. The bullwhip effect describes how small variations in intermediate and final demand levels along a supply chain can add up to significant disturbances and disruptions.

ity. Every location or unit implements and follows all steps of the new process in a way specified in the software design.

The copy-exactly strategy is particularly beneficial if the initial understanding of the process is low, the lifecycle is short and the process is difficult to improve (Terwiesch and Xu, 2004). This is true for manufacturing industries with rapidly changing production technologies and intensive technological competition. In such industries the speed of adoption of new production processes plays a decisive role for remaining at the cutting edge. On the other hand, tools such as email, knowledge management systems, wikis or instant messaging considerably improve the process of innovation in knowledge-intensive and service-oriented sectors with informal, unstructured and spontaneous types of work, such as banking (McAfee, 2006). ICT facilitates companies' innovativeness by propagating innovations that are less structured than business processes. This leads to the following hypothesis:

**Hypothesis I.3:** ICT use is positively correlated with organisational changes.

To test this hypothesis we used econometric regressions of the e-Business Survey 2007. The results reveal that the intensity of ICT usage increases the probability of organisational change in all sectors analysed. In particular, we found strong links in chemical and transportation and the weakest link in the steel sector. The available ICT infrastructure appears to be of less importance, since we found significant relationships for only two sectors, and in both cases the impact on probabilities for organisational change are much lower. Our estimates also reveal that the quality of human capital is of less importance for organisational changes than for ICT-enabled innovations.

The most obvious type of organisational change is **outsourcing**. In light of the transaction cost theory, decreasing costs of search, evaluation and monitoring of suppliers should lead to a shift away from companies and toward markets as a form of organizing economic activity (Coase 1937, and Williamson, 1985). It is therefore widely expected that ICT will introduce innovative ways of doing business, reshaping company boundaries and changing the constellations of value chains (see, for example, Johnston Gomes et al., 1988, Johnston et al., 1988a, Milgrom et al., 1990, Fulk et al., 1995). The availability of powerful ICT at reasonable cost also increases the attractiveness of markets for intermediate goods and services (Malone et al., 1987 and Lucking-Reiley et al., 2001). In fact, the authors of the *Move to the Market* paradigm argue that companies will increasingly outsource business activities in order to reduce their dependency on hierarchy. Therefore, we formulate the following hypothesis:

**Case Studies:**

**ICT-enabled business model**

*The case of Zabka examines a start-up in the retailing sector. ICT allowed Zabka to enter the Polish retail market and steadily increase its customer base in this market. This case study illustrates how ICT can influence market structure, where ICT-enabled new business models allow companies to enter, or to leapfrog existing market innovators. It also provides credibility for the hypothesis that increased ICT is positively correlated with an increasing market share.*

**ICT-enabled innovation**

*In this case study, a large financial services provider invested in ICT applications in order to facilitate the integration and standardisation of enterprise applications and automate all business processes across the company. This in turn enabled innovation within the bank, including e-banking and telephone banking. This illustrates how companies that invest in ICT applications aimed at information exchange are likely to introduce ICT-enabled product and service innovations.*

***For more details about these cases, see full study report on*** *www.ebusiness-watch.org*

**Case Study: Restructuring as a driver of ICT adoption**

*The DanSteel case study examines how restructuring in a company led to smaller and leaner companies that make use of computer networks to facilitate their operations through outsourcing. In this case restructuring was the driver in adopting ICT. The case study also provides an illustration of how the use of ICT in manufacturing streamlines the operations of a company and increases its need to turn to the market to outsource its activities.*

***For more details about this case, see full study report on** www.ebusiness-watch.org*

**Hypothesis I.4:** ICT endowment is positively correlated with outsourcing.

The relationship between ICT endowments and outsourcing is analysed by means of econometric regressions. The results of this analysis indicate that companies' ICT endowments are strongly regressions on company-level data. The results of this analysis indicate that companies' ICT endowments are strongly correlated with outsourcing activities. In fact, the more advanced a company is in its use of ICT, the more likely it is to outsource some of its business activities.

### 1.3.4 ICT, company performance and productivity growth

At the final stage of the ICT value chain, we assessed the extent to which ICT-enabled innovations are linked with better performance of a company, and if such improvements induce overall productivity growth.

TURNOVER

The effects of ICT on corporate performance are not clear because not all studies have demonstrated clear payoffs from ICT investments (Chan, 2000, Kohli and Devaraj, 2003). In addition, the results vary depending on how performance and ICT payoffs are measured and analysed. For example, an empirical study by Brynjolfsson and Hitt (1996) finds positive impacts of ICT investments on productivity, but not on profits. Another study did not find positive effects of ICT capital on productivity, while ICT labour positively contributed to output and profitability (Prasad and Harker, 1997).

To understand these somewhat ambiguous results, recent work by Koellinger (2006) suggests that changes in corporate performance are not directly caused by changes in ICT capital but by ICT-enabled innovations. In other words, rather than having a direct impact on the various value-added processes within a company, ICT capital enables the company's management to introduce various innovations which in turn should increase corporate performance. Indeed, Clayton and Waldron (2003) find in a study on e-commerce adoption and business impact that companies with a relatively high share of new and improved products in overall product sales also observe higher average sales growths than other companies. Against this background, our next hypothesis is:

**Hypothesis P.1:** ICT-enabled innovations are correlated with a company's turnover.

The assessment of this hypothesis is based on an econometric regression at the company level. The overall finding is that companies which realise ICT-enabled innovations are indeed more likely to observe turnover increases than other companies.

MARKET SHARE

Historically, distance to market and transportation costs have limited the number of customers a company could reach. At the beginning of the internet era, a common believe was that ICT and e-commerce would eliminate the limitations of location and enable companies to expand regardless of geographical locations (Cairncross 1997). ICT offers existing companies possibilities to expand their market reach, which consequently leads to market structure changes as well. This can be illustrated by the way ICT enables companies to cross boundaries of their markets and industries. An example for blurring lines between sectors and a possible thread for retailing comes from manufacturing companies like Dell.

These companies use ICT to by-pass the entire retailing sector and to sell their goods directly to customers instead of depending on a network of retailers. Against this background, we formulate the following hypothesis:

**Hypothesis P.2:** ICT endowment is positively correlated with a change of market share.

This hypothesis is tested by using econometric regressions based on company-level data. Overall, we find evidence in sectors like chemical, retailing and transport that companies which have significant ICT endowments are likely to have increased their market share. On the contrary, for steel and furniture companies none of the analysed variables appears to be correlated with structural changes.

### GROWTH AND PRODUCTIVITY EFFECTS AT THE SECTOR LEVEL

Following the productivity growth resurgence in the US and a simultaneous diffusion of ICT products in the 1990s, it was suggested that a significant part of the increased productivity growth in the US was attributable to increased ICT investments. However, on closer inspection, more recent studies have revealed that only a few countries and specific industry sectors have clearly seen an upsurge in productivity growth resulting from ICT investment (Nordhaus, 2002, van Ark, 2002). To provide a clearer understanding, industries can be divided into ICT-producing industries and ICT-using industries. The United States saw an increase in productivity growth because it is both a producer and user of ICT and successfully extends it to other sectors (Mahoney and van Ark, 2003). ICT-using sectors that exhibited productivity growth in the US were banking, retailing, and various business services. In comparison, European industries are said to have experienced much slower productivity growth although they too invested large amounts in ICT in similar sectors (see e.g. O'Mahony and van Ark, eds. 2003; van Ark, Inklaar and McGuckin 2003). Nevertheless, ICT investment has also increased productivity levels in the EU, in particular in service industries like banking, retailing and business services (Hempell, 2002, Hempell et al. 2004).[8]

Despite the different impacts that ICT had in the US and in Europe, it is widely accepted that it generally has positive effects on total factor productivity (TFP)[9] as well as on labour productivity (Pilat, 2005). Productivity gains accrue from both the ICT-producing and ICT-using sectors (Oliner and Sichel, 2000). In particular, ICT was found to have the largest productivity growth effects in the ICT-producing sectors themselves, and in selected service industry sectors like retailing, wholesale, financial and telecommunication services (Jorgenson, Ho, Samuels, Stiroh, 2007, Jorgenson, Ho, Stiroh, 2008, Inklaar, Timmer, van Ark, 2007). Against this background, we formulate the following hypothesis:

**Hypothesis P.3:** ICT capital investment has become a key element in growth of value added and labour productivity, while the importance of non-ICT capital investments has been declining.

In line with the increasing importance of ICT capital we expect strong complementarities between the traditional input factors labour and (non-ICT) capital and specific ICT capital investments. This implies that with higher investment in ICT capital total factor productivity growth also accelerates. This will be tested by the next hypothesis:

**Hypothesis P.4:** TFP growth has accelerated together with increased investment in ICT-capital, especially in ICT-using service industries like retailing, wholesale and banking.

Another important factor that may influence the extent to which ICT enables productivity growth is the complementarity between ICT capital and skills. A large body of literature on skill-bias in technical change supports the finding that technical change is biased towards skilled workers, reducing demand for unskilled labour and increasing wage inequality and polarisation (Acemoglu, 2002). The impact is clearly visible in today's advanced economies; unskilled jobs have long been declining in absolute terms in Europe and growing only slowly in the US, while skilled jobs for educated workers are being created at a faster pace in most countries (Pianta, 2004). ICT tends to be

8. Several factors are advanced to explain the differences in productivity growth between the US and Europe. The most important seem to be structural impediments like rigid labour markets, institutional impediments and distorted market integration in the EU (McGuckin and van Ark, 2003), as well as time lags and different phasing of innovation cycles (Erber, 2005).

9. TFP is a measure for all changes in total output that are not caused by changes in inputs. Such changes may be due to a variety of factors, including organisational changes (that increase productivity) or factor market distortions on e.g. labour markets (that decrease productivity).

a skill-biased technology and the application of ICT may thus increase the demand and wages for skilled labour and decrease them for unskilled labour. The analysis will therefore focus on the interdependence of ICT investments with skills requirements. The final hypothesis is therefore.

**Hypothesis P.5:** ICT and high- and medium-skilled labour have a positive direct impact on labour productivity growth.

The first step to analyse hypotheses P.3 to P.5 is to assess the pattern of value added growth since 1980 for aggregate industry and service sectors of the EU as well as for the sectors that we have analysed. Between 1995 and 2000, the era of the new economy boom, the economy-wide growth of value added has been around 2.8% per year, up from an annual average of 1.9% during the 15-year period before (1980-1995). However, with the end of the internet boom, average value added growth also dropped back to an average level of 1.8% per year in 2000-2004. For different sectors, developments have been heterogeneous. Overall, the largest growth rates can be observed for the chemical sector and for transport and logistics. These are also the only sectors for which annual growth rates are above the respective economy-wide levels in all three periods. Interestingly, value added growth in the banking sector has been above the economy-wide levels in the periods before and after the new economy boom, while falling below it during the boom time. Finally, the growth pattern in the steel sector indicates a significant increase in recent growth rates compared to the levels in 1980-1995. While annual growth rates in the banking sector have been almost constant throughout the entire period, there is a continuous slowdown of annual value added growth for retailing and the chemical sector. By contrast, growth rates in transport and logistics and in the steel industry replicate the growth pattern of the overall economy.

Based on a standard growth accounting approach we identify the contributions of different input factors to gross value added growth. The specific structure of the EU KLEMS database allows a detailed presentation of different contributions, including ICT and non-ICT capital, total working hours and the composition of the labour force by different skill levels.

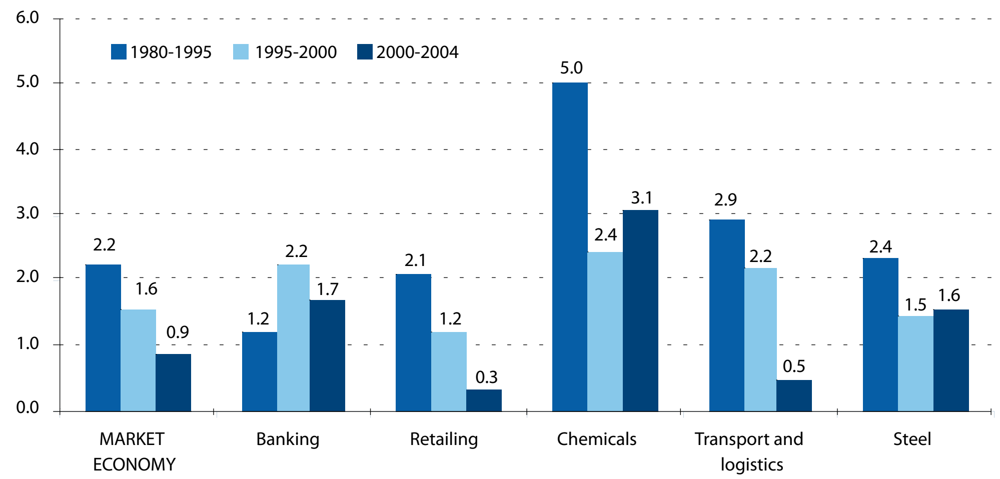
Most importantly, the comparison of different contributions to economy-wide growth during the three periods shows a modestly increasing role of ICT capital. Having been only the third-biggest contributor to growth until 1995, ICT capital became the second-largest in the two later periods. In percent of net value added growth, the contribution of ICT capital increased from 17% until 1995 to slightly more than 25% thereafter. Nevertheless, the most significant contributor to value added growth throughout the analysed periods was non-ICT capital. Hence, on an economy-wide level the importance of ICT capital for value added growth has been slightly increasing, while we do not find evidence for a diminishing role of non-ICT capital.

On the sector-specific level, we observe that there is no single factor that accounts for the most significant contributions to growth in value added over the analysed periods, nor is there a uniform tendency with respect to the changes in importance of a given factor. In fact, it appears highly sector-specific whether changes in ICT or non-ICT capital, labour composition, the number of hours worked or changes in TFP are key determinants for economic growth.

Consequently, we find the role of ICT capital to be rather heterogeneous. Clearly the sector in which it plays the most dominant role is banking. For all other sectors, ICT capital does not account for the largest or second-largest contributions to economic growth. Nevertheless, we observe that its importance has slightly increased for all sectors during the three periods.

Similar to capital, the contributions of Total Factor Productivity (TFP) to value added growth also follow a heterogeneous, sector-specific pattern. The sectors in which TFP has accounted for the largest contributions to growth during all three periods are steel and chemicals. In retailing and in transport and logistics, TFP changes were of crucial importance after 2000, while their respective contributions have been rather small in later years. In banking, TFP has accounted for significant contributions to growth only since 2000. However, the contributions of TFP have to be interpreted carefully. In fact, the growth accounting approach attributes all variations in value added which cannot be explained by changes in labour and capital to TFP. As a result, it includes not only "true" productivity advances, but also a number of other effects such as business cycles. A more specific methodology is therefore used for analysing

***Exhibit 1.3-2: Labour productivity growth in the EU-15 (in %, different periods)***




Source:
EUKLEMS data base, GGDC.

Own calculation

specific contributions to productivity changes in the next paragraph.

Overall, our analysis shows slightly increasing contributions of ICT capital to value added growth, but also a very heterogeneous as well as sector-specific pattern. With respect to the hypothesis P.3 the results from growth accounting show that with the exception of banking, ICT capital does not appear to be a key element in the growth of value added in the sectors we analyse in this report. Likewise, with the exception of banking (and chemicals to some extent) no sector shows evidence for a diminishing role of non-ICT capital.

### EMPLOYMENT AND LABOUR PRODUCTIVITY

The next step is to analyse overall employment developments in the EU as well as for the five different sectors. In principle, we observe that employment per capita and in total working hours have followed the same pattern, both at the aggregate as well as at the various sector levels. In the entire market economy, employment has increased since 1995 with stronger average growth rates until 2000. At the sector-level, the picture is quite different. In banking, retail and transport and logistics, employment levels have grown during all periods. In contrast, the steel and chemical industries have observed substantial employment reductions, mainly in 1985 -95 and since 2000.

Exhibit 1.3-2 shows the development of labour productivity (defined as gross value added per working hour) for all industrial sectors and service sectors except non-market services of the EU-15 as well as for five of the six sectors analysed in this report. The overall increase in employment as depicted above has retarded the growth of economy-wide labour productivity in the EU-15 since 1980, from an average of 2.2% per year in 1980-1995 down to an average annual growth of only 0.9% since 2000. Generally this observation is well known (see e.g. van Ark, O'Mahony and Timmer, 2008). Together with the strong increases of labour productivity growth observed in the US since 1995 (Jorgenson et al., 2007), it implies that the gap in labour productivity between the U.S. and the EU is widening.[10]

Nevertheless, the respective developments at the sector level can be quite different (see Exhibit 1.3-2). Specifically, while we find a similar pattern for retailing and for transport and logistics, where labour productivity has continuously declined, banking, chemicals and steel show different developments. In particular, productivity levels have even been increasing since 1995 for steel and – in particular – for chemicals.

10. The productivity gap between the U.S. and the EU has been observed since the 1960s. E.g. van Ark, O'Mahony and Timmer (2008) estimate that in 1960, GDP per working hour in the EU-15 accounted for less than 60% of the respective level in the U.S. Due to stronger productivity growth in the EU, this gap was closing until 1995. Since then, however, labour productivity growth in the U.S. has been accelerating while the opposite has happened in the EU. Consequently, the productivity gap has been widening again. In 2006, van Ark, O'Mahony and Timmer (2008) estimate that GDP per working hour in the EU-15 has fallen back to about 90% of the U.S. level.

This development has been mirrored by substantial employment reductions that these two sectors have experienced since 1985.

To analyse the causes for labour productivity change in the five sectors we estimated a stochastic production possibility frontier. As for the growth accounting, the analysis is based on data from the EU KLEMS database, in particular on secondary intermediate inputs as well as on the two primary input factors of capital (broken down into ICT and non-ICT capital stock) and labour (measured by working hours, separately reported for high-, medium-, and low-skill categories) for the five different sectors. In this way we were able to estimate sector-specific stochastic production possibility frontiers by using panel data from 1995 until 2004 for different countries.[11]

As a particular specification we employed the error component model (Battese and Coelli, 1992), in which the parameters of a specified production function are estimated while parts of the observed deviations are also explained by systematic differences in technical efficiency across different countries. To ensure constant returns to scale of the production technology, output and input variables were normalised by total working hours (TWHs).[12] Thus, the estimated coefficients report the impact that different factor intensities (e.g. intermediate inputs per TWH) have on labour productivity, measured as gross output per TWH. To consider the potential impact of autonomous technical change, a time dummy was included as additional variable. The estimation results based on a Cobb-Douglas production function are summarised in Exhibit 1.3-3.[13]

***Exhibit 1.3-3: Parameter estimates of a Stochastic production possibility frontier by industries (error component models)***

| Explanatory variables | Banking | Retailing | Chemical | Transport & logistics | Steel |
|---|---|---|---|---|---|
| Constant | 0.55 (+)[1] | 0.16 (+) | 0.22 (+) | 0.03 (+) | 0.03 (+) |
| Intermediate Input per TWH[2] | 0.27 (+) | 0.87 (+) | 0.84 (+) | 0.22 (+) | 0.51 (+) |
| ICT-Capital Stock per TWH[2] | 0.06 (n.s.) | 0.04 (+) | 0.02 (+) | 0.03 (n.s.) | 0.07 (+) |
| Non-ICT-Capital Stock per TWH[2] | 0.17 (+) | -0.03 (n.s.) | - | - | 0.17 (+) |
| High-Skilled-WH per TWH[2] | 0.15 (+) | - | - | 0.21 (+) | - |
| Medium-Skilled-WH per TWH[2] | 0.32 (+) | 0.04 (+) | 0.16 (n.s.) | -0.05 (n.s.) | -0.10 (n.s.) |
| Low-Skilled-WH per TWH[2] | 0.03 (+) | - | 0.04 (+) | - | - |
| Time | 0.02 (+) | - | - | - | 0.01 (+) |
| sigma square | 0.04 (+) | 0.16 (+) | 0.15 (+) | 0.02 (+) | 0.02 (+) |
| gamma | 0.93 (+) | 0.98 (+) | 0.98 (+) | 0.96 (+) | 0.98 (+) |
| eta | -0.08 (n.s.) | -0.02 (+) | -0.01 (+) | -0.14 (+) | -0.09 (+) |
| Countries included | EU-12 - Austria, Czech Rep., Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK | EU-16 - Austria, Belgium, Czech Rep., Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovenia, Spain, Sweden, UK | EU-16 - Austria, Belgium, Czech Rep.,, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovenia, Spain, Sweden, UK | EU-14 - Austria, Belgium, Czech Rep.,, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, UK | EU-14 - Austria, Belgium, Czech Rep.,, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, UK |

[1] brackets: + = significant at 95%-level, n.s. = insignificant at 95%-level
[2] TWH - total working hours
Source: DIW (own calculation)

11. Due to differences in data availability by country, the different industry samples consist of different countries (see Exhibit 1.3-3).

12 This leads to an accordingly restricted stochastic production possibility frontier where the real gross production value per working hour is explained by six factor intensities using total working hours as the denominator.

13. See appendix II for more details on technical specifications. For the econometric estimations we used the Frontiers 4.1 software package (Coelli, 1996).

Most importantly, intermediate inputs seem to have a crucial impact on labour productivity. In fact intermediate inputs are the only factor intensity for which we find high significant coefficients in all five sectors. Moreover, in four out of five sectors (banking is the exception) the coefficients are also the largest ones, indicating that changes in the use of intermediate inputs per TWH have by far the strongest impact on the observed variations in labour productivity. To a certain extent, this might be due simply to a low degree of substitutability between primary and secondary input factors. Additionally, the high coefficient values can also be interpreted as evidence for a positive relationship between the outsourcing of non-core activities and productivity growth. This finding is clearly supported by the seminal work of Coase (1937), who already argued that outsourcing contributes to productivity growth. As far as the economic potential from the use of ICT is concerned, the important role of outsourcing – reflected by the strong impact of intermediates on labour productivity – is likely to provide a starting point for the beneficial use of ICT systems as they can enable companies to increase labour productivity. This is particularly likely for chemicals and steel, where productivity increases have been mirrored by substantial employment reductions, as discussed above.

In contrast to intermediate inputs, neither the intensity of ICT nor of non-ICT capital per TWH seems to have a consistent and significant impact on labour productivity across the five sectors. Instead, we find sector-specific evidence that ICT capital matters in some sectors (retailing, chemical, steel) while it does not in others (banking, transport and logistics). In the light of empirical evidence on the causes of productivity growth in the U.S. such as Jorgenson et al. (2000), who identified strong impacts of ICT and non-ICT capital on labour productivity growth, this finding is surprising. For the case of banking, it also appears to be inconsistent with our findings from growth accounting where we identified ICT capital as the largest contributor to value added growth. At first glance, these results are surprising when compared to most of the discussed literature. However, in contrast to standard growth accounting exercises, the SPF estimation is based on much more detailed information. In particular, the analysis uses gross production values including intermediate inputs, rather than gross value added, which only accounts for primary input factors. Furthermore, labour input has been explicitly broken down by skill classes.[14] Hence, the results indicate that probably the direct positive link between ICT-capital investments and labour productivity growth is much weaker than typically suggested in the literature.

Exhibit 1.3-3 also indicates that in only some sectors labour productivity has changed significantly due to structural shifts in labour composition. In particular, productivity in the banking sector has increased due to larger proportions of high-skilled and especially medium-skilled workers. Similarly, the proportion of high-skilled labour in TWH has significantly increased productivity in the transport and logistics sector.

Finally, we note that we obtained significant estimates for the impact of Harrod-neutral technical change for only two sectors, banking and steel. Since the estimated coefficient values are relatively small for these two sectors too, we can conclude that autonomous technical change does not play a substantial role in explaining the observed changes in labour productivity. Again, this observation is somewhat in contradiction to the classical findings of growth accounting, where TFP typically accounts for important contributions in economic growth for at least some sectors.

### 1.3.5 Summary and policy implications

#### SUMMARY OF MAIN RESULTS

This study presents an empirical analysis of the economic impact of ICT on selected sectors in the EU. The central premise of our analysis is that the use of ICT as such does not affect the performance of companies, but that it enables them to improve labour productivity, to rethink and to improve processes and to develop new products. Hence, ICT is understood to be an enabler for innovation and productivity increases. Based on this central assumption we analyse the impact of ICT along an ***ICT value chain*** consisting of three main elements: ICT adoption, ICT-enabled innovation, impacts on performance.

14. On the contrary, in the growth accounting exercise we relied only on an indicator for compositional changes in the skill-structure of the labour force.

Exhibit 1.3-4 gives an overview on the results for all tested hypotheses. As the analysis indicates, the nature of relationships between buyers and suppliers does not seem to play an important role in the diffusion of ICT applications. Rather, we find some evidence that increasing competition levels (rivalry) induces companies to use ICT in order to cut costs and look for more innovative ways of conducting business.

Once a company has started to use ICT, employee skills and the intensive use of electronic information exchange systems such as SCM systems increase the likelihood of ICT-enabled innovations. Intensive ICT users are also more likely to change their organisational structure and to outsource non-core activities.

With respect to the impact of ICT use on performance we find strong evidence at the company level that ICT use is associated with increases in turnover, and some evidence for a similar impact on market shares. At the sector level, these results are much less pronounced. In fact, we find almost no evidence for a direct relationship between ICT capital investment and value added growth, and only modest evidence for a relevant impact of ICT capital on labour productivity (while we find that aggregate labour productivity growth in the EU has even been declining since 1980).

A possible explanation for the apparently less significant impact of ICT on performance at the sector-wide than at the company level could be a lag effect along the ICT value chain. At the micro level, certain companies assume a leading role in adoption and use of ICT. Those companies are leaders, which seek to secure the benefits of the first mover. Both the company-level analysis and the case studies demonstrate that ICT use has a positive impact on performance. At the sector level, the assessment is less pronounced. In fact, not all companies within a sector are ICT leaders. Hence aggregate sector-level information is obviously less able to reveal the full potential of ICT usage. Moreover, the degree

*Exhibit 1.3-4: Hypotheses summary*

| | | | Chemical | Steel | Furniture | Retailing | Transport & logistics | Banking |
|---|---|---|---|---|---|---|---|---|
| **ICT adoption, use and diffusion** | | | | | | | | |
| **A.1:** Rivalry | ⇔ | ICT adoption | no | no | no | (yes) | yes | n.a. |
| **A.2:** Relationships | ⇔ | ICT usage | no | no | no | no | no | n.a. |
| **Innovation** | | | | | | | | |
| **I.1:** Employee skills | ⇔ | ICT-enabled innovation | yes | yes | yes | yes | yes | n.a. |
| **I.2:** e-Collaboration | ⇔ | ICT-enabled innovation | yes | yes | yes | yes | yes | n.a. |
| **I.3:** ICT endowment | ⇔ | outsourcing | yes | yes | yes | yes | yes | n.a. |
| **I.4:** ICT use (infrastr.) | ⇔ | organisational change | no | (yes) | yes | yes | no | n.a. |
| ICT use (software) | ⇔ | organisational change | yes | yes | yes | yes | yes | n.a. |
| **Company performance** | | | | | | | | |
| **P.1:** ICT- innovation | ⇔ | turnover | yes | yes | yes | yes | yes | n.a. |
| **P.2:** ICT endowment | ⇔ | market share | yes | no | no | yes | yes | n.a. |
| **P.3:** ICT capital investment | ⇔ | value added growth | no | no | n.a. | no | no | yes |
| ICT capital investment | ⇔ | labour prod. growth | (yes) | (yes) | n.a. | (yes) | no | no |
| Diminishing importance of non-ICT capital | | | yes | no | n.a. | (no) | (no) | (no) |
| **P.4:** TFP growth accelerated with ICT capital | | | no | (yes) | n.a. | no | no | (yes) |
| **P.5:** ICT & medium-skilled labour | ⇔ | labour product. | yes | no | n.a. | (yes) | no | no |

Note: the grey shaded cells highlight the hypotheses that have been tested on a sector–wide level.

to which ICT-induced performance effects which we observe at the company level are also visible at the sector-wide level reveals important information about structural developments in the economy. The more that company-level observations match the results of sector-level analysis, the more that we can expect that a majority of companies has already followed the example of their best-performing peers. Against this background, the gap that we observe between company- and sector-level results seems to suggest that the lag between best performers at the company level and average performance at the sector level is still rather large. In other words, there appears to be a significant degree of still unexploited economic potential from increased ICT usage.

Finally, we need to stress the observation that we found larger companies to be significantly more likely to intensively use ICT. Given our general results, this also implies that large companies are likely to introduce ICT-enabled innovations more often than small and medium-sized enterprises (SMEs). In other words, this suggests that the gap in ICT use between small and large companies (the so-called digital divide) is widening rather than narrowing.

### POLICY IMPLICATIONS

From a policy perspective, the results of this report demonstrate that **more targeted measures to foster ICT adoption and usage in the EU are urgently needed**. Most alarmingly, the analysis confirms the well-known observation that **labour productivity growth in the EU is declining** while other empirical studies show that labour productivity in the US has been strongly increasing since 1995 (Jorgenson et al., 2007). This implies that productivity levels in the EU are falling behind their levels in the U.S. and hence that the EU is losing competitiveness. As is generally accepted, the strong productivity surge in the U.S. is to a large extent caused by the successful use of ICT capital.

This leads to the next important finding from a policy-makers' perspective, namely that SMEs – the strong engine for growth and innovation in EU economies – are significantly less likely to use ICT. While it is well known that SMEs lag behind in ICT adoption (see e.g. e-Business Watch, 2006), the results of this study suggest that SMEs are also less likely to benefit from ICT-enabled productivity increases and innovations. It is unlikely that productivity growth in the EU will pick up by itself, e.g. due to specific developments of European business cycles. Instead, what is called for are political measures to foster ICT adoption and usage. Obviously those measures should not aim at directly intervening in company-level decisions, as this would most likely induce serious efficiency losses. Instead, they should concentrate on improving the environment in which individual business decisions are taken. In this respect, our results suggest that policy measures should focus on the following directions:

**Create fully integrated common markets**

Despite significant efforts and progress, European product and factor markets are still not fully integrated. Instead, institutional and structural impediments persist. For example, key product, service and financial markets such as banking and financial services, telecommunications or energy are governed by specific – and in part even overly rigid – legislation which differs in almost all member states. Moreover, numerous structural impediments like differences in educational degrees and – even worse – exemptions from fully integrated labour markets for new member states, or differences in national wage formation and social standards, all hamper full labour mobility in the EU.[15]

It is commonly argued that all of these impediments and rigidities limit the usage of ICT (see e.g. van Ark, Inklaar and McGuckin 2003). The analysis of this report further substantiates this observation and its implications for company performance. As has been shown, companies with long-term contractual relationships with business partners are more likely to use ICT, which in turn enables them to implement new organisational structures and ICT-enabled innovations and to benefit accordingly. However, strong market fragmentation and the existence of different national legislations and regulations make it more costly for companies to expand their reach and enter into long-term relationships with companies in other EU member states, to change and adjust their organisational structures, or to enter into new markets which ICT would enable them to do. In fact, given the numerous country-specific regulations and

15. Arguably the most comprehensive source of evidence for this assessment is the website of the European Commission, which includes specific reports on the state of single market for goods, services, labour and capital.

impediments, companies cannot simply develop and implement uniform strategies and solutions on a European scale. Rather, they need to adjust their operations for various country-specific differences.

Strong additional efforts and progress in the creation of liberal and truly integrated product and factor markets are called for. While this has been a predominant objective of the EU Commission for many years, its implication has been repeatedly impeded by political resistance. As a result, empirical evidence still suggests that different markets of EU member states are not yet sufficiently integrated with one another.

The analysis also demonstrates that specific skills of a company's employees are a necessary precondition for companies to realise ICT-enabled innovations. In addition to the removal of legal and institutional barriers to labour mobility – which would allow companies to benefit from an enlarged EU-wide supply of different specialists – this also points to the second direction on which policy measures should concentrate:

**Improve and adjust education, training in e-skills and life-long learning**

In a knowledge-economy driven by rapid technical change, the ability to empower the work force through appropriate training and skill-formation is of crucial importance. In fact, the results suggest that the education of ICT users rather than the technology itself determine predominantly the success or failure of ICT investments. Naturally, this requires and incentivises individual companies to invest in appropriate training and skill-formation for their employees. However, in a liberal market environment with flexible labour markets, co-operation between industry, governments, and education institutions are likely to have more effective leverage on the development and improvement of e-skills. This includes:

- Improving the quality and business-relevance of education through specific development programmes for new and experienced teachers;
- Stimulate and allow for closer – preferably international – co-operations between universities and industry to promote research and development ventures;
- Design new EU-wide training certificates and education degrees according to the needs of the industry;
- Promote the development of EU-wide quality criteria for e-skills training and certificates.

Both the incomplete integration of EU markets and inadequate educational provision are barriers to ICT adoption for all companies, independently of their size. However, in relative terms the costs of overcoming all those difficulties is substantially higher for small than for large companies. Hence, a third policy direction is to:

**Stimulate ICT adoption by SMEs**

SMEs form significant industry segments in the EU and account for the majority share in EU employment. Thus, they require specific policy attention. While their strength lies in the flexibility with which they can adjust to changing market conditions, their small size makes them less able to face high up-front costs. For ICT, this does not primarily mean the investment in hard- and software, since competition on the respective markets keeps them at economically reasonable levels. Rather, it means the costs of gathering additional information which SMEs lack. In particular, the small size of many companies typically requires their managers to focus almost exclusively on operational activities. Little time remains for strategic planning, so new issues that require substantial up-front information are difficult to deal with.

Policy to support ICT adoption of SMEs should focus on awareness raising programmes that inform managers and entrepreneurs about the possibilities and benefits that ICT could offer to them. Ideally, this should be done through multi-national co-operation between governments, industry representatives (e.g. chambers of commerce) and the ICT-producing industry. Furthermore, SMEs could also be supported by encouraging entrepreneurship through appropriate training (in coordination with policies to improve and adjust education and training of e-skills) or through public support for the training of SME staff.

Admittedly, all three objectives have already been on the policy agenda of the European Commission for a long time. Nevertheless, the findings of this analysis clearly show that there remains a long way to go until those objectives are fully implemented in reality. Hence, more consolidated efforts along the lines suggested here are necessary. The evidence shown in this report should also be used in political discussions to substantiate the need for market integration, improvements in education and SME support, as well as to demonstrate the costs of inaction.

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## 1.4 Policy implications


**Key messages**

*In the SeBW 2007/8 studies, three policy areas emerged as playing a particularly important role: standardisation, e-skills, and integrating SMEs into value chains. These priorities need to be directed towards new policy approaches that* ***foster e-business networks*** *rather than simple ICT investment in single companies. Policy makers should also pay special attention to the use of ICT for energy consumption as well as its prospects in the common markets of the EU.*

*The European Commission emphasises the importance of standards for innovation and insists that* ***standardisation*** *remains a voluntary, consensus-based, market driven activity. In some industries such as steel, furniture and transport, it may be helpful if policy makers promoted the adoption of certain IT standards to enhance interoperability.*

*Shortage of skilled* ***ICT personnel*** *is a horizontal issue which concerns all sectors. The two main courses of action to address this challenge are to develop innovative curricula in ICT training, and to attract talent by promoting these training schemes among young people.*

*Companies in all sectors could benefit from more e-business* ***knowledge to enhance transparency and transfer*** *at both European and national levels. Improved awareness and knowledge about the effects and sustainability of ICT is necessary to take informed decisions.*

*Policy makers may foster* ***value chain development*** *through ICT and e-business use, particularly in SMEs. A sectoral focus does not guarantee success, but it facilitates such policy initiatives as it drives the involvement of experts and associations with a background and a reputation in the sector.*

### *1.4.1 Introduction to e-business policy implications*

ICT AS A HORIZONTAL ISSUE IN INDUSTRY-RELATED AND INNOVATION POLICY

The Sectoral e-Business Watch (SeBW) was established in the context of the European Commission's policies related to ICT and e-business. It originates from the eEurope Action Plans of 2002 and 2005, the i2010 Strategic Framework, the "Go Digital" initiative and the European e-Business Support Network (eBSN). ICT-related objectives are linked with the "renewed Lisbon objectives" and the "new industrial policy" of DG Enterprise and Industry. The Sectoral e-Business Watch in 2008/9, and the continuation of the European e-Business Market Watch which was launched in 2001, grew out of recent policy developments. One of the shifts of focus of the SeBW is to extend and deepen policy implications from the study findings.

A key aspect of the development in recent years is that ICT and e-business have become horizontal issues for industrial and innovation policy at large, rather than being confined to specific programmes or action plans. This reflects the role of ICT as a "General Purpose Technology" in most, if not all, sectors. It is pervasively used in all areas of business and plays a crucial role in innovation, productivity and competitiveness. Any larger policy framework in these areas will – be it explicitly or implicitly – include action lines where ICT are highly relevant. Another key change is that the goal of ICT policy has evolved. Initially it was simply designed to support basic ICT investments. With time, it started supporting more sophisticated internal e-business solutions. Today, its aim is to foster e-business value networks within and across industries. This policy evolution follows the development towards "e-Business 3.0", a trend towards digitally integrated value systems in which basic information infrastructures have already become a necessary precondition for doing business.

## CONTRIBUTIONS OF THE SEBW TO ENTERPRISE POLICY

Within the European Commission, DG Enterprise and Industry has the mission to help improve Europe's economic standing by ensuring that businesses are competitive and that they can compete openly and fairly. Research of the Sectoral e-Business Watch is intended to contribute in particular to three priorities of enterprise policy as shown in Exhibit 1.4-1.

Exhibit 1.4-2 presents an overview of these policy areas. It indicates major documents and initiatives which constitute the background for the work of the Sectoral e-Business Watch. Technically, the SeBW is itself one of the EU initiatives in the field of ICT for competitiveness and growth. However, due to the horizontal nature of ICT and e-business outlined in the previous paragraphs, there are close links with other policy areas addressed by DG Enterprise and Industry such as innovation and industrial policy.

## RATIONALE FOR POLITICAL ACTIVITY IN THE FIELD OF ICT AND E-BUSINESS

A basic assumption of the e-Business Watch is that it is each enterprise's decision whether or not to use ICT and e-business, and to which extent they invest in it. Policy initiatives should target areas in which market failures may occur. These include for example issues related to research, development and technology transfer, knowledge and skills development, network effects, standardisation, and environment protection.

Suggestions for political activity therefore need to be based on evidence that it is necessary. The e-Business Watch derives its suggestions for policy action from study findings and related analyses. In 2007 and 2008, evidence is available from two key sources: the e-Business Survey 2007 (see Section 1.1 and Annex II of this report) and a set of econometric analyses in 2007/8 (see Section 1.3 and Annex III). The e-Business Survey provides firm-level - micro - data and the e-Business Analyses used aggregate - macro - data. In addition, case studies provide firm-internal data (see Section 1.2) which substantiate and illustrate findings from the survey and the analyses.

However, **evidence from the key data sources is mixed** and different interpretations can be made of the findings. Policy implications are therefore not straightforward:

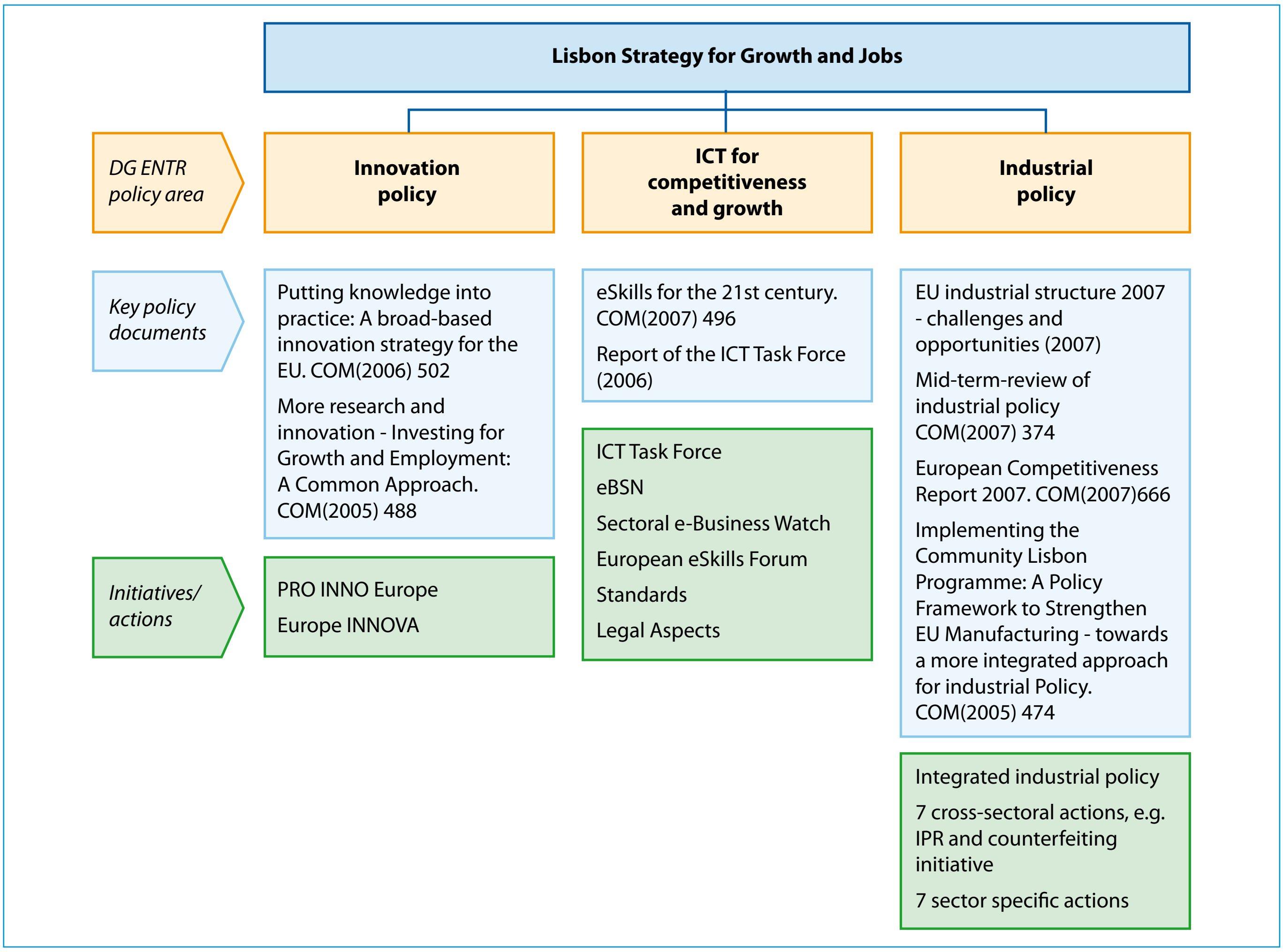
- Data from the **e-Business Survey** indicate, for example, that EU companies tend to lag behind US companies, that SMEs tend to lag behind large companies, that large companies have difficulties in filling vacancies for IT professionals, and that many customers and suppliers are not ready for more intensive e-business. These findings, together with case study substantiation, may justify policy action to promote ICT and e-business adoption.
- On the other hand, results of the **econometric analyses** indicate that ICT investment has been of limited importance for company perform-

*Exhibit 1.4-1: EC's enterprise policy priorities and SeBW contributions*

| Priority of enterprise policy | Contributions of the SeBW |
|---|---|
| "Promoting European **competitive performance** (encouraging businesses to adapt to structural change and maintaining a high and consistent level of productivity growth)" | ■ study the role of ICT for competitiveness and productivity growth<br>■ identify related barriers to exploiting the potential of ICT<br>■ suggest possible policy actions to enhance the impact of ICT |
| "Taking account of the specific characteristics and needs of the different **industrial sectors**" | ■ provide evidence of different industries' characteristics with regard to their ICT usage<br>■ assess the impact of ICT and e-business on the value chain characteristics of different sectors |
| "Promoting **innovation** – following up technological developments, new product designs and developing new ways of marketing products (e.g. e-business)" | ■ improve the understanding of innovation dynamics in different industries<br>■ analyse the role of ICT and e-business for innovative output<br>■ contribute to the development of a new conceptual framework for innovation in which ICT use is a vital element |

Source: ***http://ec.europa.eu/enterprise/enterprise_policy/index_en.htm***

*Exhibit 1.4-2: Policy framework for the Sectoral e-Business Watch*




Source: European Commission DG Enterprise and Industry website, compiled by empirica

ance. The only positive correlation observed across all industries was between ICT innovation and turnover increase. Although ICT was expected also to increase market share, value added growth, labour productivity growth and total factor productivity growth, the analyses showed this was the case only in some industries. Furthermore, when a positive relationship was found it was often small. These findings could be seen as suggesting caution in policy actions related to ICT and e-business. One could also, however, interpret the analyses results in a normative way. The fact that ICT has not played the role that it could in European industries may call for more ICT investment in order for it to exert an influence as important as it has done in the US. This would argue in favour of policy action in the sector.

A further caveat should be made about the balance between industry policies and ICT policies. In some industries, the key competitive battles are not around ICT. For example, the chemicals and the steel industries are facing rapidly rising costs in raw materials, they need to comply with far-reaching regulations, and they must fight increasing global competition. Nevertheless, without improving productivity and customer service through e-business, companies in these industries may have serious problems in winning these competitive battles. Therefore, while industry policies for these sectors are likely to have other priorities than ICT, they must still foster an effective use of ICT. All in all, there are solid arguments for policy makers to promote ICT and e-business adoption, but policies should consider carefully the company's context and the specific role of ICT for competitiveness in each specific industry.

### KEY POLICY AREAS: STANDARDS ADOPTION, E-SKILLS AND VALUE NETWORKS

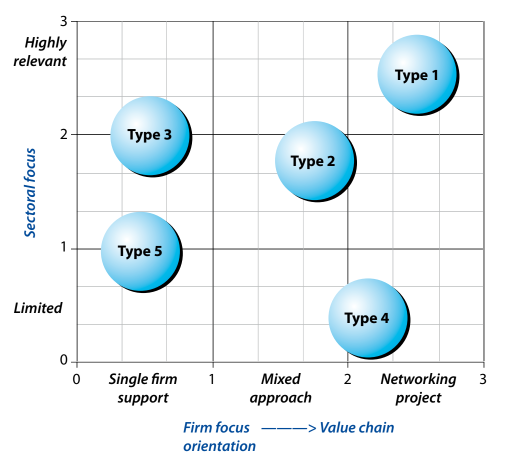
The study reports of 2007/8 identified three priority areas for ICT policy to improve competitiveness, innovation and growth. Standards must be adopted faster to meet an increasing demand for interoperability and ICT systems integration. Gaps in the availability of ICT skills must be filled. And the participation of firms, particularly SMEs, in global value networks should be promoted. These priorities reflect the fact that that e-business value networks strongly depend on interoperability and standards adoption, knowledgeable ICT use, and efficient outsourcing and services. The overarching theme of these policies is the improvement of the economic efficiency and openness of the European economy, ultimately reducing the productivity growth gap suffered by the EU in recent years.

These three areas will be elaborated further in this section. They are not new to the policy agenda and they are likely to remain important in the years to come because they constitute fundamental and evolving issues. The SeBW 2007/8 contributes industry-specific particularities of these subjects and offers specific policy approaches to help tackle them. The policy implications address in the first instance the European Commission, and subsequently national and regional governments and European and national industry associations.

### A PORTFOLIO OF E-BUSINESS POLICY APPROACHES

Policy initiatives that aim to promote the adoption of ICT and e-business among companies can be grouped according to several criteria: their objectives, the sectors they address (horizontal versus vertical focus), the applications and processes they focus on (basic versus more advanced activities), and the instruments they use (raising awareness, grants, stakeholder coordination). Exhibit 1.4-3 proposes a matrix of e-business policies according to two criteria: the extent to which the initiative is focused on a specific sector (vertical axis), and the focus of the company or network (horizontal axis), for instance whether activities concentrate on supporting single firms or on supply chains. Most e-business policy initiatives can be mapped in this matrix. As examples, five common types of initiatives have been positioned. A country or region can use this system to develop its own portfolio of ICT policies.

**Exhibit 1.4-3: Five types of sectoral policy initiatives**




Source: empirica / Databank / IDATE (2007)

In **Type 1** policy initiatives, named **"intra-industry networking"**, a sectoral approach is essential. Activities are geared towards strengthening sectoral value chains by achieving agreement among stakeholders on specific issues. This may be most appropriate to foster industry-specific value chains (see Section 1.4.4).

In **Type 2** initiatives, named **"individual firms and networks in mixed industries"**, sectoral characteristics play a smaller role. Activities may for instance support "twinning" projects which involve manufacturers and their suppliers or customers (see Section 1.4.4), or they may address framework conditions such as the deployment of e-standards (see Section 1.4.2).

In **Type 3** initiatives, named **"individual firms in specific industries"**, sectoral characteristics are relevant as well, but the activities then focus more on the individual firm rather than on value networks across companies.

In **Type 4** initiatives, named **"inter-industry networking"**, sectors are only peripherally relevant. Instead, the initiatives focus on specific or general issues, identified as action points, to enable companies to exchange electronic data. The data in question may for instance be standards for specific business processes (Section 1.4.2). This type of initiatives may also deal with e-skills (Section 1.4.3).

**Type 5** initiatives, named **"cross-industry support of individual firms",** focus on providing ICT-related support to individual companies and to raise awareness, for example of e-business management issues (Section 1.4.3). Sectoral aspects may play a role in parts of the activities, for instance when organising information events.

The policy initiatives of types 1 and 4 and also type 2 are best designed to meet the current trend towards digitally integrated value systems.

## 1.4.2 Supporting the adoption of ICT standards

### IMPORTANCE OF STANDARDS AND STANDARDS DEVELOPMENT

Technical standards are agreed upon to achieve interoperability between different systems. Without interoperability of ICT systems, advanced forms of e-business, such as the digital integration of systems in B2B exchanges, are scarcely possible. They require standards and the compatibility between standards.

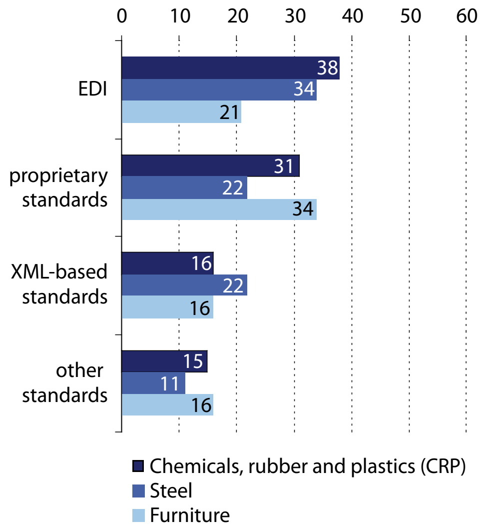
The European Commission emphasises the importance of standards for innovation, pointing out that *"the lack of standards, the limited uptake of new standardisation items or the slow updating of existing standards hamper the uptake of innovation".* It asserts that *"standardisation that is lively and strong has the power to accelerate the access of innovation to both domestic and global markets."*[16] For the European Commission, standardisation remains a *"voluntary, consensus-based, market driven activity".*[17] Standardisation is to be carried out by a number of stakeholders, including manufacturers, service providers, users, independent consultants, and authorities, who need to reconcile their positions. The EC's DG Enterprise and Industry actively promotes the adoption of standards within a standards network that is part of the Europe Innova Programme.[18] Further activities may be related to informing companies, SMEs in particular, about the existence and benefits of certain ICT standards.

### STUDY FINDINGS

Standards and standardisation policy have played an important role in the e-Business Watch since its inception in 2001. In 2007-2008, ICT standards adoption has been dealt with in most SeBW studies.

The e-Business Survey 2007 found that the adoption of ICT standards is still limited, leading to interoperability problems. The most common ICT tool used in the three manufacturing industries considered is Electronic Data Interchange (EDI). It has been implemented by companies representing 38% of employment in the chemicals, rubber and plastics (CRP) industry, 34% in the steel industry and 21% in the furniture industry. Proprietary standards are also widespread in these sectors (CRP 31%, steel 22%, furniture 34%). However fewer than one in four of the companies in each industry reported using XML-based standards (CRP 16%, steel 22%, furniture 16%) and fewer still used standards of any other kind.

***Exhibit 1.4-4: ICT standards adoption in the chemicals, steel and furniture industries in Europe***




The survey was conducted in seven EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA (USA not included in the Exhibit).

Base (100%) = companies with at least ten employees using software packages for internal operations. N EU-7: Chemicals 811, Steel 349, Furniture 661.

Figures are weighted by employment («firms representing x% of employment in the sector / country».

Source: e-Business Survey 2007

It is worth mentioning that the survey may underestimate the use of standards because the interviewees are not always aware that certain standards are implemented in purchased software their company uses.

### INDUSTRY-SPECIFIC POLICY ISSUES

With regard to the **steel industry**, the EC could initiate and co-fund European projects to develop and implement the European Steel Industry Data Exchange Language (ESIDEL) and possibly also other standards such as UN/CEFACT.[19] Only a small share of European steel firms currently uses ESIDEL,

16. European Commission (2008).
17. See ***http://ec.europa.eu/enterprise/standards_policy/action_plan/index.htm***.
18. See ***http://standards.eu-innova.org/***.
19. See also the article about ESIDEL by Freddy De Vos in Section 4.2.3 of this report.

but there is case study evidence of the language's potential benefits. Any European projects would do well to focus on SMEs, as they tend to be particularly hesitant to adopt standards due to the related investment costs. Standardisation could also be a part of projects fostering supply chain development. These projects should bring together companies from the entire steel and iron value chain, including suppliers of different kinds of goods, customers in industries such as automotive, construction and household equipment as well as steel merchants.

In the report about the **chemicals industry**, no particular activities are suggested with regard to standardisation. The Chem eStandards by CIDX, the Chemical Industry Data Exchange, have been developed specifically for data exchanges related to buying, selling and delivering chemical products. They are based on XML and were developed through a cooperative effort of more than 20 chemical companies in late 2000. Chem eStandards are widely used in the industry. No particular efforts seem necessary to promote their use.

In the **furniture industry**, the use of XML and EDI standards is limited. The majority of large firms rely on proprietary standards. On the European level, the subject of standards and interoperability has been addressed for example by the SMART-fm[20] initiative, by the FunStep[21] Interest group, and by the INNOVAFUN[22] initiative. Large scale adoption has however not kept up with technological progress in the sector. Policy measures should now aim at fostering faster and wider adoption of standards both at sector and cross-sector level, particularly in distribution and in SMEs. One of the most important standardisation issues in the furniture industry is to establish a shared products classification code. Facing a great variety of furniture items, a common language for describing products is essential for e-marketing and sales, particularly e-cataloguing. Case studies provide insightful examples of industry associations that promoted product classification.

In the **transport and logistics industry**, e-business standards must be developed to facilitate interoperability. Despite the wide diffusion of ICT in the sector, there is still unexploited potential to further increase integration through the supply chain. In particular, large companies that were interviewed for the study claimed that systems' incompatibility constitutes an important barrier to e-business diffusion. Public bodies might support the standardisation process, for example by fostering co-operation between private companies involved in standards definition. Since the vast majority of companies in the transport and logistics sector are SMEs, policy should ensure their interests are adequately considered in standardisation.

Within the **banking** industry, standardisation has been an important issue. Several initiatives have already helped harmonise rules in this sector across the EU. The most prominent step forward is the introduction of the Single Euro Payments Area (SEPA), launched by the European Central Bank and the European Commission. SEPA will allow customers to make non-cash payments (in Euro) to beneficiaries anywhere in the Euro area using a single bank account and a single set of payment instruments. All retail payments in Euro will thereby become "domestic".[23] However, the banking industry itself has not yet done much to implement SEPA as it requires substantial ICT investment. The EC could therefore promote initiatives to support and encourage the cooperation between banks in ICT development projects to implement SEPA work processes.

While the development and harmonisation of **Radio Frequency Identification** (RFID) standards accelerated in 2006 and 2007, interoperability is still a key barrier to the technology's adoption. RFID implementations have a typical lifetime of about ten years but can go up to 20 years, for example in global supply chain implementations. The challenge is therefore to minimise RFID investment risks in a long-term scenario. This situation calls for a definition by policy makers of a regulatory roadmap for the future of RFID. Regulation could help safeguard investments if the radio spectrum assigned to RFID applications went beyond ten years. There is an inevitable tension between standards development and protection of **intellectual property rights** (IPRs). Standards aim at the largest possible diffusion, while IPR tend to grant time-limited monopolies for inventions in

20. See ***http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/60707***
21. See ***http://www.fsig.funstep.org/funStep.htm***
22. See ***http://standards.eu-innova.org/Files/Publication/EUR_Standards_INNOVAFUN.pdf***
23. See also the contributions from O'Mahony and Potgieser/Meijer in Sections 4.2.8 and 4.2.9 of this report.

order to ensure commercial rewards to the inventor. The EU and the principal national bodies promote the development of open standards within the ICT industry. They believe that ensuring the widest possible level of interoperability is a key factor in the market's development. Regarding the issue of software patents versus open standards, any resolution favourable to both sides is likely to be complex, striking a delicate balance among the interests of all parties. The EC should take into account the concerns of smaller enterprises that feel at risk of being sidelined from the innovation development process because of aggressive IPR strategies of larger competitors.

The situation for **e-health standards** appears to be changing. In January 2008 the US Department of Health and Human Services recognised certain interoperability standards for health ICT which federal agencies have to include in procurement specifications for certain fields of health. This could be a step towards mandatory use of a limited number of standards for principal e-health applications. The European Commission and the Member States may be well advised to develop a common strategy and roadmap to develop e-health standards before these first steps are taken elsewhere in directions less favourable to the EU. The collaboration initiative of ISO, CEN and HL7 which started in August 2007 should be strengthened. The large-scale pilots for patient summaries and e-prescribing planned to take place in Member States should be extended to other key applications. Standards for a European e-health infrastructure are also necessary.

SUMMARY OF POLICY ACTION LINES TOWARDS ICT STANDARDS ADOPTION

| | |
|---|---|
| ***Rationale*** | Low level of ICT standards adoption, frequent use of proprietary standards → interoperability problems |
| ***Objectives*** | Promoting industry-specific standards if they are not widely used but offer proven benefits |
| ***Links with DG ENTR policy*** | General standardisation policy<br>Europe INNOVA standardisation networks |

### *1.4.3 e-Skills policy*

IMPORTANCE OF E-SKILLS

The European e-Skills Forum has adopted a definition of e-skills that covers three main categories:

- **ICT practitioner skills**, describing, for instance, the capabilities for researching, developing, designing, planning, managing, producing, consulting, installing, administering, and supporting ICT systems
- **ICT user skills**, describing the capabilities required by individuals to use the ICT
- **e-Business skills**, describing the capabilities needed to exploit business opportunities provided by ICT

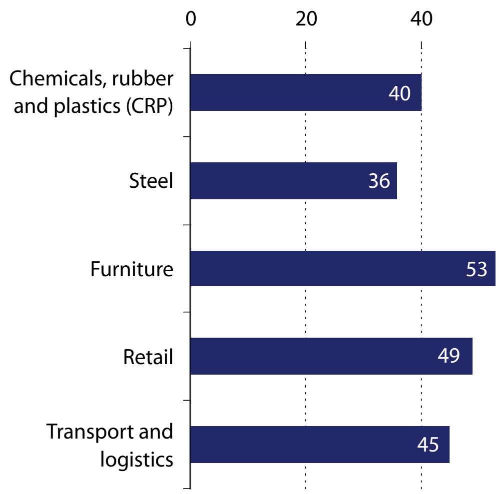
The importance of ICT skills for the competitiveness and growth of the European economy has been confirmed in several high-level documents and initiatives of the European Commission.[24] However, in the EC there are persistent concerns over the availability of ICT professionals. Furthermore, ICT user skills and e-business skills are often both necessary. It may be crucially important for the company's performance that the employees know how to use computers and software and that the management has a proper understanding of what ICT can do for the company.

There is now a wide consensus in Europe on the importance of e-skills. They are becoming central in formulating policy designed to ensure that Europe can boost the productivity and the employability of its workforce and respond to global competitive challenges. Three key messages emerged from the report of the ICT Task Force in November 2006 and the European e-Skills 2006 Conference with regard to e-skills:

- it is essential to adopt a long-term and consistent e-skills agenda;
- co-operation between the public and private sector must be improved in order to link effectively basic e-skills training, higher education and professional development;
- industry and policy makers should act more decisively and consistently regarding their strategies to promote ICT education and careers.

24. See ***http://ec.europa.eu/enterprise/ict/policy/ict-skills.htm*** for the work of the e-Skills Forum, see ***http://ec.europa.eu/enterprise/ict/taskforce.htm*** for the ICT Task Force and a related report in November 2006. See also the EC's Communication on "e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs" (September 2007) and the Competitiveness Council Conclusions on "A Long-Term Strategy for e-Skills" (November 2007).

***Exhibit 1.4-5: Companies agreeing that e-business developments have a significant impact on skills requirements***




The survey was conducted in seven EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA (USA not included in the Exhibit).

Base (100%) manufacturing = companies with at least ten employees. N for EU-7: chemicals 811, steel 349, furniture 661.

Base (100%) services = also includes companies with less than ten employees. N for EU-7: retail 1,026, transport/logistics 997.

Figures are weighted by employment («firms representing x% of employment in the sector / country».

Source: e-Business Survey 2007

## STUDY FINDINGS

The e-Business Watch studies of 2007/8 consistently show that the necessary skills must be acquired in order to implement ICT successfully. This is valid for the workforce that uses new hardware and software as well as for managers that decide about ICT investments and business organisation.

The e-Business Survey 2007 included several questions about ICT personnel. It found that large companies in particular face difficulties filling vacancies for skilled ICT personnel. More than one in five large companies in the chemicals and steel industry report this problem.

The e-Business Survey also found that e-business impacts on skill requirements (see Exhibit 1.4-5). Over a third of all companies agreed that "e-business developments have a significant impact on skills requirements", with 40% of companies in the chemicals industry agreeing to the statement, 36% from the steel industry, 53% from furniture, 49% from retail and 45% from transport and logistics (all weighted by employment).

Moreover, the econometric analyses showed that in all industries surveyed there has been a positive relationship between the level of ICT practitioners and ICT-related innovation. Many case studies conducted over 2007/8 confirm that e-skills and management changes are important for the successful implementation of e-business applications.

## SUGGESTED ACTIVITIES

Developing e-skills means educating ICT professionals, educating ICT users, and providing adequate information about ICT and e-business to managers. There are two main action lines to educating ICT professionals and users. One is to **develop innovative curricula** in ICT training. The other is to promote these training schemes among young people to attract talent. This requires close cooperation between policy, educational organisations and the ICT industry, typically in the form of "multi-stakeholder-partnerships".[25]

Many companies see ICT and e-business as a cost factor rather than an investment in benefits. Consequently, **improved awareness and knowledge** about the effects and sustainability of e-business technologies would help companies make better informed decisions. European companies in all sectors could benefit from enhanced e-business knowledge transparency and transfer at both European and national levels. Dissemination activities about e-business could be improved across the European Union. Networks of excellence involving public research institutions, retail associations and companies could be established and promoted to facilitate the transfer of knowledge on ICT and e-business practices. In European Commission research and consulting projects, the project partners are usually expected to disseminate their findings. They often do so through expert workshops and conferences, leaflets and brochures, website presentations and newsletters.

e-Skills shortages are a horizontal issue which concerns practically all sectors. There may nevertheless be a need for **industry-specific approaches**. Regarding ICT user skills, the situation may be improved if university courses that do not focus on ICT subjects also include ICT training elements. For example, medical schools could offer ICT training on hospital information systems. Regarding management skills, the most effective way to reach SME

25. A study by the EC, DG Enterprise and Industry, on «Multi-stakeholder-partnerships for e-skills» (2007) has assessed different approaches and identified best practices.

managers with valuable information on ICT may be through industry-specific, tailor-made and personalised information channels such as industry associations.

### INDUSTRY-SPECIFIC POLICY ISSUES

Several of the 2007/2008 studies mention sector-specific issues related to e-skills:

In the **chemicals industry**, case studies demonstrate that, in smaller companies, the understanding and commitment of the management is critical for introducing ICT-based innovation in the firm. Targeting the owners and managers of smaller companies may therefore provide key leverage to accelerate sector wide adoption of e-business. Policy initiatives and e-business programmes in this field found that it is important to address decision makers in companies by offering them adequate information resources. These resources should not be too technical or detailed. They should concisely explain the options available and highlight their advantages and disadvantages.[26]

The **steel industry** suffers from the largely inaccurate image of a declining industry. As a consequence, the sector may face difficulties attracting skilled employees, including in the field of ICT. The situation calls for more activity from steel firms themselves, their industry associations, and public policy. They could do much to raise awareness of the importance of ICT and e-business skills in steel companies. Related activities could include promoting managerial understanding of e-business and related benefits as well as improving skills to make best use of ICT and e-business applications. The industry would also be well advised to promote good practice in e-skills development and training in steel companies. Furthermore, decision makers can support e-learning solutions to support e-skills development. Results from the project "Equality and Diversity Learning in the European Steel Industry" (EDLESI), carried out with the support of the EC, may help to develop such e-learning solutions.[27]

In the **furniture industry**, innovative ICT applications require changes in organisation and working procedures. Upgrading skills and training personnel are important to ensure new applications are successfully implemented. Policy may have a role in encouraging the improvement of skills related to the reorganisation of working processes and the implementation of innovative technologies. A business example of the diffusion of Computer-Aided Design (CAD) in Sweden and a case study about the Danona company in Spain show the importance of improving skills in e-business initiatives. Design and creativity are strengths of the European furniture industry. Efforts should be made, at both European and national level, to equip the industry with the multidisciplinary skills necessary to combine aesthetic concepts with modern production and design methods.

**Retail** companies may be interested to learn that e-sales practices have enabled SMEs to extend their once- regional sales focus to the national level. This finding was published in the e-Business Survey 2007. The report's impact analysis also highlighted that solely adopting ICT capital without arranging for complementary organisational changes and employee training provides little return on investment. Furthermore, case studies for the retail report show the benefits of firmly rooting ICT and e-business in the company's overall strategy.

In the **banking industry**, an increasing number of jobs are being changed from traditional tellers to branch advisors and counsellors. This means that bank staff are under increasing pressure to provide highly qualified financial advice rather than to perform labour intensive and comparatively simple teller functions. Case studies provide examples of effective retraining of personnel. Restructuring branches and using ICT for process efficiency does not necessarily reduce a company's work force. To ensure such positive developments, trade federations and industry associations may play an active role in skills development among branch bank staff.

High and medium-skilled labour is required to maximise the impact of **RFID**. Enterprises adopting RFID may therefore be hiring new staff and developing specific training programs to re-qualify their employees. In parallel, RFID technology vendors will most likely hire new personnel and develop training pro-

26. See: European Commission, DG Enterprise and Industry (2007): Benchmarking e-Business Policies in Support of SMEs. p.16.

27. See ***http://www.idec.gr/edlesi/*** and the opening page of the related e-learning platform at ***http://idec.static.otenet.gr/edlesi/training/***.

grams to acquire RFID-specific skills. Considering the technology's expected adoption growth over the next five years, access to RFID training programs will be an important factor for the industry. Hence, it is important to design training programs that cater for the different operational needs of enterprises. The firms adopting RFID, industry associations, and public policy could all become more active in this respect.

Skills-related policy initiatives may also be relevant for improved use of **intellectual property rights** in ICT-producing SMEs. Recent literature about IPRs in high-tech SMEs points to somewhat contradictory findings. SMEs use fewer IPRs than larger enterprises because of their smaller endowment with resources and skills. On the other hand, SMEs actually use their IPRs well, especially patents, so perhaps the potential market failure is not so relevant. Furthermore, the study found that business models directed towards open source software also require specific IPR skills for managing licensing and copyrights.

SUMMARY OF ICT SKILLS POLICY ACTION LINES

| | |
|---|---|
| ***Rationale*** | Difficulties in filling vacancies for ICT professionals, lack of development of ICT user skills and e-business skills |
| ***Objectives*** | Develop, promote and implement a European e-competence framework and national e-skills strategies; support multi-stakeholder initiatives<br><br>Enhance distribution of e-business knowledge for managers |
| ***Links with DG ENTR policy*** | European e-Skills Forum<br><br>Industry-specific e-skills projects |

### *1.4.4 Promoting ICT and e-business in industries' value systems*

ABOUT THE IMPORTANCE OF VALUE CHAINS AND VALUE SYSTEMS

The term value chain refers to companies' activities in procuring, producing and marketing goods. This may comprise activities ranging from extracting and processing raw materials, producing semi-finished and finished goods and selling finished products to the end customer, to all kinds of support services. The principal items of a company's value chain considered here are procurement, production, marketing, sales, and distribution. The term value chain refers to in-house operations, while activities in company networks are referred to as value systems.[28] Effective management of a company's value chain is essential to gain a competitive advantage.[29] This applies to single companies as well as to industries across different regions or in the European Union as a whole.

STUDY FINDINGS

ICT and e-business applications may considerably enhance value chains in all industries. This has a particularly beneficial impact on intermediaries, but ICT offers opportunities for improvement in all parts of the value chain. Findings from the e-Business Survey 2007 show that considerable numbers of companies use ICT and e-business to enhance their value chains. The findings also show that there is still much scope for improvement. Many case studies conducted for the e-Business Watch show the benefits of e-business use in value chains.

Barriers to the adoption of e-business are apparently often related to hampered network effects. In all sectors of the e-Business Survey 2007, "suppliers and customers not being ready for e-business" was mentioned as the most important reason for not applying e-business more intensively (see Exhibit 1.4-6). Companies representing 62% of employment in the CRP industries, 57% in the steel industry, 75% in the retail industry, 64% in retail and 70% in transport and logistics agreed on this point. The concern can be traced back to a lack of e-business adoption on the part of SMEs, of which many are "suppliers or customers not ready for e-business". The second most important reason mentioned was that the company was perceived as being too small. Many of the companies surveyed also continue to see e-business technologies as being too expensive.

SUGGESTED ACTIVITIES TO FOSTER VALUE CHAIN DEVELOPMENT

In recent years, several EU Member States have launched **initiatives to facilitate e-business in**

28. See Annex V: ICT and e-Business – key terms and concepts, "e-Business and a company's value chains".
29. See Porter, Michael (1985): Competitive Advantage: Creating and Sustaining Superior Performance.

*Exhibit 1.4-6: Percentage of firms with low or no e-business use saying that ... is an important reason to not use e-business more intensively*

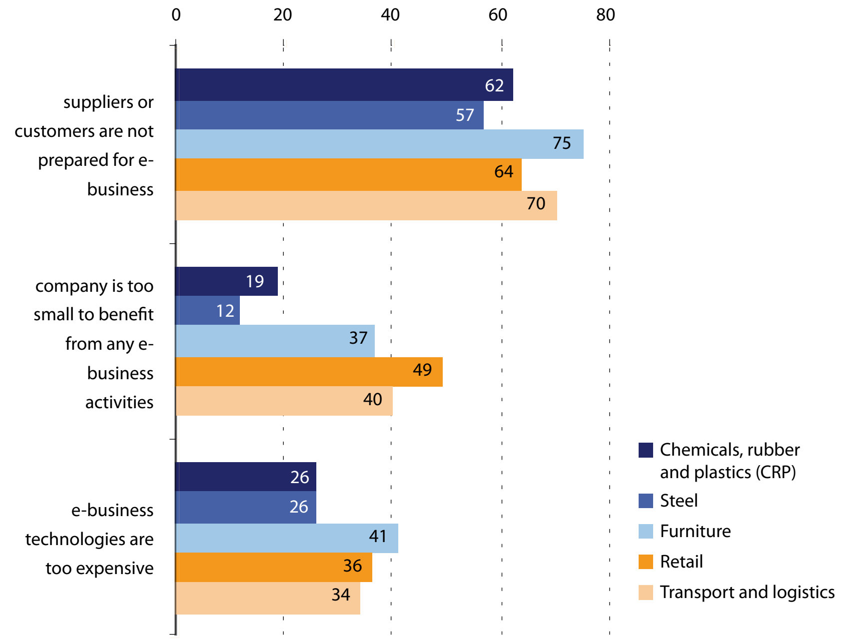



Exhibit includes data from 7 EU Member States (DE, FR, IT, ES, PL, SE, UK).

Base (100%) manufacturing = companies with at least ten employees saying that e-business plays some or no role in their operations. N for EU-7: chemicals 600, steel 284, furniture 510.

Base (100%) services = also includes companies with less then ten employees saying that e-business plays some or non role in their operations. N for EU-7: retail 756, transport/ logistics 721.

Figures are weighted by employment («firms representing x% of employment in the sector / country».

Source: e-Business Survey 2007

**industry supply chains.**[30] A key objective in most of these initiatives is to enhance SME participation in digital value chains. Large companies are increasingly streamlining and integrating their procurement processes, often with advanced e-procurement schemes based on standardised data exchange. As a result, smaller firms that cannot comply with the technical requirements of their customers risk elimination from the supply chain. The risk of negative effects on regional or national economies has motivated the EU initiatives.

e-Business policy initiatives that address this challenge typically aim at harmonising data exchanges between players in different segments of an industry supply chain. They operate in a way that takes the requirements of SMEs into consideration. The objective is to close the digital divide by supporting smaller firms in coping with ICT requirements. The involvement of large enterprises in such projects is important, because they are often key nodes in the industry's value chain. The strategic approach of these initiatives is therefore to create a win-win situation for all players involved, not only for small firms. This goal is close at hand. Buyers and sellers both stand to gain from exchanging data electronically based on agreed standards and processes. In particular, large manufacturers that maintain B2B exchanges with many business partners will benefit from improved overall e-maturity in their supply chain.

However, to achieve these mutual benefits, agreements among stakeholders on numerous complex issues are necessary. To cope with these challenges, time and adequate resources are required. These value chain initiatives will need to operate on a larger scale than earlier awareness raising policies, and to involve a broader base of stakeholders. Excellent project management, involving coordinators that are broadly accepted by the target groups, is therefore essential. Moreover, existing initiatives confirm that technical innovation in SMEs goes hand in hand with organisational innovation, requiring "soft skills", such as in change management.

To support the inclusion and participation of SMEs in vertical industrial value chains, the EU and its Member States could build on the momentum of existing ICT and e-business initiatives, ,or consider entirely new ones. Action can be seen as an instrument of sustainable and integrated industrial policy. While the European Commission could focus on the cross-border aspects of e-business, the Member States could consider launching national or regional value chain projects.

30. The information in this section is partly taken from the report "Sectoral e-Business Policies in Support of SMEs" conducted for the European Commission in 2007.

SECTOR-SPECIFIC IMPLICATIONS

A sectoral focus in digital value chains will facilitate the involvement of experts and associations with sectoral background and reputation. However, the most innovative policies will also recognise cross-sectoral aspects in consultations on data exchange standards, since smaller firms typically deal with customers from different industries.[31] In practice, ICT and e-business initiatives often take several years, first to bring together a critical mass of participants, and then to deal with the complexity of many firms and stakeholders.

Activities that foster supply chains could pay particular attention to industries which are important suppliers or customers in a given sector but which have a particularly low level of e-business applications. Initiatives that foster supply chains in the **steel industry** could for instance target the household goods industry, an important customer of the steel industry, but which use much less ICT and e-business than, say, the automotive industry.

SUMMARY OF VALUE CHAIN POLICY ACTION LINES

| | |
|---|---|
| ***Rationale*** | Suppliers and customers are not ready to apply e-business more intensively;<br>large firms in particular report difficulties in convincing SMEs of the benefits e-business has to offer |
| ***Objectives*** | Support industry-specific e-business networks, particularly including SMEs |
| ***Links with DG ENTR policy*** | eBSN activities to promote SME best practices |

### *1.4.5 Other policy implications*

Two of the ten large studies conducted by the SeBW in 2007/8 produced policy implications that cannot be subsumed under the three key issues of standards adoption, e-skills and value chains. These studies focused on "ICT impact on energy consumption" as well as "ICT adoption and its impact on innovation and performance". While the study about energy consumption produced very specific policy implications, the study about ICT impacts noted very general issues.

USING ICT TO REDUCE ENERGY CONSUMPTION

A key finding from the study about ICT and energy consumption is that electricity intensity was found to be dampened by communication devices, while computers and software were found to increase the intensity of electricity use. An analysis of ICT capital, energy and other production factors on production efficiency showed that both ICT and energy use have an overall positive impact on productivity. Output elasticities vary strongly according to industrial sector. This observation calls for coverage of additional sectors in future research. Energy Monitoring and Management Systems (EMMS) were found to help mitigate energy consumption. Finally, the study found mixed and largely lacking empirical evidence in the literature on the net benefits of ICT on energy consumption and its influence on consumer behaviour.

These findings lead to the following policy implications. First, **promoting the diffusion of communication technologies** seems worthwhile since they influence the electricity intensity of production and the company's productivity. However, computers and software have an ambiguous influence. They increase energy intensity as well as productivity. Hence there is a trade-off in this respect. Recommendations are dependent on priorities of policy makers regarding the reduction of energy intensity and the enhancement of productivity. Second, the **promotion of EMMS** as a way to target support for energy-reducing ICT, and energy consumer education, would reduce the energy intensity of production. Third, **improved data bases** would enable a more reliable and extensive quantification of economic interrelations and the coverage of additional sectors and countries.

POLICY IMPLICATIONS FROM THE STUDY OF ICT ADOPTION AND IMPACTS

The study of ICT adoption and impacts set out to provide a cross-sector analysis applying econometric methods. This bird's eye view on ICT and e-business identified the following reasons for policy actions: The productivity gap between the EU and the US has increased since 1995. In addition, in the

31. The best known example of this type of e-business policy is the large-scale action plan «ICT-SME 2010» in France (see ***www.ticpme2010.fr/***). This programme was started in 2005 and will run until 2010. It supports and coordinates digital value chain projects in about 20 sectors. The concept has triggered wide interest in other EU countries. Its activities and results are closely followed and discussed within the e-Business Support Network.

EU, SMEs are the traditional engine for innovation and employment. It is therefore worrying to note that they are lagging behind in the adoption of ICT and are thus less likely to benefit from ICT-enabled innovations. It is unlikely that EU productivity growth will pick-up by itself. These trends appear to be independent of natural variations such as European business cycles.

The situation calls for the **creation of fully integrated common markets** in the EU. Despite significant efforts and progress, European product and factor markets are still not fully integrated. Key product, service and financial markets such as banking and financial services, telecommunications, or energy are governed by specific legislation which differs in almost all Member States. Numerous structural impediments such as differences in educational degrees and exemptions from fully integrated labour markets for new Member States all hamper full labour mobility in the EU.

The study on ICT adoption and impacts substantiated that these impediments and rigidities limit the usage of ICT. For example, firms with long-term contractual relationships with business partners were found to be more likely to use ICT, which in turn enables them to implement new organisational structures and ICT-enabled innovations and to benefit accordingly. However, different national legislations and regulations make it more costly for firms to keep long-term relationships with companies in other EU Member States, to change and adjust their organisational structures, or to enter new markets. Companies cannot simply develop and implement uniform strategies and solutions on a European scale; they need to adjust to country-specific differences.

More efforts and progress are needed to create liberal and truly integrated product and factor markets. While the EU Commission has been working towards this objective for years, its completion has been repeatedly slowed down by various types of political resistance. The present political climate and the new complication in reforming EU institutions since the enlargement of the EU are unlikely to accelerate Single Market policies. It may be more realistic to call for policies that **develop better coordination and efficiency at the EU level in specific areas**. These may create building blocks for a gradual convergence towards single markets. An example of such an approach is the Member States' large-scale pilot in the field of e-health which is planned to start in the summer of 2008. The project is being funded by the ICT Policy Support Programme (PSP) in the context of the European Competitiveness and Innovation Framework Programme (CIP).[32]

### 1.4.6 References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- European Commission (2007): ***Sectoral e-Business Policies in Support of SMEs. Innovative approaches, good practices and lessons to be learned. A study by empirica, Databank, IDATE***. Version 1.1. November.
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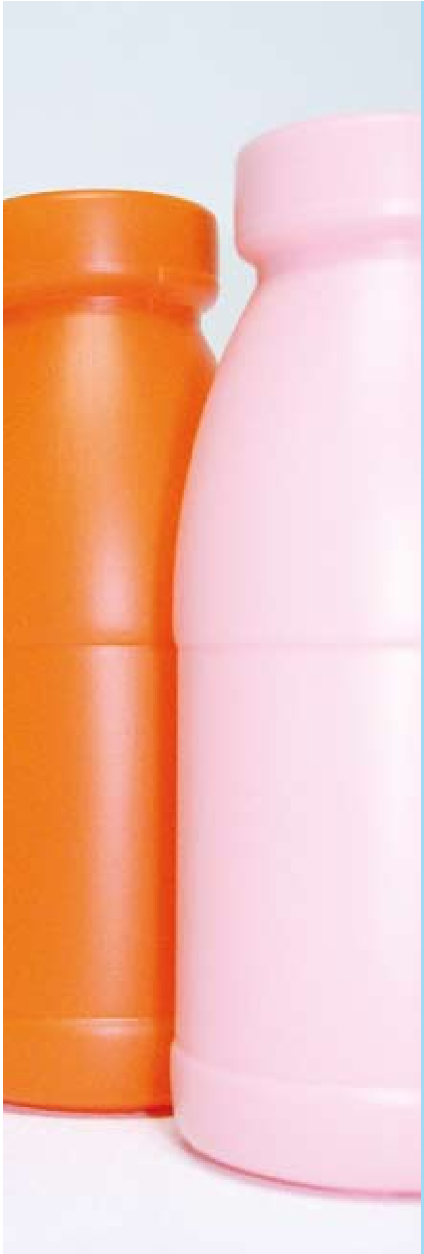
32. See Section 3.4 in this report about ICT standards in the health sector.

**PART 2**

# e-Business sector studies

## 2.1 Chemical, rubber and plastics

This e-business sector study was conducted by empirica GmbH (***www.empirica.com***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).



**Key findings**

***More companies are «e-ready».*** *The ICT infrastructure of companies has significantly improved since the last measurement by e-Business Watch in 2003, notably among SMEs in the sector. The installed base of e-business software such as ERP (Enterprise Resource Planning) has also increased.*

***Digitisation of business processes is gaining momentum.*** *Companies in the sector are eagerly embracing opportunities to replace paper-based, manual processes by electronic exchanges. One way to achieve this is to outsource e-business related processes to specialised service providers. These "e-intermediaries" either focus on a specific process (a good example is e-invoicing) or try to cover the full spectrum of B2B exchanges. Elemica is the most important "B2B connectivity hub" for companies in the chemical, rubber and plastics industry.*

***Increase in e-commerce transactions.*** *The intensity of e-commerce (measured as the average share of orders which a company receives online) has significantly increased, from about 5-8% in 2003 to about 25-30% in 2007 (among companies accepting online orders, i.e. about a third of all firms active in the sector). e-Commerce includes orders placed on their own website, through internet trading platforms, extranet connections with customers and via EDI.*

***From transactions to "e-solutions": new opportunities for customer service.*** *Companies realise that e-business is not only for facilitating business transactions (e.g. placing orders, invoicing and making payments), but increasingly for providing related information (e.g. product information about chemicals) at any time the customer needs it. ICT offer enormous opportunities for customer service. Offering customers a range of "e-solutions" is the way forward in e-business.*

***Moderate direct impact of ICT capital – complementary factors matter.*** *A macro-economic analysis finds only a moderate impact of ICT capital investments on value added growth and on productivity growth in the sector. However, results indicate a skill-biased technological change with ICT-capital as a complementary factor for driving growth. Furthermore, ICT can be embedded in other infrastructure, for example in the complex equipment of chemical plants, which is not accounted for in data on ICT capital. Thus, there is possibly a "hidden" ICT-impact.*

### *2.1.1 Context and background*

SCOPE OF THE STUDY

The chemical, rubber and plastics (CRP) industries as defined for this study cover the manufacture of chemicals, chemical products and man-made fibres (NACE Rev. 2 20), and the manufacture of rubber and plastic products (NACE Rev. 2 22). It is one of the largest manufacturing sectors, providing jobs for more than three million people in the EU. As a major supplier to many other industries, and as a provider of innovative materials and technological solutions, the sector is important for industrial competitiveness as a whole.

INDUSTRY CHARACTERISTICS AND TRENDS

**Value systems:** The use and impact of e-business depends to a large extent on the structure of value systems and the business relationships between companies, rather than on product characteristics only. The CRP industries consist of at least five main value systems. The chemical industry (NACE 20) has adopted a convention of defining itself in three main sub-sectors, which do not directly correspond to the NACE classification: basic chemicals, fine and speciality chemicals, and formulated chemicals. These are complemented by the value systems of the two "converting industries", the manufacture of rubber (22.1) and plastic products (22.2).

**Industry structure:** While the chemical industry, and in particular the manufacture of basic chemicals, is dominated by large or even global players (more than 60% of employees work in large firms), the rubber and plastics products industries are characterised by a much larger number of small and medium-sized enterprises (SMEs), many of whom are highly specialised.

**International trade:** Europe is still a major player in the global CRP industries, but it experiences increasing competition, notably from Asian competitors. In the total CRP sector, the EU had a positive trade balance in 2006 with a surplus of about €36 billion (for the EU-27). The chemical industry (NACE 20) accounts for most of the surplus. However, as in most industries, production in the emerging economies, notably the Asian-Pacific and Latin-American markets, has experienced enormous growth since the late 1990s. Annual production in Asia increased by more than 70% between 1994 and 2007, compared to about 20% in the EU. Globalisation leads to new market opportunities and rising competitive pressure in parallel. Depending on the sub-sector and the positioning of the individual company, either of the two can prevail from a single company's perspective.

**Key challenges:** In addition to global competition, a key challenge for the European industry is coping with environmental regulation, notably the REACH regulation. REACH requires that any enterprise that manufactures or imports more than one tonne of a chemical substance (per year) must register this by means of a registration dossier, which must be submitted to the European Chemicals Agency (ECHA), which was specifically founded for coordinating this activity.[33] ICT vendors have developed specific software that helps companies in complying with REACH (see 1.1.2).

Another critical challenge for the industry is the sharp increase in prices for raw materials (in particular for crude oil) and energy costs over the past few years. The chemical industry is a major energy user, accounting for 12% of total energy demand in Europe.[34] However, in spite of increasing competition in the market, chemical companies often still have the negotiating power to successfully command higher prices, and thus pass on the rising costs of intermediate inputs to their customers. For some segments of the sector (such as the tyre industry), combating counterfeiting is another challenge; emerging technologies such as RFID could be helpful in this regard.

An important goal for European policy is to ensure a level playing-field, i.e. that EU exporters do not face obstacles which their competitors, when importing into the EU, do not experience.

## *2.1.2 ICT adoption and e-business use*

### ICT INFRASTRUCTURE AND ICT SKILLS

The quality of companies' basic ICT infrastructure has significantly improved in recent years. Nearly all companies in the CRP industries are now connected to the internet, and most of them with a better quality than a few years ago, notably SMEs. For example, the share of small firms (with 10-49 employees) that have **broadband** internet connections has increased from 10% (2003) to nearly 40% (2007). Other examples of the improved "e-readiness" are:

- **Remote access:** The percentage of SMEs capable of remote access to their computer network has significantly increased.
- **Wireless LAN on the rise:** Diffusion of internal W-LANs has been rapid. Close to 60% of employees work in companies that operate a W-LAN, and more than 30% of small firms operate a W-LAN.

However, there is still scope for further infrastructure improvement. Questions are inevitably raised by the fact that even among large firms only 50% report to have broadband connections.

**More "e-workers" in the chemical industry:** In the chemical industry, the average share of employees

33. ECHA, which is based in Helsinki, started its operations in June 2007. It was set up by the European Commission, with an initial staff of about 100 (to be increased to over 400 persons by 2010). Cf. ***www.cefic.org***.

34. See CEFIC information about energy (***www.cefic.org***), Nov. 2007.

that have access to the internet is higher than in the rubber and plastics industry. This reflects the higher degree of automation in production process in this industry segment.

**ICT skills:** About 20% of the firms interviewed employ ICT specialists. Only one in seven of those reported difficulties in finding qualified ICT practitioners. However, many companies (notably smaller ones) outsource a good deal of their ICT functions to external service providers. The broadly discussed shortage of ICT practitioners thus concerns mostly the larger firms with their advanced software architectures, as well as ICT service providers. A more general concern is the managerial understanding of e-business concepts, notably among SMEs, for instance those in the rubber and plastics products sectors. Here, "e-skills" means predominantly that the company's management has a good idea of what the company can do with ICT and a strong commitment to introduce organisational changes, if needed.

## ICT FOR INCREASING PROCESS EFFICIENCY

Improving the efficiency of business processes, for example in procurement, production and supply chain management, is an important objective for all manufacturing businesses. However, the potential depends on the structure and characteristics of the respective value and supply chain. Companies from the CRP industry, depending on the segment and size of operations, have chosen different approaches to building their supply chain, linking to suppliers such as raw material providers (upstream) and to customers, including those within the same sector as well as in other sectors such as the automotive, construction and retail sectors (downstream). Some examples of ICT tools and approaches to make gains in process efficiency are presented in this section.

### ERP systems – a backbone for internal process integration

Supply chain integration via connecting Enterprise Resource Planning (ERP) systems or similar standard software packages is the most advanced approach

**Case study: Zachem, Poland: ERP implementation and organisational transformation**

*Zachem S.A., headquartered in Bydgoszcz, Poland, is a large company (with about 1,400 employees) supplying organic and inorganic chemical products to the chemical and power industry. Founded as a state company, the firm was of strategic importance for chemicals production in the former state-controlled industry system. With the political and economic transformation that started in 1989, it became clear that the firm was not able to maintain its large size and extensive scope of operations. It needed to become more efficient and flexible in order to survive in the new competitive environment.*

*A problem in this context was the lack of fast, accurate information for management decisions. The firm needed a more efficient information management system. The management decided in 1999 to implement an ERP system as a backbone to improve the internal planning and decision-making processes. Altogether, 120 of Zachem's employees and 30 external consultants were involved in the project. Nearly 300 employees went through training on system functionalities.*

*The introduction of the system went hand in hand with far-reaching organisational changes which completely transformed the company's information culture, including the digitisation of a large part of its business documents. Today, all white-collar workers use ERP-based tools on a daily basis. The company reports that the substantial complementary investments made in human capital (during the implementation phase) constituted a major source of the added value that came from the system.*

*However, Zachem uses the system only to manage its internal activities. Electronic integration with suppliers and customers has not taken place and is not considered by the management at the moment. Zachem says that each of its five production units has their own organisational structure and operates in a different value chain, which would make it very difficult to link their suppliers and customers to one central system.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

which medium-sized and larger companies in the sector prefer in order to manage their operations. ERP systems are software systems that help to integrate and cover all major business activities within a company, including product planning, parts purchasing, inventory management, order tracking, human resources, project management and finance. Ideally, they link business processes electronically across different business functions and thus help to improve efficiency in those processes. In addition, ERP systems can play an important role in supporting connectivity between enterprises; however, the extent to which companies link their internal system with those of suppliers or customers differs. In any case, the implementation of an ERP system is a complex venture and a critical milestone for any company. It inevitably requires a critical review of existing business processes and the introduction of necessary changes, as the case study on Zachem demonstrates (see box, p. 75).

The use of ERP systems is widespread among companies from the CRP industry. The earlier study of 2004 already found that the chemical industries are among the sectors with the highest ERP adoption rates. In 2007, companies representing close to 70% of employment said they had an ERP system in place (see Exhibit 2.1-1). The main gap in ERP adoption is between small firms on the one hand and the medium-sized and large firms on the other. The most important finding is that the deployment of these software systems has significantly increased since 2003.

**e-Procurement**

From a value chain perspective, the potential use of ICT and e-business starts with e-procurement. In the CRP industries, about 60% of small firms and 70% of medium-sized and large ones said in 2007 that they ordered at least some supplies online, either on the internet, from a supplier's extranet or via direct online connections with suppliers such as EDI (see Exhibit 2.1-2). Adoption has increased by 10-15 percentage points since 2003. The intensity of e-procurement activity has also increased: the average share of supplies purchased online (as % of total orders) is higher. e-Procurement promises companies cost reductions through process streamlining and often through improved purchasing conditions.

**ICT usage in production processes**

After e-procurement, the next segments of the value chain are production and logistics. The growing complexity of production and distribution of products leads to increasing needs to monitor and control such processes. This holds true for the chemical, rub-

**Case study: *Michelin Reifenwerke, Germany: The use of RFID technology in production processes***

*Founded in 1971, the Saarland Homburg plant is one of the most complex plants within the Michelin group. It produces new tyres, retread REMIX tyres, rubber mixtures, steel cord mesh and tyre fitting. Around 1,300 employees work at the plant location. For the company, product and process innovation is a top priority, with ICT playing an important role. One example for ICT-enabled process innovation is Michelin's self-developed system for replacing the existing barcode in tyre retreading, which is based on RFID technology.*

*The main reason for considering RFID was dirty bar code labels. As a result of unavoidable soiling, the handling effort of tyres increased because the automatic scanning station could no longer recognise many of the tyres. Many old labels had to be removed and replaced with new ones. But even apparently intact, clean labels bear the risk of non-readability. The main goal was to improve process efficiency in the handling of tyres by replacing the barcode labels on tyres with transponder labels. After observing RFID developments for several years and exploring different options, the company decided to introduce this innovation in 2004/05. The planning and implementation phase took about three years, and now the system is operational. The company has eliminated the use of barcode labels in most areas of tyre retreading. RFID-reading devices were installed at all stations. Intervisibility for reading is no longer a requirement, and additional information can be stored. The company feels that this has had a positive influence on the management and control of the production process.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

ber and plastics industry, in particular for the specialised segments. The case study (see p. 76) shows how RFID technology is used in the production of tyres at one of the German plants of Michelin.

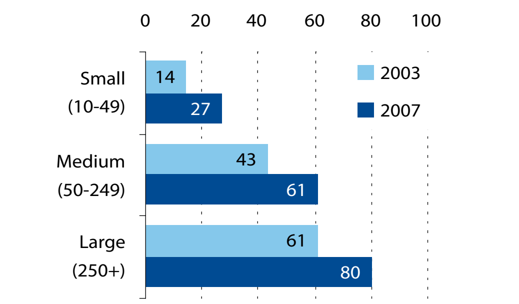
### ICT to support REACH compliance

New requirements for compliance with the REACH regulation (see previous section) have opened up a new, potentially highly relevant and sector-specific ICT application area. The REACH regulation is complex and difficult for companies to implement, since they have to rethink their organisation, processes and information systems to be able to gather, manage and declare large sets of information about the chemical substances they use and produce. Specialised software modules could help companies to deal with this challenge. A spot check in the software market conducted for this study showed that several software providers have developed (or are currently developing) specific REACH applications, which are sold either as stand-alone solutions or as add-on modules to existing software, notably ERP systems. In particular, the large vendors such as SAP and service providers that have specialised on solutions for governance, risk and compliance have developed specific applications or modules. However, software for REACH compliance is still a very recent development; the deployment of these applications has only just begun. It is too early to speculate about the diffusion which these solutions will have.

### Standards for e-business

Standards for electronic data exchange include formal standards approved by a recognised standardisation body as well as industry specifications which result from collaboration in consortia or smaller partnerships with differing levels of openness and participation. e-Business standards can be grouped into categories, depending on what they are used for and according to their technical foundations. This includes identification standards, classification standards, catalogue exchange standards, transaction standards and business process standards.[35] In the CRP industries, EDI-based standards (EDI stands for electronic data interchange), such as UN/EDIFACT, are still among the preferred e-business messaging standards, notably among the transaction standards, and in particular among medium-sized and

***Exhibit 2.1-1: CRP industries: % of firms with an ERP software system (2003/07)***

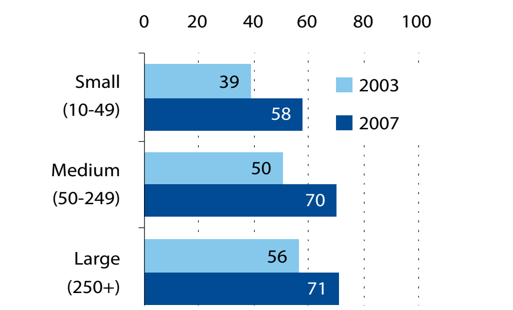



Base (100%) = companies using computers from 5 EU countries (2003) / 7 EU countries (2007).

N (2007) = 811,
N (2003) = 502.

Source: e-Business Surveys 2003 / 2007

***Exhibit 2.1-2: CRP industries: % of companies placing orders to suppliers online***




Base (100%) = companies using computers from 5 EU countries (2003) / 7 EU countries (2007).

N (2007) = 811,
N (2003) = 502.

Source: e-Business Surveys 2003 / 2007

large firms. Close to 30% of medium-sized and close to 50% of large firms reported that they used EDI. By contrast, the usage of XML-based standards for e-business is apparently only slowly gaining ground. Only about 10% of firms (accounting for 16% of employment) said they used XML-based standards. However, standards can be embedded in business systems for managing, processing and exchanging data, and companies that use these systems may not be aware that they are actually using a certain electronic standard. It is therefore hard to assess the actual deployment of different standards.

This holds true for the Chem eStandards by CIDX, the Chemical Industry Data Exchange. They have been developed specifically for data exchanges related to the buying, selling and delivery of chemical products. They are based on XML and were developed through

35. Categories of e-standards as proposed in «eBusiness 2007/08 – Jahrbuch der deutschen Wirtschaft» (2007), p. 46f., and PROZEUS information brochures (***www.prozeus.de***).

a cooperative effort of more than 20 chemical companies in late 2000. The core of the Chem eStandards is the message standards (current version 4.0). They are available in a "starter edition" which supports basic aspects of the order-to-invoice process, and as a "complete edition" with additional components for more advanced users. Chem eStandards are widely used in the industry, notably by the large chemical companies in their e-business activities, but also by Elemica (see next section).

### BUSINESS PROCESS OUTSOURCING AND "E-INTERMEDIARIES"

Another opportunity for companies to gain in process efficiency is to outsource e-business related processes to specialised service providers. These "e-intermediaries" either focus on a specific process (such as e-invoicing) or try to cover the full spectrum of B2B exchanges, promising companies to make their exchanges with suppliers and customers more efficient. This section introduces two examples of such e-intermediaries

**Elemica**

The most important intermediary in the CRP industries is Elemica, a platform and network provider for the global chemical industry, developed by 22 leading chemical companies in 2000. Elemica claims that it is not an "aggregator" of chemical purchasing, nor a "buyer," "seller," or "owner" of products, but a facilitator of transactions (order processing and supply chain management of contract and repeat chemical transactions).

The similarity with marketplaces (such as ebay) and other intermediaries (such as credit card companies) is that Elemica is financed by transaction fees: for each transaction conducted by members through the Elemica network, a certain fee is charged. However, apart from this parallel, Elemica is a horizontal and vertical B2B intermediary which does not present itself as an e-marketplace in the sense of a trading platform. The benefits which companies that connect via Elemica aim to reap is increased efficiency and effectiveness in transaction processes; "effective-

**Case study: Acordis / OB10, UK: the use of electronic invoicing**

*This case study evaluates Business Process Outsourcing (BPO) for the receipt of supplier e-invoices through a solution provider OB10, for an 'early adopter' chemical company, Acordis, in the UK. A manufacturer of cigarette filter tow and acetate film, it was one of the early adopters of the new B2B tax compliant electronic invoice delivery service brought to the market by OB10 in 2001.*

*With existing efficient purchase order disciplines and 99% electronic payment already in place, Acordis aimed to enrol the goods-for-production suppliers into electronic invoice delivery, automating the entire process and making available for more value added activities the staff released from the tedium of data-entry. After checking its references, Acordis contracted with OB10 in April 2003 to replace paper invoices with a compliant electronic service, and started the supplier enrolment campaign in the same year.*

*Before Acordis commenced this project, they were receiving approximately 30,000 invoices per year from their supplier base within the project scope. The percentage of paper invoices exceeded 99%. By mid 2007, 56% of Acordis invoices in project scope were routinely delivered electronically by OB10.*

*Both the invoice issuer (the supplier to Acordis) and the receiver (Acordis, as the customer) pay fees to OB10 related to this Business Process Outsourcing. This is more than balanced by the benefits for both sides. The benefit to suppliers is that OB10 guarantees delivery of their invoices directly into the Acordis financial system, ready for processing. This removes the potential for lost in mail, delays or mis-keying upon entry into Acordis' financial system. As a result, it was possible to restructure the Acordis A/P department and reduce it from three operational sites in the UK to two, with direct gains in process efficiency and productivity. Moreover, Acordis secured a stronger reputation with its vendor community as a reliable / on-time payer of its invoices.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

ness" means in particular a reduced error rate compared to manual or other non-standardised forms for data entry and transmission; "efficiency" means in particular reduced processing times.

**Outsourcing e-invoicing to financial service providers**

Besides providers of e-procurement solution and connectivity managers such as Elemica, there are intermediaries that focus on specific e-applications. Electronic invoicing is currently the prime example of a process where specialised third party service providers have established themselves as intermediaries. The market of service providers offering B2B e-invoicing services differs considerably between EU countries; banks are active in this field as well as specialised companies. Most of these companies do not operate in specific sectors, but provide their services widely to companies. The case study on OB10/Acordis (see box, p. 78) presents how Acordis, a chemical company in the UK, has benefited from outsourcing the receipt of supplier e-invoices to OB10, a globally operating service provider in this market.

## E-COMMERCE AND ICT FOR CUSTOMER SERVICE

ICT, and in particular the internet, can be used in various ways to support marketing activities, including communication with customers, offering products for sale, and developing new marketing strategies. An earlier e-Business Watch study on the CRP industries (of 2004) already concluded that these application areas would gain in importance in this sector. This forecast has been broadly confirmed by the new study.

*Exhibit 2.1-3: e-Commerce platforms used by companies in the CRP sector*

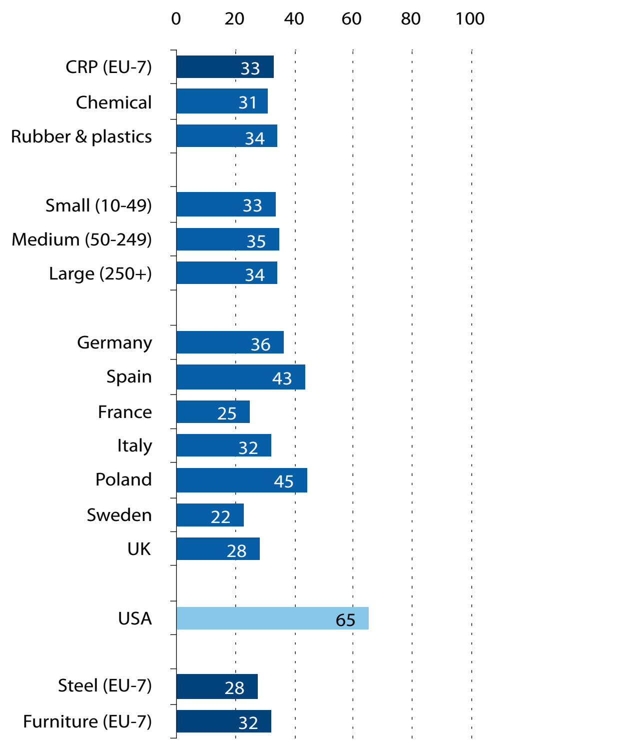
| Type | Key characteristics | Typical users in CRP industry |
|---|---|---|
| **EDI (Electronic Data Interchange)** | Point-to-point connection between two companies based on EDI standards; high set-up cost; efficient means for trade with regular customers involving frequent exchanges and large order volumes | Mainly used by large firms – widely diffused legacy system dating back to the 1970s/80s. |
| **ERP-to-ERP** | Most advanced form of electronic data exchange – enables automated processing of data from order to invoice | Mainly among large firms |
| **Extranet** | A sales portal on a company website with restricted access (typically password-protected) for customers. Functions typically include a well-structured overview of the status of all orders a customer has placed and their supply fulfilment. | Mainly operated by larger companies, often as a service for their SME customers which do not have their own advanced systems for data exchange and managing orders. |
| **Company website** | A website with an online shop function, enabling any visitor to place an order for products offered by the company. | More popular in B2C e-commerce (e.g. retail); does not play a major role in the CRP industries. Websites are mostly used for company presentations. |
| **Internet trading platforms (operated by third parties)** | An internet market place operated by a third party (or consortia from the sector), where sellers can offer their products to potential buyers. | Have not been successful in the CRP industries. Most B2B platforms did not survive the new economy crisis after 2001. |
| **Intermediaries / connection hubs** | A third-party service provider acting as an «integrator» between a seller and a buyer, by matching document formats and processes between the two trading parties. | Elemica is the best known and most important example of a connection hub for companies in the CRP industries. It was developed by 22 of the leading chemical companies. |

**Increase in e-commerce adoption**

"e-Commerce" describes the sale of chemicals, rubber and plastic products over the internet or other computer-mediated networks. e-Commerce in the CRP industries is mainly business-to-business (B2B): manufacturers of chemicals, rubber and plastics products typically do not directly sell to end consumers, but to other companies; these can be users of CRP products in other industries (for example the automotive and construction industries), but also wholesalers and retailers. Technically, companies can take different routes to e-commerce (see Exhibit 2.1-3).

About a third of all firms active in the CRP industries said in 2007 that they enabled customers to order products online. This includes orders placed on their own website, through internet trading platforms, extranet connections with customers and via EDI. There is practically no difference between companies from the various size-bands in this respect, an observation which holds true for many sectors. An intriguing detail in the results from the survey is that the adoption of e-commerce appears more widespread among US companies (see Exhibit 2.1-4). An amazing finding, however, is the significantly increased intensity of e-commerce, measured as the average share of orders that are received online. In 2003 as well as in 2007, companies were asked to estimate how large a share of their total sales to customers (2003) / orders from customers (2007) was conducted online. Back in

*Exhibit 2.1-4: CRP industries: % of companies receiving orders from customers online (2007)*



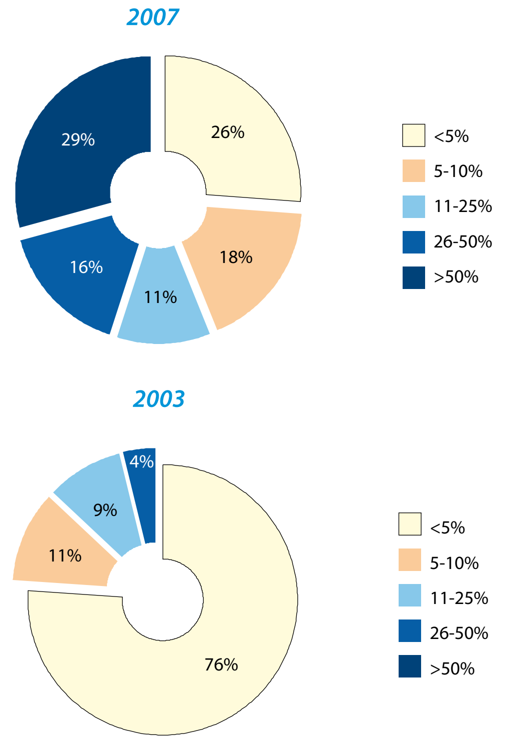

Base (100%) = companies using computers.

N (Chemical, EU-7 and USA) = 911.

Weighting: Figures for sector totals and countries are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms.

Source: e-Business Surveys 2003 / 2007

*Exhibit 2.1-5: Average pourcentage of orders received online : 2003 vs. 2007*




Base (100%) = companies accepting orders online.

N (2007) = 294, N (2003) = 42.

Weighting: Figures for are weighted by employment ("firms representing x% of employment in the sector").

Source: e-Business Surveys 2003 / 2007

**Case study: BASF e-solutions, Germany**

*BASF, headquartered in Ludwigshafen, and with production sites in 41 countries and customers in more than 170 countries worldwide, claims to be the world's leading chemical company. In response to growing requirements in all its business fields, BASF turned to modern e-business solutions to make itself available for the customer whenever needed, and has become a leading company in this respect, too. BASF is convinced that this is the way forward to manage business in a global market.*

*From 2000-2004, standardisation, connectivity and transactional performance were key success factors. In 2006, BASF revised its strategic approach by taking the purely transactional e-commerce a step further to "e-solutions". This concept, summarised by the vision "BASF e-solutions – The easy way to do business", is closely linked to the business strategy. Depending on the customer interaction models of the different business units, it positions the e-activities in a business context.*

*Key elements of the e-solutions approach are "WorldAccount" (the BASF global extranet platform) and Elemica, a neutral electronic marketplace to which BASF's ERP is linked (BASF is one of the founding companies of Elemica). WorldAccount bundles all product categories (except oil & gas) under one single internet presence. Functionalities include order placement, order status, e-reporting, access to certificates of analysis, material safety data sheets and a broad range of product information. It gives users the option to order directly via the web or via a specific fax channel ("fax-to-ERP"). In addition to targeting process efficiency and automation, a focal area of the BASF e-solutions approach is supporting marketing through direct customer interaction.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case study: Toly Products, Malta: linking sales office operations through CRM**

*Toly Products is a global supplier of high-quality plastics packaging components for cosmetic products sold around the world by leaders in the cosmetic, fragrance and skin-care industries. In the late 1990s, the company was confronted with a key challenge: to manage order requests from various sales offices in different countries and time zones. Senior management at Toly Products found that the original systems for sharing and managing data transfers were not capable of meeting the rising demands of an international business. Standardisation of processes was non-existent, and paper-based CRM was cumbersome and resource-hungry, thus constricting the enterprise-wide decision-making.*

*Against this background, Toly decided to implement a centralised CRM solution for use across its sales offices operations, to facilitate management reporting and improve customer service performance. The system was successfully introduced in 2001. It enables Toly Malta's personnel to collate and analyse data very rapidly, compare performance at different sales offices, and significantly reduce both workload and costs. Furthermore, the innovation translated into a more efficient and better customer service. For example, whereas before, following a sales order request, it would have taken Toly Malta approximately one week to send feedback to the respective sales office, it now takes less than twenty-four hours. Therefore, Toly can process five times more orders today than they could ten years ago.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

2003, a majority of those firms that sold online (about 75%) said that online sales accounted for less than 5% of their total sales. It was, for them, only a marginal sales channel. According to the new survey results of 2007, this has since changed dramatically. In 2007, 30% of the firms that receive online orders said that these orders already make up more than 50% of their total orders, and 16% said it was in the range of 25-50% of their total orders (see Exhibit 2.1-5). Based on these data, the study estimates that the average total share of sales that are conducted online in the CRP industries (by those companies that actually sell online) has increased from about 5-8% in 2003 to about 25-30% in 2007. Counting all companies, including those that do not accept orders online, the total share of online sales (as % of total sales) has probably increased from less than 1% (2003) to about 10% (2007).

**e-Business to improve customer service**

Accomplishing sales transactions is, however, only one aspect of customer-facing e-business. It becomes increasingly clear that ICT can be a powerful tool to provide customer service, in particular for companies with global operations. For examples, company extranets can efficiently channel up-to-date information (in electronic format) to customers in a fast and cost-effective way (compared to the costly and time-consuming process of updating brochures and other printed matter). Moreover, software tools such as ERP and CRM (customer relationship management) enable companies to collect, process and analyse customer data, with visible improvements in customer service. The following examples show that e-business plays an increasingly important role not only for giant companies such as BASF (see case study, p. 81), but also for small firms with an international customer base such as Toly Products in Malta (see case study, p. 81).

## 2.1.3 ICT and e-business impact

ICT, VALUE ADDED AND PRODUCTIVITY GROWTH

Studies on the impact of ICT confirm productivity-increasing effects in both user sectors and ICT-producing sectors (Oliner and Sichel, 2000). In particular, positive effects have been identified on labour productivity and total factor productivity (Pilat, 2005). An important finding is, however, that ICT-induced productivity effects vary significantly between sectors and among countries (Nordhaus, 2002). Recent research suggests that the largest productivity-growth effect occurs in the ICT-producing sectors themselves, and in selected service industry sectors like banking, wholesale, retailing, and telecommunications (Jorgenson, Ho, Samuels, Stiroh, 2007, Jorgenson, Ho, Stiroh, 2007, Inklaar, Timmer, van Ark, 2007). These results indicate that ICT-induced productivity effects are relatively less pronounced in capital intensive, mature manufacturing industries such as the chemical industry.

An economic analysis based on the EU KLEMS Growth and Productivity Accounts database[36] broadly confirms this. Growth accounting for the CRP industries in nine EU Member States suggests that the key components of **industry growth** (in terms of gross value added) are total factor productivity growth, growth in capital investments and changes in labour quality (i.e. a higher skilled workforce). Non-ICT-capital investments contributed to a higher extent to value-added growth in the CRP industries than those in ICT-capital. However, this evidence reveals that ICT can be embedded in other infrastructure, for example in the complex equipment of chemical plants. Results cannot take account of a possible "hidden ICT-impact", due to the limitations of what is measured as "ICT capital" in the data.

A key driver for **labour productivity growth** (measured as gross production value per working hours) was found to be related to the intermediate inputs intensity, while ICT capital investment again had only a moderate impact. This was analysed by estimating a stochastic possibility frontier (SPF), which provides measures for the output elasticity of input factors. The results also point towards problems with the standard approach in growth accounting, which typically assumes that total factor productivity (TFP) growth instantaneously increases with increased investments in ICT-capital. However, there may be a time lag between the initial investment and implementation of new technology (and the respective organisational changes) and their actual impact on TFP growth. This might partly explain the mixed results found on the basis of EU-KLEMS data, when

36. The «EU KLEMS Growth and Productivity Accounts» are a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union Member States. The compilation of this database was a project funded by the European Commission. See ***www.euklems.net***

comparing the changes between ICT-capital stock growth and TFP growth over the two periods analysed (1980-1995 and 1995-2004).

In summary, the following hypotheses were specified and tested by means of econometric analysis models:

| No. | Hypotheses | Results | |
|---|---|---|---|
| **P.1** | ICT-capital investment has become a main element in value added and productivity growth in the CRP industry, while other capital inputs summarised as non-ICT-capital have diminished in their respective importance. | Cannot be confirmed. Growth accounting points to larger impact of non-ICT capital inputs; SPF analysis points to intermediate inputs as key drivers of labour productivity growth. ICT by itself is not the key driver of growth in this sector. | **not confirmed** |
| **P.2** | TFP growth in the CRP industries has accelerated together with increased investment in ICT-capital. | No significant average annual rate of technical progress for the common possibility frontier was found. | **not confirmed** |
| **P.3** | ICT has, together with high- and medium-skilled labour, a positive impact on output growth. | Labour quality change from low-skilled towards medium- and high-skilled labour had a positive growth impact → indicates a skill-biased technological change with ICT-capital as its complementary factor driving growth of the CRP industries. | **(partly) confirmed** |

## ICT AND INNOVATION

The links between ICT adoption, e-business activity and innovation are broadly recognised. In the CRP industries, **process innovation** in particular is driven by ICT. Out of all companies that said they had introduced new or significantly improved processes, more than 70% (by their share of employment) said that the new processes are enabled by ICT. However, within the sector, the picture for small companies differs from the one for medium-sized and large firms: in small firms, "only" about 50% of companies reported that their process innovation(s) were ICT-enabled. The innovativeness of European CRP companies is considered an important factor in facing global competition and in maintaining their position in higher market segments which rely on differentiation and quality.

A regression analysis of micro-data from the e-Business Survey 2007 indicates that ICT has an impact on process innovation in an organisational setting by facilitating inter-organisational links. The use of ICT tools for **e-collaboration** (e.g. sharing information on inventory levels or production plans electronically with business partners) was found to be positively correlated with the likelihood of conducting ICT-enabled innovations. Out of several variables tested, the use of applications to collaborate with business partners in the design of new products or services has the strongest correlation with a firm's propensity to introduce ICT-enabled innovations.

It was also found that innovative output is positively linked with **firm performance** (using turnover increase as a proxy variable). Firms with a higher incidence of ICT-enabled innovation activity are more likely to report a turnover increase, i.e. to have experienced sales growth. However, this should not be read as a simple formula for success ("the more ICT-enabled innovation, the greater a firm's turnover"), as there are possible complicating factors such as growth of a company in general.

**Software matters:** finally, the analysis also explored links between ICT and the organisational changes. It was found that a company's endowment with more advanced e-business software (e.g. the usage of systems such as ERP and CRM) is positively correlated with the introduction of organisational innovation, while there is no significant correlation between basic ICT infrastructure (such as internal networks) and organisational innovation activity.

## ICT AND MARKET STRUCTURE

Case studies in this report show clearly that ICT and e-business are becoming indispensable tools for market development and growth in the CRP industries, notably for large companies which operate in a global marketplace. On the other hand, the increase in competition in specific markets could be a major driver of ICT adoption, as companies are seeking opportunities to cut

**Case study: Medikémia, Hungary: The impact of ICT on skills and employment**

*Medikémia is a medium-sized manufacturer of cleaners for cars, housekeeping and PCs, aerosol paints, insecticides and pesticides, and ingredients for construction. The company sells its products mainly to wholesale traders both on the local and foreign market.*

*Medikémia uses ICT-based applications in all their organisational processes, from manufacturing to selling. For example, they use ICT-based quality control, computer-assisted supply chain management and e-marketing. This case study assesses the impact which the increasing use of ICT and e-business has had on Medikémia's competitiveness, performance and organisation. Findings indicate that ICT-based innovation and e-business adoption have been essential to survive in the market, as it enabled the firm to rationalise their intra-organisational processes. In this company, this has led to workforce reductions which could not be counterbalanced by growth: back in 2000, Medikémia had still almost 200 employees; since then, the number has decreased to 136 (2006). This is partly attributed to the efficiency gains stemming from ICT. For instance, many positions in administration, such as typewriting secretary or archivist, were made redundant. In production, new technologies, such as a barcode system, have also reduced the required workforce.*

*On the other hand, the average qualification requirements for employees have increased, which translates into higher salaries. In this regard, company costs have significantly increased; but if output is considered, these costs are refunded.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

their operating costs to stay competitive. Although this assumption is a commonplace and reflects the findings of many case studies, it is difficult to prove by means of statistical analysis. The assumption that a (perceived) increase in market rivalry triggers ICT adoption (as a measure to withstand the pressure) is difficult to verify by means of simple regression analysis.

ICT adoption is, however, positively correlated with outsourcing: companies with a more intensive use of ICT are more likely to have outsourced business activities in a period of 12 months prior to the interview. This indicates that ICT is a facilitator in coordination with external service providers. The case study on Medikémia (see box) illustrates how ICT adoption and a firm's adaptation to changing market conditions are typically intertwined, notably in transition periods. In such complex environments, no simple causality between ICT usage and firm performance or innovation can be established.

### 2.1.4 Outlook

#### ICT IS BECOMING A GENERAL PURPOSE TECHNOLOGY

The findings of this study confirm the dynamic development of ICT adoption and e-business activity in the chemical, rubber and plastics industries. In particular, the volume of e-commerce transactions has significantly increased, and e-business solutions are becoming indispensable tools to meet customer expectations and to enter new markets. The smart use of ICT matters for the competitiveness of firms in this sector, and the importance of an adequate e-business strategy will probably further increase. ICT is becoming a "general purpose technology" (GPT) in the sector. Economists use this term for technologies which are so pervasively used in all business areas that they have a profound effect on the entire economy rather than just causing incremental innovation.

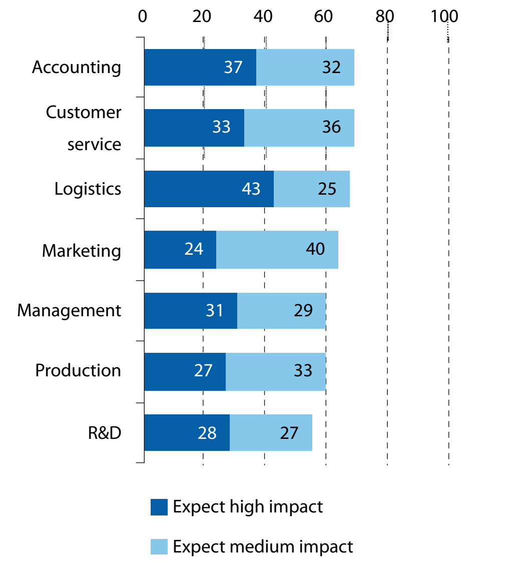
However, this is a process that is still unfolding, and is far from being completed. The uses of ICT in business are progressing toward more advanced and sophisticated forms of data exchange, which could be described as innovation cycles. The real technological disruption (in the sense of the GPT concept) comes with automated data flows within and between companies, enabled by connected ICT systems. These – more advanced – forms of e-business are now being widely practised by large companies in all manufacturing sectors, but the digital divide with smaller firms is still hampering full deployment.

Nonetheless, companies in the CRP industry expect that ICT will actually have a major impact in the years to come in practically all areas of business. In the survey, companies were asked to rate the expected impact of ICT for several primary and support activities of their value chain. For all business functions, companies representing more than 50% of the sector's employees anticipate a «high» or at least a «medium» impact of ICT (see Exhibit 2.1-6), which further supports the concept of ICT as a «General Purpose Technology».

CUSTOMER SERVICE 24/7

One of the main trends emerging from the study is the increasing importance of e-business applications for providing optimal customer service (see, for instance, the case study on BASF). Companies realise that e-business is not only for facilitating business transactions (e.g. placing orders, invoicing and making payments), but also for providing related information (e.g. product information about chemicals) at any time the customer needs it. ICT offer enormous opportunities in this regard (see Section 3.5). The web can be used as a cost-effective channel for information provision, while internal information management systems (e.g. ERP-based modules) deliver the required data.

***Exhibit 2.1-6: CRP industries: % of CRP companies expecting that ICT will have a high/medium impact on … in the future (2007)***




Base (100%) = companies using computers from 7 EU Member States (DE, FR, IT, ES, PL, SE, UK).

N = 811.

Weighting: by employment ("firms representing x% of employment in the sector / country")

Source: e-Business Surveys 2003 / 2007

## *2.1.5 Policy implications*

GENERAL CONSIDERATIONS – ICT-RELATED MEASURES AS PART OF A BROADER INDUSTRIAL POLICY FRAMEWORK

Even if e-business is important, this does not automatically imply a need for direct policy intervention. To a large extent, these developments occur in an evolutionary way, and the study has not found any convincing evidence of a market failure in this process which could be expected to cause undesirable effects. Thus, economic policy could decide to just leave e-business adoption in the CRP industries to the market.

Moreover, the sector (the chemical industry in particular) is confronted with urgent and highly complex issues such as the need for new environmental regulations, in combination with ensuring a fair regulatory framework for international competition, and challenges in accessing raw materials (see section on "context and background"). These challenges pose, by all measures, more direct concerns for industrial policy than the use of ICT.

Nonetheless, from a European perspective, the rising importance of e-business for a firm's (and ultimately for an industry's) competitiveness should not just be ignored. It can be argued that the evolutionary development described in this study could and should be accelerated by appropriate measures, in order to sustain and enhance the – still existing – competitive advantage of the European CRP industry, as its strong international trade balance demonstrates. ICT infrastructure and e-business can be seen as an increasingly important "factor condition" for the competitive advantage of an economy (cf. Porter 1990), notably in the emerging knowledge economy.

Policy measures in this field should be embedded within the broader policy framework of the European Commission for promoting integrated industrial policy and the competitiveness of European industry, in which innovation plays a central role.[37] This reflects the fact that innovation (notably organisational and process innovation) and ICT usage in firms are inseparably linked with each other, as clearly demonstrated by this study.

37. Important reference documents for the industrial policy approach of the European Commission include the following communications: «Mid-term review of industrial policy. A contribution to the EU's Growth and Jobs Strategy», COM(2007) 374. «Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing - towards a more integrated approach for industrial policy», COM(2005) 474 final; "Common Actions for Growth and Employment: the Community Lisbon Programme", Communication of the European Commission, COM(2005) 330; "Working Together for Growth and Jobs: a New Start for the Lisbon Strategy", Communication of the European Commission, COM(2005) 24.

In line with this broader framework, innovation has been identified as a key success factor specifically for the competitiveness of the chemical industry by the High Level Group (HLG) on the Competitiveness of the European Chemicals Industry, which the EC set up in June 2007 to analyse the competitive scenario of the sector in Europe. The HLG recommends that, in order to maintain the world-leading position of the European chemical industry, the following measures should be taken: strengthening innovation networks; increased spending in Research and Development (R&D); better development of human resources; and improvements in information and communications. While there is no explicit mention of ICT and e-business, the relevance of ICT for the proposed measures is obvious.

The following suggestions are therefore to be considered as inputs to the existing framework as well as the work of the HLG. The proposed action lines should be regarded as possible contributions and instruments to address the specified objectives. At the same time, they express a concern that some of the central policy documents may not adequately reflect the importance of ICT for industrial competitiveness in general and the close links between innovation and ICT usage in particular.

### POLICY SUGGESTIONS

Against these general considerations, the study findings suggest four priority areas for policy measures to support ICT-enabled innovation. Except for the last point (ICT and REACH), these areas are more horizontal than sector-specific, which is in line with the Commission's commitment "… to the horizontal nature of industrial policy and to avoid a return to selective interventionist policies."[38]

**1. e-Skills related actions (I): improving the managerial understanding of e-business among smaller companies**

The study confirms that there is still a "digital divide" between large and small firms in e-business practices, notably when it comes to advanced forms of data exchange. This hampers the network effect of e-business and reduces the potential of productivity gains on the aggregate (industry) level. Case studies demonstrate that, in smaller companies, the understanding and commitment of the management is a critical factor for introducing ICT-based innovation in the firm. There is a wide range of instruments to raise awareness and to promote the understanding of e-business concepts among smaller firms; some examples which have been proven successful in initiatives[39] are mentioned in the table below.

**2. e-Skills related actions (II): focus on educational schemes to ensure the adequate supply of ICT and e-business professionals in Europe**

e-Skills are also an important issue for large firms, but in a different way. Here, the critical issue is to ensure access to ICT and e-business professionals. Europe faces the risk of a shortage in the supply of "e-professionals". IDC, an ICT market research company, estimates that there is already a shortage of some 500,000 full time ICT professionals in the EU, that this is growing by up to 10% per annum, and that almost half of Europe's organisations are facing difficulties hiring staff, with implications for growth.[40]

| | |
|---|---|
| **Possible measures:** | ■ Collection and dissemination of best e-business practices among SMEs in the sector<br>■ Grant schemes for SME projects, ideally combined with documentation of best practices afterwards<br>■ Establish peer-to-peer platforms where SMEs can exchange their experiences<br>■ Digital value chain projects / stakeholder coordination to agree on digital business processes and exchange formats (involving large firms and their network of suppliers) |
| **Stakeholders to be involved:** | ■ Regional and national e-business policy makers<br>■ Industry associations in the chemical, rubber and plastics industry<br>■ Large companies from the sector (to leverage their relations with suppliers) |
| **Links with DG Enterprise industrial policy:** | The High Level Group (HLG) on the Competitiveness of the European Chemicals Industry (set up by the EC) recommends that «developing human resources» should be a priority measure to ensure the sector's competitiveness |

38. COM(2005) 474 final, p. 3.
39. See eBSN study on «Benchmarking Sectoral e-Business Policy Initiatives» (2007).
40. Presentation by Marianne Kolding, IDC, at the e-Business Watch Conference 2008 («Understanding the e-Economy»), Brussels, 19 May 2008.

This shortage affects not only the ICT industry itself, but also larger companies in the ICT using sectors: first, they face difficulties in finding professionals for their own IT departments and e-business operations. Second, a shortage of professionals among ICT service providers negatively affects the quality of the services offered to their customers. This is a horizontal issue which concerns practically all sectors. The two main action lines to address this challenge are to develop innovative curricula in ICT training and to promote these training schemes among young people to attract talent. This requires close cooperation between policy, educational organisations and the ICT industry, typically in the form of "multi-stakeholder-partnerships".[41]

**3. Further harmonisation of the regulatory framework for e-business in Europe – particularly considering issues in cross-border trading and payments**

In specific areas, existing regulatory frameworks can be difficult to apply to new ways of electronic data exchange, which can lead to legal uncertainty for business and hinder innovation. It is the main responsibility of policy to address such issues and thus create a favourable overall framework for ICT usage. A primary example in recent years has been the legal uncertainty with regard to e-invoicing (see box). The European Commission is well aware of this challenge and has taken action to solve the problem. An informal Task Force on e-Invoicing which was set up to address the issue submitted its final report in July 2007.[42]

This report confirmed that "… regulations on e-invoicing… do not adequately provide legal certainty for businesses" (p. 29) and mentions that e-signature implementation is hampered, inter alia, by a lack of transparency concerning the grounds for acceptability of an e-signature from other EU countries (p. 30). Further studies such as a "Legal study on functioning of the Invoicing Directive (2001/115/EC)" are expected for the end of 2008, and concrete actions to follow the recommendations are anticipated. Thus, the issue is well taken care of; the recommendation in this study should be seen more as a reminder that confirms the importance of solving the existing problems, as companies interviewed for this study are still concerned about it.

| | |
|---|---|
| **Examples of issues to be addressed:** | ■ Consider harmonisation of the way that the Electronic Signatures Directive has been transposed by Member States<br>■ Remove legal uncertainties as to whether different practices of e-invoicing are in compliance with (national) taxation regulations, e.g. by means of stakeholder consultations with tax authorities |
| **Stakeholders to be involved:** | ■ EU and Member States (in close consultation with industry federations, chambers of commerce and business associations) |
| **Links with DG Enterprise policy:** | ■ Actions on improving the framework for e-invoicing, including the work of the eBSN in this field<br>■ SEPA – Single Euro Payments Area |

**4. Explore opportunities to facilitate REACH compliance by use of ICT**

The final suggestion is highly sector specific: careful consideration of the potential of ICT to make the technical implementation of the REACH regulation as efficient as possible – for both sides, the companies and the regulatory authorities. This study provides examples of ICT service providers that have developed specific modules for managing REACH in companies. To ensure that these solutions meet the requirements and are widely used by enterprises, including SMEs, policy could consider stakeholder coordination initiatives (involving the ICT industry and federations from the CRP sector) and provide targeted information about opportunities to SMEs. ECHA, the European Chemicals Agency has already implemented a "REACH-IT portal" on its website as the main channel for compa-

41. A study by the EC, DG Enterprise and Industry, on «Multi-stakeholder-partnerships for e-skills» (2007) has assessed different approaches and identified best practices.

42. European Electronic Invoicing – Final Report of the Informal Task Force on e-Invoicing, Version 3.2 final, July 2007.

nies to submit data to ECHA (see ***http://echa.europa.eu/reachit_en.asp***). The portal supports the creation of company accounts in REACH-IT. It also supports online entry and submission of pre-registrations for single substances. It should be ensured, however, that companies can link their internal systems with this channel in order to automate the registration procedure as much as possible.

| | |
|---|---|
| **Possible activities:** | ■ Stakeholder coordination, e.g. agreement on processes and interfaces for registering chemical substances online in close cooperation with ICT vendors<br>■ Provide information to SMEs about available software solutions that support REACH requirements |
| **Stakeholders to be involved:** | ■ EU (notably represented by ECHA, the European Chemicals Agency)<br>■ European and national industry federations, large companies from the sector<br>■ ICT service providers |
| **Links with DG Enterprise industrial policy:** | ■ Technical implementation of the REACH regulation<br>■ Sustainable industrial policy |

## 2.1.6 References

(The full list of sources used for the study is included in the study report.)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## 2.2 Steel

This e-business sector study was conducted by empirica GmbH (***www.empirica.com***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).

**Key findings**

***ICT usage is important for the steel industry.*** *It increases productivity, reduces costs, and improves customer relationships. Almost two thirds of the large steel companies reported that ICT use has increased competition in the sector.*

***No lag behind other industries.*** *ICT use in steel firms is similar to the furniture and chemicals industries, which contradicts the industry's old-fashioned image.*

***Considerable ICT impact on skills requirements.*** *More than 40% of the medium-sized and large steel firms confirmed such impacts.*

***ICT may have high future impacts.*** *Steel firms representing 80% of the industry's employment foresee ICT impacts on logistics, 75% on management and controlling.*

***Current policy activities lack ICT focus.*** *They may not adequately reflect the importance of ICT for the steel industry. ICT standards development may be of particular importance.*

### *2.2.1 Context and background*

SCOPE OF THE STUDY

The steel industry as defined for the purposes of the study covers large parts of division 24 in NACE Rev. 2, "manufacture of basic metals".[43] The steel-related parts of NACE 24 are 24.1 "manufacture of basic iron and steel and of ferro-alloys", 24.2 "manufacture of tubes, pipes, hollow profiles and related fittings, of steel", 24.3 "manufacture of other first processing of iron and steel", 24.51 "casting of iron", and 24.52 "casting of steel". The steel industry has not been covered by e-Business Watch in previous years. It was selected for the 2007/2008 studies because of the key economic importance of steel as a material for many manufacturing sectors and because of the high world-wide competition in the sector.

INDUSTRY CHARACTERISTICS AND TRENDS

The European iron and steel industry comprised 9,459 enterprises and employed 776,800 people in 2004, the most recent year for which data are available. The basic metals manufacturing sector is dominated by large multinational enterprises, with 74% of its EU-27 value added created by enterprises with 250 or more employees. However, the majority of companies in the industry are small or medium-sized. While the strategic importance of the steel producing industry for Europe has declined during the past decades, steel remains a very important production material.

Since 2003 there has been an unprecedented **upward cycle** in the industry, caused by increased demand for steel, particularly from China. A further trend is an ongoing process of **consolidation** of the steel industry, which may lead to further mergers resulting in very large-scale enterprises. **Skills** and employment issues are becoming more important in the industry, since many employees will retire within a few years and hiring new skilled personnel may become difficult. Furthermore, **environmental** issues, energy saving in particular, are becoming more important for the steel industry.

43. NACE Rev. 2 is a classification of business activities. It is a revision of the "General Industrial Classification of Economic Activities within the European Communities", known by the acronym NACE and originally published by Eurostat in 1970. NACE Rev. 2 replaced the previously used Rev. 1.1 on 1 January 2008.

## 2.2.2 ICT adoption and e-business use

### OVERALL ASSESSMENT

This study shows that ICT and e-business can be beneficial for the whole value chain of the steel industry. ICT and e-business can support procurement, internal workflows and external communication, as well as sales and distribution. Process efficiency is a major objective for steel enterprises that implement and enhance ICT and e-business applications, and there are many examples of steel enterprises that attained this objective. The e-Business Survey 2007 revealed that steel firms do not lag behind other manufacturing industries in using ICT and e-business solutions. However, there are also indications of challenges related to e-business use, for example related to acceptance among the workforce, integration difficulties in the course of mergers, and unsolved problems of ICT standardisation. Along the value chain, the e-Business Survey 2007 shows that e-procurement is widely practised, internal systems are fairly well developed, but e-sales are not very common.

### ICT INFRASTRUCTURE

Steel business can, it appears, no longer be conducted without the internet: practically all steel companies are connected to it. The case study of the Patina foundry in Hungary shows that internet and e-mail communication offers benefits even for a small foundry with very basic ICT use (see case study, p. 91).

However, the share of steel firms saying that they have a broadband connection to the internet, i.e. a bandwidth of more than 2 Mbit/s, was 41%, leaving much scope for improvement. Local Area Networks (78%) have become a commonplace in the steel industry; Wireless LAN technology was reported to be used in 30% of firms. About 37% of firms are equipped with remote access to the company's computer network, a rather small share that also indicates opportunities for upgrading ICT infrastructure.

### ICT SKILLS

In total, 24% of all steel companies said that they employed ICT practitioners in 2007. If employing

*Exhibit 2.2-1: ICT skills requirements (2007)*

| | Employ ICT practitioners | | Have experienced difficulties in finding qualified practitioners | | Companies saying that e-business developments have a significant impact on skills requirements | |
|---|---|---|---|---|---|---|
| Weighting scheme: | % of empl. | % of firms | % of empl. | % of firms | % of empl. | % of firms |
| **Steel – 2007 total (EU-7)** | **52** | **24** | **20** | **5** | **36** | **28** |
| NACE 27.1: basic steel | 29 | 18 | 23 | 5 | 35 | 24 |
| NACE 27.2-3: hollow / cold processed steel | 66 | 26 | 17 | 5 | 41 | 32 |
| NACE 27.51+52: casting | 57 | 25 | 22 | 6 | 34 | 24 |
| **Steel – by size (EU-7)** | | | | | | |
| Small (10-49 empl.) | | 11 | | (0)* | | 19 |
| Medium (50-249 empl.) | | 38 | | (0)* | | 42 |
| Large (250+ empl.) | | 61 | | (20)* | | 41 |
| **Steel – USA** | **13** | **12** | **(--)**** | **(--)**** | **33** | **28** |
| **Other sectors (EU-7)** | | | | | | |
| Chemicals | 45 | 22 | 21 | 15 | | 36 |
| Furniture | 33 | 18 | 7 | 9 | | 39 |
| Base (100%) | All firms | | Firms employing ICT practitioners (E1=yes) | | All firms | |
| N (2007, EU-7+USA) | 449 | | 96 | | 449 | |
| Questionnaire reference | E1 | | E3 | | E5 | |

The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.
* = percentage only indicative due to a small number of observations (N = 20-50)
** = percentage not shown due to a too small number of observations (N < 20)
Source: e-Business Survey 2007

**Case Study: Basic ICT use at the Patina foundry, Hungary**

*Patina is a medium-sized foundry located in Budapest that produces semi-finished and finished products of iron, bronze and aluminium. The company sells its products mainly in the vicinity of Budapest, but also in the whole country and to a small extent abroad. Patina uses basic ICT applications especially in its procurement and sales processes. The company has a website, communicates with suppliers and customers by e-mail, accepts e-mail orders and pays invoices by online banking. Patina also uses software for internal processes such as registration and processing of orders, bookkeeping and payroll accounting. However, Patina does not have more advanced e-business applications such as an interface for online orders, and the company does not send or accept electronic invoices. The impacts of computer and internet use on the company have been notable but not large: ICT and e-business have made internal processes more effective, have accelerated data exchange with business partners and information research, and have seen a slight increase in the number of customers. Patina currently faces no pressure to further invest in ICT and e-business. The case illustrates that small foundries may do well without advanced e-business solutions.*

practitioners is used as a proxy for having an IT department, "only" 61% of large companies reported that they employ ICT practitioners. Outsourcing IT is common: About 22% of the companies interviewed in 2007 said that they had outsourced ICT functions which they had previously conducted in-house. 41% of the large steel firms and 42% of the medium-sized ones said that e-business developments have a significant impact on skills requirements. This may indicate a need for ongoing personnel development (see Exhibit 2.2-1).

### ICT INVESTMENT

Steel companies representing 85% of the industry's employment said that they had made investments in ICT during the past twelve months. This is similar to the chemicals and furniture industries, indicating that the steel industry is responding well to e-business challenges. 69% of the steel companies (by their share of employment) said that they would keep the ICT budget at about the same level. About one third (30%) of the companies said they would increase the budget and only a tiny share of 1% would decrease it.

### ELECTRONIC PROCUREMENT

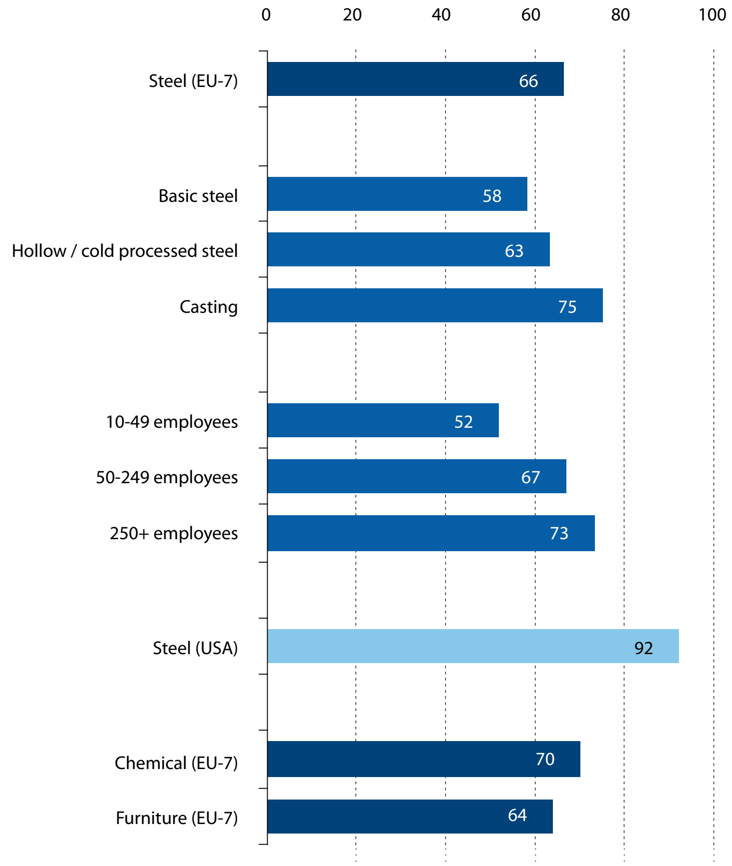
Procurement management is a fundamentally important activity in the steel industry, as in most manufacturing industries, because upstream supply chains tend to be complex and fragmented. Electronic procurement is widely adopted in the industry: steel firms representing 66% of the industry's employment reported procuring goods electronically. However, the share of goods procured online tends to be small; in almost half of the steel firms it is less than 5% of total orders. Furthermore, steel companies are likely to continue to procure raw materials in long-term offline relationships, due to an oligopolistic market structure in iron ore supply, and to the need for high quality standards for input raw material (see Exhibit 2.2-2).

Online procurement practice can offer considerable cost reduction benefits to the steel industry, mainly through process streamlining and improved purchasing conditions. At ThyssenKrupp Steel, Germany, an online sourcing system was reported to save the company a two-digit million sum of euros within one and half a year after introducing the system – see the related case study (p. 93).

### INTERNAL E-BUSINESS SYSTEMS

Internal e-business systems can significantly enhance workflows and business processes and thus increase productivity and reduce costs in steel enterprises. While large companies may benefit from implementing comprehensive applications such as enterprise resource planning (ERP) systems, small companies may already benefit from simple software. The use of a software for managing orders is widespread: firms representing 76% of the sector's employment said they use such a software. More than half (59%) of the steel companies (weighted by employment) reported having an ERP system. The use of other internal systems is not so widespread: Document Management system (27%), Supply Chain Management (SCM) (27%), Customer Relationship Management (CRM) (21%), and Radio Frequency Identification (RFID) (12%). Furthermore, production-oriented systems play a

### Exhibit 2.2-2: Companies ordering goods or services on the internet or via other computer-mediated networks




The survey was conducted in 7 EU countries (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.

Basic steel = NACE Rev. 1.1, 27.1; hollow / cold processed steel = NACE 27.2+3; casting = NACE 27.51+52.

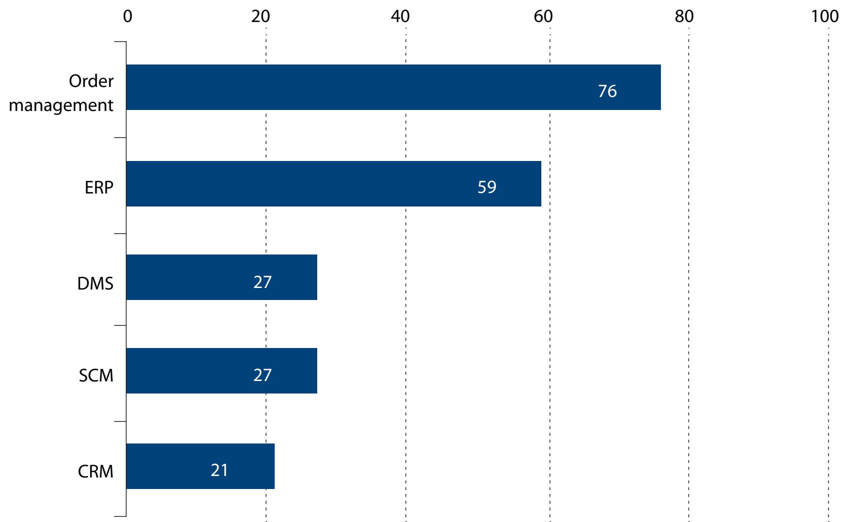
Base (100%) = companies with at least 10 employees and using computers; N (Steel, EU-7) = 349,

N (Steel, USA) = 100.

Weighting: Figures for sector totals and countries are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms. Questionnaire reference: B1

Source: e-Business Survey 2007 by the SeBW

### Exhibit 2.2-3: Internal systems use in steel companies (in %)




Order management = a software for managing the placing or receipt of orders
ERP = Enterprise Resource Planning
DMS = Document Management System
SCM = Supply Chain Management System
CRM = Customer Relationship Management

The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA. Base (100%) = companies with at least 10 employees and using computers;

N (Steel, EU-7 and USA) = 449.

Weighting: Figures are weighted by employment ("firms representing x% of employment in the sector").

Questionnaire reference: A6, A7

Source: e-Business Survey 2007 by the SeBW

**Case Study: Electronic sourcing at ThyssenKrupp Steel, Germany**

*ThyssenKrupp is the tenth-largest producer of steel in the world and the largest in Germany. In 2000, ThyssenKrupp Steel introduced a platform for electronic tendering of goods. Suppliers have to register and place their offer in the platform and are selected by price and fulfilment of specified requirements. Within one and a half years, gains from reduced prices and process enhancement amounted to a two-digit million sum of euros. Suppliers also appreciate the platform because it provides a transparent tendering and selection process. Due to its success, the system was expanded and integrated into the "ThyssenKrupp Strategic Sourcing" system in 2005. It is open to suppliers from anywhere in the world and available in English, German, French, Spanish, and Italian. While e-procurement proved to be beneficial, production goods such as iron ore will continue to be purchased offline in long-term business relationships.*

**Case Study: Enterprise resource planning at Srem iron foundry, Poland**

*Located in the city of Śrem in Poland, Odlewnia Żeliwa Śrem (OZS, Srem Iron Foundry), is one of the three largest iron foundries in Poland. It produces around 50,000 castings per year and employs about 1,450 people. Over the past twenty years, OZS has been confronted with a number of challenges. It had to undertake drastic restructuring measures, making overdue investments and improving business process efficiency. The implementation of an Enterprise Resource Planning (ERP) system, which started in January 2000, was one of the important decisions on the way to restructuring the company. The new system had two strategic impacts on the company. First, OZS was able to organise its business processes efficiently, which led to substantial reduction of inventory costs and increased utilisation of production capacities. Second, due to increased transparency of operation, the firm was able to improve business processes and management practices.*

**Case Study: Enterprise Resource Planning with an Oracle system at Farwest Steel, USA**

*Farwest Steel is headquartered in Eugene in the state of Oregon in the Pacific Northwest of the United States. The company serves as a distributor or service centre in the steel supply chain serving companies in the region. The company also provides value added services such as flame cutting, plasma cutting and punching, and shearing. The major e-business project for the company has been an implementation of the Oracle e-Business Suite, a broad Enterprise Resource Planning application. The initial impetus for the project was a modernisation of a largely self-developed application running on an aging mainframe. The company has developed a customised extension to the ERP system that allows for the quoting and subsequent ordering of highly specified and customised products. The main benefits of the system include improved order-to-delivery, inventory visibility, and cost tracking. The main lessons learned include that the implementation of such a far-reaching system involves massive change management requirements and thorough software roll-out preparations. Future plans are to further extend the implementation to improve integration with customers, automate warehouse management, and sales force tracking.*

crucial role in the steel industry because they make it possible to reduce waste and production costs. 89% of the large steel firms reported using a Computer-Aided Design (CAD) system (see Exhibit 2.2-3).

Case study evidence points to the benefits of internal e-business systems, but also to the challenges of systems implementation related to ICT acceptance and the need for changing management practices. The case studies of the Srem foundry in Poland and Farwest Steel in the US deal with the benefits and challenges of ERP systems (see case study, p. 93).

e-Business solutions may also support business objectives in the environmental, health and safety fields. These applications are particularly important because steel production implies gas emissions and toxic waste, and plant workers are exposed to very high heat, glaring light, and noise. Tenaris Dalmine in Italy provides a related example (see box).

### ELECTRONIC SALES AND DISTRIBUTION

The main sectors that use intermediary steel products include construction, automobiles, and household goods manufacturing. 25% of the steel firms reported that they sell goods electronically, which is less than in US steel firms and in other manufacturing industries. This confirms the perception that steel is difficult to sell electronically. However, the percentages for companies selling more than 10% of their goods online are considerable: In 22% (weighted by employment), the share of online sales was reported to be between 26 and 50% and in 18% more than half of total sales. This means that e-sales is not very common in the steel industry, but those companies that apply this practice do it in considerable scope (see Exhibit 2.2-4).

In any case, ICT and e-business applications can significantly enhance sales-side processes even without actual e-transactions. e-Business solutions may facilitate communication with customers with regard to negotiation, product specification, scheduling, shipping and invoicing. This is confirmed by the case studies of Corus IJmuiden in the Netherlands and Baosteel in China (see boxes, p. 95 and 96). ICT may also support distribution of steel products to customers. e-Warehouse management makes it possible to keep an overview of packages on the way to and stored in warehouses as well as packages being transported to customers. The case study of ArcelorMittal Gent provides a related example (see p. 96).

### E-MARKETPLACES

Many electronic marketplaces for the steel industry were created at the end of the 1990s, but none of them survived in Europe. The last active e-marketplace for the steel industry in Europe, Steel 24-7, closed in September 2007. There may be three main reasons for failure: steel trade is customer-driven and largely personalised; steel products are very specific and difficult to translate into electronic processes; and customers mainly used e-marketplaces to obtain lower prices. These arguments are supported by a case study of the former e-Arbed.com (see p.96).

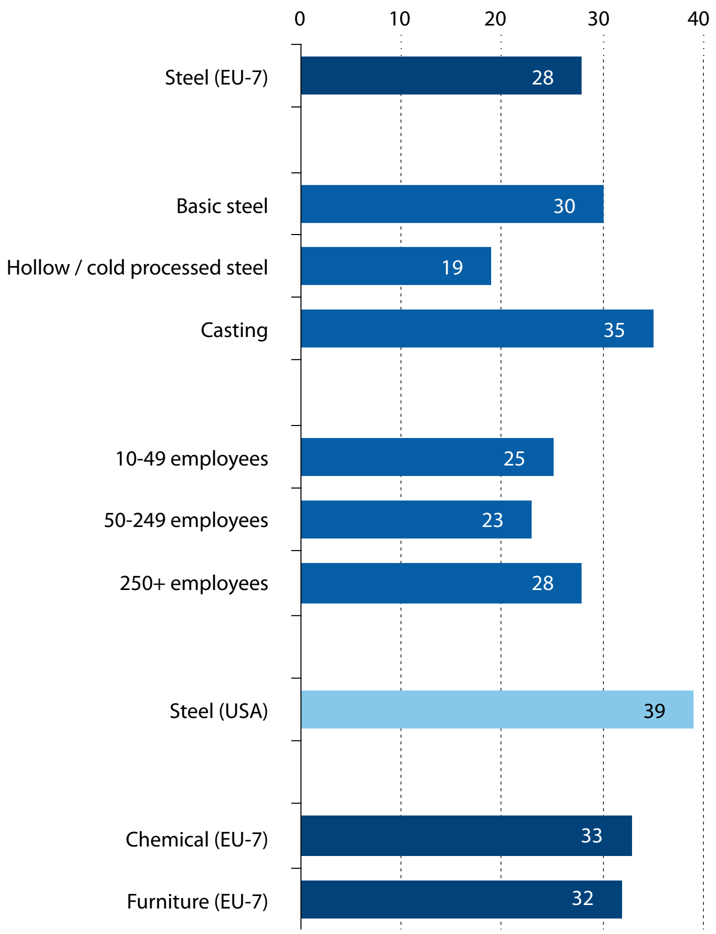
**Case Study: Electronic environment and safety management at TenarisDalmine, Italy**

*Tenaris is a global manufacturer and supplier of tubular products and services with 23,500 employees and headquarters in Argentina. Tenaris' primary customers are in the oil and gas industry, but the company also supplies other manufacturing and construction industries. In order to improve its business processes, especially those related to safety and environmental data management, Tenaris developed the Tenaris Safety and Environment (TSE) software. In 2003 Tenaris first deployed this application in its Italian plant, TenarisDalmine, from where it has been distributed worldwide to other branches. The application facilitates the management of all safety and environmental aspects at different organisational levels, i.e. technicians, physicians, and top managers. It also allows for accurate observation of international environmental standards. TSE facilitates internal processes related to health, safety and environment. Furthermore, Tenaris considers TSE as a driver to stronger corporate cohesion and to competitive advantage, because health and environmental issues are important for customers' choices of supplier .*

### Case Study: e-Business platforms at Baosteel, China

*Baosteel is the largest and most modern steel producer in China, with a domestic market share of around 6.5%. The key driver in Baosteel's implementation and extension of e-business applications is to align processes towards customer-centric operations. This implies building a solid collaboration platform with strategic partners. In addition, Baosteel seeks to improve operational efficiency and to drive down process costs. It established an ICT subsidiary that created three platforms: one for e-sales, one for e-procurement, and one for e-collaboration with business partners. Digitised interaction and data exchange with external parties have dramatically reduced manual operations, allowing almost complete elimination of staff required for in routine operations. The work of the sales team has been upgraded into a higher profile. On average, workflows now require only 60% of the time that was spent before digitised operations were introduced. The order cycle time has also been reduced by up to 20%.*

**Exhibit 2.2-4: Companies selling goods on the internet or via other computer-mediated networks (2007)**




The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.

Basic steel = NACE Rev. 1.1, 27.1; hollow / cold processed steel = NACE 27.2+3; casting = NACE 27.51+52.

Base (100%) = companies with at least 10 employees and using computers; N (Steel, EU-7) = 349,

N (Steel, USA) = 100.

Weighting: Figures for sector totals and countries are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms.

Questionnaire reference:B3.

Source: e-Business Survey 2007 by the SeBW

**Case Study: Internet-based information about customers' orders at Corus IJmuiden, Netherlands**

*Corus Strip Products IJmuiden is a subsidiary of Tata Steel in IJmuiden, Netherlands. It produces hot rolled, cold rolled and metallic-coated steels mainly for the automotive and transport, construction, and consumer appliances industries. In order to enhance the efficiency of its customer communication, Corus IJmuiden developed an internet-based application called YMonline that offers customers anytime insight into information related to their orders. Customers are able to obtain essential order information simply by accessing the system: They can check their order portfolio, product properties, the stage of the production process, the packaging lists for shipments, and the processing of claims. Furthermore, Corus staff uses the application to send order confirmations via e-mail. However, the system does not permit ordering or invoicing online. YMonline decreased costs by reducing time- and resource-consuming phone calls, faxes and paper mail. The system also increased customer satisfaction; customers use the system intensively. The involvement of customers at a very early stage of developing YMonline had a significant positive effect on the outcome.*

**Case Study: e-Warehouse management at ArcelorMittal Gent, Belgium**

*ArcelorMittal Gent is a steel company situated in Gent, Belgium. Its main business activity is the production of flat carbon steel for the automotive, construction and household appliances industries. The company uses a tailor-made, internally developed and web-based tool to support external warehouse management activities. This tool offers an alternative to both an Electronic Data Interchange (EDI) system, which may be costly to implement by external warehouses and smaller customers, and a manual information circuit, i.e. e-mail or fax, which is insecure and burdensome. The web application, although quite simple, had a clear positive impact on shipment and warehouse management at ArcelorMittal Gent. It allowed integrated communication with warehouses at low cost. The application has also improved the company's ability to rapidly develop a full network of external warehouses, regardless of their ability to implement EDI, and improved business relationships with smaller clients.*

**Case Study: Electronic sales with the former e-Arbed.com platform, Luxembourg**

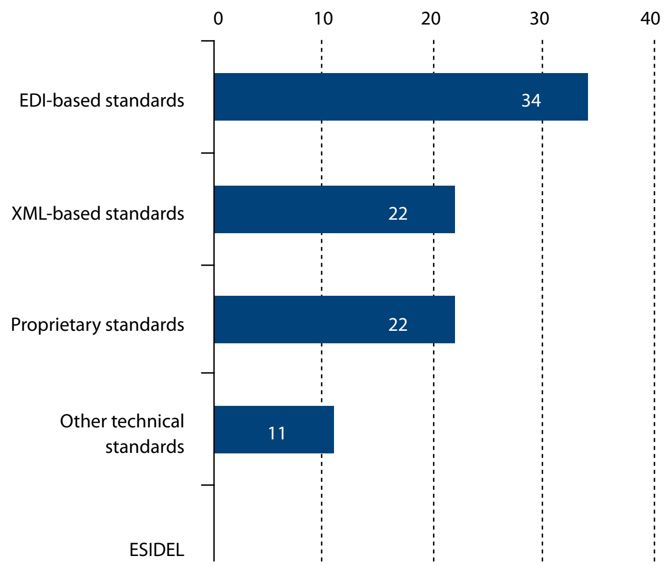
*e-Arbed.com was an attempt to establish electronic sales of steel in the Arbed Group, which is today part of ArcelorMittal. Driven by the high expectations of the "e-economy", Arbed had developed a detailed e-commerce introduction plan, and it launched a strategy called e-Arbed in 1999. e-Arbed.com, which was part of this strategy, was an e-business platform for customers of Arbed's distribution branch. However, in 2003 the system was terminated, for several reasons: virtual and real distribution channels had struggled to sustain their competencies; steel demand - which is highly specific - turned out to be not sufficiently suitable for e-commerce; and steel business turned out to be too heavily dependent on personal relationships. Finally, in the course of the merger of Arbed (Luxembourg), Aceralia (Spain), and Usinor (France) with Arcelor in 2001, representatives from each of the companies promoted their own e-business solutions. The case is an example of the barriers to successful e-business implementation.*

### ESIDEL STANDARD

A particular standard, the European Steel Industry Data Exchange Language (ESIDEL) was developed for trade in the European steel industry. It is however not widely used in Europe – only 0.4% of steel firms reported using it – and it is no longer maintained by Eurofer, the developing organisation. However, the standard's documentation is available for free download, and even 7% of steel firms in the US reported using ESIDEL (see Exhibit 2.2-5).

Experience from Australia, where the ESIDEL standard has also been implemented, shows that the further development of this standard may be worthwhile – see the case study of CMC Coil Steels (see box).

***Exhibit 2.2-5: Use of ICT standards for data exchange in the EU-7 steel industry in % (2007)***




The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA. Base (100%) = companies with at least 10 employees and using computers; N (Steel, EU-7) = 349.

Weighting: Figures are weighted by employment ("firms representing x% of employment in the sector / country").

Source: e-Business Survey 2007

**Case Study: ESIDEL standard implementation at CMC Coil Steels, Australia**

*CMC Coil Steels, headquartered in Lane Cove, Australia, is a distributor of flat rolled steel products, and chairs the Australian Steel Institute's (ASI) Steel Online Group. This ASI Group has prioritised the application of standards for business processes in trading partner agreements. Their objective is to realise the advantages of lower cost internet-based trading: improved interoperability and related supply chain efficiencies. To this end, the ASI adopted and enhanced the European Steel Industry Data Exchange Language (ESIDEL) standards. The subsequent implementation of agreed order processes between CMC Coil Steels and its main supplier BlueScope Steels is an example of successful ESIDEL standards use. The standards facilitated the automation of order processes which increased the accuracy of inventory records and reduced costly manual data entry. This experience may encourage European steel enterprises to use ESIDEL standards and policy makers to promote their further development. Nonetheless, the standards may be refined, particularly with regard to order specifications and trading partner identification. The convergence of the standards with global cross-industry e-business standards may also be advisable.*

### 2.2.3 Drivers and barriers for ICT use

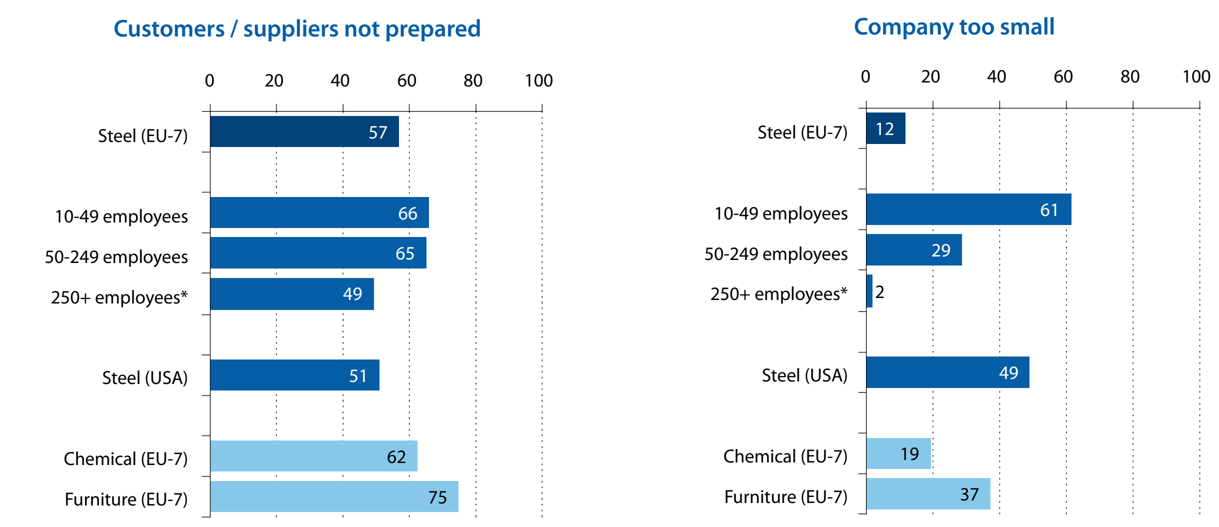
BARRIERS: "CUSTOMERS AND SUPPLIERS NOT PREPARED" MOST IMPORTANT

In the e-Business Survey, those companies that stated that they conduct only some or none of their business processes as e-businesses were further asked why they do not use e-business more intensively. The single most important reported barrier to adopting ICT solutions was that customers and suppliers are not ready to use such technology. 64% of the steel firms stated this. Another important reported reason was size: 61% of the small steel firms stated that they are too small to benefit from e-business solutions. Both reasons are interlinked. Many large steel firms may seek to streamline their processes with small and medium-sized suppliers, but often these suppliers are not ready to implement e-business solutions. They argue that investment costs would be higher than expected benefits. Other possible barriers, such as expensive or complicated technology or security or legal issues, do not appear to play an important role (see Exhibit 2.2-6).

DRIVERS: CONSIDERABLE PRESSURE FROM CUSTOMERS ON LARGE STEEL FIRMS

Companies may be forced to reduce the costs of their products and processes in order to remain competitive, and it may be taken for granted that ICT may help to reach this goal. The e-Business Survey 2007 asked more specific questions, namely whether the steel companies experienced pressure from customers and suppliers to adopt ICT solutions. There is considerable reported pressure from steel companies' customers to adopt ICT solutions, particularly on large steel firms (45%). The majority of steel firms (91%, employment-weighted) responded to such pressure. This is in line with assessments from SeBW advisory board members who stated that large steel companies often have to meet the ICT requirements of their large and powerful customers, for example in the automobile industry. Pressure from suppliers is apparently small. Vice versa, only a small share of steel firms exerted pressure on customers and suppliers to adopt ICT solutions.

*Exhibit 2.2-6: Barriers to e-business adoption as perceived by steel companies (2007)*




The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.
Basic steel = NACE Rev. 1.1, 27.1; hollow / cold processed steel = NACE 27.2+3; casting = NACE 27.51+52.
Base (100%) = companies with at least 10 employees and using computers; N (Steel, EU-7) = 349,
N (Steel, USA) = 100. * = % only indicative due to small number of cases (20-40).
Weighting: Figures for sector totals and countries are weighted by employment («firms representing x% of employment in the sector / country»), figures for size-bands in % of firms. Questionnaire reference: F2.
Source: e-Business Survey 2007

### 2.2.4 ICT and e-business impact

Findings from an econometric analysis conducted for this study, as well as from the e-Business Survey and the case studies, show that ICT and e-business have considerable impacts on the steel industry. However, they have not fundamentally changed business in this industry.

PRODUCTIVITY

Results from other studies indicate that ICT-induced productivity effects are relatively less pronounced in capital intensive, mature manufacturing industries such as the steel industry. On the other hand, evidence from the e-Business Survey shows that particularly the larger companies in the steel industries have dynamically adopted ICT for a variety of purposes. Growth accounting analysis conducted for this study suggests that changes in the ICT-capital stock accounted only for minor shares of overall value added growth in the basic and fabricated metals industries. TFP growth was found to account for much stronger contributions. Changes in ICT capital and non-ICT capital had about the same importance for value added growth. However, ICT can be embedded in other capital, so there may be a "hidden ICT-impact" which cannot be measured by means of the data on ICT-investment available in the database. As regards labour productivity, non-ICT capital intensity and the intermediate inputs intensity were found to be the main components of labour productivity growth.

INNOVATION

In the steel industry, ICT impact appears to be mainly on process innovation, not on product innovation. Many case studies conducted for this report confirm that ICT can be considered as an enabler of innovation and positively impact on firm performance, even if the impact cannot always be measured concretely. ICT's potential to drive innovation, derives in part from employing IT practitioners, which significantly increases steel firms' propensity to use ICT to develop new products and services. In addition, the use of applications and practices that support the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations. As regards impacts, the analysis found firstly that ICT-enabled output is positively related with turnover increase irrespective of firm size and age. Secondly, it found that ICT software is an important driver of organisational changes, while hardware apparently is not.

MARKET STRUCTURE

In the steel industry, the number of potential customers is limited and the products sold are not well-suited for online sales. ICT and e-business are used mainly to support, not execute, sales processes. As regards market structure as a possible driver of ICT adoption, hypotheses about the relevance of increasing market competition for the intensity of ICT adoption were not confirmed. Findings also indicate that, as regards impacts of ICT, ICT and e-business can hardly be used to open up new markets, to cross boundaries of industries and markets or to increase the number of customers. In other words, ICT appears to have little impact on the steel market's structure.

VALUE CHAINS

ICT as a facilitator of B2B interactions continues to be used in a way that enhances rather than replaces individual companies' business strategies. The case study of ThyssenKrupp's online sourcing platform (see above) may confirm this. The econometric analysis found that the use of applications and practices supporting the electronic exchange of information between companies occurs simultaneously with close relationships with business partners. As regards outsourcing, the general expectations regarding the potential of ICT to change value chains were very high. The econometric analysis found that ICT intensity indeed increases the propensity to outsource business activities. The Farwest Steel case (see above) study may confirm this.

### 2.2.5 Outlook

DRIVING FORCES FOR FURTHER E-BUSINESS DEVELOPMENTS IN THE STEEL INDUSTRY

The main driving forces for further e-business developments in the steel industry may be continued cost pressure and ongoing industry consolidation. As prices of raw materials as well as competition between steel companies may continue to be high, companies will be facing continuing pressure to reduce process costs. This is likely to promote the implementation of refined ICT and e-business applications. Mergers have an ambiguous impact on ICT and e-business use. On the one hand, mergers may impede or delay ICT sophistication because of interoperability problems. On the other hand, the need to make different systems interoperable may lead to improved solutions and the adoption of the best solutions available in the merged company. Another factor that could shape the steel industry's approach to ICT and e-business may be a forthcoming change of generations in management. In a few years, many older managers will retire and have to be replaced by younger talents who may be very open to information technology because they grew up with it.

MAIN AREAS OF FUTURE ICT AND E-BUSINESS IMPACT

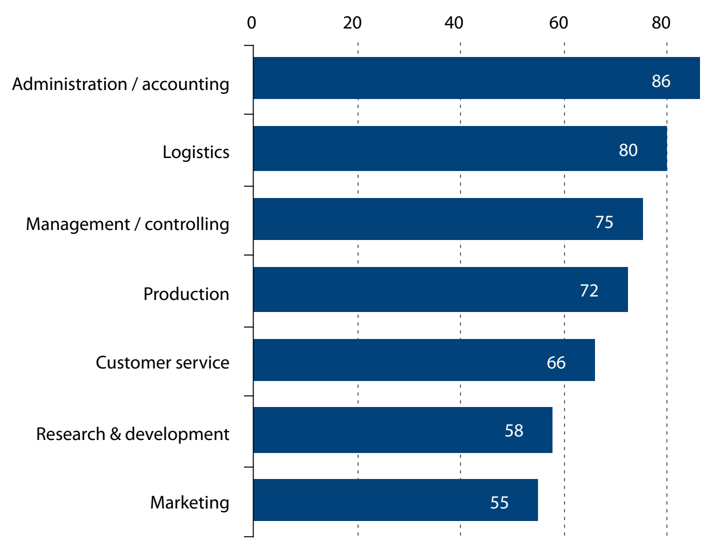
In the e-Business Survey 2007, firms were asked about expected future impacts of ICT on seven business functions. For all business functions, more than 50% of the interviewees stated high or medium impact, indicating that ICT will generally be very important for the steel industry in the future (see Exhibit 2.2-7).

The highest level of combined high and medium impact was attributed to **administration and accounting** (86%). A very large share of interviewees (of firms representing 75% of employment) expected considerable impacts on **management and controlling**. This confirms the exceptional importance of ICT and e-business for back-office data collection and processing. The second largest impact was expected for **logistics** (80%), which may indicate that steel companies have switched to give high importance to distribution issues. Steel firms representing 72% of the industry's employment expect future impacts of ICT on **production**. This confirms the importance of ICT in this business function. Furthermore, the values for expected impacts on customer-related functions, namely **customer service** (66%) and **marketing** (55%), were relatively low. This indicates that ICT and e-business may continue to play a relatively minor role on the sales side, except logistics.

## 2.2.6 Policy implications

Current industry policy at European Commission level does not, it appears, adequately reflect the importance of ICT and e-business for the steel industry. Neither the EC's mid-term review of industrial policy published in July 2007 nor the Communication on competitiveness of the metals industry issued in February 2008 refer explicitly to ICT. Furthermore, the steel-industry specific initiative named European Steel Technology Platform (ESTEP), created in 2004 as part of the European Research Area (an EU initiative to combine Member States' forces in European research), does not have a focus on ICT and e-business issues. It may be important to promote competent ICT and e-business use for enhancing the industry's competitiveness. The following suggestions may contribute to considering ICT and e-business more prominently in the EC's policies towards the steel industry.

*Exhibit 2.2-7: Steel firms expecting that ICT will have a high or medium impact on … in the future in %*




The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA. Base (100%) = companies with at least 10 employees and using computers; N (Steel, EU-7 and USA) = 449.

Weighting: Figures are weighted by employment ("firms representing x% of employment in the sector / country"). Questionnaire reference. F6.

Source: e-Business Survey 2007 by the SeBW

FOSTERING VALUE CHAINS AND E-BUSINESS USE

In the e-Business Survey 2007, lack of readiness among suppliers and customers for e-business was mentioned as the most important reason for not applying e-business more intensely. Enhancement opportunities may exist in all parts of the value chain. Public organisations may support activities to foster value chain development through ICT in the steel industry. While the European Commission should have a focus on cross-border activities, Member States may promote national or regional activities. In recent years, several EU Member States have launched initiatives to facilitate e-business exchanges within specific industry supply chains. A key objective in most of these initiatives is to enhance SME participation because they are at risk of elimination from the supply chain.

SUPPORTING ICT SKILLS DEVELOPMENT

The importance of e-skills for competitiveness and growth of the European economy has been confirmed in several high-level documents and initiatives of the European Commission. The steel industry has the image of a declining industry and may thus face difficulties in attracting skilled employees, also in the field of ICT. Steel firms themselves, their industry associations, and public policy could become more active in this respect. They can promote awareness about and uptake of e-business skills in steel companies. They can also support e-learning solutions and enhance co-operation activities with universities to support e-skills development. Results of the project "Equality and Diversity Learning in the European Steel Industry" (EDLESI), which was carried out with the support of the EC, may help to develop such e-learning solutions.

PROMOTING ICT STANDARDS

The EC could play a more active role towards standardisation of electronic communication processes in the steel industry. The EC could promote the positive Australian experience with the ESIDEL standard, and support the idea of further development of ESIDEL among European steel enterprises as well as among their customers and suppliers. The EC could also initiate and co-fund European projects for wider adoption of this standard. Such projects could focus on SMEs because they tend to be reluctant to adopt standards due to the related investment costs. Examples of similar projects already exist for the furniture and construction industries.

PROMOTING ICT USE FOR SAVING ENERGY

ICT and e-business can help to reduce energy consumption but they can also lead to additional demand for energy. In an energy-intensive industry like steel, the overall effects of ICT may tend to be that energy consumption is reduced. Since the steel industry is a major producer of greenhouse gas emissions, it may be worthwhile promoting the idea of using ICT and e-business to reduce energy consumption and to increase environment protection in this industry, for example in ESTEP.

## 2.2.7 References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## 2.3 Furniture

This e-business sector study was conducted by Databank spa (***www.databank.it***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).

**Key findings**

***A fairly good basic infrastructure…*** *the results from the SeBW Survey indicate that this sector is fairly well equipped in terms of basic ICT infrastructure. The quality of companies' internet access is fairly good, even among SMEs; similarly, other basic indicators such as the usage of internal networks indicated that this industry is keeping pace with other manufacturing sectors.*

***… with limited e-business integration.*** *The high prevalence of small companies - many of which have the low propensity for ICT adoption characteristic of traditional craft & trade companies - accounts for the limited adoption of more sophisticated ICT and e-business solutions. A major hurdle is also the lack of "pull" potential from distribution chains and business partners.*

***Importance of the design area:*** *CAD and 3D tools are playing an increasing role in furniture companies. Employee access to CAD systems varies according to company size, from 50% in small enterprises to 93% in large factories, with an average of 72% of companies.*

***Policy focus*** *should be on interoperability and standardisation, the creation of a favourable environment for innovation and the improvement of skills.*

### *2.3.1 Context and background*

SCOPE OF THE STUDY

The furniture industry as defined for this study covers those business activities described by NACE Rev. 2 Chapter 31, namely 31.01, 31.02 and 31.09. It is an economically important sector, providing employment to 1.4 million people and generating a turnover of €118 billion in 2004. In most European countries, furniture represents between 2 and 4% of the production value of the overall manufacturing sector. Furniture has traditionally been a labour-intensive industry, which has however gone through structural changes and a drop in employment in the past decade. Actions to support its competitiveness are considered necessary, as this sector is particularly sensitive to the overall economic context.

INDUSTRY CHARACTERISTICS AND TRENDS

The spread and use of ICT and e-business in this industry is driven by the organisation and breakdown of activities along the value chain, and by the business relationships between companies. Small enterprises often act as sub-contractors for larger companies, producing components, semi-finished products, or finishing and assembling furniture. They are generally highly specialised by type of product and operate on a regional scale for a limited number of customers. The handcrafting background of most of these companies accounts for the model of ICT and e-business adoption: mainly system automation for production and collaborative product development, and only limited business management or system integration within companies or with business partners.

Medium and large companies, operating on a national and an international scale, face the challenge of managing complex networks of business partners in a low-volume and price-sensitive production environment. Vital to their success is, therefore, the ability to control costs and optimise processes. As a result, an increasing number of medium and large furniture companies are focusing on improving supply chain processes management, on streamlining operations and on optimising their ability to adapt to a changing business environment.

**Industry structure**: the furniture industry overall is characterised by a large number of SMEs, often family owned. The breakdown between small, medium-sized and large enterprises varies by country, ranging from an average employment of 78 in Germany to 6 in Italy.

**International trade**: Europe is a major player in the global furniture industry, accounting for about half of the world's furniture production. The industry is experiencing increasing competition, notably from Asian competitors. In 2002-2005, imports of furniture from outside the EU 25 have been steadily growing; in 2005, they were more than €11 billion, out of which €4.2 billion were imports from China In that year, the overall trade deficit was about 1 billion euros. EU exports are dominated by the USA, which represented about 22% in 2005 - compared with 33% in 2000. This considerable loss is mainly due to the growth of Asian competitors in the US market.

**Key challenges**: A rapidly changing and highly competitive environment is putting increasing pressure on EU furniture manufacturers. Product innovation and reduced lead times are the key success factors for businesses to respond to such challenges and to remain competitive. A closer link with both intermediary and final customers is also a clue to keeping pace with market changes and providing adequate customer service. Horizontal and preliminary to these factors is the availability for furniture manufacturers of appropriately skilled human resources. Furniture companies need to pursue innovation strategies based on creativity, quality and differentiation of products, as well as on improved customer service.

In addition to global competition, a key challenge for the European industry is coping with environmental regulation[44]. The impact of this type of regulation on the European furniture industry relates to costs, because the more environmentally friendly solvents and varnishes are less effective and more expensive, and add to production time. This clearly poses a competitive challenge too, since imported products are not subject to the same controls. However, environmental-friendly and green design products are becoming part of the marketing strategy of EU furniture manufactures as a response to increasing consumer demand.

### 2.3.2 ICT adoption and e-business use

ICT INFRASTRUCTURE

The quality of furniture companies' basic ICT infrastructure is fairly good, notably among SMEs. All furniture companies are connected to the internet and broadband adoption is in line with other manufacturing sectors. For example, the share of small companies (with 10-49 employees) that have broadband internet connections is around 40%. The diffusion of Wireless LAN (W-LAN) technology is also high: close to 60% of employees work in companies that operate a W-LAN. In addition, the share of companies that enable remote access to their computer network is about 50%.

Many furniture companies are therefore equipped to introduce more advanced forms of e-business. A major question examined by the SeBW study on the furniture sector is why this is not, in fact, occurring. The prevalence of small companies - many of which have the low propensity for ICT adoption characteristic of traditional craft & trade companies - accounts for the limited adoption of more sophisticated ICT and e-business solutions, such as ERP and SCM. Another major hurdle is the lack of "pull" potential from distribution chains and business partners. In short, both for structural reasons and following a strategic choice, ICT investments are concentrated in the design and production area, while the integration between design, production and operation management is still weak.

ICT SKILLS

About 18% of the companies interviewed in the SeBW survey employ ICT specialist and only 9% report difficulty in finding qualified ICT practitioners. From these figures, it may appear that the e-skill issue is not relevant in this sector. There is however a general concern, especially among larger companies, that e-business does have a significant impact on skills requirements. Furniture companies are aware that ICT and e-business are rapidly changing the way business is conducted. They are also aware that innovative applications require changes in organisa-

44. The main EU environmental Directives which directly affect the furniture industry relate to industrial emissions: Integrated Pollution Prevention and Control (IPPC, currently being revised ), Volatile Organic Compounds (VOC ), and waste (Packaging and Packaging Waste).

## Case study: Danona, Spain: design of furniture at the point of sale

*Danona Sociedad Cooperativa is a medium-sized Spanish company that manufactures and markets household furniture. In 2002, Danona launched a project - which cost about €120,000 - for designing and implementing a software application that allows the design of furniture at the point of sale, with the option of choosing different colours and other product features such as materials. Both the company's sales representatives, when presenting the catalogue to the points of sale, and the actual retail outlets themselves, now have a tool to facilitate their work and improve the way in which products are presented. As outlets were extremely diversified in terms of computer types and models it was vital to opt for a simple software tool. Specifically, it was designed using an Access Database, which did not interfere with existing IT systems in the outlets.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

tion and working procedures. Business examples and case studies reported in the Study Report demonstrate the importance of skill upgrading and training of personnel to assure the successful implementation of new e-business applications.

**ICT-enabled design and production**

In the furniture industry, design of new products is a complex process that involves a synthesis of elements related to comfort, aesthetics and resistance. Furniture manufacturers face many challenges when designing and modelling new products. These include the difficulty in exchanging and sharing information with the shop floor, as well as with business partners along the supply and sales chain. The use of integrated, ICT-supported furniture design procedures can be a real competitive advantage in this sector, where most designers have an aesthetic rather than a technical background.

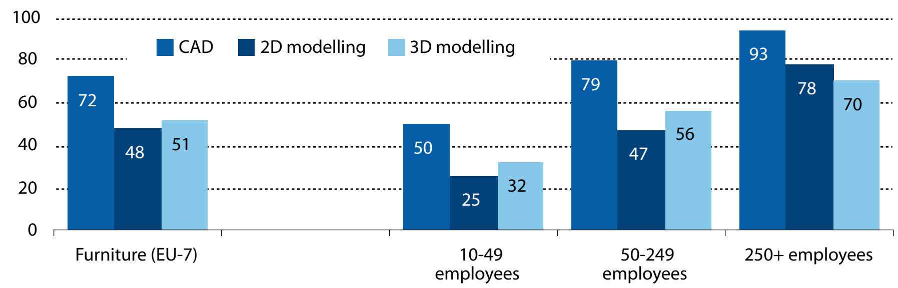
There is evidence that CAD and modelling tools are playing an increasing role in furniture companies of all sizes and product lines. Data from the CATI Manufacturing Survey 2007 confirm the high percentage of companies using CAD systems, with an average of 72% of companies; the access of employees to CAD systems varies according to company size, from 50% in small enterprises to 93% in large companies.

Design tools can be exploited for the purpose of customer-driven production and innovation, allowing a cost and timely-effective way to meet customers' needs. Moreover, design tools can be used to enhance the customer experience at the point of sale, providing virtual visualisation of product options and, ultimately, leading to customer-driven production and innovation (see Exhibit 2.3-1).

### "GREEN" DESIGN AND PRODUCTION AS A WAY TO GAIN COMPETITIVE ADVANTAGE

Issues relating to sustainability and "green" design are increasingly important to the furniture design and production process. This trend is driven by national and EC regulation and is fostered by customers' awareness.

***Exhibit 2.3-1 Adoption of CAD, 2D and 3D packages in the furniture industry***




Base (100%) = companies using computers.

N (Furniture, EU-7) = 661.

Weighting: Figures for sector total are weighted by employment (read: "companies representing x% of employment in the sector"), figures for size-bands in % of firms.

Source: e-Business Survey 2007 by the SeBW

**Business example : American Steelcase, USA: green marketing in office furniture**

*American Steelcase, one of the world's principal producers of office furniture, is strongly basing its communication on green issues, touting the environmental benefits of its chairs and workstations in everything from print ads to product literature. In 2007, Steelcase created product environmental profiles for each of its major furniture lines that tell customers how much recycled content is in each product, what certifications it has achieved and other environmental information. Independent groups have certified that its products do not harm indoor air quality and are made of recyclable materials. Steelcase also develops and teaches programmes for design professionals on topics such as designing for the environment, recycling and materials choice. The company also sponsors pro-environment speakers as well as green events run by the U.S. Green Building Council and other groups*

***For more details about this example, see full study report on www.ebusiness-watch.org***

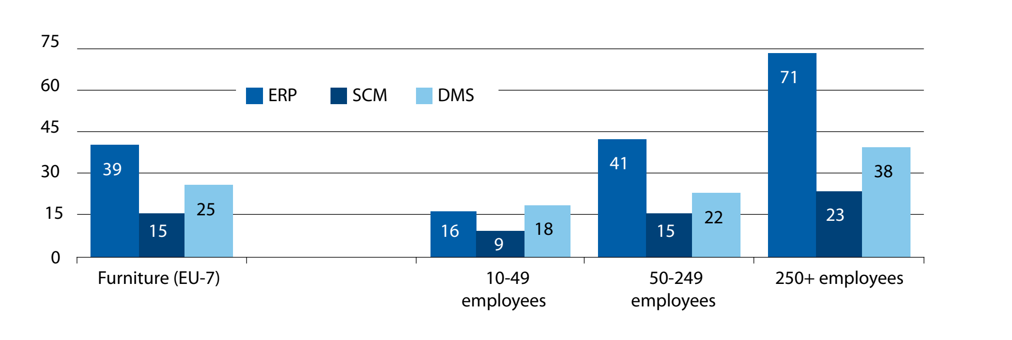
For an increasing number of consumers, "good design" now involves more than simply good looks and functionality; they also want reassurance that their furniture has been ethically designed, made and shipped, and that they will be able to dispose of it responsibly.

The role of e-business is mainly in supporting the concurrent engineering process, with a comprehensive approach that follows the global environmental impact of the product: environmental issues need to be taken into account from the product concept and design phase onwards, through procurement, production and post-sales, until de-manufacturing. The analysis carried out in the furniture sector report indicates that innovative companies have started to adopt environment-friendly strategies, based on ICT tools for the life cycle assessment of furniture products. It is worth noting that these companies succeed in converting the burden of additional costs (due to compliance with strict regulation) into a competitive advantage: the possibility to base communication and marketing on "green" issues that are particularly appealing with the high-end segments of the market (see box).

## ICT FOR VALUE CHAIN INTEGRATION

The furniture industry faces new business complexities. Product demands span a broad range, from commoditised to highly customised products. Customer demand is continuously changing, while competition from low-cost countries is increasing. To keep pace with customer demands, manufacturers are offering expanded product lines and custom options. The resulting wide variety of colours, finishes, fabrics and product options are placing increased demands on information systems to provide the functionality and flexibility required to address all the business requirements. On top of this come demands from customers for reduced delivery times. Extensive cost reductions and time savings from integrating all aspects of the supply chain can be supported by the implementation of proper ICT and e-business solutions, such as SCM. This process is strictly dependent

*Exhibit 2.3-2: Adoption of ERP, SCM and DMS in the furniture industry*




Base (100%) = companies using computers.

N (Furniture, EU-7) = 661.

Weighting: Figures for sector total are weighted by employment (read: "companies representing x% of employment in the sector"), figures for size-bands in % of firms.

Source: e-Business Surveys 2007 by the SeBW on the effective implementation of internal business process management systems, such as ERP.

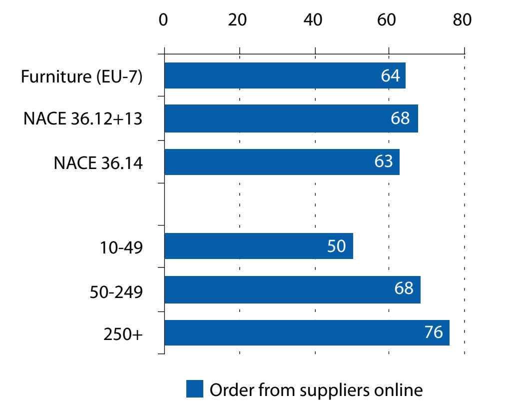
Companies representing 39% of employment use ERP systems, a percentage that grows to 71% in large companies. There is a deep divide between small, medium and large companies in the adoption of ERP systems. Even large companies, however, generally do not extend the advantages of optimisation and integration to the entire supply chain: SCM is poorly diffused across all the size bands. The slightly higher adoption of DMS is explained by the volume and complexity of operations related to document management in this industry (see Exhibit 2.3-2).

The case study on PROFIm, Poland (see p. 108) illustrates how ICT applications can improve interactions along the supply chain, between the manufacturing and distribution processes, leading to significantly reduced delivery times and increased production capacity.

**How to keep it simple: using the Web**

In contrast to the relatively low penetration of internal and supply-chain management tools such as ERP, SCM and DMS, European furniture companies are active on the web. More than 60% of furniture manufacturers use the internet or other computer-mediated systems to order goods and services, a percentage rising to 76% in the case of large companies, but quite high (50%) also for SMEs (see Exhibit).

*Exhibit 2.3-3: Percentage of companies ordering goods or services on the internet or via other computer-mediated networks (2007)*

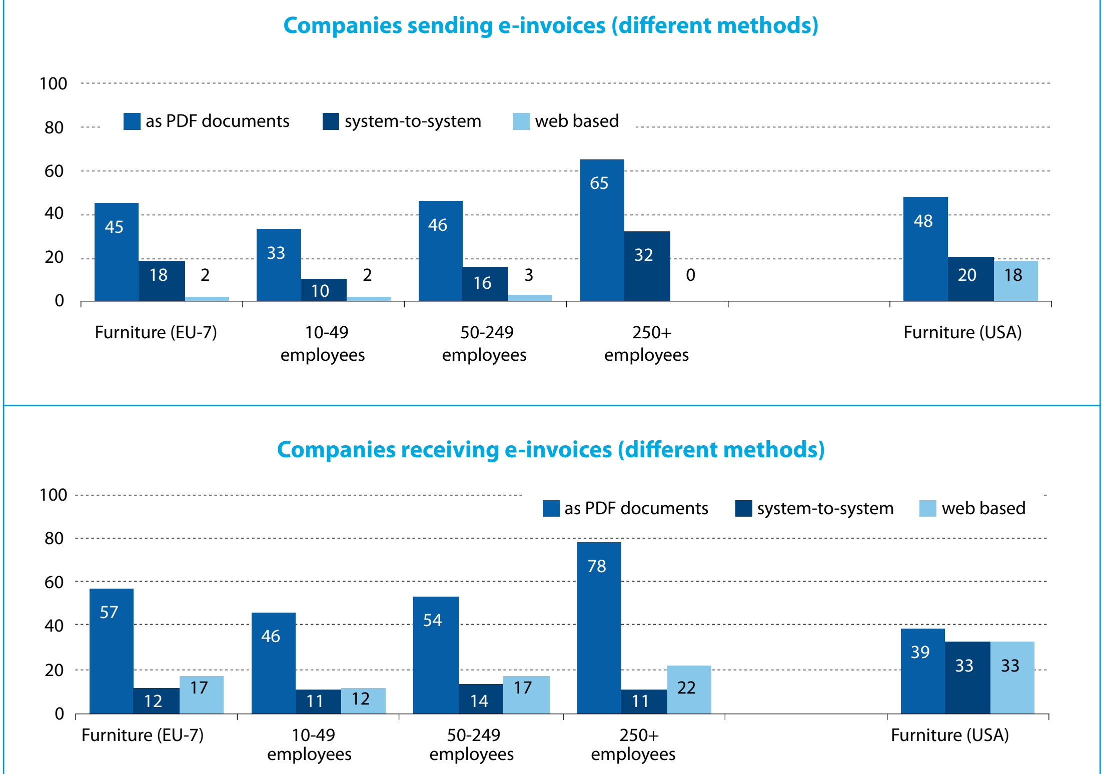



Base (100%) = companies using computers. N (Furniture, EU-7) = 661.

Weighting: Figures for sector totals are weighted by employment (read: "companies representing x% of employment in the sector"), figures for size-bands in % of firms.

Source: e-Business Surveys 2007 by the SeBW

*Exhibit 2.3-4: Percentage of companies sending / receiving e-invoices in 2007 (different methods)*




The survey was conducted in 7 EU countries (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = all companies. N (Furniture, EU-7 and USA) = 761.

Weighting: Figures for sector totals and countries are weighted by employment («companies representing x% of employment in the sector / country»), figures for size-bands in % of companies. Questionnaire reference: B5, B6

Source: e-Business Survey 2007 by the SeBW

It should be noted, though, that the survey question did not specify whether e-mail exchange was to be included – and probably many of these exchanges are simply «conventional orders» transmitted via e-mail, mainly in SMEs.

The survey results concerning e-invoicing confirm how the «keep it simple» approach works also when ICT is involved: the exchange of PDF documents is a simple way of communicating and is widely adopted even in SMEs, while system-to-system exchanges are limited to medium-large enterprises. The e-invoicing practices seem to work more easily in an upwards direction, as the percentage of companies sending e-invoices is higher than the one of receiving e-invoices; this could highlight a discontinuity in the supply chain management methods. The case study on Scavolini, Italy, relates to the automation of internal

**Case study: PROFIm, Poland: benefits of ERP application**

*PROFIm is a leading designer and manufacturer of office chairs in Poland. A changing market and increasing demands from customers required customisation of production and efficient logistics, and PROFIm implemented an integrated ERP system encompassing nearly all areas of business. ICT tools now support all of the company's operating and strategic activities. The application implemented by PROFIm is a software solution optimised for ERP, Enterprise Asset Management (EAM), as well as Maintenance Repair and Operation (MRO). It consists of some 60 different functionalities structured within a few modules that can be implemented one by one and expanded according to the company's needs It is a Service-Oriented Architecture (SOA), centred around actual business processes, such as processing purchase, requisitions or customer invoices. The new system has had a significant impact on company production volume, logistics and relations with clients, leading to shorter delivery times, lower costs, and less overstocking. Due to implemented Customer Relationship Management modules, customer service has also improved significantly.*

***For more details about this example, see full study report on www.ebusiness-watch.org***

**Case study: Scavolini, Italy: intranet for document management**

*Scavolini is the leading brand in the Italian kitchen market. The weekly need to manage at least 10,000 paper and electronic internal and external documents (8,000 of them relating to essential operations, such as offers, order management, invoicing and delivery notes) was the motivation for the company to develop an intranet application for document management. In the past, both external documents - received via e-mail, fax or traditional mail service - and documents partially produced internally - through ERP systems - were managed by using a very simple system of file sharing (through shared folders on the company's LAN). Organising, managing and, above all, searching for documents was very time-consuming, with consequent problems for information filing and management. The implementation of the intranet aimed to improve information flows, rationalise document management activities, start a progressive dematerialisation process with the reduction of paper costs and ultimately increase human resources productivity. The implementation was carried out following a step by step approach, in order to better meet the requirements of each business area and implement the application according to their specific needs. This process has made it possible to analyse the requirements of micro business areas within the relevant departments (order processing, invoicing, etc.) each time, collecting the specific requirements of the staff, solving their problems and training human resources to reorganise their workflows. The step by step approach adopted made it easier to change staff working habits rather than to reorganize the entire working structure.*

***For more details about this example, see full study report on www.ebusiness-watch.org***

business processes in the area of invoicing and document management.

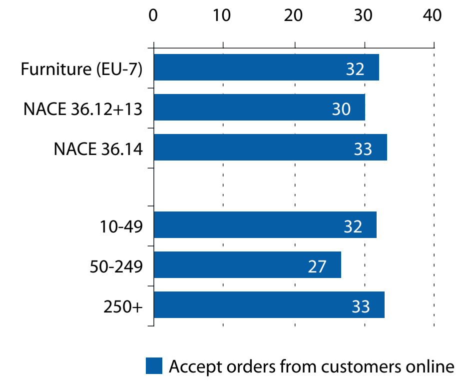
## E-COMMERCE IN THE FURNITURE INDUSTRY

### Business to consumers

In the furniture industry, e-marketing and e-sales activities towards final customers are aimed both at providing technical and commercial information and at actual e-commerce functions. There are still market-related constraints to the development of e-commerce. Big market players are sometimes reluctant to sell online, due to a strategy based on local stores and price differentiation. Moreover, purchasing a piece of furniture implies a long and complex process, due to the high cost and aesthetic function of products: in highly "emotional" purchases, such as home furniture, the personal and first-hand experience of the customer is paramount.

The survey results illustrated in the exhibit show a relevant share of companies addressing their customers via the internet. Unfortunately, the absence of previous surveys does not allow a comparison with older data. The overall percentage is 32%, with a slightly higher value for B2C–oriented NACE 36.14 manufacturers, while kitchen and office furniture manufacturers rely more on e-catalogues. These figures are in line with the other manufacturing sectors and slightly less than in the US furniture sector. For most furniture companies, the proportion of electronic sales is limited (see Exhibit 2.3-5).

***Exhibit 2.3-5: % of companies where customers can order goods or services on the internet or via other computer-mediated networks (2007)***




Base (100%) = companies using computers. N (Furniture, EU-7) = 661. Weighting: Figures for sector totals are weighted by employment (read: "companies representing x% of employment in the sector"), figures for size-bands in % of firms.

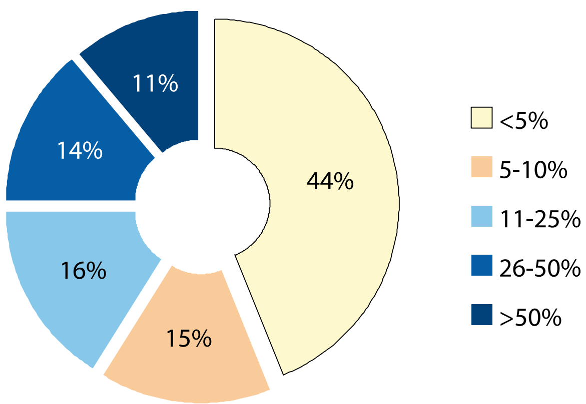
Source: e-Business Surveys 2007 by the SeBW

An example of successful furniture e-commerce is given in the Quatuor case study. A particularly interesting aspect is the complementary role of the web site versus traditional selling activities.

### e-Catalogues

Selling furniture depends on the product style, quality, appearance and price. Catalogues are considered the most important marketing tool and the most usual way of communication in this sector. In this sense, the quality of information and the way it is presented is a key success factor. On the other hand, there are frequent errors when ordering the prod-

***Exhibit 2.3-6: Average percentage of orders received online (2007)***




Base (100%) = companies receiving orders online. N (Furniture, EU-7 and USA) = 761.

Source: e-Business Surveys 2007 by the SeBW

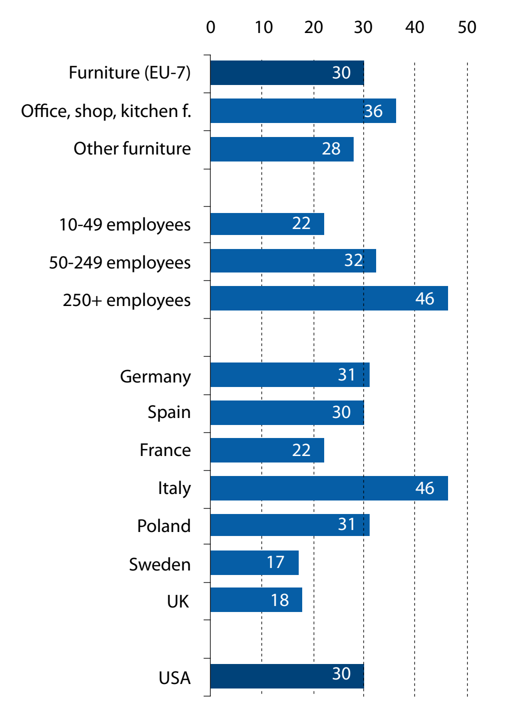
**Case study: Quatuor, Belgium: a web site for communication and e-sales**

*Quatuor is a retail business in furniture and decoration, located in Belgium. Created in 2004, the business has grown rapidly. This success is partly due to Quatuor's website. First designed as a communication and online catalogue, the website became progressively an e-shop. Quatuor developed e-business activities while maintaining its core activities and values, based on high quality service and advice. Following this business strategy, the e-business solution developed by Quatuor is not fully-integrated. Quatuor's e-business tools were developed in order to retain flexibility and contact with clients. The idea was not to create a fully integrated e-sales platform, but more to equip the store with distance-selling instruments, so that it could enlarge its customer base without creating a break with its core business and strategy. This strategy has proved to be successful: it offers good visibility to the store and helps to attract more distant, diversified and numerous clients.*

***(for more details about this example, see full study report on www.ebusiness-watch.org)***

ucts, which may represent high losses for the company (between 3-7% of furniture companies' income on average). These errors are due to the high number of possible variations, that is, different dimensions, fabrics, materials, finishing. In this sense, e-catalogues are easier to update for the manufacturer and more searchable by the customer, in comparison to traditional catalogues. Besides, this makes it easier to address the contract market, that needs quick and flexible selection and ordering systems, as well interior designers, who need product information that is easy to store (compared with paper catalogues).

***Exhibit 2.3-7: Percentage of companies having an electronic catalogue describing their products or services based on a certain industry standard for e-catalogues (2007)***




The survey was conducted in 7 EU countries (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = all companies. N (Furniture, EU-7 and USA) = 761.

Weighting: Figures for sector totals and countries are weighted by employment ("companies representing x% of employment in the sector / country"), figures for size-bands in % of companies.

Questionnaire reference: C2

Source: e-Business Surveys 2007 by the SeBW

The following exhibit shows a relatively high adoption of e-catalogues in the furniture industry, more evident in large companies. The Webmobili case study is a good example of a trend towards e-communication that seems to be well established in the European furniture industry (p. 112).

### Business to Business

B2B furniture transactions (direct sales of contract furniture to companies through e-commerce, and/or subcontracting of various production/distribution activities) are also a promising trend. The use of web standards such as XML language help customers to better manage the acquisition of furniture products and services, providing access to efficient trading mechanisms and commerce processes: content management services, global supplier directories, sourcing tools, B2B auctions and reverse auctions, electronic payment and streamlined transaction services. An interesting example of how the internet can be successfully exploited to improve contacts between furniture industries is the IWOfurn platform (see case study, p. 111).

### Interoperability and standardisation

One of the main technical challenges to integration between manufacturing and distribution is the standardisation of data and of information systems, a task which is also related to the variety of legacy systems adopted by the different manufacturers and distribution networks. The establishment of international standards is paramount for a wider adoption of e-business in the furniture industry.

Most companies still rely on proprietary standards (see Exhibit 2.3-8); a policy which is even more frequent among large companies that can impose their standards on suppliers and distribution networks (and often even have their own distribution networks!). While 18% of companies (61% of large companies) adopt proprietary standards, only 8% of companies adopt EDI-based standards, and 9% use XML-based standards. This percentage, however, is somehow

*Exhibit 2.3-8-: Companies using technical standards (2007)*

| | EDI- based standards | | XML- based standards | | Proprietary standards | |
|---|---|---|---|---|---|---|
| Weighting scheme: | % of empl. | % of firms | % of empl. | % of firms | % of empl. | % of firms |
| **Furniture (EU-7)** | **21** | **8** | **16** | **9** | **34** | **18** |
| Office, shop & kitchen f. | 21 | 7 | 16 | 9 | 30 | 16 |
| Other furniture | 20 | 9 | 15 | 9 | 37 | 19 |
| **Furniture – USA** | **29** | **18** | **12** | **14** | **26** | **22** |
| **Furniture – by size (EU-7)** | | | | | | |
| Small (10-49 empl.) | | 6 | | 6 | | 16 |
| Medium (50-249 empl.) | | 17 | | 21 | | 25 |
| Large (250+ empl.) | | 42 | | 18 | | 61 |
| **Other sectors (EU-7)** | | | | | | |
| Chemical | 38 | 15 | 16 | 11 | 31 | 18 |
| Steel | 34 | 12 | 22 | 10 | 22 | 14 |
| Base (100%) | all | | all | | all | |
| N (Furniture, 2007, EU-7+USA) | 761 | | 761 | | 761 | |
| Questionnaire reference | C1a | | C1b | | C1c | |

The survey was conducted in 7 EU countries (DE, FR, IT, ES, PL, SE, UK) and in the USA.
Source: e-Business Surveys 2007 by the SeBW

**Business example: IWOfurn, Germany: a B2B portal for the furniture industry**

*IWOfurn is a B2B web portal for the European furniture industry. It permits registered companies to present themselves through a detailed company profile, upload brochures, presentations and catalogues, contact users and manage mailing-lists within the community. The portal is a communication channel able to standardise companies' catalogues and support companies' information in all aspects of communication with their business partners. IWOfurn is not only a marketing and communication service but also an e-commerce service provided by IWOfurn Service GmbH, with the final aim to connect European furniture manufacturers and retailers. Future business prospects point to the implementation of functionalities including logistic and financial services as well as the possibility to adopt radio frequency identification (RFID) technology for product traceability, logistics and transport.*

**Case study: Webmobili, Italy: a search engine for e-marketing**

*Webmobili is a spin-off from Federmobili, the Italian Association of Furniture Retailers. It is a publishing company running a search engine that provides consumers with a point of comprehensive information about the national offer of medium-high range furniture and related items. It is a marketing and communication service for independent retailers and manufacturers. The service is free for consumers. Customers of this service are retailers as well as furniture manufacturers.*
*Webmobili has built a database of catalogues of manufacturers and retailers: All collected information has been standardised and migrated to the service in such a way that it can be easily accessed by the public. The main objective of Webmobili is to give visibility to the offer of Italian furniture, which is mainly produced by small-medium sized manufacturers and sold by independent retailers with limited investment capability for advertising and promotion. A unique feature, at least on the Italian market, is that catalogues are edited and harmonised: they are designed and presented in a user-friendly way, in order primarily to provide objective and comparable information (including price range) to the public. Webmobili proved to be a communication channel bridging an information gap between demand and offer.*

***For more details about this example, see full study report on www.ebusiness-watch.org***

contradicted by the relatively large number of companies adopting e-catalogues (as XML is the chosen standard for web catalogues). This discrepancy could be due either to the adoption of other e-catalogue typologies, or to a lack of awareness about this technical aspect among the survey respondents.

### 2.3.3 ICT and e-business impact

Findings from an econometric analysis conducted for this study, as well as from the e-Business Survey and the case studies, have identified some of the most important driving forces of using ICT and its impact on selected dimensions in the furniture industry: innovation, the market structure and the sector value chain.

#### ICT AND INNOVATION

In micro-economic terms, a product innovation corresponds to the generation of a new production function. In the furniture sector this may range from the introduction of a radically new product to changes in product features, such as material, fabric or even colours. The capability for product innovation is considered very important by European companies in order to face global competition and to keep their position in higher market segments, which rely on differentiation and quality.

A process innovation, on the other hand, can be viewed as an outward shift of an existing supply function which generally aims at lowering the variable costs of operations. In this sector, process innovation may include the automation of existing processes and the streamlining of operations and of information flows, and it is often related to the organisation of production. In recent years much effort –and related debate - has been expended around the concept of mass customisation, i.e. the ability to produce customised products at a price which is normally associated with standard products.

The links between the adoption of new e-business technologies and innovation are broadly recognised. ICT investments in general and e-business applications in particular enable and drive process innovation. They are drivers, because ICT implementation, to be successful, typically requires changes in working routines.

To acquire some evidence on the role of ICT for innovation, the Sectoral e-Business Watch asked the interviewed companies whether they had "launched any new or substantially improved products or services" during the 12 months prior to the interview, and if they had introduced "new or significantly improved internal processes" in the same period of time. Enterprises representing about 47%

of sector employment said that they had launched new (or improved) products in 2006/07 and about 44% of those said that their product innovations had been directly related to or enabled by ICT. Out of all companies that said they had introduced new or significantly improved processes, nearly 70% (by their share of employment) said that the new processes are enabled by ICT. Even the share of small companies is quite high, as about 50% of companies reported that their process innovation(s) were ICT-enabled. A regression analysis of micro-data from the e-Business Survey 2007 highlights some interesting findings:

**Skills matter**: the ICT-driven innovative process is linked to the proportion of employees with university degrees and the number of ICT practitioners. This finding provides evidence that the success of the ICT-driven innovative process is linked to the availability and quality of complementary assets, i.e. ICT-related knowledge and skills. Not surprisingly, these results illustrate that staff who are familiar with ICT can better exploit ICT technologies in a creative manner. In this sector, in particular, innovation is often linked to the usage of ICT for design, requiring adequate skills for full exploitation. These findings suggest that efforts should be made to encourage synergies between design and supporting technologies in this sector.

**Inter-company collaboration enhances innovation:** the use of applications and practices supporting the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations. ICT-enabled innovation is also linked to the existence of long-standing and electronically-organised relationships with business partners. This is exactly the kind of business relationships that are typical of this industry, where activities are often organised around a network of business partners. Also in this case, therefore, there is untapped potential for further and sustainable innovation. A wider spread of applications supporting inter-company collaboration could be very helpful for the competitiveness of the sector, not only – as it is commonly observed - in terms of efficiency, but also for the innovation activity that it is likely to induce and support.

**Small companies can successfully pursue innovation** in this industry: There is no clear evidence of a negative impact of small size and age of the company on innovation, in contrast to other sectors. Given the importance of innovation in the competitive scenario, this result should be regarded with particular attention, as micro and small companies constitute the vast majority of players in this sector. This is also supported by the empirical evidence of the case studies presented in the Sector Report and it is particularly true for the higher market segments.

It was also found that **innovative output is positively linked with company performance**: Companies that introduced ICT-enabled innovations were more likely to have experienced sales growth, although the validity of this conclusion should be checked against market fluctuations over years.

Finally, the analysis explored the links between **ICT and organisational change.** The intensity of the use of ICT applications and the availability of IT-skilled employees are major drivers of organisational changes in the furniture industry. Hardware infrastructure, by contrast, is a necessary condition but is not sufficient to create a competitive advantage. It can be concluded that the improvement of e-business skills related to the re-organisation of working processes and procedures is fundamental for the deployment and exploitation of innovative ICT solutions.

### ICT AND MARKET STRUCTURE

The econometric analysis investigated the drivers and impacts of ICT diffusion with respect to market structure. A major result of this exercise is that **ICT has a limited influence on competition and on changes in the market structure**.

Increasing rivalry in the market is not a driver for the adoption of ICT: companies see ICT neither as a competitive priority nor as a means to gain competitive advantage. This is also mirrored by the finding that the impact of ICT on market share is not proved. In short, the influence of ICT on competition in the sector is limited, and most of the sector's companies do not see ICT as a priority.

### ICT AND THE SECTOR VALUE CHAIN

Finally, the drivers and impacts of ICT diffusion with respect to the furniture industry's value chain were analysed. In particular, the analysis addressed whether the relationships between suppliers and buyers (i.e. industry structure) affect the diffusion of advanced ICT systems and, secondly, the way ICT use affects the companies' decisions regarding outsourcing decisions.

**Strong ties support specific ICT investment:** the analysis revealed that close relationships between business partners facilitate investments in specific technologies, and that collaborative practices and ICT applications strengthen the relationships between the companies and lead to the creation of organisational networks.

The strength of relationships between companies interacting with each other plays an important role in the diffusion of ICT applications that support inter-company collaboration. The positive effective of close relationships is that it facilitates investments in specific technologies. There may however be a negative effect: strong ties may limit the adoption of sectoral open standards. In this sector, most companies, particularly the largest ones, rely on proprietary standards: they have made investments in proprietary system and do not have any need for migrating to open solutions.

Another important finding is that **ICT and make-or-buy decisions are related**, although it is not possible to establish the direction of this link. In other words, it is not possible to say whether the intense usage of ICT drives outsourcing or the necessity to outsource activities is a driver to the adoption of ICT.

### 2.3.4 Outlook

The market developments and changes in the business environment for the furniture sector have been comprehensively analysed in the "Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries" issued in May 2007 by the DG Enterprise and Industry of the European Commission. Some of the main conclusions regarding the furniture industry and relevant for their e-business implications can be summarised as follows:

**A thorough restructuring is taking place in this industry**. This will bring a selection process in which many companies –especially small ones– will disappear. The most advanced competitors will, in turn, attempt to concentrate their activities, with a dual purpose: improving market positions and becoming global. Concentration allows better market control, as well as cheaper outsourcing of components to remote competitive specialised suppliers.

Competitive companies are **investing in design technologies and skills** to build their own brands and to raise their service level, especially at the point of sale. Investments are being made to develop private retail networks so as to come closer to consumers' expectations and tastes and to increase market response competencies as key elements of market strategies.

The **geographical relocation** of markets is expected to continue and increase: most market growth will be located in the emerging economies, which means that export skills and competencies are going to be increasingly necessary for EU industries. This will imply increased networking requirements for all players.

**Globalisation will also affect sourcing and subcontracting strategies** in order to improve cost control and time-to-market: more reactivity, better traceability, higher differentiation, and better environmental performance will be necessary to compete on the international market.

Dynamic developments of ICT and e-business can be expected in response to such challenges. But the full deployment of this process is likely to be hampered by the market structure and trends, and by the attitude of furniture companies.

#### MAIN AREAS OF FUTURE ICT AND E-BUSINESS IMPACT

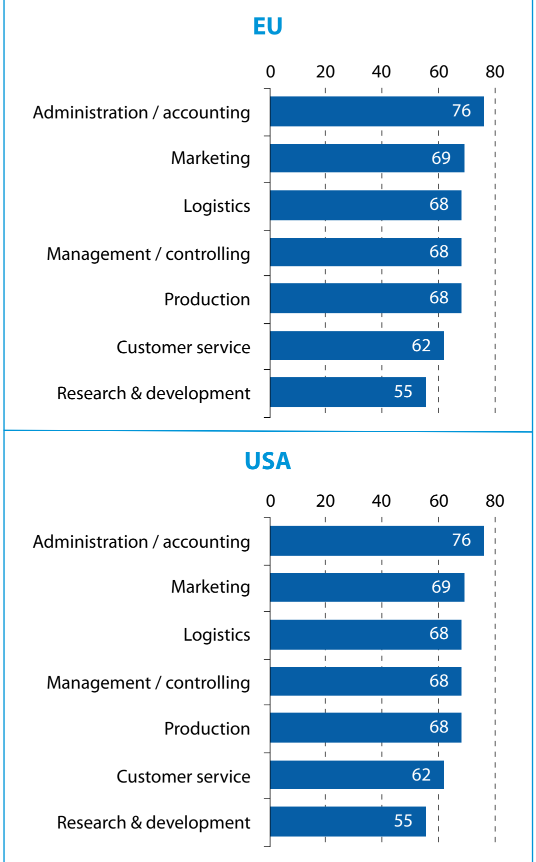
In the e-Business Survey 2007, companies were asked about expected future impacts of ICT on seven business functions. The highest level of combined high and medium impact was attributed to **administration and accounting** (76%). For all business functions, more than 55% of the interviewees stated high or medium impact, indicating that ICT will generally be very important for the furniture industry in the future. Interestingly, European furniture companies attribute a higher importance to ICT in the future than their US counterparts (see Exhibit 2.3-9).

## 2.3.5 *Policy implications*

The results of the SeBW analysis indicate a complementary role for ICT in the furniture industry. Generally, furniture companies do not perceive ICT as a strategic priority that impacts on their competitive positioning and performance (less than half the companies think that ICT has a relevant influence). They view ICT pragmatically, as a means to carry our a few selected processes in a more efficient way. However, furniture companies appear to be aware of the benefits related to ICT, and have adopted advanced solutions, such as 3D, whenever they prove to bring real advantages.

The main question stemming from the above considerations is whether more ICT and e-business are needed in this sector and, if so, in which specific areas. The identified policy issues address the areas where efforts should be made by public bodies to stimulate ICT adoption, for example where ICT-supported processes could strengthen innovation and competitiveness. These issues are:

**Exhibit 2.3-9: Furniture companies expecting that ICT will have a high or medium impact on … in the future (2007)**




The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.

Base (100%) = companies with at least 10 employees and using computers.

Weighting: Figures are weighted by employment ("firms representing x% of employment in the sector / country").

Questionnaire reference. F6.

Source: e-Business Survey 2007 by the SeBW

### INTEROPERABILITY

Most furniture companies still rely on proprietary standards, particularly large companies that can impose their standards on business. While electronic exchanges with suppliers (more concentrated and linked with long-standing relationships) are relatively more advanced, interoperability with the downstream part of the value chain is still limited.

Currently, there are so many business partners and so many systems in place that automation processes are practised only with very few players, because of the technological challenges in product coding and the economic justification of the necessary investments. This situation is common to other manufacturing sectors where most players are SMEs and both manufacturers and distributors are fragmented[45]. In sectors such as food[46], it has been the role of distribution –in general more advanced and concentrated than manufacturers– to drive the whole sector to adopt standards for interoperability on a large scale. The situation of the furniture sector is somehow in between and varies widely across countries.

In the absence of market forces, it is an open question what can be done at public level. Efforts have been made on the technological side, especially at European level. The subject of standards for interoperability has been addressed, e.g. by the SMART-fm[47] initiative, by the FunStep Interest group[48], and currently by the INNOVAFUN[49] initiative. Progress on the technological side, however, has not been matched by large-scale adoption in the sector.

45. See e-Business W@tch Sector Study on the Furniture Industry (2006), see **www.ebusiness-watch.org** ('resources').
46. See e-Business W@tch Sector Study on the Food Industry (2006), see **www.ebusiness-watch.org** ('resources').
47. ***http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/60707***
48. ***http://www.fsig.funstep.org/funStep.htm***
49. ***http://standards.eu-innova.org/Files/Publication/EUR_Standards_INNOVAFUN.pdf***

Policy measures should now aim at fostering faster and wider implementation of standards both at sector and at cross-sector level, in particular in integration with distribution, and with SMEs. This would ultimately bring advantages to the whole furniture manufacturing industry in terms of efficiency and responsiveness to the market.

At sector level, measures should also include awareness-raising and support mechanisms for standardisation initiatives, with the aim to stimulate participation of SMEs. Stakeholders such as industry federations and standardisation bodies should be encouraged to disseminate information about standardisation and its benefits.

### PROMOTE A FAVOURABLE ENVIRONMENT FOR INNOVATION

Furniture companies operate in a competitive environment at domestic and international level. To remain competitive they need to improve the efficiency of business processes, especially in those market segments where production operations are complex and involve a large number of players, typically the kitchen sub-sector. In general, but mostly in the "other furniture" sub-sector, European manufacturers have to pursue innovation strategies based on creativity, quality and differentiation of products. This requires continuous investments and improved governance of knowledge. Again, it is an open question what the role of public bodies could be in supporting European companies. From the analysis carried out, the following main points come up:

**Broad band** has been spreading widely and is currently used by a large proportion of companies. The availability of broadband should be assured for all European players in all countries and regions, in order to avoid situations of e-exclusion. The availability of broadband connections, together with the development of standards, as pointed out above, are conditions for cooperation and joint development activities between furniture enterprises.

The econometric analysis shows that innovation in furniture companies is linked to the availability of ICT-skilled resources and of staff with university education. It is also well known that design and creativity are points of strength of the European furniture industry. Efforts should be made at a European and national level to **encourage synergies between design and supporting technology in order to favour cross-fertilisation between these two fields**.

Finally, ICT may have a role in protecting innovation and intellectual property rights. Discussion should be promoted about technologies (such as RFID) that may help EU companies to control their IPR and fight counterfeiting.

### IMPROVE E-BUSINESS SKILLS WITHIN THE FURNITURE INDUSTRY

ICT and e-business are rapidly changing the way business is conducted in this industry. Innovative applications require changes in organisation and working procedures. Skills upgrading and training of personnel are important to assure the successful implementation of new applications. However, SMEs may have difficulty in exploiting opportunities related to the introduction of new technologies due to a lack of necessary skills. Policy may have a role in:

- **Promoting entrepreneurial and managerial understanding of e-business applications**. The involvement of all organisation layers and strong commitment of management are essential whenever e-business initiatives are implemented, as highlighted in case studies and business examples presented in the report. Possible measures to support decision-making in management include the provision of management-style information about e-business (e.g. about service providers, available e-standards and software solutions). Furniture industry associations may support the sharing of successful e-business practices at sector level between companies of similar size.
- Encouraging the **improvement of skills related to the reorganisation of working processes** and procedures and the implementation of innovative technologies. Again case studies and business illustrate how the involvement of key resources has been fundamental for the development and the adoption of innovative e-business solutions.

## 2.3.6 References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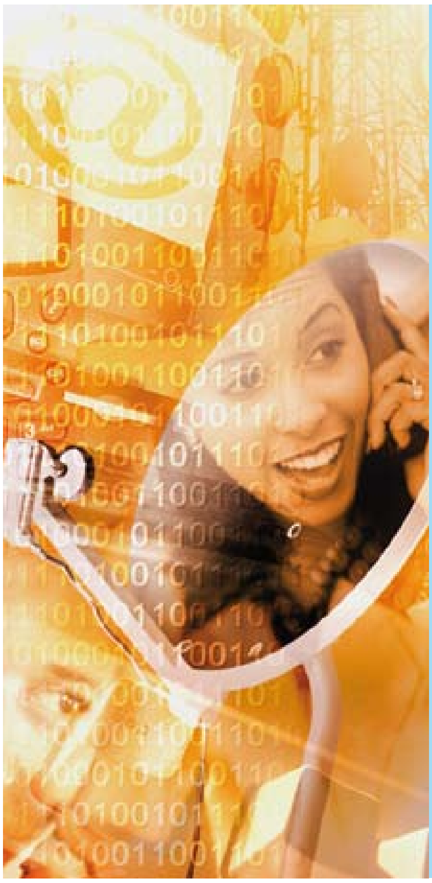
## 2.4 Retail



**Key findings**

***Increase of e-business use 2003-2007:*** *as of 2007, firms representing more than half of the industry's employment procure electronically, intense use of in-house e-business solutions is rare, and more than one third sell electronically. The share of firms with e-sales activities doubled between 2003 and 2007.*

***Digital divide owing to firm size continues to exist:*** *retail SMEs lag behind large retailers in ICT uptake – overall, e-business activities often tend to increase with firm size.*

***e-Commerce environment less vibrant in the EU than in the US:*** *EU retailers tend to use less e-business processes than US retailers. There are also signs that the e-business ecosystem differs notably between the EU and the US (e.g. barriers to and drivers for e-business differ).*

***Level of e-business use is similar across retail industry sub-sectors:*** *the three retail industry sub-sectors, non-food, food and other retail show no significant differences in ICT uptake and e-business use.*

***ICT capital investments alone are insufficient:*** *without changes to the business and especially re-engineering of business processes, there is little return from investments in ICT.*

***ICT drive innovation:*** *in the retail industry, ICT mainly drives process innovation but the use for product and service innovation is larger than in other industries*

### *2.4.1 Context and background*

#### SECTOR COVERAGE

The retail sector study covers firms that resell new and used goods to the general public for personal or household use and consumption. This definition corresponds to NACE Rev 2. Division 47: 'retail trade, except of motor vehicles and motorcycles'. Two types of retail activities are dominant in the EU: retailers that sell non-food items in store (Class 47.12 and Groups 47.4 to 47.7) and retail sale of food items in store (Class 47.11 and Group 47.2). The remaining NACE categories fall into the "other retail" group: retail sales of automotive fuel in specialised stores (Group 47.3)[50]; retail sales via stall and markets (Group 47.8); and retail trade not in stores, stalls or markets (Group 47.9).

#### INDUSTRY CHARACTERISTICS AND TRENDS

The retail industry is one of the largest economic sectors in Europe, providing employment to some 17 million people, and services to approximately 480 million consumers in the European Union. Retail firms act as an interface between the manufacturers and wholesalers on the one hand, and consumers on the other. A retail firm is typically the last point in a supply chain; the point from which a product reaches the end-consumer. The main difference between retailers and wholesalers is that retailers direct their sales efforts towards end-consumers whilst wholesalers primarily sell to retailers and other businesses. One common characteristic of the retail industry is that the vast majority of the sector's value added is generated by large enterprises employing more than 250 people and micro enterprises employing fewer than 10 people. This variety of organisational forms coupled with the extensive assortment of goods sold and markets targeted, illustrates the heterogeneous structure of the retail industry.

Retail industry performance is heavily dependent on macro-economic developments: the industry's turnover reflects consumer spending habits. With economic prospects for consumers uncertain, given a strong rise in food and energy prices over the last

50. Included in the "other retail" group as this sub-group was not originally part of NACE Rev. 1 Division 52; the initial structuring criterion used for this study.

year, the economic outlook for the retail industry remains volatile. Another consumer-related trend affecting the retail industry is changes in consumer preferences: consumer sensitivity about environmental issues is, for example, increasing, leading to greater demand for sustainability and sustainable products. Similarly, retailers are affected by demographic changes such as a larger share of older people with particular consumption habits. Besides consumer-driven trends, the retail industry is characterised by increasing concentration and competition: in many retail sub-sectors large chains are driving out smaller players. In Germany and France, for example, more than two thirds of total food sales were made by the top five retailers in 2007.

### 2.4.2 ICT adoption and e-business use

Retail companies need to make decisions regarding ICT and e-business strategies. This includes decisions about investments in ICT, types of information systems to adopt and ICT-induced business processes changes. This section explores e-business activities and ICT use in the retail industry. It commences with presenting findings about ICT investment trends and adoption dynamics between 2003 and 2007. Next it discusses findings about e-procurement, in-house e-operations, e-sales and e-marketing.

#### ADOPTION DYNAMICS

Compared to 2003, findings from 2007 indicate that ICT and e-business use is more prevalent in retail firms of all size classes. Internet access, for example, was already common in 2003, but the quality of companies' internet access has significantly improved since, notably among SMEs. The share of micro-retailers (with 1-9 employees) that say they are connected with broadband[51] for example has doubled from 15% to 30%. Among small- and medium-sized retailers, broadband diffusion has increased to about 45%; and broadband adoption among large retailers went from 40% to 60% between 2003 and 2007. Overall however, the use of e-business in the retail sector remains below average when compared to other sectors. Yet, the findings confirm that some of the main e-business opportunities in the retail industry, similarly as in other sectors, are efficiency and productivity gains and, thus, cost savings.

#### ICT INFRASTRUCTURE

The ICT infrastructure of retail firms is an indicator for the e-readiness level of the retail industry. The average share of retail employees with internet access at their workplace is, for example, close to 50%. This is more than in other sectors, including manufacturing sectors such as the steel and furniture sectors (about 25-30%) and the chemical industries (45%). Similar to remote internet access, the use of ICT to connect computers internally to a company network (Local Area Networks – LAN) has become commonplace in the industry with 66% of firms using it. The adoption of wireless LAN (W-LAN) is another indicator: more than 50% of large retailers operate a W-LAN, and 35-40% of small and medium-sized retailers do so. The adoption of open source technologies is also gaining momentum in the industry: 31% of retailers are using open source browsers (such as Mozilla Firefox) while 22% use open source databases (such as MYSQL) and a further 22% use open source operating systems (such as Linux).

#### INVESTMENT IN SKILLS: ICT PRACTITIONERS AND ICT OUTSOURCING

11% of retail companies employ ICT specialists, but numbers differ significantly across firm sizes: a critical divide between SMEs and large retail firms exists. Hence, overall direct investments into ICT skills remain low with small numbers of micro and small firms (10% and 15% respectively) employing ICT practitioners. The numbers rise to 32% for medium-sized firms with almost half (48%) of large firms employing ICT practitioners. In contrast, indirect investment in ICT skills in the form of ICT outsourcing is more balanced across firm sizes, although micro- and small firms are less active than medium-sized and large firms (45% and 59% versus 63% and 69% respectively). Overall, about 40% of the retailers interviewed in 2007 said that they had outsourced ICT functions to external service providers which in the previous 12 months they had conducted in-house.

#### ICT INVESTMENT TRENDS

The general climate for ICT investments has significantly improved over the past few years: 74% of retail firms have made investments in ICT hardware and software in 2006/2007. About 70% of small and medium-sized firms and more than 90% of large firms said that they invested in ICT in the past twelve

51. Broadband is defined in this study as internet connection with a bandwidth of at least 2 Mbit/s.

**Case Study: Smart Supermarket, Malta**

*Smart Supermarket was the first supermarket in Malta to introduce online shopping services in 2001. While the company faced many challenges and online sales have not reached a critical mass of customers needed to attain profitability, Smart Supermarket continues to invest in its online activities. The reason for this continued investment in ICT is that Smart Supermarket anticipates benefits in the longer term. Another factor is that business relationships with suppliers have improved notably due to the investment made in online activities as suppliers were encouraged to participate.*

**Case Study: Globus, Germany**

*Globus Holding GmbH & Co. KG is a large family-owned retail company based in Germany trading mainly home improvement (DIY) products and consumer electronics. An e-procurement solution, initially adopted in 2001, has resulted in some major changes to the company's business processes since the solution was adopted: it has, for example, streamlined the entire process of procuring indirect goods; and as one of the results, it enables company staff and managers to focus on core activities. Moreover, the system enables the firm to procure strategically through pooling demands of single departments within the various stores and setting up framework contracts with preferred suppliers. The implementation of e-procurement at Globus illustrates the need for a holistic approach to e-business adoption. The pure installation of a technical system bears little return on investment without the re-organisation of business processes and the full support of management and end-users.*

months. Companies were also asked whether, in the forthcoming financial year, they intend to increase, decrease or roughly keep their ICT budget. 60% of companies expect to maintain the ICT budget at the same level. About 35% of companies said they intend to increase their budget while few companies (3%) said they planned to decrease their ICT budget. The Smart Supermarket case study is an example as to how European retailers continue to invest into ICT.

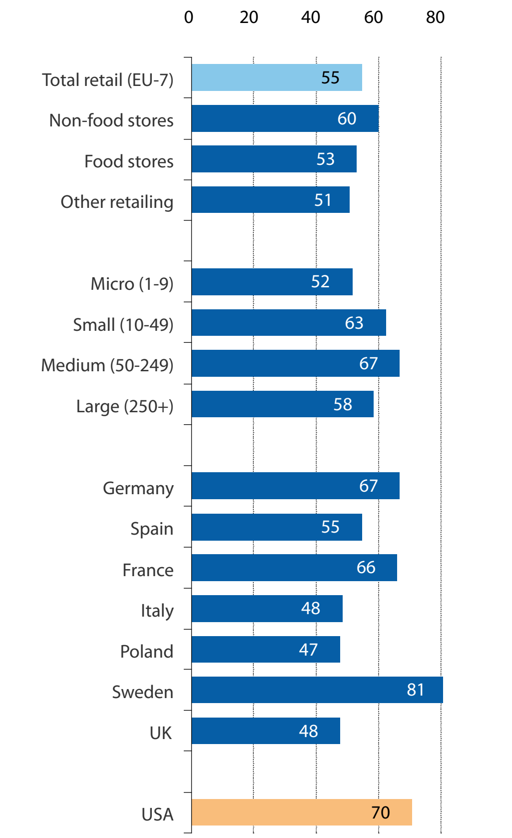
### E-PROCUREMENT

Retailers are a vital part of whole supply chains. In order to be able to offer goods to customers, retailers have to procure those goods. The function of procurement is to design and manage the processes, information and material flows between retailers and suppliers of goods and services. e-Procurement covers electronic business processes, electronic information flows between retailers and suppliers and electronically supported material flows between the stakeholders. The Globus case study (see box) illustrates some of the benefits that retailers can reap from adopting e-procurement.

As retailers do not produce goods, procurement is one major source of competitive advantage for retailers: procurement is a significant cost factor for retailers and e-procurement can potentially decrease these costs. In 2007, retailers accounting for 55% of employment in the sector said that they ordered at least some goods from suppliers over the internet or through other computer-mediated networks such as EDI (Exhibit 2.4-1).

e-Procurement activities in the retail sector have increased since 2003 when the respective number was 43%. Since then, adoption has increased mainly among SMEs, and to a lesser extent among large retailers. Overall, the intensity of e-procurement has increased but remains low. In 2007, retail companies representing 35% of employment (among those that place orders for supplies online) said that their online orders accounted for up to 5% of their total orders from suppliers. The equivalent number was 60% in 2003. At the same time, the share of intensive users (procuring more than 25% of goods online) has increased from 17% in 2003 to 40% in 2007. Calculated as a total, the share of

*Exhibit 2.4-1: Percentage of retail firms placing orders to suppliers online*




The survey in 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = companies using computers.

N (Retail, EU-7 and USA) = 1151.

Weighting: Figures for sector totals and countries are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms.

orders placed by retailers online (by those companies that actually order online) has increased from about 10-15% in 2003 to about 25-30% in 2007. Counting in all retail companies, including those that do place any orders online, the total share of online orders has probably increased from about 5% (2003) to about 15% (2007).

## IN-HOUSE E-OPERATIONS

Internal e-business operations can significantly enhance workflows and business processes and thus increase productivity. Companies were asked about the extent of e-business use for conducting e-business processes. Companies representing almost half of the industry's employment said that they only conduct some processes as e-business. 22% even said "none"; a "good deal" was stated by 20%, and in 11% most processes are conducted electronically. As regards particular systems, firms representing 60% of employment reported to have a software application to manage the placing or receipt of orders, 59% a bar-coding system, 51% a warehouse or depot management system, and 16% an Enterprise Resource Planning (ERP) system. The e-Business Survey 2007 also found that retailers representing 20% of the industry's employment use a Customer Relationship Management (CRM) system, an increase from 8% in 2003. The Casino case study illustrates the effects a CRM software application is having on this large European retailer.

Another indicator for in-house e-operation activities is the level of software applications used to manage the placing or receipt of orders. EU-7 companies representing 60% of retail employment said they use such software (see Exhibit 2.4-2). Again, there are differences between size classes: the level of use of applications for order management increases by size class. 47% of the micro retailers reported to have such a system and 76% of large retailers. The level of order management applications use was found to be exactly the same in EU-7 and US retailers.

## E-SALES

Retailers representing 38% of the industry's employment stated that they sell goods "through the internet or other computer-mediated networks" (see Exhibit 2.4-3). Almost half of the large retail firms (45%) and 35% of the medium-sized ones sell online, but only 24% of the small retailers and 26% of the micro retailers do so.

The share of companies that sell online doubled from 19% (employment-weighted) in 2003 to 38% in 2007. There was an apparent increase in all size classes. There has also been an increase in the amount of sales conducted online. Online sellers representing almost half (47%) of the industry's employment said that they sell less than 5% of their total sales volume online. 19% said they make between 5 and 10% of their sales online, and in 6% the reported share was between 11 and 25%. More than a quarter (28%) of the online sellers reported an online sales volume above 25% of their total sales: 12% said they sell between 26% and 50% online, and 16% of the online sellers stated to sell more than 50% online. Compared to 2003, the share of firms in which online sales account for more than 25% of their sales volume increased sharply, from 5% to 28%. Thus, in the past five years there has not only been an increase in the share of online sellers but also in the amount of sales conducted through the internet or other computer networks. Compared to the figures in gen-

## Case Study: Casino Group, France

*The Casino Group is one of France's leading food retailers. Founded in 1898, it sells products through various sales channels including different types of stores such as hypermarkets and discount shops. In 2006, the Casino Group implemented a Customer Relationship Management (CRM) system at its hypermarket branch. With this solution, the Casino Group aims to improve relationships with the 'professional groups' customers which include public institutions, large enterprises and associations. Giving sales people access to a centralised database significantly improved sales operations at the Casino Group. Furthermore, the solution has a positive effect on marketing strategies and activities. Overall, the solution has resulted in efficiency gains for the sales force and the marketing department; productivity gains for the till employees; and improvement of logistics, quality, hygiene, security and environment management within the Group.*

## Case Study: EMPiK, Poland

*EMPiK, the large book retail company in Poland, demonstrates that e-commerce embraces more than just selling a product. After four years of absence from the Polish e-commerce market, following an unsuccessful attempt at e-commerce between 1999 and 2001, EMPiK re-introduced online sales in 2005. The previously unsuccessful online experiences motivated EMPiK to engage in mutual learning and to strongly integrate the online sales channel in its portfolio of business activities. EMPiK, for example, attracts new clients through offering an accessible and easy to use online tool which provides additional services besides book selling. The so-called click-and-mortar business model adopted by EMPiK furthermore allows online customers to benefit from an extensive network of physical stores in Poland which can, for example, be used to make payments for products ordered online. Physical stores in turn benefit from a wide selection of books available as customers can order online in stores via online 'info-point' terminals*

## Case Study: 4fitness, Germany

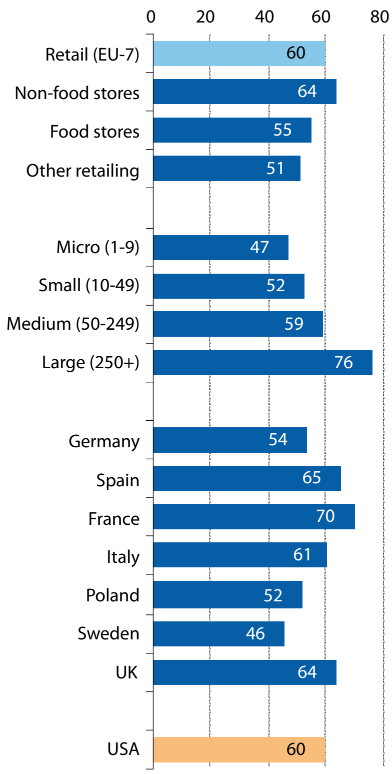
*4fitness, a small fitness equipment retailer based in rural Southern Germany, successfully uses e-marketing activities to generate more than two thirds of its sales from an internet shop. Yet, e-marketing is a complex issue, especially for micro firms who often face ICT skill shortages. 4fitness successfully overcomes these shortages through close cooperation with an expert technology provider. The case study furthermore illustrates that the impact of e-marketing is difficult to measure as effects of e-marketing are often intangible. Exceptions are direct effects such as an increase in sales following a specific online campaign. While many different kinds of e-marketing techniques are generally available, the type and extent of activity chosen determines the degree of the effect and, indirectly the activity's success. 4fitness observed that e-marketing activities involving Google had the highest impact on actual internet sales of all the e-marketing activities the company engaged in.*

eral sales areas, it appears that online sales helps to extend the geographic focus slightly from regional to national sales while the international focus remains on the same low level. The EMPiK case study (see box) shows the experiences of a large Polish retailer with e-sales.

### E-MARKETING

With the diffusion of the internet and online retail opportunities adherent with this spread, e-marketing is increasingly gaining importance. The survey asked retailers about two types of e-marketing activities: online placement of advertisements, and engage-

*Exhibit 2.4-2: Companies using a software application to manage the placing or receipt of orders*



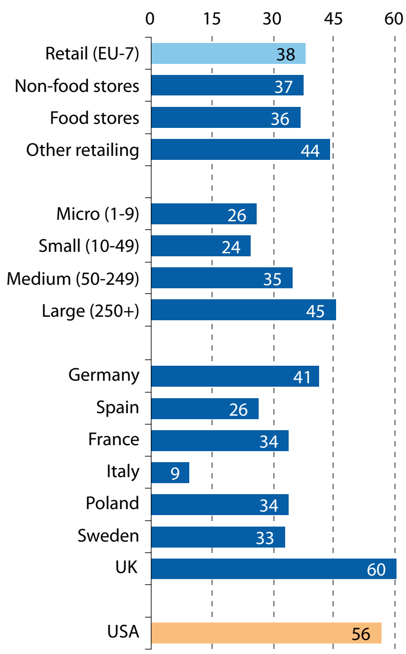

The survey in 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = companies using computers;

N (Retail, EU-7 and USA) = 1151.

Weighting: Figures for sector totals and countries are weighted by employment («firms representing x% of employment in the sector / country»), figures for size-bands in % of firms.

*Exhibit 2.4-3: Percentage of retail companies selling online*




The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = companies using computers;

N (Retail, EU-7 and USA) = 1151.

Weighting: Figures for sector totals and countries are weighted by employment («firms representing x% of employment in the sector / country»), figures for size-bands in % of firms.

ment in optimising search engines. Companies representing 16% of the retail industry's employment in the EU-7 reported placing online advertisements on other companies' websites. Online advertisements on other companies' websites are more frequently used by large (20%) and medium-sized firms (21%) than by small (11%) and micro (18%) firms. The employment-weighted percentage is much higher in the US (43%). This implies that the market for online advertisements appears to be largely untapped in the EU. 47% of European retailers are engaging in search engine optimisation (Exhibit 2.4-4) with the aim of increasing visitors to their company's website. Food stores are slightly more active at search engine optimisation than non food stores and other retailing companies: 52% of food stores are engaging in search engine optimisation while 46% and 42% of non-food stores and other retailing respectively engage in it. There are no significant differences between firm sizes with all sizes of firms being in the 40% area. European retailers are also not far behind their US counterparts with 53% of US retailers engaging in search engine optimisation compared to the 47% in the EU. The micro retailer 4fitness (see case study, p. 123) uses e-marketing to successfully advertise its online shop and equipment on sale to a wide range of potential online customers.

## 2.4.3 e-Business drivers and barriers

### BARRIERS: "CUSTOMERS AND SUPPLIERS NOT PREPARED" MOST IMPORTANT

Retail companies that stated that they conduct some or none of their business processes as e-businesses were asked why they do not use e-business more intensively. Seven possible reasons were suggested and the single most important reported barrier in adopting ICT solutions was that customers and suppliers are not ready to use such technology. 64% of the retail firms stated this (Exhibit 2.4-5).

The overall share in the US was significantly smaller (43%) indicating that the technology environment in the retail industry is more vibrant with regard to ICT use in the US. Another important reported reason is size: 64% of micro firms and 44% of small firms said that their company is too small to benefit from e-business. Of the seven categories of barriers asked about, the numbers for the US are always lower than for the EU-7 except for 'security issues', where 46% of

US retailers face barriers compared to 36% of retailers in the EU-7. This indicates that overall, US retailers seem to face other or even fewer barriers to e-business than EU-7 retailers. The Fleria Floral Creations case study (see p. 126) illustrates some of the barriers that retailers face when selling online.

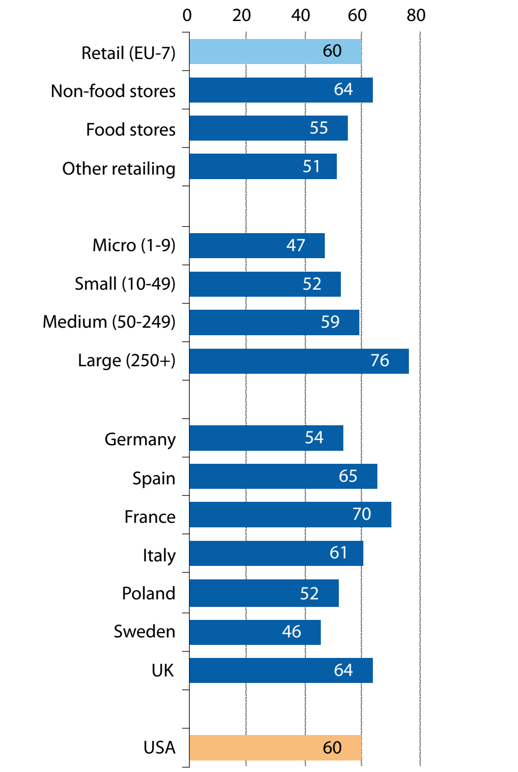
### DRIVERS: PRESSURE FROM SUPPLIERS AND CUSTOMERS

Pressure from customers and suppliers can notably stimulate the adoption of e-business and ICT. 9% of the retail firms in the sample, which is firms representing 11% of the industry's employment, reported to have experienced pressure from customers (consumers) to adopt e-commerce. This phenomenon is most prevalent in the non-food group with 13% of firms reporting this issue, closely followed by the other retailing group with 12%. The lowest number with 9% comes from the food group which seems to be least affected by intangible end-consumer pressures to adopt e-commerce. Hence, overall, consumers seem to be content with the existing sales channels provided by retailers. The lack of pressure from consumers could also be interpreted as a hint that e-commerce in the retail industry is not as important a sales channel as often advocated. As regards firm size, the shares of medium-sized (15%) and large firms (13%) that reported pressure from customers was larger than the shares of micro (9%) and small firms (8%) (see Exhibit 2.4-6).

At the other end of the supply chain management scale is the pressure from suppliers. 10% of retail firms in the sample reported to have experienced pressure from suppliers to adapt their ICT. These numbers are similar to the pressures from customers to adopt e-commerce, indicating that there is neither strong pressure on either sides of the supply chain, i.e. there is little pressure on retailers from both, customers and suppliers, to adopt and adapt ICT and e-business technologies. There are no firm-size specific differences emerging, with between 10% and 14% of firms reporting pressures from suppliers to adapt ICT. The Cyprus-PC.com case study (see p. 126) shows how consumers can indirectly drive retailers to adapt their online services to suit the needs of potential customers.

Due to the buying power of especially large retail firms which have a sizeable slice of the retail market, the question was raised whether EU-7 retailers demand the adoption of e-business and ICT solutions from their suppliers. Indeed, 37% of large retail firms use their buying power to demand from their suppliers new ICT or changes to the supplier existing ICT structure. This power over suppliers decreases

***Exhibit 2.4-4: Percentage of companies engaging in search engine optimisation***

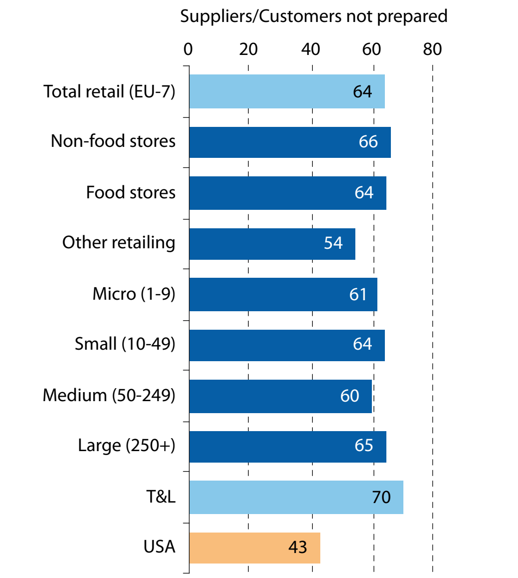



The survey in 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = Question A5 = Yes, excl. «Do not know»; N (Retail, EU-7 and USA) = 768.

Weighting: Figures for sector totals and countries are weighted by employment («firms representing x% of employment in the sector / country»), figures for size-bands in % of firms

***Exhibit 2.4-5: Perceived barriers to e-business adoption:***




The survey in 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Base (100%) = Companies who stated that some or none of their business processes are conducted as e-business;

N (Retail, EU-7 and USA) = 858.

Weighting: Figures are weighted by employment («firms representing x% of employment in the sector / country»). Questionnaire reference: F2

**Case Study: Fleria, Greece**

*Fleria Floral Creations is a medium-sized flower retailer based in Athens, Greece. In 2003, Fleria commissioned a third-party provider to develop an e-shop. The aim was threefold: to increase the number of orders placed through the internet; to sell more ready-made floral creations; and to extend its market share. This aim was not achieved as of 2008 due to industry-specific and cultural reasons. Buying flowers is a sentimental process which is not easily experienced through the internet. Selling floral creations online is further deterred by the fact that Fleria's wealthy customers prefer to introduce themselves to sales agents and expect personalised service and customised products. Another barrier is that Fleria management paid inadequate attention to the e-shop. Although the e-shop was supposed to be automated to a large degree, and one employee was assigned to check the orders with a certain frequency on a daily basis, strategic planning regarding the e-shop proved to be inadequate. Finally, low trust in products presented on the internet and reluctance to place orders on-line appears to be linked to the fact that many Greek consumers do not yet buy over the internet.*

**Case Study: Cyprus-PC.com, Cyprus**

*The small firm, Cyprus-PC.com is one of the largest online stores in Cyprus. It supplies high quality computer products (such as laptops and PC peripherals) and related services to Cypriot residents. The company sells its goods online over the internet, via telephone orders and through retail shops. These combined methods have been successful, resulting in a rapid increase of total sales and turnover since the firm was founded. The value of using a combined sales approach is of utmost importance for Cyprus-PC.com, as it is indirectly driven by customer pressures: the Cypriot market is not yet a mature market regarding e-commerce and online sales; and Cypriot customers prefer to talk to someone, find out who is at the other end of the line and who to contact in case they have a question. While the company's website is widely used and appreciated, pure online sales presently account for a rather modest share of 10-15% of total business sales. The remaining orders are either confirmed through phone calls (the majority of them) or customers who prefer to visit the firm's retail shop. Also satisfying customer requirements are the various payment and delivery options offered by Cyprus-PC.com.*

**Case Study: AMJG Comunicações, Portugal**

*The small Portuguese telecommunications company AMJG specialises in selling mobile phones and related services, including internet access to consumers in the Portuguese regions of Aveiro, Espinho, São João da Madeira, and Ovar. It developed a Customer Relationship Management (CRM) system, which allows users to manage client information from several sources. The introduction of this system significantly improved the productivity of employees and, as an indirect result, increased sales to a specific customer group by an estimated 6.4%. Efficiency was boosted by decreasing delays in product delivery to clients by an estimated 1/4 to 1/5. With the CRM tool, client information is readily available and marketing campaigns are easier to prepare which again boosts productivity at the small retailer AMJG.*

**Exhibit 2.4.6: Customer and supplier e-business/ICT pressures (2007)**

| | e-Business pressure | | | | | |
|---|---|---|---|---|---|---|
| | Customer pressures to adopt e-commerce | | Supplier pressures to adapt ICT | | Put pressure on / Demand from suppliers to adapt / implement new ICT | |
| Weighting scheme: | % of empl. | % of firms | % of empl. | % of firms | % of empl. | % of firms |
| **Retail – 2007 total (EU-7)** | **11** | **9** | **12** | **10** | **20** | **10** |
| NACE 52.12, 52.3-5 (non-food) | 13 | 9 | 13 | 11 | 23 | 11 |
| NACE 52.11, 52.2 (food) | 9 | 7 | 10 | 5 | 15 | 5 |
| NACE 50.5, 52.6 (other) | 12 | 18 | 11 | 15 | 14 | 12 |
| **Retail – by size (EU-7)** | | | | | | |
| Micro (1-9 employees) | | 9 | | 10 | | 9 |
| Small (10-49 employees) | | 8 | | 12 | | 15 |
| Medium (50-249 employees) | | 15 | | 14 | | 22 |
| Large (250+ employees) | | 13 | | 13 | | 37 |
| Base (100%) | All firms | | All firms | | All firms | |
| N (2007, EU-7+USA) | 1151 | | 1151 | | 1151 | |
| Questionnaire reference | B11a | | B13 | | B15 | |
| The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA. | | | | | | |

Source: e-Business Survey 2007

with firm size from 22% of medium-sized firms to 15% of small firms and only 9% of micro firms putting pressures on suppliers. The non-food group which, for example, includes the large hypermarkets is the one where most firms (23%) put pressure on suppliers to adapt or implement new ICT. The food and other retailing groups are almost equal with 15% and 14% of firms respectively reporting that they put ICT pressure on suppliers.

## 2.4.4 ICT and e-business impact

Findings from an econometric analysis conducted for this study, as well as from the e-Business Survey and the case studies, show that ICT and e-business affect the retail industry considerably. Effects on productivity, innovation, market structure and value chains are measured.

### PRODUCTIVITY

ICT-capital investments have not been key drivers in the growth of real value added in European retailing. Total factor productivity, which includes for example organisational changes, was found to account for much stronger contributions. As regards labour productivity, intermediate inputs intensity were found to be the main components. This may predominantly be due to outsourcing activity. ICT capital investments, as well as the employment of a large share of medium-skilled workers, play a positive but minor role in labour productivity growth. Overall, the findings indicate that ICT capital investments alone are insufficient to increase labour productivity significantly. It may be necessary to also invest in organisational changes and training. AMJG Comunicações, for example, has been able to significantly improve workforce productivity through adopting a CRM solution (see case study, p. 126).

### INNOVATION

In the retail industry, the e-Business Survey 2007 found the impact of ICT to be mainly on process innovation but it also plays an important role in product and service innovation. An econometric analysis found, firstly, that employing people with a university degree as well as employing IT practitioners significantly increases retail firms' propensity to use ICT to develop new products and services. Secondly, the use of applications and practices that support the electronic exchange of information between companies positively affects

**Case Study: Brookland Plus Products / Dirk van den Broek, Netherlands**

*Brookland Plus Products is the logistics subsidiary of the Dutch retail chain Dirk van den Broek. Brookland operates six warehouses for Dirk van den Broek, located throughout the Netherlands. In order to ensure fast replenishment efficiencies for all stores supported, Brookland replaced a legacy supply chain system with a new supply chain management solution. This replacement process began in 2001 and continues into 2008. The new system is driving organisational changes at Brookland but it also highlights the change management effort required when implementing a new software solution at a large retail chain. User training requirements, for example, were extensive as was management time spent organising for changes and managing technology vendor relationships and communication.*

**Case Study: Mercator, Slovenia**

*Poslovni sistem Mercator, a large Slovenian retail chain operating in South-East Europe launched its e-commerce activities in 1999. Originally focused on introducing e-commerce into its upstream supply chain management, the introduction of e-procurement at Mercator is affecting the entire e-commerce landscape in Slovenia. Over the years, the solution adopted and developed further by Mercator and its technology partners has been adopted by other retail firms trading in Slovenia. Mercator and these other retail firms contribute to the expansion as they promote e-commerce among their array of business partners. Another factor is the EANCOM Slovenia subset standard. Mercator's e-commerce exchange is based on GS1 EANCOM standards but these had to be simplified to fit Mercator's requirements. In 2003, GS1 Slovenia formally granted the simplified version of GS1 EANCOM standards developed for Mercator's e-commerce the status of 'EANCOM Slovenian subset standard'. It is now widely used in Slovenia.*

the likelihood of conducting ICT-enabled innovations. The analysis also found that ICT-enabled innovation is positively related to turnover increase, irrespective of firm size and age. Secondly, ICT software is an important driver of organisational changes, while hardware apparently is not. For example, the supply chain solution at Brookland Plus Products, the Dutch logistics subsidiary of Dirk van den Broek, is driving organisational changes including new business processes (see case study).

#### MARKET STRUCTURE AND VALUE CHAINS

The relevance of increasing market competition for the intensity of ICT adoption was confirmed. Findings also indicate that ICT and e-business can be used to open up new markets, to cross boundaries of industries and markets, and to increase the number of customers. The e-commerce activities at the Slovenian retail chain Mercator, for example, have resulted in a Slovenian-wide recognised standard for exchanging e-procurement messages. For value chains, the econometric analysis found that ICT intensity indeed increased the propensity to outsource business activities.

Exhibit 2.4-7 summarises hypotheses formed for the economic analysis of the retail industry in Europe and illustrates whether these hypotheses are confirmed or rejected.

### 2.4.5 Conclusion and outlook

#### CONCLUSION: DIFFERENCES BETWEEN SIZE CLASSES, COUNTRIES AND SUB-SECTORS

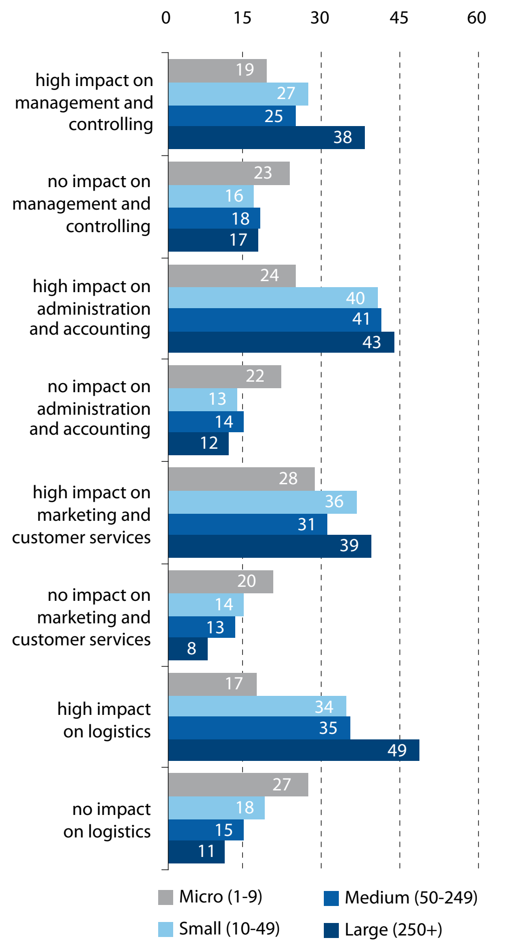
Having analysed survey results for the retail value chain in detail, it is valuable to compare differences between retail companies of different size classes and different sub-sectors as well as from the EU versus the US on an aggregate level. For this purpose, average values for groups of indicators were calculated for four principal domains: ICT infrastructure, e-procurement, internal systems, and e-sales. The results are summarised in the following.

**Size classes:** Analysing differences between retail firms of different size classes, the average values of the selected indicators show that micro retail firms

*Exhibit 2.4-7: Results economic analysis ICT and market structure*

| # | Hypotheses | | Result |
|---|---|---|---|
| | **…related to ICT and productivity** | | |
| **P.1** | ICT-capital investment has been a main element in value added and productivity growth in the retail industry. | Not confirmed. Growth accounting indicates that TFP changes played a dominant role while ICT and non-ICT capital inputs are less important<br>A production possibility frontier analysis points at intermediate inputs as key drivers of labour productivity growth.<br>=> ICT is a small driver, not the key driver of growth in this sector. | **(No)** |
| **P.2** | TFP growth in the retail industry has accelerated together with increased investment in ICT-capital. | Not confirmed. There is no instantaneous impact of ICT investment on TFP growth. | **No** |
| **P.3** | ICT and high- and medium-skilled labour have a positive impact on labour productivity growth. | Weakly confirmed. ICT capital and medium-skilled labour have a positive impact on labour productivity growth, but the impact is small. The impact of high-skilled labour was found to be insignificant in statistical terms. | **(Yes)** |
| | **…related to ICT and innovation** | | |
| **I.1** | Retail firms characterised by a higher share of employees with a university degree are more likely to conduct ICT-enabled innovations. | Confirmed: Changes in share of employees with a higher university degree as well as employing IT practitioners positively affect the likelihood of conducting ICT-enabled innovations. | **Yes** |
| **I.2** | Retail firms that use ICT applications to exchange information or collaborate with business partners are more likely to introduce ICT enabled innovations. | Confirmed: The use of applications and practices supporting the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations. | **Yes** |
| **I.3** | ICT-enabled innovations are correlated with retail firms' turnover. | Confirmed: ICT-enabled innovative activity positively affects the likelihood of a firm reporting a turnover increase. | **Yes** |
| **I.4** | ICT use in retail firms is positively correlated with organisational changes. | Partly confirmed: network infrastructure usage and internet access does not have a large impact on the likelihood of introducing organisational changes, but software has. | **(Yes)** |
| | **…related to ICT and market share** | | |
| **M.1** | Increasing rivalry in the retail market is a driver for the adoption of ICT. | More intense competition forces companies to use innovative technologies to cut costs and look for more innovative ways of conducting business. | **Yes** |
| **M.2** | ICT endowment is positively correlated with a change of market share. | Companies that intensively use ICT applications are likely to take advantage of their potential to increase their market reach and relative position to the competitors. | **Yes** |
| | **…related to ICT and value chains** | | |
| **V.1** | ICT endowment in retail firms is positively correlated with outsourcing. | ICT intensity increases the propensity to outsource business activities. | **Yes** |

*Exhibit 2.4-8: Expected impacts of ICT and e-business on selected indicators by size class*




The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.
Base (100%) = companies using computers; N (Retail, EU-7 and USA) = 1151.

Weighting: Figures weighted by firms.

lag behind small ones, small firms lag behind medium-sized ones, and medium-sized ones in turn lag behind large firms. The differences between micro and large retail firms are most pronounced for internal e-operations and e-sales, while the differences for e-procurement are small. For e-procurement, micro firms (34%) are close to small (38%), medium-sized (39%) and large (42%) firms. For internal e-operations, micro firms reach 25% which is only half of the value for large firms (49%). For e-sales there is a pronounced difference between micro (20%) and small firms (22%) on the one hand as well as medium-sized (31%) and large ones (38%) on the other.

**EU versus US:** Another issue underlined by comparing average values is that EU retail firms lag behind US retailers in all four domains. The US lead is strongest in e-sales, quite strong in e-procurement, and small in ICT infrastructure and internal e-operations. In e-procurement, EU retail companies (37%) are twelve percentage points behind the US (49%). In internal e-operations, the lag of EU retail companies (36%) behind US ones (39%) is small. However, US retailers are much more advanced in e-sales: they reach 52% of the possible maximum, leaving EU retailers (34%) far behind.

**Sub-sectors:** In terms of differences between the three retail sub-sectors in ICT and e-business performance, "other retailing" appears to be the most advanced, having a slight lead over food and non-food in ICT in internal e-operations and e-sales. The food sub-sector tends to perform the lowest values. In e-procurement, non-food (39%) and other retailing (38%) are close by, while food (31%) lags behind. The values for internal e-operations are quite similar for non-food (34%), food (38%) and other retailing (40%). In e-sales, non-food (33%) and food (34%) lag behind other retailing (41%).

## OUTLOOK: ICT AND E-BUSINESS IMPACT EXPECTED BY THE INDUSTRY

Retailers expect ICT and e-business to have an effect on selected indicators. The highest expected impacts were found to be on administration and accounting. 43% of the large retailers, 41% of the medium-sized ones and even 40% of the small ones expect high impact of ICT in this regard. These expectations may reflect the high opportunities of e-business for collecting, storing, retrieving and analysing large amounts of data. The expected effects on logistics are also high, but there are large differences between, firstly, large firms (49% "high impact"), secondly, medium-sized (35% "high impact") and small firms (34% "high impact"), and finally micro firms (17% "high impact"). The differences in the assessment of the expected impact of ICT on marketing and customer services were not that large. 39% of the large firms expect high impacts in this regard, 31% of the medium-sized firms, 36% of the small firms, and even 28% of the micro firms. This is the largest value for micro firms for all four indicators. These figures may reflect the widespread experience, even of small retailers, that internet use has become important for many customers and that the internet is consequently a viable means of communicating with customers. As regards management and controlling, 38% of the large firms expect high impacts of ICT. Almost the same percentage of medium-sized (25%) and small firms (27%) stated high impacts in this regard, but only 19% of the micro firms.

For all indicators, the percentage of large firms stating a high expected impact of ICT was the largest of all four size classes. This may indicate that large firms are going to keep on investing considerably into ICT, possibly further widening the gap of ICT use between large firms and SMEs. The overall low figures for micro firms expecting high impacts may reflect the generally limited perceived importance of ICT and e-business in these firms, currently and also in the future (Exhibit 2.4-8).

## 2.4.6 Policy implications

Barriers for increased uptake of e-business in retail can be found along the complete value chain. Consequently, policy makers should seek to promote e-business along the whole retail value chain and business ecosystem. The following policy implications are henceforth suggested:

**Promote SCM among SMEs**: Policy makers may support supply chain development in retail through e-business use. While the European Commission should have a focus on cross-border activities, Member States may naturally promote national or regional activities. A sector focus facilitates such policy initiatives as it drives the involvement of experts and associations with sector background.

**Promoting e-business on a regional level:** Since retailers are generally rooted in the local and regional economy, support to e-business should predominantly take place at the local and regional level. Retailing associations or chambers of commerce could take a leading role in promoting the adoption and extension of e-business practices in retail.

**Foster dissemination of e-business knowledge**: Many retail firms consider ICT as a cost factor rather than an investment in benefits. Improved awareness and knowledge about the effects of e-business would be important. Key findings from this report which are of interest to retailers include, fore example, that ICT investment should be complemented by organisational changes, employee training and rooting ICT in the company's strategy. Dissemination activities about e-business in the retail industry could be improved.

**Promote e-ordering by consumers:** The low level of e-sales penetration in the EU may also be due to a relatively low affinity towards ordering over the internet on the part of consumers. They may have security concerns, they may find online shops too complicated, and they may require enhanced personal communication. Policy makers can promote examples of secure, simple and personal e-sales practice among consumers and retailers.

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## 2.5 Transport and logistics services

This e-business sector study was conducted by Consultrans, part of the Altran Group (***www.consultrans.es***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***)


**Key findings**

***Digital divide.*** *The transport and logistics services (TLS) sector is characterised by a pronounced digital divide between small and large companies. ICT systems of large companies are normally more powerful and sophisticated than those of small firms. This translates into more intensive and advanced electronic business practices, and a greater potential for exploiting cost-saving opportunities. Many of the smaller companies feel that they are simply "too small" to benefit from e-business, or that the required technologies are too expensive.*

***Enterprise Resource Planning (ERP) systems as an important backbone.*** *ERP is the technical backbone for various e-business applications, including systems for product planning, purchasing, inventory management, order tracking and finance. Again, there is a considerable gap in ERP adoption between small firms on the one hand and the medium-sized and large firms on the other.*

***EU firms on par with US firms.*** *In international comparisons, European TLS enterprises are – on average – level with their counterparts in USA in their use of ICT. TLS companies from France, Italy, UK, Sweden, Germany and Spain are very similar in their use of ICT, particularly the larger firms. Firms from the only participating new Member State in this study – Poland - took the lowest rank in this benchmarking exercise, although, Polish enterprises are not far behind in its use of some ICT technologies.*

***Logistics sector as a frontrunner in ICT usage.*** *ICT usage in the logistics sector is more advanced than in the passenger and freight transport services sectors.*

***Links between ICT, innovation activity and firm performance.*** *A statistical regression based on e-Business Watch survey results finds that ICT-enabled innovation activity is positively correlated with the development of firms' turnover, i.e. innovative companies are more likely to report an increase in turnover. Furthermore, the use of ICT for collaboration between business partners is positively correlated with introducing ICT-enabled innovations.*

***ICT and skills as complementary factors for productivity growth.*** *It has been observed that ICT together with high and medium-skilled labour has a positive impact on total factor productivity growth. ICT usage and high levels of employee skills complement each other, leading to skill-biased technological change and an advantage to firms with highly skilled employees when adopting and using ICT. Therefore, skills-related investments are important complementary measures to ICT adoption. Smaller companies often lack a coherent ICT investment strategy and the related skills, partly because many of them cannot afford to employ ICT practitioners (only about 9% of small firms and 33% of medium-sized firms employ ICT practitioners).*

### 2.5.1 Context and background

SCOPE OF THE STUDY

The study covers business activities specified by NACE[52] Rev. 2, 49.1, 49.2, 49.3, and 49.4: rail transport (both passengers and freight) and land/road transport (passengers and freight). Furthermore, the logistics sectors of warehousing and storage, cargo handling and other transportation support activities (NACE Rev. 2, 52.10, 52.24, and 52.29) are considered, to the extent that these sectors interact with the main business activities covered by the study (49.1-4). The selection of activities covered in this study responds to the need of having comparable e-business data and results for the land transport and logistics sectors, due to their huge importance in the European competitiveness and future economic challenges of the region.

INDUSTRY CHARACTERISTICS AND TRENDS

Transport and logistics are key components of a successful economy, and governments worldwide seek to increase competitiveness through new or replacement infrastructure. The transport and logistics sector plays a major role in national economies and is a significant contributor at both the national and local level. It underpins the economy, enabling the movement of goods, services and people as efficiently as possible. The transport sector in Europe plays a significant role in its economic development. It currently generates 7% of European Union gross domestic product (GDP) and for around 5% of employment in the EU.

The expected increase in road freight of 38% until 2010 will far outstrip the existing and planned capacity in road infrastructure.[53] Road delays and congestion will therefore probably get worse. Combating Europe's worsening road congestion – and the increased costs and environmental damage it causes – requires new attitudes and recourse to resolutely modern logistics and transport systems. The challenge is to find solutions for freight and passengers that are economically viable and that also promote sustainable growth, fuel economy, the reduction of emissions, safe and healthy lifestyles and social inclusion.

**Road transport**. The greatest competitive advantage of road transport is its capacity to carry goods all over the European Union, and indeed the entire continent, with unequalled flexibility and at a low price. Road transport services account for 1.6% of the EU GDP and give jobs to 4.3 million people.[54] The whole economy and society depends heavily on efficient road transport: 44% of the goods are moved by trucks[55] (compared with 41% for short sea shipping, 10% for rail and 4% for inland waterways) and 85% of passenger transport is moved by cars, buses or coaches (compared with 5% by air and 6% by railways). Demand factors, such as a reduction in heavy bulk transport and the increasing importance of door-to-door and just-in-time services, undoubtedly contributed to the strong sustained growth of road transport.

However, the disadvantage of this situation lies in its harmful effects on the environment (road construction, land use for parking, emissions etc.) and on public health and, of course, the heavy toll from road accidents. Road transport is the main source of $CO_2$ emissions since it alone accounts for 84% of the total attributable to transport. In this context, efforts already made, particularly in the road sector, to preserve air quality and combat noise, have to be continued. This is in order to meet the needs of the environment and public concerns without compromising the competitiveness of the transport system and of the economy.

**Rail transport**. Rail is a contrast: a mixture of ancient and modern. On the one hand, there are high performance high-speed rail networks serving their passengers from modern stations; on the other hand, antediluvian freight services and decrepit suburban lines at saturation point, with commuters jammed into crowded trains which are always late and eventually release their floods of passengers into sometimes dilapidated and unsafe stations.[56]

52. NACE stands for «Nomenclature générale des activités économiques dans les Communautés Européennes», which is the standard for classification of economic activities in the EU.
53. European Commission (2001), White Paper «European transport policy for 2010: time to decide".
54. European Commission, Road Transport Policy: ***http://ec.europa.eu/transport/road/policy/index_en.htm***
55. The roads' share of the goods market has been growing constantly, from 41 % in 1990 to 44 % in 1998, and, if no action is taken, is expected to reach 47 % by 2010.: White Paper «European transport… ibid.
56. European Commission (2001), White Paper «European transport… ibid.

Between 1970 and 2003 the share of the goods market carried by rail in EU-15 fell from 20% to 8% (down from 283 billion tonnes per kilometre to 241 billion). For the 25 Member States of the European Union, the modal share of rail freight declined from 20.9% in 1995 to 17.4% in 2005.[57] In absolute terms, the number of tonne-kilometres dropped from 494 billion in 1970 to 392 billion in 2005 in the EU25, which represents a decrease of more than 23%.[58]

The European Commission's goal is to maintain the modal share of rail transport at the same level as in 1998, and to achieve this by 2010, thus reversing the decline in rail transport observed over the last 30 years. Rail transport is thus expected to grow significantly as the total transport demand in 2010 is expected to be 40% higher than in 1998. The rail stakeholders, who engaged on a joint definition of a common strategy for European rail, agree to achieve the objective to increase its market share of passenger traffic from 6 to 12% and of goods traffic from 10 to 15% by 2020.[59]

**Logistics**. Logistics is the process of planning, implementing and controlling the movement of raw materials, half-finished products and finished goods. These should arrive in time at the right destination and retain the right quantities and quality, while respecting the level of service selected for the process. The global logistics industry is estimated at roughly € 5.4 trillion, or 13.8% of the global EU GDP. On average, logistics' costs account for 10-15% of the final cost of the finished product. Although logistics is becoming increasingly important, there is a lack of reliable statistical information on the situation. Nonetheless, EU companies do increasingly recognise that there are competitive alternatives to road freight.

The availability of high quality transport and logistics services is of a crucial importance to the competitiveness of the European economy. Co-modality[60] and high efficiency in the transport system are also indispensable for Europe to manage the increasing flows of goods. However, globalisation and a wider Europe create new challenges. In June 2006, a communication from the EC outlined the main problems faced by the organisation and operation of the European Transport system.[61]

There are a vast number of trends and challenges in the transport and logistics industry. The EU transport policy identifies these challenges: to offer a high level of mobility to people and business throughout the EU; to protect the environment; to ensure energy security; to promote minimum labour standards for the sector; to protect passengers and citizens; to innovate in support of the above aims; and finally connect Member States and the Union internationally.

## 2.5.2 ICT adoption and e-business use

### ICT infrastructure and skills

Information and communication technologies (ICT) can have a significant influence on the mobility of people and goods. ICT is also a potentially important enabler of change in social and organisational practices, thus affecting the demand for transport in spatial and temporal terms. Technological trends will meet the demand for comfort, safety and speed through advances in ICT in the field of telematics. This covers systems for traffic and transport management, travel information and reservations, vehicle guidance, and mobility cards. Over the last few years firms operating in the TLS sector have made significant progress in their adoption of new technologies, particularly those linked to the internet and e-business.

Nearly all companies (97%) which use computers in the TLS sector said that they are connected to the internet. On the path to the adoption of e-business, connectivity is the first step and also a precondition for all potential benefits of the use of computer networks. There is a clear trend towards broadband connections. Only 17% of the sector's companies (representing 8%

57. COM (2007) 609 final. Communication from the Commission to the Council and the European Parliament on monitoring development of the rail market.

58. European Commission, Rail Transport and Interoperability. Rail transport: the current situation and the Commission's initiatives. ***http://ec.europa.eu/transport/rail/overview/current_en.htm***

59. Strategic Rail Research Agenda (SRRA) of the European Rail Research Advisory Council (ERRAC). The Agenda identifies key scientific and technological priorities for both passenger and freight rail transport over the next 20 years.

60. 'Co-modality' means the efficient use of transport modes operating on their own or in multimodal integration in the European transport system to reach an optimal and sustainable utilisation of resources.

61. European Commission (2006). Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. "Freight Transport Logistics in Europe – the key to sustainable mobility" Summary of the Impact Assessment - Points for Reflection, Brussels, 28.06.2006 SEC (2006) 820.

of the sector's workforce) are connected with up to 144 kbit/s, while half of the sector's firms have bandwidth connection ranging from 144 kbit/s to 2 Mbit/s and nearly a third with more than 2 Mbit/s.

Regarding ICT and e-business skills, only 8% of enterprises actually employ ICT practitioners, usually medium-sized (33%) and large-sized (66%) firms. The minor share of small enterprises that say they employ ICT practitioners can be explained by the fact that it seems to be more economic for smaller companies to outsource ICT services (e.g. desktop management or web hosting) than to employ their own ICT practitioners. 45% of all firms had outsourced ICT services to external service providers in the past 12 months prior to the interview. Survey data about ICT skills indicate limited recognition of the skills and resources needed to exploit technological innovation and to support reorganisation of work processes. The availability of qualified personnel with specialised skills is limited. This could represent a critical issue for the European Transport and Logistics Services (TLS) industry in its focus on technological innovation, process reorganisation and striving to remain competitive in the international market.

**ICT-enabled business processes**

The improvement of the basic ICT infrastructure in the TLS sector has allowed companies to embrace opportunities to substitute paper-based and manual processes by electronic exchanges, thus optimising the flow of information and documents in and between companies, taking advantage of the increased diffusion of e-business software systems. ERP (Enterprise Resource Planning) systems are currently the main platform to enable this goal. If a customer or supplier has an ERP system, data related to orders (received or placed) is typically exchanged in a paperless way between the ERP systems of the two companies trading which each other.

13% of the firms (23% by their share of employment) say that their exchanges with business partners are mostly conducted electronically; another 10% (with 15% of the employment) say that they process data with business partners mostly electronically, but exchanged in paper based format. However, there is still a considerable gap in ERP adoption between small firms (with up to 49 employees) on the one hand, and medium-sized and large firms on the other: about 41% of large companies and 23% of medium-sized ones said they had an ERP system, but less than 8% of micro and small firms did. The relatively high implementation costs for ERP systems remain a critical challenge for SMEs.

With regard to the deployment of specific software solutions for the TLS sector (for example Cargo Handling Technology, Fleet Control System and Intermodal Transportation Management Systems),

**Case studies: Hupac, Switzerland: improving customer service through ICT**

*Hupac, located in Chiasso, Switzerland, is leader in combined transport across the Swiss Alps and number two in transport of containers, swap bodies, semi-trailers, and trucks by rail in Europe. It offers innovative combined transport solutions by road, rail and sea. Hupac operates a network with more than 100 trains a day between Europe's most important economic areas as well as between the major harbours and the European hinterlands.*

*In order to manage its European transport activities and better control information about their trains, Hupac has implemented an innovative IT solution that provides transport information in real time and enables the coordination of all phases of intermodal traffic from departure to arrival. The information is provided by a GPS (Global Positioning System) train control system.*

*The adoption of the ICT solution has resulted in a notable increase in customer service at Hupac: information about trains is accurate and available at the spot, and customers can, for example, immediately be informed about potential delays. Furthermore, Hupac was able to reduce cost although roaming costs for the GPS solution are high. The cost reductions stem from being in a better position to negotiate prices and fewer penalties having to be paid to customers. On a related note, Hupac points out that there is scope for improvement of the GPS solution as it does not work in tunnels and higher mountains; and basic issues such as battery life are an important factor.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

survey results show that companies within the TLS industry use these technologies quite differently. Again, the picture for small companies differs from the one for medium- and large-sized firms: about 22% of the small firms reported that they use Fleet Control Systems, while in medium-sized firms the share was about 35%, and in large firms the share reached 43%. The pattern is the same for the Cargo Handling Technology and for the Intermodal Transportation Management System (see Exhibit 2.5-1, and case study Hupac, p. 136).

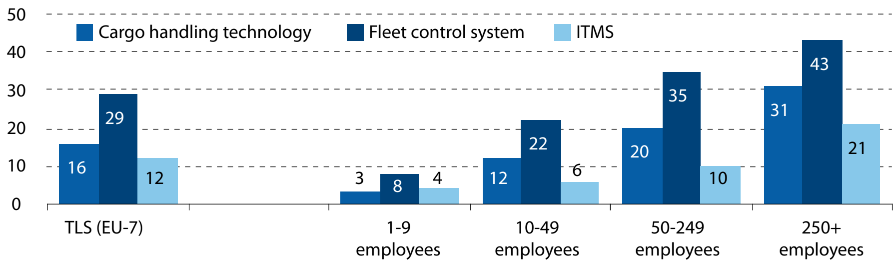
With regard to the deployment of standards, about a third of medium-sized companies and more than 40% of large firms said that they used Electronic Data Interchange (EDI), while only 7% of micro companies and 12% of small companies did so. EDI based standards will probably continue to play an important role for e-business messaging in TLS industries in the near future.

**Improving customer service by means of ICT**

ICT, and in particular the internet, can be used in various ways to support marketing activities, including communication with customers, offering products for sale, and developing new marketing strategies.[62] e-Business leads to a fundamental shift in the structure and services of transportation and logistics businesses. Firms are transporting more on-line purchased goods and they are actually subordinating their individual business plans and identities and becoming an integrated part of their electronic business customers' supply chain. The role of the order and its delivery is evolving to one that includes full-scale logistics, supply chain management and warehousing. For individual customers, studies have shown that online shoppers check the status of their package on average of seven times from the moment the "buy" button is clicked until the package arrives.[63]

35% of TLS firms (by their share of employment) said they accepted orders online. There is practically no difference between companies from the various size-bands in this respect (see Exhibit 2.5-2). Even among small firms, 30-35% said that they allowed customers to order products online. This appears to be quite a high figure at first sight. However, a vast

*Exhibit 2.5-1: % Companies* using specific transport & logistics software systems*

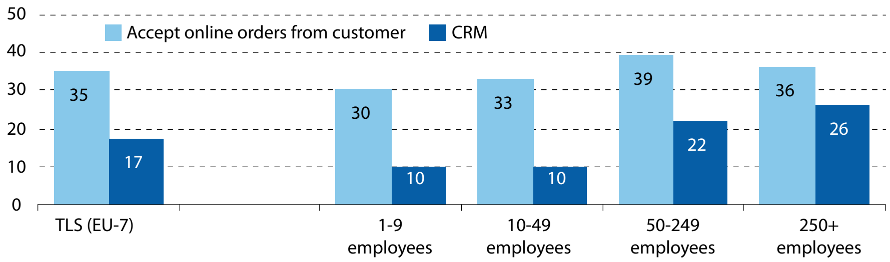



* figures for TLS total (EU-7) weighted by employment

ITMS = Intermodal Transportation Management System

Source: Sectoral e-Business Watch (Survey 2007)

*Exhibit 2.5-2: % of companies* accepting orders online / using a CRM system*




* figures for TLS total (EU-7) weighted by employment

Source: Sectoral e-Business Watch (Survey 2007)

62. A detailed analysis of all case studies presented in this report shows that customer service is the main driving force in the adoption of ICT-related technologies.

63. E-Logistics, Free Essays, Cliff Notes and Term Paper Database. Available at: ***http://www.essays.cc/free_essays/b2/utv192.shtml***

**Case study: Trafikanten, Norway**

*Trafikanten is the joint information provider for the three public transport authorities in the Oslo region of Norway. Trafikanten's main objective is to promote public transport and ensure easy access for passengers to the network of all public transport operators in the region, regardless of transport mode or company, providing travellers with real time accurate information about vehicle arrival and departure time via internet, mobile channels and through signs available at the stops. The solution is a proprietary solution based on meter measuring, GPS and General Packet Radio Service (GPRS) technologies. This case demonstrates a successful solution implementation in the public transport area that allowed achieving significant benefits in terms of passenger communication and service improvement, lower travel times and increased planning efficiency for the Public Transport Authorities and operators.*

*Trafikanten has achieved its main goal of providing this real-time information on the punctuality of all targeted transport modes through the internet, mobile channels and signs to the public. Passengers can now conveniently access the website from their home or office and conveniently gain information about the real departure times they need for planning their trip. And, even better, someone that is already on the move always has up-to-date information. Passenger information data can be accessed using a dialogue-oriented user menu on a WAP-compatible mobile phone (Wireless Application Protocol).*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case study: ALSA, Spain: success in integrated sales system and ERP implementation**

*The case study of ALSA demonstrates the advantages, challenges and success factors of important e-business solutions used by large European bus transport companies. ALSA is one of the leading road passenger transport companies in Spain, employing about 3,600 people. ALSA operates in different areas of the road passenger transport services.*

*ALSA operates a new online e-ticketing system which is fully integrated in the company, with complete Java internal support and external web interfacing for the e-ticket sales via internet and mobile phone. The integrated operations platform manages the base and intermediate layers of the system in order to control each of the different sales channels.*

*ALSA has also developed a new resource planning system (as an internal tool). This resource planning system is similar to an ERP (Enterprise Resource Planning) system, but includes resource planning as well as incident management functions especially suited to the road passenger transport operations of the company. One of the main functions of the system is the resource optimisation to accomplish the daily objectives in operations, maximising the efficiency and usage of the available resources. The system includes features that allow naming the different services, controlling the execution of tasks and managing the possible incidents.*

*These integrated systems enable the company to centralise sales information processes. The main benefits are cost reductions (in particular by reducing ticketing process costs), improved customer satisfaction and a competitive advantage in winning passenger transport concessions. The impact of all this is an increase in profitability of the company.*

*The cost reductions stemming from process optimisation and improved use of resources (enabled by the new resource planning system) are estimated at €4-5 million. Furthermore, the system has increased the transport security and services productivity, through alarm controls, intelligent incidence management and real-time analysis tools.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

majority of close to 95% of those companies said that online orders accounted for up to 25% of their total orders received. Only about 5% receive more than a quarter of their orders online. Companies representing 17% of the sector's employment said they used a Customer Relationship Management (CRM) system (see also case study Trafikanten, Norway, p. 138).

**e-Ticketing: a commitment towards innovative retailing and ticket solutions**

The continued growth of urban transit will depend on its ability to respond to individual traveller's needs through the spread of e-ticketing, interoperability and journey planning information. Electronic ticketing provides a striking example of the benefits of ICT to the transport industry. e-Ticketing is a ticket-less concept which ideally presents a win-win situation for passengers as well as the service providers (i.e. the transport companies). Companies benefit from opportunities to reduce administrative costs and, at the same time, provide a higher level of service. The case studies on ALSA (Spain, see box on p. 138) and CFR Călători (see box) demonstrate these benefits, the latter outlining the importance of such e-business solutions for the modernisation of the public rail transport sector in Romania. The case study on Fret SNCF shows that introducing new types of e-services can have significant implications on work processes and thus requires professional change management (see box p. 140).

**B2B online trading**

Typically, business-to-business (B2B) is about transforming the back office functions of firms to make them more efficient and impacts along the entire value chain of an industry. B2B accounts for a significant amount of the trade which is conducted on the internet, and is expected to account for the vast majority of it within a few years. As trade between businesses increasingly moves online, the processes and services which support this trade, such as logistics and warehousing, are also moving online. 41% of all firms active in the TLS industry said that they place at least some orders to suppliers online. The

**Case study: CFR Călători, Romania: e-ticketing**

*The national company for passenger railways in Romania, CFR Călători, is a public company operating the 4th biggest railway in Europe and providing rail transport to public passengers in Romania. CFR Călători is one of the four independent companies which emerged from the split of CFR after the liberalisation of the railway in 1998. As part of the modernisation programme and to be more competitive, an e-ticketing/e-reservation system has been implemented all over Romania.*
*This case study demonstrates the importance of e-business solutions for the modernisation of the public rail transport sector in Romania. The two main strategic goals of the national company for passenger railways in Romania are to modernise the rolling stock and to improve the service for the customer. Among its strategic priorities, CFR Călători (the passenger service division of CFR) has identified the need to have a national system for e-ticketing. The solution has been implemented in over 245 railway stations where each selling point is equipped with a PC and a printer linked to the different systems. 90 million tickets have been sold through the system and 23 millions passengers have been served in the period from January to July 2007.*
*This enables the company to provide better customer services and to get detailed market and financial data. Analysis of this data allows the company to take efficient decisions for the continuous modernisation of the railways. This case study demonstrates the importance of e-business solutions for the modernisation of the public rail transport sector in Romania.*
*The main impact of the e-ticketing and e-reservation solution has been felt by CFR employees in charge of ticket selling. Since the working processes for ticket selling and reservation needed to be completely redesigned, approximately 5000 CFR employees working in this area have been heavily affected. Before the deployment of this solution, there was a manual system in place which was very complicated and time consuming. For example, employees working at the selling points had to spend a lot of time at the end of the day counting the tickets sold.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case study: Fret SNCF, France: efficient e-services for customers**

*Fret SNCF handles freight carriage for SNCF (Société Nationale des Chemins de Fer, French railways). It provides three general types of service, which are merchandise transport, container transport and lorry transport. The e-services project, launched by Fret SNCF in 2006 is part of this new strategy and aims to provide customer services over the internet for a simpler, faster and more reliable exchange of information with the customer.*
*The "Clic Services Fret SNCF" portal went live in July 2007, providing four major e- services to customers allowing them to directly order transport services on the internet (Commande@RESAFRET), follow transport progression in real time (Info@RESAFRET), transmit their transport documents (e-LV) and consult their invoices (Info Facture). The "Clic Services Fret SNCF" portal was developed using PHP and Dot Net languages. The e-services solution affects the whole company, as it requires major changes of working processes and thus has implications for the company culture.*
*Quality of information is key; an issue which needs to be respected by all employees. Before the implementation of the solution, the majority of employees had to concentrate their efforts on the correct operation of the transport. With e-services, the management and correctness of the information becomes as important as the rail service itself. It was found to be quite difficult to change the mindset and working priorities of employees who used to work in a specific way for many years. Thanks to intensive internal communication and change management, results are satisfactory; however, the company says that it will take time until the new working modes will be fully adopted by the majority of employees.*
*The new service has been a success with customers. The number of visits to the portal has been continuously growing since the launch of the service and customer feedback has been very positive.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

incidence increases by firm size. However, more than 50% of the firms that purchase online said that these purchases account for less than 5% of their total procurement. Only 13% of firms purchased online for more than 25% of their total procurement.

**ICT for increasing process efficiency: Supply Chain Management (SCM) and Warehouse Management Systems (WMS)**

The evolution of **Supply Chain Management** (SCM) has followed that of ERP and relies heavily upon it. The two areas, intra-enterprise integration (mainly represented by ERP) and inter-enterprise integration (mainly represented by SCM) present a low rate of adoption in the TLS sector and have similar features (6% of enterprises say they have an SCM system and the same percentage say they have an ERP system). In certain ways, they are complementary approaches for addressing the same strategic challenges. It is worth noting that most suppliers address these two areas with interlinked modules. SCM however provides the opportunity to expand the advantages of optimisation and integration to the entire supply chain through the creation of a collaborative, networked environment.

The use of applications and practices supporting the electronic exchange of information between companies occurs simultaneously with close relations with business partners. This provides support to the hypothesis that close relationships facilitate investments in specific technologies. Collaborative practices and ICT applications, in turn, further strengthen the relationships between the companies and lead to a creation of organisational networks. These hypotheses have been positively tested for the TLS sector as can be found in Section 4.5.1 of the present report.

**Warehouse Management Systems** (WMS) are a key part of the supply chain and primarily aim to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving, put-away and picking. The systems also direct and optimise stock put-away based on real-time information about the status of bin utilisation. Warehouse management systems utilise Auto ID Data Capture technology, such as barcode scanners, mobile computers, wireless LANs and potentially RFID to efficiently monitor the flow of products. Once data has been collected there is either batch synchronisation with, or a real-time wireless transmission to, a central database. The database can then provide useful reports about the status of goods in the warehouse. The detailed setup and processing within a WMS can vary significantly from one software vendor to another; however the basic logic will use a combination of item, location, quantity, unit of measure, and order information to determine where to stock, where to pick, and in what sequence to perform these operations.

In the TLS sector about 15% of companies (representing more than 40% of the sector's employment) use a WMS. Generally, larger companies tend to make more use of WMS than smaller ones: while about 15-20% of small enterprises used a WMS in 2007, close to 70% of large TLS companies did so (see Exhibit 2.5-3). However, competition increasingly drives small companies to adopt WMS, as shown by the case study on AIT (France) – see p. 142. WMS are mainly relevant for the freight transport industry and the logistics sector.

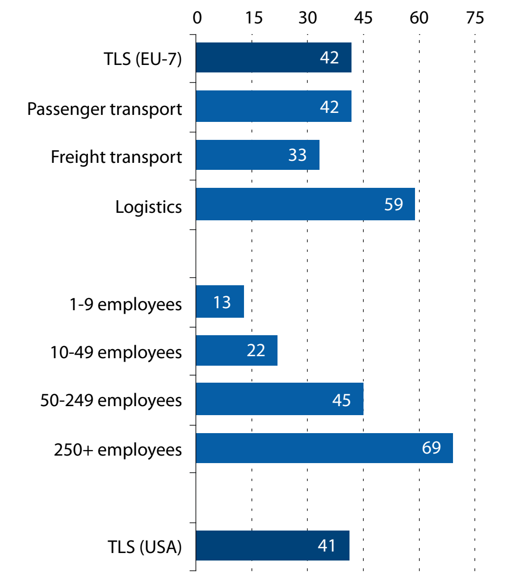
**e-Business adoption in European vs. US companies**

In terms of ICT infrastructure, US companies from the TLS industry appear, on average, to be slightly better equipped than their European counterparts. This applies as well to specific applications such as the use of ITMS (Intermodal Transportation Management systems) and the adoption of RFID (radio frequency identification) technology. European companies, on the other hand, are more likely than US companies to use Warehouse Management Systems or Maintenance Management Systems. If the percentage of firms that say that their data exchanges with business partners are "mostly processed and exchanged electronically" is taken as an indicator for the overall degree of e-business deployment, the situation in Europe and in the US is similar. In both economies, this applies to 13% of the firms interviewed in the TLS sector.

**Overall assessment**

About a quarter of firms (by their share of employment) have not introduced any e-business activity in their normal operations. On the other hand, 10% of companies carry out most of their business processes in the e-business mode, while almost another quarter do so with a good deal of their processes and 42% use e-business with some of their business operations. Thus, about 75% of companies in the TLS industry use e-business in one way or another (see Exhibit 2.5-4).

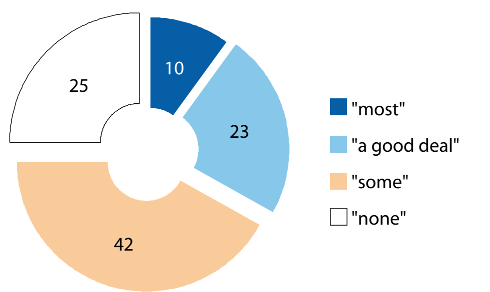
*Exhibit 2.5-3: Deployment of WMS in the TLS industry*




Data for sector totals and sub-sectors are weighted by employment; data for size-bands in % of firms.

Source: Sectoral e-Business Watch (Survey 2007)

*Exhibit 2.5-4: % Companies* saying that … of their business processes are conducted as e-business (2007)*




* weighted by employment (read: "companies representing x% of employment")

## 2.5.3 *ICT and e-business impact*

ICT, VALUE ADDED AND PRODUCTIVITY GROWTH

Studies on the impact of ICT confirm productivity increasing effects in both the user sectors and in the ICT producing sectors (Oliner and Sichel, 2000). In particular, ICT was found to have positive effects on labour productivity and total factor productivity (Pilat, 2005). An important finding is, however, that ICT-induced productivity effects vary significantly between sectors and among countries (Nordhaus, 2002). Recent research suggests that the largest productivity growth effect occurs in the ICT-producing sectors themselves, and in selected service industry sectors like banking, wholesale, retailing, and telecommunication (Jorgenson, Ho, Samuels, Stiroh, 2007, Jorgenson, Ho, Stiroh, 2007, Inklaar, Timmer, van Ark, 2007).

**Case studies: Warehouse Management Systems**

***Geodis Group***

*The case study of Geodis Group shows a typical example of an automated warehouse management as it is used in the logistics sector. It demonstrates the requirements and benefits for a successful implementation of such a solution. The Geodis Group (France) is a global logistics player and present in all segments of the transport and logistics market. The warehouse management system of Geodis manages all activities of their warehouse. It handles the product architecture, multiple references (shipper, commercial, supplier, manufacturer, etc.) and multiple packaging schemes. These systems are fully compatible with the most common ERP applications today on the market and allow an easy set-up of connectivity. In the world of global logistic service providers today, warehouse management systems form the backbone of operations and are a prerequisite for global logistic service providers in order to remain competitive in this market.*

***AIT***

*AIT is a supplier of transport and logistics services (for all kinds of goods) located near Lyon, in France. AIT employs 42 people and faces huge competitors precisely like Geodis, as well as a myriad of small companies. ICT technology is the main key to support AIT in its market position. The solution implemented by AIT allowed the company to organise their multimodal transport, taking into account the whole transport process with, at the same time, a flexible and ergonomic interface to manage its warehouse activities. The solution also provided the company with detailed data analysis on the whole company activity and the optimisation of different processes such as customer billing, purchasing and business operations. This is also a good example for demonstrating – especially to small companies – the major advantages that can be achieved through outsourcing business processes, since the solution is managed by specialists in a controlled technical environment.*

*These cases were selected in order to illustrate how two different sized firms can successfully coexist in a market where competition is very aggressive. The first case study focuses on a company that operates in 120 countries and has about 26,000 employees. Geodis posted nearly €3.8 billion in net sales in 2006. The second case study illustrates an ICT empowered small company - which provides the organisation of Euro-national transport services throughout Southern Europe (AIT, with its 42 employees, has generated a turnover of about €8,5 million in 2006) and has evolved into a competitor for traditional and well established companies.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

An economic analysis conducted for this study, based on the EU KLEMS Growth and Productivity Accounts database,[64] assessed to what extent ICT adoption (measured as ICT capital investments) contributes to growth of value added and productivity in the transport services industry. The results indicate that ICT capital by itself is not the main element, but that it rather requires complementary investments and organisational innovation. The main results of this analysis can be summarised as follows (see also Exhibit 2.5-5):

**ICT and industry growth**

Growth accounting for the transport sector in 10 EU Member States suggests that changes in the ICT-capital stock have accounted only for minor shares of industry growth (measured as gross value added) in this sector. Rather, the strongest contribution by far was found to be total factor productivity growth. Changes in ICT and non-ICT capital have had about the same importance for value added growth. However, ICT can be embedded in other infrastructure, for example in the complex equipment of the transport and logistics sector. Thus, there is probably a "hidden ICT-impact" which cannot be measured by means of the data on ICT-investment available in the database.

**ICT and labour productivity growth**

High-skilled labour intensity and intermediate inputs intensity were found to be key drivers for labour productivity growth (measured as gross production

64. The «EU KLEMS Growth and Productivity Accounts» are a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union Member States. The compilation of this database was a project funded by the European Commission. See ***www.euklems.net***

value per working hours), while ICT capital investment again had only a moderate impact. This was analysed by estimating a stochastic possibility frontier (SPF), which provides measures for the output elasticity of input factors. The results also point towards problems with the standard approach in growth accounting, which typically assumes that total factor productivity (TFP) growth instantaneously increases with increased investments in ICT-capital. However, there may be a time lag between the initial investment and implementation of new technology (and the respective organisational changes) and their actual impact on TFP growth.

These observations have implications for policy. They suggest that investments in training and skill-formation are at least equally as important as investment in ICT capital itself in order to realise the optimal benefits (see Section 2.5.5). In other words, in a knowledge economy driven by rapid technical change, the ability to empower the work force is a necessary complementary measure to ICT adoption. Without having the right skills in place, costly investments bear the risk of becoming ineffective.

### INNOVATION, MARKET STRUCTURE, VALUE CHAIN

Using micro-data from the e-Business Survey 2007, regression analyses were conducted to explore links between ICT usage, companies' innovation activities and their performance (using the development of the market share and turnover as proxies). Results indicate that the following factors are positively correlated with ICT adoption and could thus be drivers:

- **Competition matters:** increasing rivalry in the market appears to be a driving force behind ICT adoption. As companies are facing more intense competition, they are under pressure to cut costs and to look for more innovative ways of conducting business. ICT is one of the key instruments that support the achievement of these goals.
- **Customer and supplier relationships:** companies which trade mostly with long-term business partners (rather than having a changing customer and supplier base) are more likely to adopt and use ICT applications for inter-firm collaboration.
- **IT skills for innovation:** the availability and quality of ICT skills in the company facilitates conducting ICT-enabled innovations; considering the general importance of ICT for process innovation, there is probably a strong link between a company's e-skills and its attitude towards innovation in general.

Statistical regressions also found evidence that ICT adoption correlates with innovation, outsourcing activities and organisational change:

- **ICT facilitates outsourcing**: advanced ICT users in the TLS industry were found to be more likely to have outsourced business activities. This provides support to the hypothesis that ICT ena-

***Exhibit 2.5-5: Results of the econometric analysis of ICT impact on industry growth and productivity***

| No. | Hypotheses | Results | |
|---|---|---|---|
| P.1 | ICT-capital investment has become a key component in value added and productivity growth in the transportation and logistics sector, while other capital inputs summarised as non-ICT-capital have diminished in their respective importance. | Cannot be confirmed. Growth accounting indicates that TFP changes have played a dominant role while ICT and non-ICT capital inputs have about the same importance; SPF analysis points at intermediate inputs as key drivers of labour productivity growth.<br>→ ICT by itself is not the key driver of growth in this sector | **not confirmed** |
| P.2 | TFP growth has accelerated together with increased investment in ICT-capital. | No significant average annual rate of technical progress for the common production possibility frontier was found. | **not confirmed** |
| P.3 | ICT and high- and medium-skilled labour have a positive impact on TFP growth. | Only high-skilled labour had a positive growth impact<br>→ indicates a skill-biased technological change with ICT-capital as its complementary factor driving growth of the transport sector. | **(partly) confirmed** |

bles companies to redefine their make-or-buy decisions.

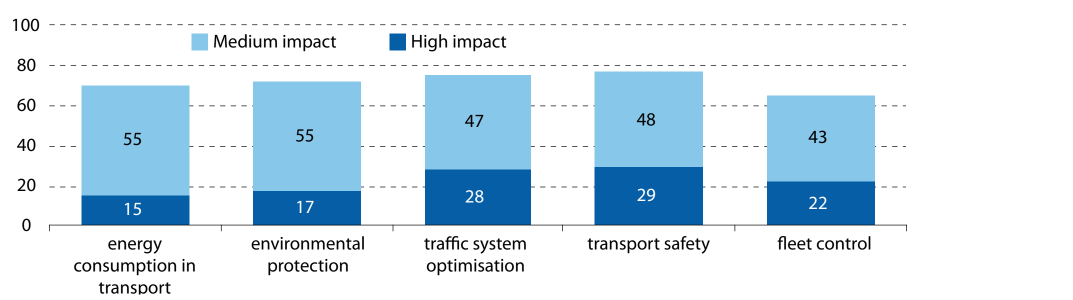
- **ICT and organisational change**: the intensity of ICT usage and the level of ICT-skills available in the company are positively linked with organisational change. More specifically, the analysis shows that it is the use of e-business applications and the availability of IT-skilled employees that lead to organisational changes. By contrast, the endowment with ICT hardware (basic infrastructure) was not correlated with organisational change. In other words, the basic technology has become a commodity that does not offer companies any potential to create a competitive advantage. More advanced applications, however, do.
- **ICT usage has a positive impact on company performance**. Firms in the TLS sector that introduced ICT-enabled innovations were more likely to have experienced sales growth and an increase in market share.

However, although turnover increase was used as a dependant variable, this should not be read as a simple formula for success ("the more ICT-enabled innovation, the more turnover a firm will have"), as there are possible confounding factors such as the growth of a company in general. A similar result might also have been obtained by exchanging the dependent and independent variables, in the sense that successful companies (i.e. firms experiencing turnover growth) are more innovative. In any case, the results indicate that the dynamics of business growth and innovativeness are strongly linked, possibly reinforcing each other.

### 2.5.4 Outlook

Companies interviewed in the e-Business Survey 2007 were asked to indicate in which areas they foresee an important impact of ICT in the future. Companies in the TLS sector expect that ICT will have a high, or at least some, impact on practically all business functions, in particular for management and controlling, administration, marketing and customer service (see Exhibit 2.5-6). Nearly 80% of firms expect ICT to have an impact on these business functions. Figures related to specific impact on features associated with the TLS sector are almost the same: companies from TLS sector expect that ICT will have a high or medium impact on business areas such as energy

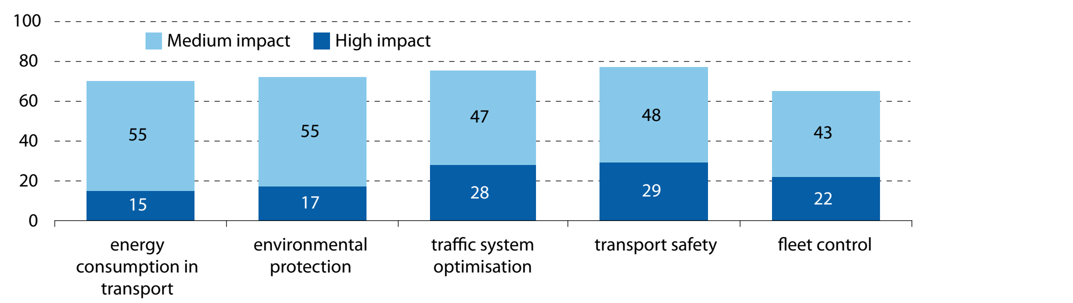
*Exhibit 2.5-6: Where companies expect ICT to have an impact in the future*




% of companies in the TLS sector expecting ICT to have a high/medium impact on … in the future

Source: Sectoral e-Business Watch (Survey 2007)

*Exhibit 2.5-7: Where companies expect ICT to have an impact in the future*




% of companies in the TLS sector expecting ICT to have a high/medium impact on … in the future

Source: Sectoral e-Business Watch (Survey 2007)

consumption in transport systems (70%), environmental protection (72%), traffic system optimisation (75%), transport safety (77%) and fleet control (65%) – see Exhibit 2.5-7.

## 2.5.5 Policy implications

Exhibit 2.5-8 illustrates the possible implications arising from an increase in e-business activity in the TLS industry. However before going deeper into the analysis of policy implications, it is necessary to outline some important facts related to the construction of a policy framework for ICT adoption in all sectors in Europe, especially in the TLS sector.

PROMOTING ICT SOLUTIONS FOR SMES, ESPECIALLY THE DEVELOPMENT OF AFFORDABLE ERP SYSTEMS FOR SMES

Although ICT uptake has certainly increased amongst SMEs in this sector, small businesses are slower than the larger ones to adopt new ICT, as is the case with other sectors. Principal reasons for non-adoption are not yet so clear. In some cases it is associated with a lack of applicability and little incentive to change business models when returns are unclear. In a nutshell SMEs' ICT requirements are that they support their core business, work well, are user-friendly, easy to upgrade and at as low a cost as possible. In this case, financial support in the form of tax deductions, subsidised grants, or free consultancy and training

***Exhibit 2.5-8: Policy implications arising from e-business activity in the TLS sector***

| Policy issues | Suggested actions | Possible initiators |
|---|---|---|
| Promoting ICT solutions for SMEs, especially the development of affordable ERP systems for SMEs | ▪ Improve dialogue and cooperation with software providers.<br>▪ Encourage initiatives for networking and cooperation.<br>▪ Stimulate the participation of SMEs in business networks and clusters.<br>▪ Develop mechanisms to help SMEs set challenging and realistic targets for their B2B implementations.<br>▪ Improve access to finance and risk capital for SMEs.<br>▪ Provide the resources to educate, coach and integrate the SMEs relying on IT-SMEs and local support centres. This can help to get the applications adapted to their particular needs and business models. | Sector associations<br>Business intermediaries<br>Competence centres |
| Improving ICT skills and managerial understanding and skills for e-business | ▪ Facilitate knowledge transfer between research centres and enterprises.<br>▪ Counteract e-business skill-shortages in the market, e.g. by promoting multi-stakeholder partnerships in ICT training programmes.<br>▪ Provide incentives for ICT training of employees.<br>▪ Improve skills related to the reorganisation of working processes and procedures, helping SMEs managers to better understand organisational aspects of e-business.<br>▪ Create opportunities for dialogue between SMEs and ICT service providers. | European Commission<br>National Governments<br>Regional Governments<br>Competence centres<br>Chambers of commerce<br>Member States (via their e-business programmes)<br>Other intermediaries |
| Developing standards for e-business, facilitating the process of interoperability | ▪ Support projects to improve standards for e-business (like INTEROP FP6 Network of Excellence and ATHENA FP6 Integrated project).<br>▪ Promote relevant industry initiatives.<br>▪ Encourage adequate representation of SMEs in standardisation processes.<br>▪ Policy can act as a neutral coordinator and promoter of standardisation initiatives. | Standardisation bodies<br>European Commission<br>National Governments<br>Innovation centres<br>Industry associations |
| Promoting efforts towards innovation | ▪ Create incentives for innovation, recognising the specific role of ICT in this context.<br>▪ Improve skills related the implementation of innovative technologies.<br>▪ Improving the framework conditions for innovation in general; this includes education, R&D and market regulation.<br>▪ Create a level playing field for **cooperation** between large companies and SMEs. | European Commission<br>Innovation centres<br>Regional Governments<br>Industry federations<br>Business support networks |

programmes might help. On the other hand, some firms claim that their reluctance to engage in e-business is due to the fact that they cannot see how this could be implemented in their company (a clear awareness problem).

There is still a considerable gap, for instance, in ERP adoption between small firms on the one hand (14%) and the medium-sized (23%) and large firms (41%) on the other. A faster deployment of an ERP system among medium-sized and small enterprises would create a much broader base for sectoral e-business and this could drive process efficiency and productivity gains in European enterprises. Now there is a positive market environment to attain this goal: driven by market requirements, and enabled by technological advances, ICT companies are increasingly addressing the SME market. They are developing affordable, smaller-sized solutions (e.g. ERP and CRM suites) that can be connected with the more powerful systems of large firms. Policy makers could, in fact, use some of their instruments to give this trend additional momentum.

The limited degree of B2B integration between large firms and their smaller business partners is one of the principal bottlenecks to a better exploitation of the potential of e-business in terms of process efficiency and cost savings. Indicative evidence is the low percentage of small firms (8%) that have linked their ICT systems with suppliers. The use of SCM software is also very limited among smaller companies (6%). Against this background, mechanisms to enhance and accelerate this development should be considered.

### IMPROVING ICT SKILLS AND MANAGERIAL UNDERSTANDING AND SKILLS FOR E-BUSINESS

Skills requirements arise as an important issue whenever e-business is implemented. Smaller companies are obviously less equipped in terms of ICT skills and tend to be less receptive towards sophisticated solutions. ICT usage and high levels of employee's skills complement each other, leading to skill-biased technological change and an advantage to firms with highly skilled employees when adopting and using ICT.

The European e-Skills Forum, established by the European Commission and the CEN Workshop Agreement (CWA) could be appropriate forums to discuss the issue of ICT skills development in the TLS sector. A product of such discussion could be an assessment of required skills for enterprises in the TLS. The required skills can be provided at a general level, such as public education, or it can be about more specific ICT skills which could be provided by vocational and higher education institutions or professional educational programme vendors (private operators).

Investment in training and skill-formation is at least equally as important as investment in ICT capital itself in order to realise the optimal benefits. Thus investments in e-skill formation and training have to be prioritised.

### DEVELOPING STANDARDS FOR E-BUSINESS, FACILITATING THE PROCESS OF INTEROPERABILITY

Setting standards and promoting interoperability is another important policy implication that has been identified by the analysis in this sector study. In particular, large companies that were interviewed claimed that systems' incompatibility constitutes an important barrier to e-business diffusion. Thus, despite the wide diffusion of ICT applications in this sector there is still potential for further productivity increases through supply chain integration, but that remains underutilised due to interoperability problems. The importance of standards as a means of reducing transaction costs and increasing competitiveness has fortunately been recognised by policy makers.

European standards have to be developed in line with existing legislation, international conventions and international standards, in order to facilitate the secure integration of transport modes in the logistic chain. The European Commission is supporting the work on ICT standards and interoperability, including the interoperability of networks, which is performed by the European Committee for Standardisation (CEN). Although the process of standardisation is not the responsibility of public bodies, the policy challenge is to encourage the cooperation between private companies. In particular, support for developing uniform standards might help to overcome the market failure resulting from coordination problems. Furthermore, as large companies pursue their own interests, standards multiply and companies at lower levels of the supply chain need to adopt various standards required by their customers. This increases the overall cost of integration and weakens the incentives to use ICT.

PROMOTING EFFORTS TOWARDS ICT-ENABLED INNOVATION

The implementation of new ICT and complementary investments can lead to innovations, and innovations are positively associated with turnover growth. In other words, innovative firms are more likely to grow. The empirical evidence presented in this study corresponds with the theoretical predictions that suggest that ICT and innovation are positively associated with turnover and productivity growth at the firm level. This holds for ICT and for non-ICT-related innovations, as well as for process and product innovations. A set of hypotheses regarding the impact of ICT on the above mentioned factors was formulated and tested econometrically: ICT-enabled output positively correlates with turnover increase; ICT use is positively correlated with organisational changes; ICT does have positive effects on labour- and total-factor-productivity. Nonetheless, there is no direct link between ICT and economic variables such as productivity and employment dynamics. Instead, ICT has only indirect effects that occur via innovations that are carried out and triggered by the adoption of new ICT.

Therefore, innovation activities should be fostered, with a particular emphasis on SMEs. The European Commission has taken an active role in this respect: two programmes which are of particular importance are the *'Competitiveness and Innovation Framework Programme'* and the *'7th EU Framework Programme for Research Technological Development and Demonstration'*.

Finally, as the EU ICT Uptake Working Group has recommended: EU policy makers should envisage the creation of lead programmes in fields of excellence such as, amongst others, logistics and transport.

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(The full list of sources used for the study is included in the full study report.)


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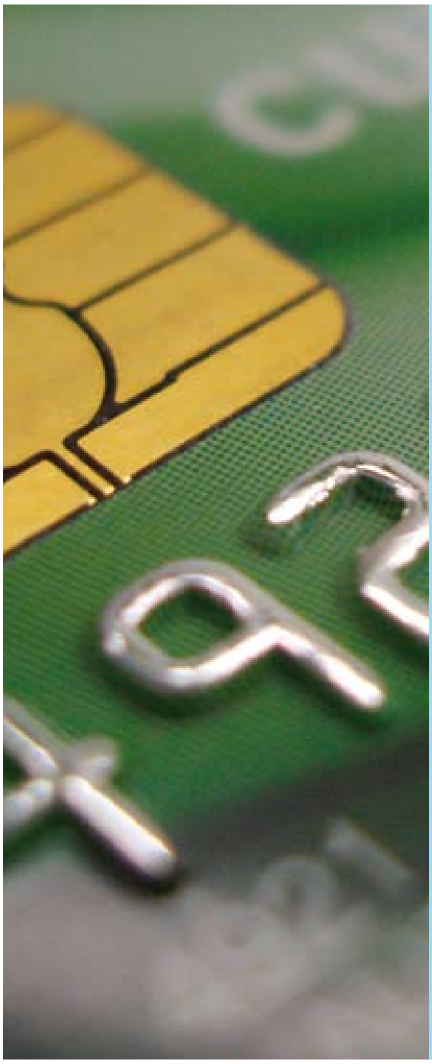
## 2.6 Banking

This e-business sector study was conducted by Rambøll Management (***www.ramboll-management.com***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).



**Key findings**

***Process efficiency is gaining ground.*** *ICT capital investments are largely taking the place of labour, particularly in retail banking, by standardising ordinary financial services and having customers perform basic financial services online, thus changing the role of counter staff. However, if the workforce does not have sufficient capabilities for using ICT efficiently, the costly investments risk becoming ineffective.*

***Branch renewal.*** *ICT use is positively correlated with company-restructuring activities, especially since the internet has made it possible for banks to cut costs by offering online banking. The use of ICT enables companies to redefine the boundaries of their organisations and possibly gain a competitive advantage.*

***The Single Euro Payments Area (SEPA).*** *The banking industry has so far taken limited measures to comply with SEPA. It is expected that the industry will have to make significant ICT investments in order to comply with SEPA, which may offset any short-term benefits. However, these investments are expected to bring about benefits in the long run through product innovation, such as the development of e-invoicing. Banks however have troubles in seeing how the benefits of increased standardisation can compensate for the significant ICT-investments needed.*

***The impact of ICT on market structure.*** *The market structure in the industry is changing as a result of mergers and acquisitions, which have called for increased investment in ICT in order to integrate the different banking systems. However, mergers and acquisitions also happen as a result of ICT, when large banks with branch networks acquire innovative internet-only banks in order to combine a traditional brand with an innovative business model.*

***Customer and bank readiness for the use and provision of e-banking.*** *e-Banking across Europe is still not widespread among private and corporate customers in all member states. Basic understanding of and confidence in the internet is required to adopt e-banking, and not all member states have reached a critical mass of behavioural change among customers. Moreover, not all banks are ready for e-banking.*

### *2.6.1 Context and background*

SCOPE OF THE STUDY

The banking industry (BI) is defined for this study as covering the following business activities: NACE Rev. 1.1 65.12 "Other monetary intermediation" (Rev. 2 64.19), and 65.22 "Other credit granting" (Rev. 2.0 64.92).[65] The industry employs about three million people in the EU (according to the European Central Bank) and generates about €490 billion in value added (latest available figures – 2004, Eurostat). In value added terms, the financial services sector was largest in the United Kingdom, which generated just over one fifth (21%) of the EU-25's value added in 2004, followed by Germany (19%).

INDUSTRY CHARACTERISTICS AND TRENDS

**The renewal of branch and processing capabilities:** e-Banking has become a commodity in Europe and banks report that more than 30% of standard banking transactions are conducted online. This has increased pressure on the service offerings among

65. NACE Revision 2 is a four-digit classification of business activities. It is a revision of the "General Industrial Classification of Economic Activities within the European Communities", known by the acronym NACE and originally published by Eurostat in 1970. NACE Rev. 2 replaced version Rev. 1.1 on 1 January 2008.

branch banks[66], as banking anywhere at any time is normal procedure for many customers today. This has driven banks to improve their abilities, going beyond acting as a mere mediator. With the introduction of e-banking and the increased focus on prices, banking clients expect standard services at minimum cost or free of charge. The increase in self-service has removed a substantial workload from the tellers, who are expected to use this new scenario to sell high level and high margin products.

**Introduction and improvement of customer relationship management:** The European industry is increasingly focusing on creating greater customer loyalty through an improved focus on customer relationship management (CRM). It is important that any CRM implementation takes into account not only the technology requirements, but also the broader organisational requirements. The challenge for banks in this respect is to introduce an extensive training and skills development programme to support the introduction of an ICT-based CRM system.

**Protection of data and ability to recover data:** With the increased use of information technology and the reliance on business-critical data, the importance of preventing the loss of customers' financial data and business operation data has increased significantly. Of companies that have suffered a major loss of computerised records, 43% never reopen, 51% close within two years, and only 6% will survive in the long term[67]. European banks currently invest heavily in disaster recovery management, in terms both of process and of ICT, in order to avoid data loss and to develop support systems for data recovery.

**e-Business and e-banking security:** Customer data protection is another important aspect of the increased use of ICT in the industry. There are still many bank customers that do not use online banking services, including those who refrain because they do not perceive online banking to be safe[68]. Online banking users are in general confident of online security while offline customers doubt the safety of online banking. This means that offline customers' resistance towards e-banking is not based on bad experiences[69], but rather on a general perception that e-banking is risky. However, banks cannot provide the comprehensive security guarantees that offline customers need in order to feel safe, which means that customers need to take reasonable safety measures as well if e-banking is to be safe.[70]

When discussing Internet security as being a barrier to the expansion of online banking, it should be kept in mind that the number of Europeans accessing bank services over the Internet is constantly increasing. According to a recent study from Deutsche Bank Research, the share of online banking customers in EU-15 increased from 19% in 2003 to 29% in 2007. e-Banking is thus a rather widespread e-service, but the uptake and the positive development could be fuelled even more by ensuring that the sceptical 70% of the European population gets the best possible conditions to join e-banking. Moreover, the adoption rate of e-banking varies greatly within the EU, which is also something that could be looked into and improved. While the Nordic countries have a very high adoption rate (50-70%), it is only 2% of the Bulgarian population that uses e-banking. Also, there is a tendency that it is primarily young, relatively well-educated people that engage in e-banking[71].

**e-Business standards and e-invoicing:** In order to make the industry efficient, e-business standards and especially standards regarding e-invoicing are important. According to a recent Commission report on European Electronic Invoicing[72], streamlining the information flow in a value chain leads to inefficiency reductions, improves certainty and reduces costs. As Europe is adopting the Single Euro Payments Area (SEPA), it is logical to link this to the business processes that give rise to the vast majority of Business-to-Business and Business-to-Government payments.

66. Interactive Net Design, ***www.brokat.de***, 11.04.2007.

67. Cummings, Haag, & McCubbrey, 2005.

68. Deutche Bank Research (2008): Secure online banking needs a little help from its users, ***http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000220572.pdf***

69. Deutsche Bank Research (2008): Online Banking: What we learn from the differences in Europe.

70. Deutche Bank Research (2008): Secure online banking needs a little help from its users, ***http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000220572.pdf***

71. Deutsche Bank Research (2008): Online banking: The young and well-educated extend their lead until 2010.

72. European Commission Informal Task Force on e-Invoicing (2007): European Electronic Invoicing Final Report, ***http://ec.europa.eu/information_society/eeurope/i2010/docs/studies/eei-3.2-e-invoicing_final_report.pdf***

However, three barriers to e-invoicing standardisation must be dealt with before this can become a reality:

1. Legal uncertainty, non-compliance with requirements and lack of confidence in the implementation of e-business solutions,
2. Management of the storage of electronic invoices as well as the risk associated with the electronic exchange and automated processing, and
3. The current lack of standardisation of electronic invoices[73].

**The renewal of automated teller machines:** There are several technologies in the pipeline that have not yet reached worldwide acceptance, but are expected to influence the development of ATMs in the near future. Examples include biometrics[74], where authorisation of transactions is based on the scanning of a customer's fingerprint, iris or face; Co-ordination of ATMs with mobile phones; and integration with non-banking equipment. These upcoming technologies force the banks to invest in renewal of ATMs in line with customer expectations and to decrease customer reliance on bank branches for standard banking interactions such as account balancing and cash withdrawal/payment.

**Anti-money laundering and the fight against misuse:** As a result of increased ICT integration in the global financial industry, increased misuse of the banking industry has been observed in recent years, including for financing of terrorist activities, drug trafficking and money laundering. Handling this issue requires a coordinated effort from banking institutions, regulators and law enforcement agencies.

All of the above trends and challenges are ICT-driven. The renewal of branch and processing capabilities is largely driven by the demand for e-banking. The increased focus on CRM is possible thanks to ICT, and data protection has been fuelled by increased investment in ICT in order to create systems to support data recovery. Customer confidence is only an issue with respect to online banking. The development of standards is increasingly necessary with increased online banking and consequent increases in banking across borders. Standards will also allow for streamlining the information flow in the value chain, which can give Europe a competitive advantage in the long run. The introduction of ATMs is largely possible due to investments in ICT, and the fight against the misuse of banking services can be further enforced by using ICT to block activities like money laundering. However, the introduction of ICT in the industry also calls for increased focus on data protection and fighting misuse of the industry, as ICT has made it possible for instance to hack into other people's bank accounts

## *2.6.2 ICT adoption and e-business use*

### ICT INFRASTRUCTURE USED BY BANKS

**Internet access**

An important indicator of the general uptake of ICT in the sector is the use and availability of internet. Internet access is a precondition for e-business, as this is the main channel for e.g. e-banking. The different broadband connections used to access the internet are used not only as the basis for advanced e-business applications, but also to support internal and external collaboration and to provide customer services over the internet. While the general availability of internet is almost complete across size bands in the banking industry, the internet technology used varies according to size band. About 8 in 10 of the large companies connect to the internet via a >2Mb/sec DSL connection, while about 6 in 10 of the small enterprises use a connection >2Mb/sec DSL connection (see Exhibit 2.6-1). This confirms the general assumption of a correlation between company size and ICT uptake.

**Use of internal networks**

The application of networks is a vital part of an effective ICT-enabled system, which is especially true in the case of banks with a branch network. Local Area Network (LAN) can be seen as a basic indicator of the minimum infrastructure required to enable companies to conduct e-banking at a substantial level[75]. In the banking industry, wire-based LAN is currently the dominating technology, whereas wireless LAN is a relatively new technology. The reason for the lower uptake of wireless LAN in the sector may be data security concerns, as security is an important topic in the banking industry. The uptake of wireless LAN seems to be related to company size, as 26% of large banks (250+ employees) use wireless LAN, above the corresponding uptake in the small and medium banks. Intranets are widely used (8 in 10 banks use it), while extranets are less common, with only 5 in 10 banks using them.

73. European Commission Informal Task Force on e-Invoicing (2007): European Electronic Invoicing Final Report, ***http://ec.europa.eu/information_society/eeurope/i2010/docs/studies/eei-3.2-e-invoicing_final_report.pdf***
74. Biometrics on ATMs can be found in Asia.
75. e-Business W@tch, Sector Study on the Financial Industry, 2002/2003, p. 25.

*Exhibit 2.6-1: Use of internet in the European banking industry*

| | Have access to internet | Use a computer connected to the www at least once a week | Bandwidth: Connect to the internet … | | | |
|---|---|---|---|---|---|---|
| | | | … below 144 Kb/s | … ≥144 Kb/s and < 2Mb/s | … via DSL (< 2 Mb/sec) | … via DSL (≥ 2Mb/sec) |
| **2006 (EU25)** | | | | | | |
| **Total (10+ empl.)** | **99** | **64** | **6** | **38** | **27** | **54** |
| Small (10-49 empl.) | 98 | 57 | 11 | 47 | 33 | 41 |
| Medium (50-249 empl.) | 99 | 71 | 4 | 39 | 61 | 56 |
| Large (250+ empl.) | 100 | 64 | 1 | 15 | 11 | 84 |
| | | | | | | |
| Banks | 99 | 65 | 7 | 40 | 27 | 50 |
| Insurance | 99 | 63 | 2 | 32 | 26 | 65 |
| Banks & insurance | 99 | 77 | 6 | 35 | 26 | 58 |
| Base (100%) | firms using computers | firms using computers | Computers linked to the Internet | Computers linked to the Internet | Computers linked to the Internet | Computers linked to the Internet |
| Questionnaire reference | B1 | B2 | B4 | B4 | B4 | B4 |
| **2002 (EU Total)** | | | | | | |
| Total | 95 | | | 50 | 29 | |
| Micro & small (<50 empl.) | 95 | | | 62 | 10 | |
| Medium (50-249 empl.) | 100 | | | 59 | 22 | |
| Large (250+ empl.) | 94 | | | 47 | 32 | |
| Base (100%) | firms using computers | | | Computers linked to the Internet | | |
| Questionnaire reference | A2a | | | A4a | A4b | |

Source: Eurostat Community Survey on ICT usage in enterprises 2006 (data extraction and table by SeBW)

Remote access is also not widely used in the sector, except among large banks (250+ employees).

**Specific ICT software systems**

With a dedicated IT system, all procurement processes are gathered into one system, across functions and locations. This ensures transparent, effective and automated management of all purchases. About half the banks have implemented dedicated systems for managing orders and purchases. There is, however, a difference in uptake across size-bands, as about 7 in 10 large banks (250+ employees) have dedicated systems for managing orders, and about 6 in 10 have linked the system to an internal IT system (normally an ERP system). In contrast, less than 50% of small and middle-sized banks have this type of system implemented. The apparent relationship between the uptake of IT systems for managing orders and purchases may be explained by the volume of operations, as larger banks have larger procurement volumes that can justify the development and maintenance of an ICT-enabled procurement system.

**Substitution of postal mail**

The banking industry is currently being renewed in many areas. One of these is the digitisation of formerly paper-based processes. Electronic mail is increasingly being used, especially for non-legal correspondence like account statements, marketing and sales. Despite the development in electronic mail, postal mail is still the preferred medium, but the industry is highly fragmented in its uptake of electronic mail as a means of communication.

**ICT security measures**

Security is of special concern in the banking industry, as banking is highly based on trust from its customers. The risks to be managed include hackers, denial of service attacks, technological failures, breach of privacy of customer information, and opportunities for fraud created by the anonymity of the parties to electronic transactions. Security in general is high in the banking industry. While offline bankers could be attracted to online banking with more comprehensive security guarantees from the bank, there

*Exhibit 2.6-2: Security facilities used in the banking industry*

| | Use of virus checking or protection software | Use of firewalls | Use of secure servers | Use of off-site data backup | Have encountered ICT related security problem in the last 12 months |
|---|---|---|---|---|---|
| **2006 (EU25)** | | | | | |
| **Total (10+ empl.)** | **98** | **95** | **78** | **85** | **19** |
| Small (10-49 empl.) | 97 | 92 | 70 | 78 | 15 |
| Medium (50-249 empl.) | 99 | 97 | 80 | 90 | 20 |
| Large (250+ empl.) | 100 | 99 | 92 | 94 | 27 |
| Banks | 98 | 94 | 78 | 87 | 17 |
| Insurance | 99 | 97 | 77 | 80 | 25 |
| Banks & insurance | 98 | 93 | 70 | 84 | 22 |
| Base (100%) | firms using security facilities | firms using security facilities | firms using security facilities | firms using security facilities | firms using security facilities |
| Questionnaire reference | B10 | B10 | B10 | B10 | B12 |

Source: Eurostat Community Survey on ICT usage in enterprises 2006
(data extraction and table by SeBW).

is a limit to how much security a bank can provide without encouraging irresponsible behaviour from customers. Hence, online bankers should themselves take reasonable security measures in order to avoid digital fraud. Exhibit 2.6-2 shows the deployment of various security facilities in the industry.

**Authentication**

A common concern among users of e-banking is the authentication of users and data connections. 36% of the banks use digital signatures, which is - interestingly - not as widespread as the application of PIN codes (68%) or encryption (61%). Digital signatures are however being increasingly introduced, especially in the Nordic countries where national standards have been developed and implemented as a result of government-sponsored digital signature projects.

The reasons for the limited application of digital signatures as seen in the survey data above may result from the cost associated with developing customised digital authentication systems in each bank as well as possible hesitancy by some banks in the face of ongoing discussions on the development of a pan-European standard. Until these discussions are resolved, investment in customised authentication systems in banks may be delayed.

## ICT IN EXCHANGES WITH CUSTOMERS

**e-Marketing and sales**

Almost all large banks have a website, compared to about 8 in 10 of small banks and 9 in 10 of middle-sized banks. The possibility to use e-marketing is hence greater in large banks. The fact that some small and medium-sized enterprises have not taken advantage of websites as a means of promotion is surprising, as this is a relatively low-cost technology. Personal assistance in the form of branch personnel is still regarded as the best medium for customer interaction; however, online banks have shown that it is possible to deliver satisfactory services online, without the face-to-face opportunities in brick-and-mortar banks, as the example of the UK online bank Egg demonstrates (see case study, p. 154).

**Offering e-banking services**

About 6 in 10 banks offer financial services online (e-banking). Offering financial products online is

**Case study: Egg, United Kingdom: Acquiring online capabilities**

*Online Bank Egg was one of the first to provide e-banking services to UK customers. Being an online bank, Egg puts great emphasis on maintaining a modern ICT platform, as this provides the flexibility needed to meet the changing requirements of the market. When being acquired by Citibank UK in 2007, the bank found a partner which supported this objective.*
*Egg was established in 1996 as an online-only alternative for technologically skilled customers, and is now the world's largest internet-only bank. Egg started out successfully and rapidly acquired about 7% of the credit card market. Service-oriented Architecture (SoA) is an important component of the banks' competitive edge, as SoA - and ICT in general - in Egg enable a user-centric instead of a product-centric focus in banking. SoA is tied closely to all business processes and enables Egg to give a "single view" of its products to the customers, reducing complexity for both customers and Egg itself.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

more common in large banks (74%) than in small banks (45%). Large geographical variations in the uptake of e-banking are also evident, with the Nordic countries (especially Finland and Sweden) as the front runners. Among services offered in e-banking, payments services are the most common, as these are often the first element developed by banks for an online setting. Payments services also show the greatest potential for quick efficiency gains as they replace labour-intensive operations traditionally conducted by staff in a branch office.

**Customer interaction via the internet**

In interactive ordering via bank websites, the most common scenario is that 10-25% of a bank's customers use this facility online. With respect to both private and corporate accounts, there is room for increased online banking, as only 2% of the banks have more than half of their customers ordering online. This indicates that internet-only banks are still niche players and that the majority of the banks still operate on a traditional branch-based platform or a combination of the two. This manifests itself through brick and mortar banks offering an increased number of services online, starting up an online branch or acquiring internet-only banks.

**Interaction with the public sector**

Another important element of ICT uptake and usage in the sector is the banks' interaction with public authorities via the internet. About 8 in 10 banks use the internet for interacting with public authorities. The simpler online interactions like information gathering are more frequent than the more advanced interactions like e-tendering or e-filing,[76] which corresponds to the pattern in most industries. The low share of banks engaging in e-tendering could also be explained by the mere fact that banks seldom engage in public tenders for financial services.

### DEMAND FOR AND SUPPLY OF ICT SKILLS

Attracting competent ICT staff for the development and maintenance of ICT solutions and e-banking services is of key importance to the competitiveness of a modern bank. In the banking industry, the demand for personnel with the required ICT skills has grown in line with the development of new market segments related to the internet[77]. However, a survey conducted for this study indicates that there is currently no divide between availability and demand for ICT-skilled labour in the sector. One of the possible explanations is that banks, as previously discussed, increasingly outsource these services either to national or international ICT subcontractors, reducing their need for ICT-skilled labour.

### SEPA

Currently, the Euro area economy is not fully exploiting the benefits of monetary union and a single market, as stakeholders are subject to dif-

76. Electronic tax filing (or e-filing), a process where tax documents are submitted to the tax authorities through the internet or direct connection.
77. ***ftp://ftp.jrc.es/pub/EURdoc/20749-ExeSumm.pdf*** (August 2007).

### Case study: Eurobank, Greece: ICT-facilitated Business Process Management

*In early 2006, Greece-based Eurobank started applying Business Process Management (BPM) to the business processes of its mortgage division, with full implementation 18 months later. The main objectives were to improve the internal business processes within the mortgage division, and to provide better service for customers.*
*Using one division as a testing organisation, Eurobank sought to achieve greater process efficiency by closer alignment between business processes and ICT. The test organisation would offer valuable lessons before applying BPM to the entire organisation. The project was more difficult than Eurobank initially expected, as the implementation of this ICT-concept was initially met with distrust among employees. Fully implemented, BPM has, however, allowed many routine tasks to be automated, making the new streamlined approach to banking popular among employees.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

ferent rules and requirements depending on their country of origin. To overcome this, the Single Euro Payments Area (SEPA) was launched on 28 January 2008. SEPA is an initiative of the European Central Bank and the European Commission for European financial infrastructure, and involves the creation of a Euro-zone in which all electronic payments are considered domestic, eliminating the difference between national and intra-European cross border payments.

**Potential barriers and benefits**
Over time, the benefits of an integrated payment market are expected to evolve along the following lines:

- More efficiency. Europe will become more efficient thanks to the harmonisation of payments in almost every economic transaction that takes place in society.
- More opportunities. The integration of banking legislation is expected to facilitate innovation and competition.
- Support for the Euro as a currency. Integrated payment systems will support the development of the Euro by promoting greater confidence and deeper economic relations throughout SEPA[78].

**Business implications**
SEPA will have implications for businesses, banks and consumers. All electronic payments will be affected, and core credit transfers, direct debits and card payments are expected to be replaced by interoperable formats and processes.

As Europe moves to adopt SEPA, banks will need to rethink the business processes that necessitate a vast majority of Business-to-Business and Business-to-Government payments, as cross-border payments within the Euro area are now to be as easy as national payments. The banking industry is expected to see increased competition as a result of the consolidation of infrastructure. It is expected that SEPA payment instruments will allow banks to expand their business and compete on a pan-European level, as any bank can offer its services to anyone in the Euro area without additional cost or extra effort[79].

SEPA is expected to impact the ICT and e-business approach in the banking industry. Some banks may have the ICT resources (hardware, software and human) to develop SEPA-compliant ICT applications and work processes in-house, while other banks may be better off buying standard ICT systems for SEPA transactions than developing their own or buying national solutions. Impacts on the banking industry may be positive, if the opportunities of technology advancements are exploited. SEPA could then trigger the migration of banks and their customers towards standardised solutions for direct and highly automated connectivity between their various systems. SEPA moreover has the potential to bring benefits

78. SEPA explained, European Payments Council, 2006, p. 1.
79. SEPA Brochure, European Commission, 2006.

**Case study: National Irish Bank, Ireland: the impact of ICT on post-merger branch renewal**

*The merger of the National Irish Bank (NIB) with the Danish financial institution Danske Bank A/S in 2005 meant the start of a radical renewal of the Irish bank. NIB has since then experienced wide-ranging changes to its brand and ICT infrastructure, giving a competitive advantage over less technologically advanced competitors. This has allowed NIB to expand its market share and increase its revenue. The primary success of NIB after the branch renewal process can be attributed to the implementation of a state-of-the-art ICT-platform which, like the organisational design and portfolio of financial products, has been provided by the new parent company Danske Bank.*

*After the merger, NIB had to implement the IT infrastructure used in Danske Bank. Achieving full alignment with Danske Bank A/S standards took about 18 months, although the most radical changes were done in the very early stages of the branch renewal project. During the Easter holidays of 2006, the old NIB ICT systems went offline. When the staff returned four days later, the old systems had been replaced by new IT infrastructure and work flow processes. 4,000 employees were deployed to ensure a smooth transition of the 1.1 million customer accounts to the new platform, as well as establishing broadband connections at 180 locations, and replacing 3,000 PC work-stations. Furthermore, 55,000 tests were performed as a part of this organisational transformation, in order to avoid costly errors after the ICT-platform had been fully implemented.*

*Renewing NIB virtually overnight was a major task which had been planned to the smallest detail. The challenges and costs of training employees in how to use the new technology were considerable, with 450 Irish employees going through basic training in Danish branches. Moreover, Danske Bank used e-learning and temporarily brought in 300 skilled Danske Bank employees to provide on-location guidance on how to use the new IT-platform and the new portfolio of financial products. Within the first two weeks of the ICT transition, Danske Bank sent staff to each NIB branch to provide ICT support. It eased the transition considerably that each branch had an ICT-capable resource readily available.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

to the customer through increased competition, improved integration and secure instruments.

## ICT AS A DRIVER OF PROCESS EFFICIENCY

### Potential benefits and barriers

ICT-enabled developments may include savings in personnel and time from automated processes, reduced costs from streamlined and automated process flows, reduced costs from fewer errors, and identification and utilisation of economies of scale from lower unit processing costs[80]. The case study on Eurobank (see p. 155) illustrates how the introduction of a BPM-system has impacted on the bank.

An econometric analysis carried out in connection with this study shows that banking industry productivity growth rose in the EU from the year 2000 onwards, while average working hours per employee were decreasing in most countries. According to the analysis, ICT capital investments are largely replacing labour, particularly in retail banking. This is achieved by standardising ordinary financial services and having customers perform basic financial services online, rendering some staff superfluous. It is expected in the coming years that standardisation will continue, contributing to decreasing employment and increased investments in ICT. The case studies, on the other hand, show that the role of counter staff has changed: they are no longer performing basic financial services, but their skills have been upgraded so that they are now able to perform more complicated financial services. Thus, counter staff are rarely made completely redundant.

ICT allows for tailor-made services with high added value, such as e-banking combined with the option

80. A Central Bank's view on technology based efficiency and productivity in the financial markets, Technology Driven efficiencies in Financial Markets, 2006 p. 11.

of face-to-face advisory meetings to a level that satisfies the customers. Moreover, it allows banks to meet customers' needs faster and leads to a better flow of information and communication.

The introduction of ICT to increase efficiency may also encounter barriers. First of all, ICT implementation and exploitation often require substantial investments. As previously mentioned, this can especially be burdensome for smaller banks which do not have the financial resources to invest as heavily as larger banks. Another barrier is the common fear among employees that ICT is primarily introduced to save personnel cost and to limit errors. The impact of internal resistance against innovation is especially strong for lower qualified employees, such as counter staff in the banking industry[81]. These employees might however be re-trained as was seen in the case study of the National Irish Bank, where new ICT digitised many tasks formerly performed by staff. The counter staff in Citibank also had their skills improved when Citibank acquired Egg and thus changed the bank's business processes, so that they could perform more advanced financial tasks.

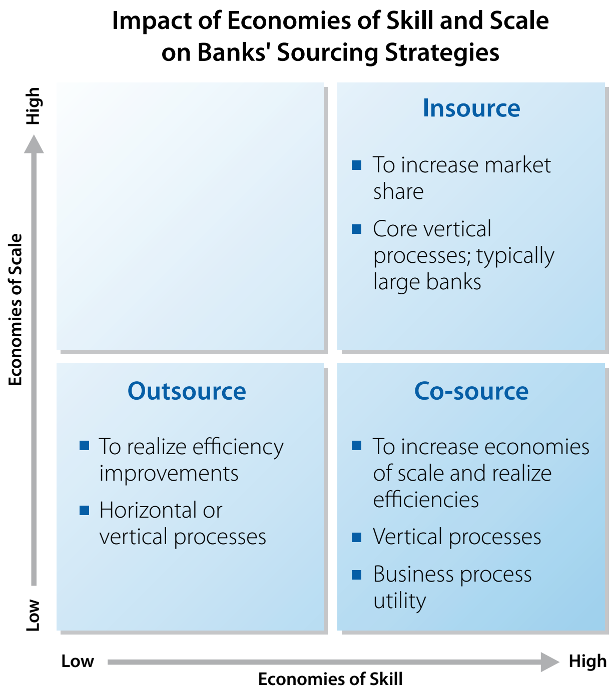
**Business implications**

The increased use of ICT for process efficiency has implications. Banks need to put resources into securing intuitive ICT software and hardware. Otherwise the costs, especially in terms of (re-)training, will exceed the benefits from ICT-enabled processes and may lead to dissatisfaction among employees. The case study on the National Irish Bank (see p. 156) illustrates how the introduction of ICT has led to increased process efficiency, and how the re-training of employees has been done in an effective manner.

The implications for large and small banks are not the same. Due to the capital intensive nature of ICT investments, large banks may be better equipped for in-house ICT developments, while small banks may be better off with outsourcing or buying off-the-shelf. Exhibit 2.6-3 illustrates some of the options small (and large banks for that matter) may have to source ICT.

ICT operations in the banking industry involve continuous maintenance and development of ICT-

*Exhibit 2.6-3: Various forms of ICT sourcing*




Source: ***www.celent.com*** (February 2008)

systems, and have traditionally been an in-source/in-house activity. In-sourcing is in this respect observable in banks where all ICT-related processes are in the bank, as they wish to maintain control of critical processes or competencies. Hence, large banks may select the in-sourcing model, due to readily available financial and human resources. This is the case for the case studies on NIB and Eurobank. The case studies on Tapiola Bank and Glitnir Bank (see p. 158) are examples of the co-sourcing approach where the bank still has some control of the ICT being developed but the actual development is left in the hands of someone else.

The development of ICT-enabled banking processes has also impacted business customers. Economies of scale and increased transaction volumes allow business customers to benefit from the lower cost of finance, increased convenience, time saving and operational efficiency.

81. Henrik Schneider, Employee Knowledge Obsolescence and Update in the Mobile and Telecommunications Industry.

**Case study: Tapiola bank, Finland: dual-combination banking**

*Tapiola bank is part of the mutual Tapiola Group, a customer-owned institution consisting of several operating companies providing insurance, pension, investment management and banking services. The Tapiola Bank division was established in 2004 to provide consumer banking services via the internet and through 50 insurance branch offices nationwide, and was directly related to the increasing use of ICT among customers. In its first year of operation, Tapiola Bank won nearly 25,000 new customers, and is currently winning more than 30,000 additional customers each year.*

*The success is largely attributed to the synergies of combining online banking with on-location advisory services. The synergy effects were created by successfully using the Tapiola insurance branch infrastructure for face-to-face meetings – which purely internet-based banks cannot provide - and building an ICT-driven bank on this foundation. This kind of dual-combination banking concept encompasses the possibility to successfully combine the benefits of branch banking with the cost-structure of a purely ICT-driven bank.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

THE IMPACT OF ICT AND E-BANKING ON BRANCH RENEWAL

**Potential benefits and barriers**

In general, e-banking and ICT have caused traditional branch-based banks to change the service offerings in their branches. A dual-banking business model is emerging, covering both e-banking and branch banks. Internet-only banks, despite a lower cost structure than branch banks, are faced with challenges in terms of customer confidence. On the other hand, many traditional branch banks need the innovation displayed by internet-only banks. The dual-banking model can give traditional branch banks the opportunity to adjust their branch network towards advisory functions and away from traditional counter services, thus adding value to their customers from direct and customised bank advisory services. This combination of the two types of banking has been successfully implemented in the Finnish Tapiola bank, which has launched an internet-only bank (see case study).

The process of branch renewal may encounter barriers. The change in human resource profile of the individual branch banks and often the reduction of the number of branches may lead to issues with existing staff. Staff re-education and skills development is essential to successful transformation of a traditional counter staff-intensive branch office towards an advisory-based branch bank network. In the case studies, it is also very rare that employees welcomed the branch renewal process but, with time, most banks found that the employees grew accustomed to the new structure or even liked it better. Few banks have experienced problems with key personnel leaving as a result of branch renewal.

**Business implications**

In many cases, ICT has given the traditional branch-based banks both the need (due to the rise of e-banking) and the means (due to developments in ICT) to transform branch offices into advisory "centres" for customers that normally conduct their day-to-day banking business via the banks' online application. The impact for the banking industry is significant, with e-banking and ICT developments bringing drastic changes to the role of the bank branches. This is depicted in the case study on Glitnir bank (see p. 159).

## 2.6.3 ICT and e-business impact

Economic literature suggests that the ongoing diffusion of ICT and e-business technologies and services among companies in the economy at large is a striking example of the possible dynamics of technological change and economic development (see, for example Breshnahan and Trajtenberg, 1995, Helpman, 1998a and 1998b). The adoption and diffusion of new technologies can be spurred by many drivers and can have far-reaching consequences. Virtually all economic spheres can be affected by technologically induced changes, including innovation dynamics, productivity and growth, the development of market structures, company performance, and the composition of the demand for labour. An econometric analysis based on the EU KLEMS database as well as Zephyr and the European Restructuring Monitor largely confirms that the diffusion of ICT drives the innovation process in the banking industry.

The following points summarise the effects of the ICT-enabled innovation process in the banking industry:

- **Impact on productivity growth:** The analysis of the impact of ICT capital on labour and total factor productivity growth confirms to some extent that ICT capital has a moderate impact on productivity. The full exploitation of total factor productivity growth is however only found when high- and medium-skilled labour is combined with organisational changes.
- **Impact on employment:** The impact of ICT capital on the employment perspectives in EU member states shows that overall employment in the financial service industry tend to decline in most of them, especially since the beginning of the new millennium. However, some countries are benefiting from the concentration of international financial services in their territories, with Ireland and Luxembourg as prime examples. ICT investments tend to have a diminishing impact on average working hours in the member states, although significant differences remain between countries.
- **Impact on skills requirements:** With regard to compositional changes according to three different skill-classes, the econometric analysis indicates that medium-level skills are the most important labour source associated with an increased ICT-capital intensity in financial services. This finding coincides with the findings from the case studies, where counter-staff are increasingly being retrained to perform financial services in the banks, moving them from the low-level skill class to the medium-level skill class, but not all the way to the high-level skill class.
- **ICT and innovation:** The analysis confirmed the innovation-enabling role of ICT. Entrepreneurial companies without legacy capital are able to deploy new ICT, turn it into commercial innovations and challenge the existing way of doing business. The case studies support this through the examples of the introduction of internet-only banks in the banking industry, as SkandiaBanken, Tapiola Bank and Egg were all able to rapidly gain a large share of the banking market.
- **ICT and mergers & acquisitions:** According to the analysis of the effects of ICT on the intensity of mergers and acquisition (M&A) activity,

**Case study: Glitnir Bank, Iceland: banking in an on-line society**

*The case study on Glitnir Bank in Iceland shows how the role of branches is changing as e-banking becomes the norm for everyday transactions. With high uptake of ICT among the country's inhabitants, banks in Iceland are in a favourable position to market the advantages of self-service e-banking to customers. Migrating customer transactions to their online bank has provided Glitnir Bank with significant savings.*
*Since the bank was launched in 1996, it has been successful in moving a large number of transactions to its online e-banking platform, allowing a more efficient and cost-effective approach to banking. The reason, according to Glitnir Bank, is the generally high internet uptake among the Icelandic population (90% uptake).*
*Introducing e-banking has meant large savings for Glitnir Bank in reduced costs related to branch-based operations. Providing customers with the possibility of performing routine banking tasks online has reduced the need for branches and manual handling of transactions by employees. With 70-80% of customers using Glitnir Bank's e-banking portal on a regular basis, the nature of work conducted in the branches has changed. ICT (e-banking) allows branches to become advisory centres rather than service centres, which represents a radical change of focus for bank branches.*

***For more details about this case, see the full study report on** www.ebusiness-watch.org* the results from the econometric analysis do not allow for precise conclusions regarding the effects of ICT on competition in the banking industry. The case studies can however provide explanations for the correlation between the diffusion of ICT and increased M&A activity. First of all, ICT allows for new ways of banking that are especially taken up by new banks, which makes them interesting acquisition targets for traditional banks (Egg/Citibank case). Secondly, ICT enables M&As to proceed more smoothly, as the NIB case study clearly illustrates.

- **ICT impact on the value chain:** The analysis of the impacts of ICT on the value chain revealed that ICT enables companies to review their make-or-buy decisions and drives the process of outsourcing business activities and company restructuring. This has been true in several case studies, as ICT has enabled the banks to restructure their business processes.

The hypotheses which were developed and tested by means of econometric modelling are summarised in Exhibit 2.6-4.

### ICT AND PRODUCTIVITY

There are productivity increasing effects from ICT in both the user sector and in the ICT-producing sector. In particular, ICT was found to have positive effects on labour productivity and total factor productivity. An important finding is that ICT-induced productivity effects vary significantly between sectors and among countries. For example, the largest productivity growth effect occurs in the ICT-producing sectors

*Exhibit 2.6-4: Various forms of ICT sourcing*

| No. | Hypothesis | Results | |
|---|---|---|---|
| 1.1 | ICT-capital investment has become a key element in productivity growth while other capital inputs summarised as non-ICT-capital have diminished in their respective importance. | Overall, ICT-capital played an important role for all countries. However, the direct positive link between ICT-capital investments and labour productivity growth is much weaker. | **Partly confirmed** |
| 1.2 | TFP-growth accelerated together with increased investment in ICT-capital. | No instantaneous impact, might however be delayed | **Not confirmed** |
| 2.1 | ICT has together with high- and medium-skilled labour positive impact on TFP growth. | Significant heterogeneity in the Member States | **Partly confirmed** (only in some countries) |
| 2.2 | ICT has significant skill-bias towards high- and medium-skilled labour. | Labour quality change from low-skilled to medium-skilled labour due to retraining, but not all the way to high-skilled labour | **Partly confirmed** |
| 3.1 | The number of Initial Public Offerings is positively correlated with the diffusion of ICT. | The only variable that has a positive and significant impact on the number of IPOs is the one that controls for the share of ICT in total capital compensation -> the increased number of IPOs in the BI can largely be attributed to the diffusion of ICT in the BI | **Confirmed** |
| 4.1 | The number of mergers and acquisitions is positively correlated with the diffusion of ICT. | The only variable that has a positive and significant impact on the number of M&As is the one that controls for the share of ICT in total capital compensation. | **Confirmed** |
| 5.1 | ICT diffusion is positively correlated with firm restructuring. | The likelihood of discarding assets increases with the ICT endowment level, the likelihood of asset restructuring is the highest in the cluster with the highest ICT endowment level, and the highest negative impact on employment is observed in the high level ICT cluster | **Confirmed** |

themselves, and in selected service industry sectors like banking, wholesale, retailing, and telecommunications. However, only a few countries have seen a significant upsurge in productivity growth in those sectors of the economy that have invested most in ICT. These sectors include banking, wholesale, retailing, and business services.

Looking at the different countries' growth performance – and using their respective real gross value-added as an indicator – it is observed that nearly all countries until 2004 experienced fairly high growth in financial services. However, only some countries could maintain their steady growth pattern after the burst of the new economy bubble in 2000. Denmark, Spain, Ireland, Greece, Portugal and the UK were the only countries where financial services did not face slow growth after 2000 (see Exhibit 2.6-5).

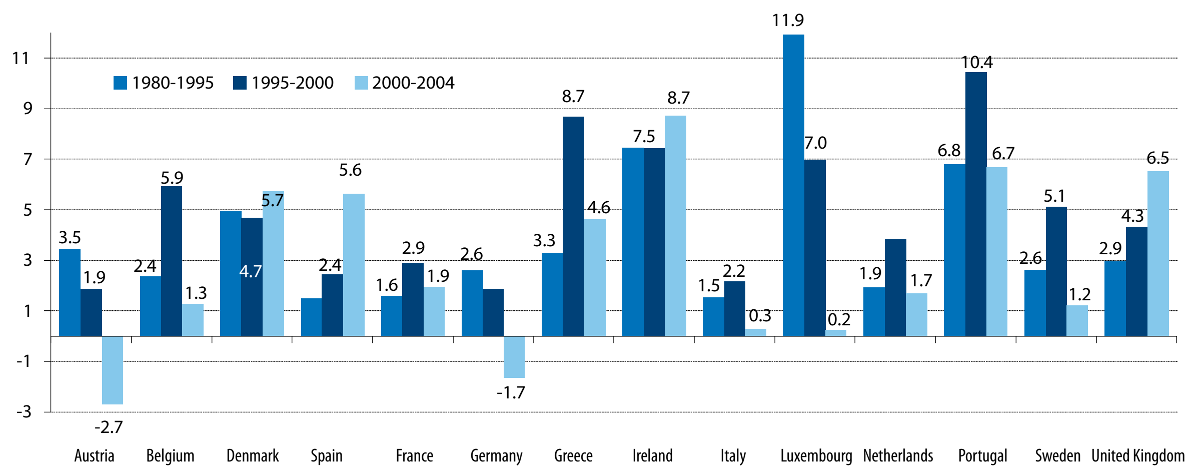
The strongest overall growth in value added can be observed in the UK with 5%, Denmark with 4.2%, Spain with 3.5% and the Netherlands with 3%. Lagging far behind are Germany - with no growth at all - and Austria with 0.2%. The most common reason for these differences relates to the total factor productivity (TFP) growth differentials between EU member states. While Denmark experienced 2.4% TFP growth over the nine years, Austria experienced a 2.0% decline. Interestingly, ICT capital in all EU countries contributed positively to overall output growth, ranging from 2.7% for Denmark to as low as 0.6% for Italy. In contrast, non-ICT capital contributed much less or even negatively to the financial intermediation service industry growth. To sum up, the key drivers to industry growth come from ICT capital investments plus labour quality changes.

With respect to labour productivity growth, it can be seen that the direct positive link between ICT capital investments and labour productivity growth is weak. This suggests that human capital inputs, organisational changes incorporated in the total factor productivity growth, and outsourcing of non-core activities included in the intermediate inputs all play a predominant role in labour productivity growth alongside pure ICT capital growth.

### ICT, EMPLOYMENT AND WORKFORCE COMPOSITION

In terms of ICT as a driver for total factor productivity growth, there is significant heterogeneity in the labour productivity performance in the different countries. While some –the UK, Sweden, Spain and Denmark– experienced significant acceleration in 1980-2004, Austria, Germany, Luxembourg and others experienced the opposite. In the same period, average working hours per employee decreased, with the exception of countries where international financial centres existed or were developed, such as Ireland, Luxembourg and the UK. Here, labour productivity and employment growth were positively correlated. ICT capital investments are increasingly replacing labour in the branch banking system, particularly in retail banking. However, high-skilled finan-

***Exhibit 2.6-5: Growth of gross value added in financial intermediation services, 1980-2004***




Source: EUKLEMS data base, GGDC; own calculation.

cial analysts working e.g. in the international financial centres in some EU member states face increasing employment opportunities.

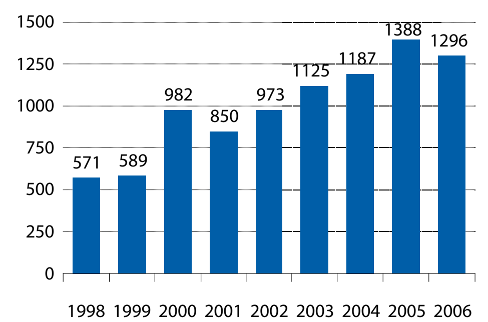
The case studies do not provide information on the concentration of financial centres, but do confirm the increased spending on ICT capital due to the increased use of online banking for traditional financial services. However, counter-staff are retrained to perform other financial services rather than being laid off. In the long run, this could lead to reduced demand for banking personnel, as counter-staff are gradually becoming superfluous, leading to a decrease in the banking industry workforce.

ICT AND MARKET STRUCTURE

ICT-enabled innovations change the cost structure of companies and are therefore expected to have a significant impact on the market structure in which these companies operate. One way of investigating this is to see if there has been an increased rate of asset reallocation measured in terms of mergers and acquisitions (M&A). Exhibit 2.6-6 shows that over the analysed time period, the banking industry experienced a clear rise of M&A activity. A sharp increase was observed in 2000, followed by a slight drop in the number of M&As in 2001. From 2002, the total number of M&As has continued to grow.

Other factors besides ICT influence companies' cost structure, their market share and ultimately the structure of the market in which they operate. It was however shown by the econometric analysis that the only variable that has a positive and significant impact on the number of M&As is the one that controls for the share of ICT in total capital compensation. The case studies can provide explanations for the correlation between the diffusion of ICT and increased M&A activity. First of all, ICT allows for new ways of banking that are especially taken up by new banks. This implies that the new banks quickly gain a certain share of the market, which makes them attractive acquisition targets for larger, traditional banks. Secondly, the increase in M&As can be explained by the fact that ICT enables M&As to run smoother.

***Exhibit 2.6-6: Number of M&A in the banking industry (EU 27), 1998-2006***




Source: ZEPHYR, DIW Berlin (2008)

ICT AND THE SECTOR VALUE CHAIN

Empirical findings suggest that some of the main effects of ICT diffusion are organisational changes and the redefinition of organisational boundaries. It can be shown that ***'move to the market'*** decisions are driven by ICT diffusion. The effects of companies' decisions to buy instead of make have been visible in the form of a restructuring wave that shook nearly every industry in the last twenty years. The econometric analysis of the variables controlling for various restructuring activities states that he likelihood of discarding assets increases with the ICT endowment level. Consequently, companies with the highest ICT shares in capital compensation are the most likely to have outsourced, relocated or off-shored some of their activities. Similarly, the likelihood of asset restructuring is highest in companies with the highest ICT endowment level. The highest negative impact on employment is observed in companies with the highest ICT shares as well. This confirms that ICT capital tends to replace labour in the banking industry. In conclusion, the current analysis provides support for the hypothesis that ICT diffusion is positively correlated with company restructuring.

## 2.6.4 Outlook

PROCESS EFFICIENCY

Process efficiency is expected to reduce costs in the banking industry, an assumption that is supported by the econometric analysis. ICT capital investments are largely replacing labour, particularly in retail banking. This is done by standardising routine financial services and having customers perform basic financial services online, thus rendering counter-staff superfluous. However, most banks have retrained the displaced staff so that they are now able to perform more complicated financial services. Banks have not dismissed counter-staff. The analysis and the case studies developed for this report could not provide conclusive evidence regarding shortage of personnel with ICT skills. The econometric analysis however discusses the increasing demand for high-skilled labour, which could provoke a shortage in the long run.

BRANCH RENEWAL

The introduction of ICT in the European banking industry has had a significant impact on banks operating with bricks-and-mortar branches. The internet has made it possible for banks to cut costs by offering online banking at a lower cost. A prevalent change in the branch structure is dual combination banking. With dual-combination banking, traditional manual banking services can now be performed online while the more sophisticated banking services are still performed in the branch bank, thus taking advantage of the low-cost nature of e-banking and the face-to-face advisory services of the branch bank. The process of branch renewal may however encounter some barriers. When traditional banking services are performed online the need for counter-staff is diminished. Staff re-training and skills development are essential to a successful transformation of a traditional counter-staff-intensive branch office towards an advisory-based branch bank network.

SEPA

SEPA provides benefits to different elements of the banking value chain. The benefits for the industry, as seen from the point of view of the legislators, come from increased transparency, less risk of money laundering, increased transactions across borders and access to new markets. It is however observable that the business case for SEPA, seen from a bank's perspective, may not be as clear. Due to uncertainty about the actual role of SEPA, many banks are settling for minimum solutions that implement only the basic mandatory SEPA instruments but do not make full use of the embedded potential in SEPA. The industry has as of yet taken very limited measures to comply with SEPA. However, SEPA is expected to bring substantial benefits in the long term for end users, businesses and banks in Europe, as product innovation such as the development of e-invoicing is expected to happen as a result of ICT-investments.

THE IMPACT OF ICT ON MARKET STRUCTURE

Market structure in the banking industry is changing as a result of mergers and acquisitions. Recent mergers and acquisitions have generated the need for increased investment in ICT in order to integrate the different banking systems. However, ICT also helps implement the merger more smoothly. Mergers and acquisitions also happen as a result of ICT, when large branch banks acquire innovative internet-only banks in order to obtain both a well-known brand from the traditional bank and an innovative business model from the internet-only bank.

CUSTOMER AND BANK READINESS FOR THE USE AND PROVISION OF E-BANKING

e-Banking has now developed into an advanced ICT solution where most everyday banking tasks can be conducted online. The statistics do, however, indicate that e-banking across Europe is still not widely implemented among private and corporate customers. Basic understanding of and confidence in the internet is required to adopt e-banking, and not all member states have reached a critical mass of behavioural change among customers. Not all banks are ready for e-banking either. Moreover, a Deutsche Bank Research study showed that offline customers still perceive online banking to be unsafe, despite the online banks being very secure. Because of the significant differences in ICT-uptake across member states, a pan-European initiative to either increase safety to an equal level in all member states or to promote the high security level towards customers could help increase customers' perception of safety.

### *2.6.5 Policy implications*

REINFORCE STANDARDISATION TO INCREASE EFFICIENCY

Increased e-business standardisation is expected to help obtain a more effective BI, as for instance payments will be carried out in the same way no matter which country in the European Union the banks and/or their customers are doing business with. SEPA is one of the recent initiatives in this area. As Europe is adopting the SEPA, a logical next step is to look at how the business processes that facilitate the majority of the B2B and B2G payments can be standardised as well. One of the areas that could be looked into could be e-Invoicing. The expected gains from increased standardisation such as a well-functioning SEPA and standardised procedures for e-invoicing are numerous. Companies with substantial numbers of cross-border payments can benefit both from the standardised payments and standardised e-invoicing and payments procedures can also lead to easier market access for the companies in question. Banks are expected to gain from the easier work processes, as there will be less paper-based work related to the transactions. If banks are able to take the SEPA principles and develop them further to include other business processes, such as e-invoicing, they might even gain a competitive advantage.

The overall success of the SEPA initiative rests on the adaptation by banks and the development of a critical mass in the number of transactions within a reasonable time frame. The BI itself has not yet done much to implement SEPA as it requires substantial ICT investments, and the banks have difficulties in seeing that these ICT-investments can be compensated by the potential gains from SEPA.

In order for the BI – and Europe in general – to reap the potential benefits stemming from increased standardisation, the European Commission could play a more active role along with industry organisations. For instance, the industry organisations could support ICT development projects in the BI by bringing banks together and helping the banks in deciding what is needed in order to fully reap the benefits of the SEPA or e-invoicing. Moreover, the industry organisations could facilitate a forum where banks could cooperate on developing the ICT systems needed for further standardisation, and thereby share the costs. Discussions on how these ICT-investments could be used for further product innovation in the respective banks could also be discussed in these forums. The European Commission could support the initiatives from the industry organisations with grant schemes, if needed.

**The following recommendations are therefore proposed:**

- Promote initiatives such as shared ICT development processes in the banks or facilitate a forum where banks could cooperate in developing ICT systems to support increased standardisation, such as SEPA and e-Invoicing
- Encourage the cooperation between banks in ICT development projects to implement SEPA work processes and e-invoicing standards. This should be facilitated by the industry organisations as banks are not likely to cooperate on ICT development projects by themselves

### INCREASE CUSTOMERS' PERCEPTION OF SAFETY

The general uptake and use of ICT in the BI is rather high. For instance, 99% of the banks in the BI have access to the Internet and about 5 in 10 banks use a computer connected to the Internet every day. Hence, the preconditions for increased e-business in the BI are in place. But in order to conduct e-banking, the safety measures must also be in place.

Despite the measures taken by the BI to secure safe e-banking, the analysis shows that the customers currently not using e-banking (offline customers) are not entirely ready to embrace e-banking. While online customers' (customers already engaging in e-banking) perception of security is on the rise, the same cannot yet be said for offline customers. This obviously has to be seen in the light of the fact that e-banking is one of the most well-developed e-services, and that many customers are increasingly using e-banking as part of their everyday banking routines.

There are two aspects of increasing consumer safety in the BI. The first is related to what banks can do and the latter is related to what customers can do. With respect to the first aspect - what banks can do - it seems from the survey and the analysis conducted in this study and referred to above that banks are in general doing what is needed in order to ensure safe e-banking.

However, one way for the banks to enhance customer safety could be to establish clear audit trails (clear overview of the processes in all transactions, in order to ensure increased transparency), which could provide the customers with increased transparency. The Commission could support this by promoting the establishment of such audit trails in cooperation with the industry organisations, or make it mandatory for the banks to establish such trails. It should however be further investigated if this is the right way to go for the banks in increasing consumer confidence.

With respect to the second aspect, customers can take reasonable safety measures before engaging in e-banking, by for instance applying anti-virus software to their computers. The Commission could help facilitate responsible behaviour on the Internet and increase consumer knowledge on how to behave responsibly when engaging in e-banking by promoting a "Safety on the Internet"-campaign in all Member States. National governments could also be responsible for this campaign; however, this would not help align customers' perception of safety across the Union.

It should be mentioned that as the global reach of the Internet implies that financial services are in-creasingly borderless and global, a pan-European initiative could increase customer confidence, as certainty for customers that all banks are equally well protected may increase the customer's perception of security.

**The recommendations are therefore as follows:**

- **For the banks :** promote the establishment of clear audit trails for e-banking transactions, for instance through the industry organisations, or make it mandatory for the banks to establish clear audit trails
- **For the customers :** initiate a pan-European (alternatively multi-national) campaign to increase bank customers' awareness and knowledge about safe behaviour on the Internet

SUPPORT SKILLS DEVELOPMENT AMONG BANK PERSONNEL

e-Banking and ICT have caused the traditional branch-based banks to change the service offerings in their branches. The business model of dual-combination banking (banks offering internet-banking and branch-based banking) is emerging, which implies that customers are increasingly performing basic banking tasks online while relying on bank branches only for more sophisticated, advisory tasks. This means that an increasing number of jobs are being changed from traditional tellers to branch advisor/counsellors. Bank staff is under increasing pressure to provide highly qualified financial advice rather than perform labour intensive and comparatively simple teller functions.

With the current branch renewal process in the BI (especially the introduction of dual-combination banking) brought forward by technological advances it could be feared that a group of staff would be unable to develop their skills accordingly. However, from the case studies on e.g. Tapiola bank it can be seen that retraining of personnel has proven efficient as the staff now can perform more advanced financial tasks. This observation is supported by results of the econometric analysis. Hence, restructuring of branches and using ICT for process efficiency may not necessarily result in a decrease of the work force. It is more a question of ensuring that the existing personnel in the banks are retrained so that their skills can be used to create high value for the banks. To ensure that this positive development continues in the future, it is therefore recommended that especially trade federations and industry associations play an active role in skills development among branch bank staff to prepare them for the new role of the branch banks.

The industry organisations could arrange training courses for the staff in risk of becoming redundant; in order to ensure that they are able to perform the more sophisticated tasks which add value. Moreover, industry organisations could arrange forums where banks could meet and possibly exchange best practises to the benefit of the entire BI. Training courses by the industry organisations will ensure that the positive trend of retraining redundant tellers continues. The European Commission could support these training courses, for instance in the form of grant schemes to develop the curricula, or facilitating exchange of best practise.

**The recommendations are therefore as follows:**

- Industry organisations could support training and skills development among bank staff by arranging training courses or facilitate networks for exchange of best practise
- The European Commission could support these training courses or networks with grant schemes.

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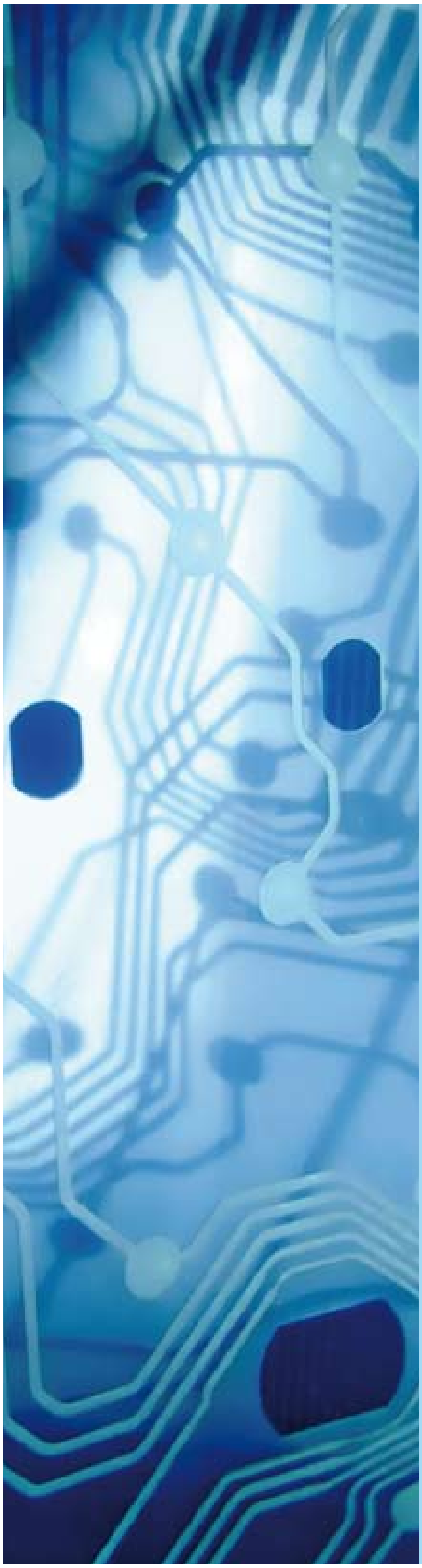
PART 3

# Studies on specific ICT application areas

## 3.1 RFID adoption and implications

This study was conducted by Global Retail Insights, an IDC Company (***www.idc.com***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).



**Key findings**

***RFID may become mainstream in Europe over the next 5-10 years.*** *Compared to the estimated RFID adoption rate of 17.7% of enterprises in 2006, and 24.5% in 2007, resulting from a significant adoption uptake in retail, transportation, and logistics, adoption of RFID is expected to grow rapidly in the EU-7 over the next five years. An annual growth of approximately 27% in the number of enterprises adopting RFID is estimated during 2007-2009 among EU-7 enterprises in manufacturing, retail, transportation, and hospital activities.*

***Business drivers to RFID implementations.*** *Projected growth in RFID adoption will be driven by key business motivations including the opportunity to achieve cost reductions and productivity improvements along the supply chain and in production processes, achieving regulatory compliance, increasing quality of service to customers and improving enterprise assets management efficiencies. The usage of RFID technology is expected to move gradually from operational execution activities to the optimisation of business planning and intelligence capabilities.*

***Average payback time for RFID investments is estimated between 2 to 3 years.*** *Empirical evidence indicates the implementation of RFID can enable labour and total factor productivity growth, as well as innovation in the way enterprises conduct business. RFID-enabled innovative activity on products, services and within collaborative value networks positively affects the likelihood of a company reporting a turnover increase. RFID-enabled companies can achieve on average a 12-18 month competitive advantage depending on the implementation scale, as demonstrated, for example, with the RFID projects conducted by the METRO Group, Royal Ahold, and NYK Logistics.*

***The adoption of RFID impacts workforce composition.*** *About 30% of companies already using RFID have experienced some workforce reductions. In turn, workforce reductions in RFID-enabled departments are often compensated by a reallocation of the workforce to other business functions. A minority of enterprises created new technical (22%) or business process oriented (18%) jobs. Although it is difficult to assess whether an increasing use of RFID creates or destroys jobs, it may be deduced from empirical evidence that high and medium-skilled labour is required to maximise the impact of RFID implementation.*

***Outlook for further developments.*** *Technological innovation will lead to greater integration of RFID with other technologies, real-time locating systems (RTLS), and business intelligence platforms. This may enable innovations such as the self-service totally automated store. Trends towards embedding RFID in products - such as contactless cards - and incorporation of RFID into product packaging to facilitate recycling can also be envisaged.*

### 3.1.1 Context and background

SCOPE OF THE STUDY

This section summarises the Sectoral e-Business Watch study on Radio Frequency Identification (RFID) activities in the manufacturing, transportation, healthcare and retail industries. Radio Frequency Identification is mostly used for identifying people, objects, transactions or events through a wireless communication connection. The objectives of the study are to describe how companies in these industries use RFID for conducting business, to assess impacts of this development for companies and for the industry as a whole, and to indicate possible implications for policy. Findings presented in this report are based on literature, expert interviews, case studies and the results of an international survey of enterprises on their RFID usage conducted by the SeBW in August and September 2007 in seven European countries.

RFID TRENDS AND CHALLENGES

RFID is an automatic identification and data capture method (AIDC) which not only helps to identify, but also to collect data attributes about, a certain object or person, including localisation and environmental measurements when integrated with sensor networks. The development of RFID technology emerges as one of the most interesting innovations for the improvement of business process efficiency across the manufacturing, transportation & logistics, wholesale distribution and retail trade sectors. This is because RFID systems offer enterprises an advanced method of gathering and processing business data in real-time. RFID is becoming a real opportunity to drive business process re-engineering and business model re-thinking through a systematic usage of RFID-collected data in specific-use case scenarios.
From commercial and public sectors to medicine and education, enterprises can process, collect and analyse information faster, with greater accuracy and more efficiently compared to traditional data collection methods, including barcode scanning. For example RFID can reduce the amount of time to receive products at a warehouse, by automatically reading RFID tagged incoming units at a dock door portal. Electronic proof of delivery enabled by RFID typically reduces errors in logistics and distributive trades. Asset management, products, components and pallets visibility along production stages and supply chains are key benefits resulting from RFID adoption.

RFID will run in parallel to barcodes for many years. However, it is worth noticing that RFID-based systems enable concrete operational advantages compared to barcodes. While barcode scanning is a manually assisted process, RFID scanning is fully automatic, providing higher process efficiency.

Key challenges arising from RFID implementation include:

- **Interoperability and standardisation: the importance of a global standard for RFID.** The importance of a single frequency band allocation for RFID applications by type and geography is a fundamental milestone in order to enable widespread usage of this technology. This single frequency allocation can result in easier interoperability of RFID solutions among different technology vendors. A global standard for RFID is also expected to reduce the implementation costs for RFID projects. In addition, due to the long-term nature of RFID projects (e.g. RFID deployments can typically operate for more than 10 years), the availability of a global frequency standard helps organisations in minimizing investment risks, taking into consideration the actual limitation of radio communication bandwidths and the emergence of new wireless technologies and mobile application scenarios.
- **Return On Investment – The challenge of creating the business case.** Financial justification for RFID implementation always faces uncertainty about the project's success. Because there is no universal ROI calculator available for companies exploring RFID projects, the process to apply consists of understanding end-users' expectations, analysing successful and unsuccessful experiences and applying relevant sector variations on best estimate ROI. Overall, the design of RFID projects requires the assessment of specific use case scenarios, including product or application categories, financial cost/benefit analysis, business processes challenges and opportunities (both internal and with external value chain partners), IT challenges and opportunities (for example data sync, integration, middleware strategies, analytics), RFID and sensor technologies scenarios.
- **Value chain collaboration and RFID.** Excellence in value chain collaboration is found to be a recurring theme in the consumer products manufacturing and distributive trade indus-

tries. Collaborative excellence is a crucial factor for extending supply chain efficiencies as well as for making sure the highest possible returns are made on the RFID investment. Pursuing the implementation of advance shipping notices (ASN), Demand Driven Supply Network models, collaborative ordering and replenishments, Global Data Synchronisation (GDS) and EDI (Electronic Data Interchange) initiatives have the potential to improve the business case for EPC/RFID or to make adoption worth the effort.

- **RFID concerns on security, privacy and health risks.** With the current level of information and scientific understanding on potential health risks associated with the use of RFID, it appears that exposure below recommended levels poses no health risks. Security in data sharing, exchange of information and data protection are concerns held by companies looking at investing in RFID. Privacy is the principal concern among consumers and citizens. However, the extremely short communication range available with passive UHF RFID tags limits privacy concerns by design. It is fundamental that enterprises must ensure consistent, open and repeated communication to end-users on privacy policies. Offering extra rewards to loyal customers is a possible remedy to counteract consumers' concerns over potential misuse of personal information.

RFID implementation has begun in the retail, transportation, manufacturing and healthcare sectors with the applications scenario summarised in Exhibit 3.1-1.

### *3.1.2 Deployment of RFID solutions*

This chapter provides insights into current trends of RFID usage in the sector analysed by the SeBW RFID survey. The survey was conducted in seven European countries (France, Germany, Ireland, Italy, Poland, Spain, and the UK) among more than 434 companies in the transportation, retail distributions, manufacturing, and hospital sectors. To provide an assessment of adoption dynamics, IDC survey data on RFID adoption in 2006 are also provided.

#### RFID ADOPTION TRENDS

Enterprises' expectations have shifted towards a perspective driven by the optimisation of process execution. The approach towards RFID implementation is more of a business journey than a complex technology project. An increasing number of European companies are nowadays either piloting or implementing RFID, because the development of industry standards, best practices and technological advances has generated greater confidence in the way RFID can strategically make possible productivity gains and business process efficiency improvements.

As of 2006, 18% of companies already implemented or piloted RFID across the manufacturing, transportation and retail sectors in the top five European countries (Germany, France, Italy, Spain and UK) (Source: IDC European Vertical Market Survey, 2007). Manufacturing and logistics were the two sectors with the highest adoption levels, at about 20%. In turn, RFID adoption was lagging behind in the retail sector, with 13% of organisations that had already implemented or piloted RFID. In 2007, according to the survey conducted by the Sectoral e-Business Watch, 24% of enterprises (by their share of employment) were using, piloting or implementing RFID, with the percentage of pilots being much smaller than implementation or regular business usage (see Exhibit 3.1-2).

Among business sectors, transportation is currently the leading sector for RFID use in business. Retail is the leading sector that already implements RFID in their regular business processes. The highest percentage of pilots and ongoing implementation was reported in manufacturing. Hospital activities lag behind on the RFID adoption. In addition, adoption of RFID is currently driven by large companies with more than 1,000 employees across the sectors covered. (see Exhibit 3.1-2) However, RFID can also be useful for companies with fewer than 1,000 employees.

Respondents from Italy showed the highest percentage of companies adopting RFID. The highest percentage of pilots was found in France. The majority of respondents indicated that RFID was used for inventory management, while nearly half the respondents showed usage or intended use of RFID for labelling single product items (see Exhibit 3.1-3). Other key application areas include person identification, production tracking and container or pallet tracking.

Enterprises mostly see the benefit of using RFID to improve supply chain execution effectiveness, with the objective of increasing supply chain productivity, reducing logistics costs and, based on improved

*Exhibit 3.1-1: RFID Applications Trends by Industry*

| Industry | RFID Application | References |
|---|---|---|
| **Retail** | • Cold/perishable goods chain management<br>• Supply chain pallet/case tracking<br>• Warehouse workflow (goods receiving, allocation, picking, store deliveries)<br>• Product recall management<br>• Item tracking (clothing, books, high-value items)<br>• Reducing out-of-stocks/improving replenishment efficiencies | METRO Group<br>Tesco<br>M&S<br>BGN<br>WalMart<br>Auchan |
| **Logistics** | • Returnable assets tracking<br>• Freight tracking | DHL<br>Europool Systems<br>NYK Logistics |
| **Manufacturing** | • Production process efficiency and quality management<br>• Product authenticity<br>• Distribution centre: order picking<br>• Inventory reduction<br>• Cold/perishable goods chain management<br>• Product lifecycle management | Nestlè<br>Procter & Gamble<br>Kraft Foods |
| **Aviation** | • Mobile assets tracking (trolleys, in-flight and airport assets)<br>• Cargo tracking<br>• Baggage tracking<br>• Maintenance (aircraft parts identification & location tracking) | Amsterdam Schiphol<br>Hong Kong airport<br>Airbus<br>Boeing |
| **Pharma & hospitals** | • Drugs authenticity<br>• Medical equipment tracking<br>• Patient identification<br>• Medical samples tracking (for example blood transfusion safety) | Istituto dei Tumori<br>Purdue Pharma |
| **Automotive** | • Yard management/cars real-time location<br>• Manufacturing quality control<br>• Work In process / just-in-time vehicle assembly<br>• Supply chain/logistics optimisation<br>• Spare parts management | Honda<br>Land Rover |
| **Postal** | • Process monitoring (quality of service, envelopes tracking)<br>• Sorting<br>• Roll-cages asset management<br>• Parcel tracking (long-term) | DHL<br>UPS<br>Correos<br>Royal Mail |
| **Railways/public transportation** | • Returnable assets tracking<br>• Maintenance<br>• Mobile payment (multi-mode transportation and other passenger services) | |
| **Other/cross-industry** | • Animal feeds tracking<br>• Defence (logistics, high-value item tracking<br>• Document tracking<br>• IT assets tracking<br>• Person identification | US DoD<br>Motol Hospital |

Source: Global Retail Insights, an IDC Company, 2008 execution abilities, gaining the ability to optimise supply chain planning at a later stage. This finding is confirmed by case studies conducted with METRO Group and Land Rover (see p. 174 and p. 175).

As of 2007, SeBW survey results show that about 3% of respondents had concrete plans to implement or pilot RFID in 2008, with 19% of respondents adopting a waiting position towards adoption of RFID, and about 9% of respondents reporting that they will not use RFID in the next 3-4 years. No plans for RFID is the answer from most respondents.

RFID is expected to grow rapidly in the EU-7 over the next 5 years, according to the 2007 RFID SeBW survey results. On average, an annual growth of approximately 27% in the number of enterprises adopting RFID is estimated during the period 2007-2009. By 2011, it is estimated that approximately 44% of enterprises will have implemented RFID, and potentially, by 2012 half of EU-7 enterprises may have done so. In conclusion, a cautious assumption is that RFID may become mainstream over the next 5-10 years. Evidence suggests that RFID adoption will grow significantly within the next five years.

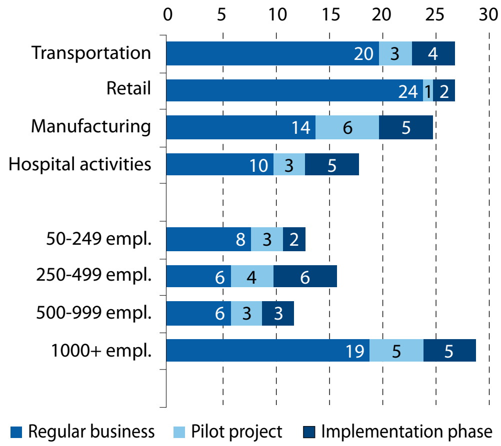
### KEY BUSINESS OBJECTIVES DRIVING RFID ADOPTION

Key drivers for RFID adoption are mostly focused around cost reductions and productivity improvement opportunities along the supply chain, as well as the potential to increase quality of service, to achieve regulatory compliance, and to decrease time-to-market and downtime. Although companies across business sectors indicated different business objectives driving RFID adoption, there exists a common thread of motivations driving small, medium and large companies to evaluate RFID deployments.

According to the survey, improving product and service safety or authenticity and improving product track-and-trace capabilities are two business objectives that are mostly indicated by companies either already using RFID or planning to do so (see Exhibit 3.1-4).

The supply chain is the principal area of focus for RFID applications because automation and real-time detection allow improvements in inbound logistics efficiencies, inventory management accuracy and responsiveness, distribution centre efficiency and loss prevention capabilities. The main applications of RFID

***Exhibit 3.1-2: RFID adoption status by sector and company size (in % of respondents)***




The survey was conducted in 7 EU countries (DE, FR, IE, IT, ES, PL, UK)

Base (100%) = all companies.

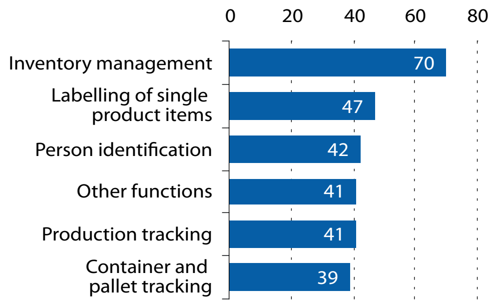
N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 434

Weighting: Figures for sector totals are weighted by employment ("companies representing x% of employment in the sector / country"), figures for size-bands in % of companies.

Source: e-Business Survey 2007 by the SeBW

***Exhibit 3.1-3: RFID application areas by current adopter (in % of respondents)***

**Q. For which of the following purposes does your company use or pilot RFID?**




The survey was conducted in seven EU countries (DE, FR, IE, IT, ES, PL, UK)

Base (100%) = All companies using RFID

N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 75

Questionnaire references = B1

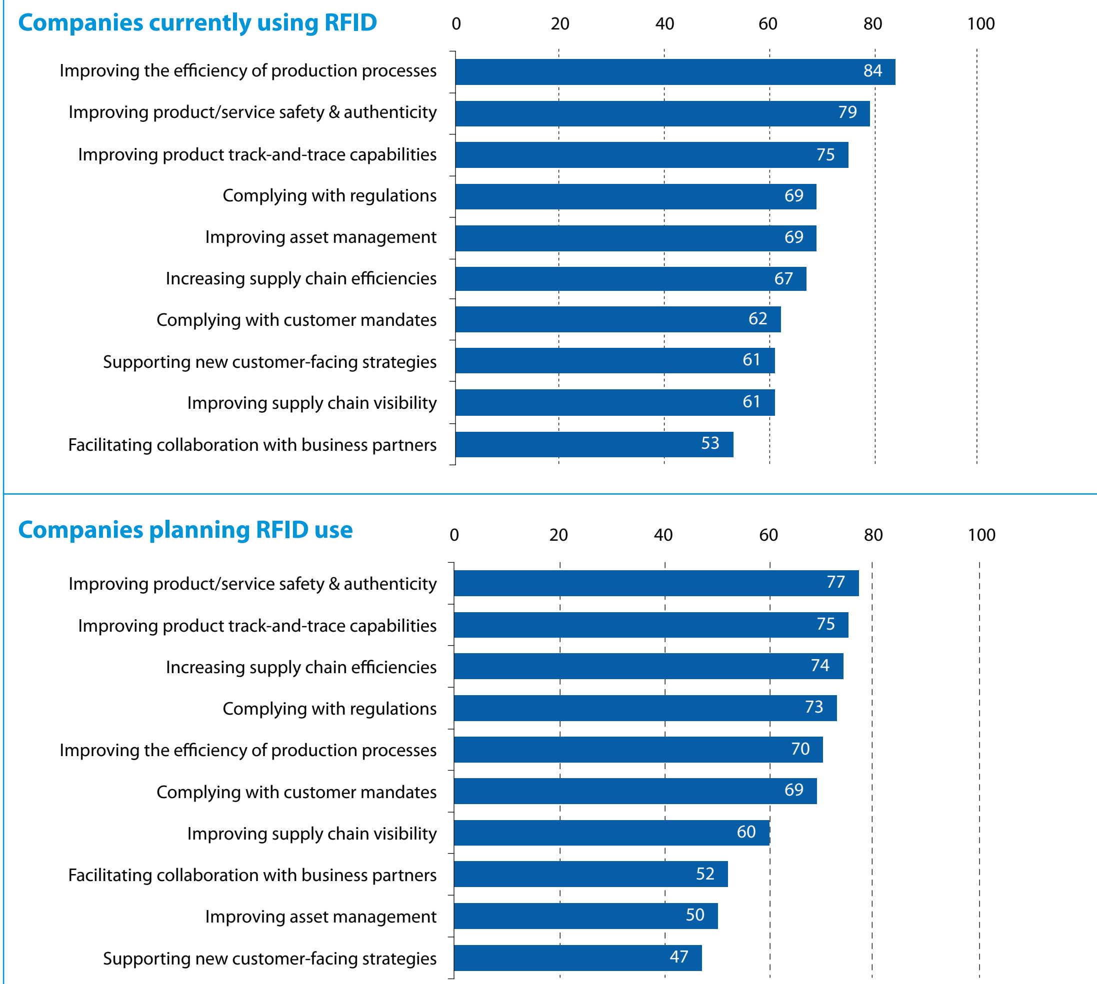
Source: e-Business Survey 2007 by the SeBW

are inventory management (70% of respondents), labelling single product items (47% of respondents), container or pallet tracking, and person identification and production tracking. In summary, the principal motivations to implement RFID are:

- **Improving product and service safety or authenticity** – Product authenticity optimisation can be a reality for manufacturers compared to the current situation where counterfeiting and diversion continue to cause considerable

*Exhibit 3.1-4: Key business objectives driving RFID adoption (in % of respondents)*

**Q. What are the key business objectives that will determine RFID adoption decisions and investments in your company?**




Base (100%) = All companies using RFID.

N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 75

The survey was conducted in 7 EU countries (DE, FR, IE, IT, ES, PL, UK)

Questionnaire references = B3

Source: e-Business Survey 2007 by the SeBW

Base (100%) = All companies planning to use RFID.

N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 81

The survey was conducted in 7 EU countries (DE, FR, IE, IT, ES, PL, UK)

Questionnaire references = B3

Source: e-Business Survey 2007 by the SeBW

**Case Study: RFID in retail supply chain and store at METRO Group, Germany**

*METRO Group is among the biggest retailers in Germany. It operates through more than 2,400 stores in 31 countries in Europe, Africa, and Asia. To achieve higher productivity of logistics and supply chains, to optimise inventory levels and to minimise stock losses, METRO Group has implemented RFID in its supply chain and for an item-level field trial. RFID implementation in the supply chain was initiated in November 2004 with a gradual and systemic approach. The item-level field trial was started by METRO Group at Galeria Kaufhof Essen in September 2007. For this trial, the Galeria is also equipped with RFID gates, RFID enabled checkout desks, mobile RFID readers, and RFID-enabled business intelligence applications. METRO Group indicated that RFID implementation improves supply process efficiencies, reduces loss/theft shrinkage and improves sales and customer services. Among the lessons learned, it has emerged that retailers using RFID in supply chain operations could achieve a competitive advantage of 8-12 months.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

loss and brand reputation damage. This applies especially to high-value items where the cost of RFID tags represents a negligible percentage of the total product cost. This finding is confirmed by case studies conducted for this study. The example of Schuitema (see case study) shows how RFID is used for managing the supply chain of perishable goods.

- **Enabling faster operational turnarounds and improving the efficiency of production processes**. Positive business case opportunities exist for RFID applications in operationally complex sectors. Early adopters of RFID reported reductions in production cycle times and improvements in production line efficiencies (Hewlett Packard - see case study on p. 177, Honda, and Futura Systems), and productivity enhancements and improved reconciliation efficiencies with customers (NY Logistics, DHL, and Europool System). In the healthcare sector, as illustrated by the Istituto dei Tumori case study (see p. 176), ensuring blood transfusion safety to patients was a major achievement resulting from RFID adoption.
- **Improving product track-and-trace capabilities in compliance with regulations,** for example European regulations on consumer products tracking & tracing, Restriction on Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE).
- **Increasing supply chain efficiency, visibility and predictability.** Warehouse and logistics productivity improvements emerge as the major supply chain goal in the short term.

### Case Study: RFID for vehicle tracking at Land Rover, UK

*Land Rover has produced four-wheel drive vehicles since 1949, progressing from utilitarian to premium vehicles. Today, the company's most widely recognized vehicle is the luxury utility vehicle with a starting price of more than €60,000. Land Rover started the first RFID project in 2002, focusing on material replenishment. In 2006, production managers approached Land Rover's IT organisation asking for a way to better manage work-in-progress inventory and track vehicles as they come off the assembly line and are prepared for delivery to the dealers. The implementation went live in January 2007, and Land Rover estimates it is receiving a return on its investment in less than a year.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

### Case Study: RFID in the supply and distribution process at Schuitema, The Netherlands

*Schuitema is a goods and service delivery provider in the Netherlands for 450 local supermarkets operating under the C1000 brand. As a distribution company, Schuitema faces challenges to reduce the quantity of decayed goods, and to decrease product loss and out-of-stocks. The company chose its Breda Distribution Centre for the RFID pilot implementation. The pilot involved other key players along the supply and distribution chain, including one of its suppliers, W. Heemsherk, and one of its end-users, a C1000 supermarket. The main IT vendor leading the pilot RFID deployment was Cap Gemini. The so called Fresh Link project began in May 2005 and took two years to complete. The pilot project ended in May/June 2007 and Schuitema has now started to develop a business case to involve all its suppliers, distribution centres and end-user C1000 supermarkets. Schuitema expects ROI for the implementation in 2.7 years. Furthermore, Schuitema experienced improvements in alerting functionality, transparency, and optimisation in production.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

- **Improving asset management efficiencies.** Due to the faster operational turnarounds and higher process visibility that RFID allows, there is an opportunity to increase asset utilisation rates, especially for mobile assets and returnable assets that are currently subject to uncertainty over their locations. For example, Netherlands-based Europool, which rents out transport packaging goods such as containers and crates, implemented RFID to cut wastage of asset value caused by crates being left around un-utilised. Prior to RFID implementation, Europool used to experience frequent delays in the return of crates from customers. Now, with the RFID tracking system in place, Europool has achieved visibility in its distribution & logistics process, and can rapidly react so as to maximise utilisation of crates and to ensure a smooth reconciliation process with customers.

### RFID AND SMES

Large companies drive adoption of RFID. However, RFID can also be relevant for medium-sized companies in the range of 50-499 employees. The main study findings related to the RFID usage by companies of this size are:

- Person identification and inventory management emerge as the most important application areas.
- Limited financial resources and small project scale largely hamper SMEs' capability to label single items with RFID.
- Container and pallet tracking applications seem more beneficial for medium organisations.
- Improving product and service safety or authenticity, improving asset management, and improving the efficiency of production processes are the most important business reasons for small enterprises (50-249 employees).
- Complying with customer mandates, complying with regulation, and improving product and service safety or authenticity are the top business reasons for medium-sized enterprises (250-499 employees).

The optimisation of core business processes plays a fundamental role for SMEs to take advantage of RFID. In turn, high project costs represent a major challenge for smaller companies. Moreover, managed RFID services may be an interesting opportunity for SMEs to implement RFID without incurring prohibitive start-up costs and high project risks.

Among SMEs that have already adopted RFID, person identification and inventory management are indicated as the most important application areas. The importance of inventory management is also indicated by SMEs that plan to adopt RFID. In addition, as indicated by small and medium enterprises that already use RFID, the most important business reasons driving RFID adoption are: improving product and service safety or authenticity, improving asset management, and improving the efficiency of production processes. Furthermore, among SMEs that have already adopted RFID, benefits are indicated on efficiency of inbound logistics operations, and optimised merchandise management.

**Case Study: RFID for patient safety at Istituto dei Tumori, Italy**

*The Fondazione IRCCS Istituto Nazionale dei Tumori in Milan is recognized nationwide as a centre of excellence in cancer care and research. In addition to conducting research, the institute admits approximately 14,000 acute-care patients and about 12,000 day-patients every year. The initiative of RFID implementation at the blood bank aimed to address two major points: patient safety and the lack of audit of the transfusion process. In 2005, the ICT department launched a pilot for the implementation of RFID solutions at the blood bank. The pilot yielded the expected results in terms of traceability of transfusions, thus increasing patient safety, saving time usually spent tracking blood bags, and enhancing compliance with auditing processes. Because of the excellent results, the institute received a new round of funding from the regional government to extend the solution to the entire transfusion cycle. It will evaluate the applicability to tissue banks and will collaborate with other hospitals in Milan which the regional government is pushing to adopt the same model.*

## Case Study: RFID in the manufacturing process at Hewlett-Packard, Brazil

*HP is a major worldwide player in the information technology market, with its products and services including personal computers, servers, printers, digital photography, storage, managed services, and software. HP implemented RFID in its printer operations in Sao Paulo, Brazil, including manufacturing and finished goods packaging, and the management of distribution and service centres. HP began exploring RFID as early as 2002, focusing on the use of RFID tags at the case and pallet level. It then recognized that the technology deserved greater attention for the benefits it could bring internally, and which could possibly evolve into products and services HP could market to other companies. In 2004, when the company decided to expand RFID to the item level, it chose its Sao Paulo Brazil facility, where it could integrate RFID into an end-to-end supply chain spanning manufacturing, distribution, repair, reverse logistics, and recycling. Today, HP is using RFID for greater visibility and automation of manufacturing and supply chain processes, changing the way it operates internally, and the way it collaborates with its partners.*

SMEs that plan to adopt RFID expect that RFID can improve inventory management and efficiency of inbound logistics operations.

KEY BARRIERS TO RFID ADOPTION

Among the key barriers to RFID adoption, EU-7 enterprises are mostly concerned about the following:

- **ROI is the major barrier to RFID implementation, for companies of all sizes, but mostly for small companies.** ROI concerns are also the result of high technology costs that are perceived by the majority of survey respondents.
- **Interoperability concerns represent a key barrier to RFID adoption.** Interoperability is a key concern especially for large enterprises.
- **Complexity of implementation and IT integration also emerge as a relevant barrier to RFID adoption.** RFID implementation and IT integration complexity is hampering RFID adoption, especially for medium companies with 250-499 employees.
- **Privacy** (mostly for hospitals) and security concerns (mostly for transportation companies and hospitals) are perceived as key barriers to RFID by only 1 out of 3 organisations.
- In turn, the lack of technical expertise and skilled workforce in-house does not represent a key barrier to RFID and insufficient market acceptance does not appear as a key reason to stop RFID implementations in the retail sector.

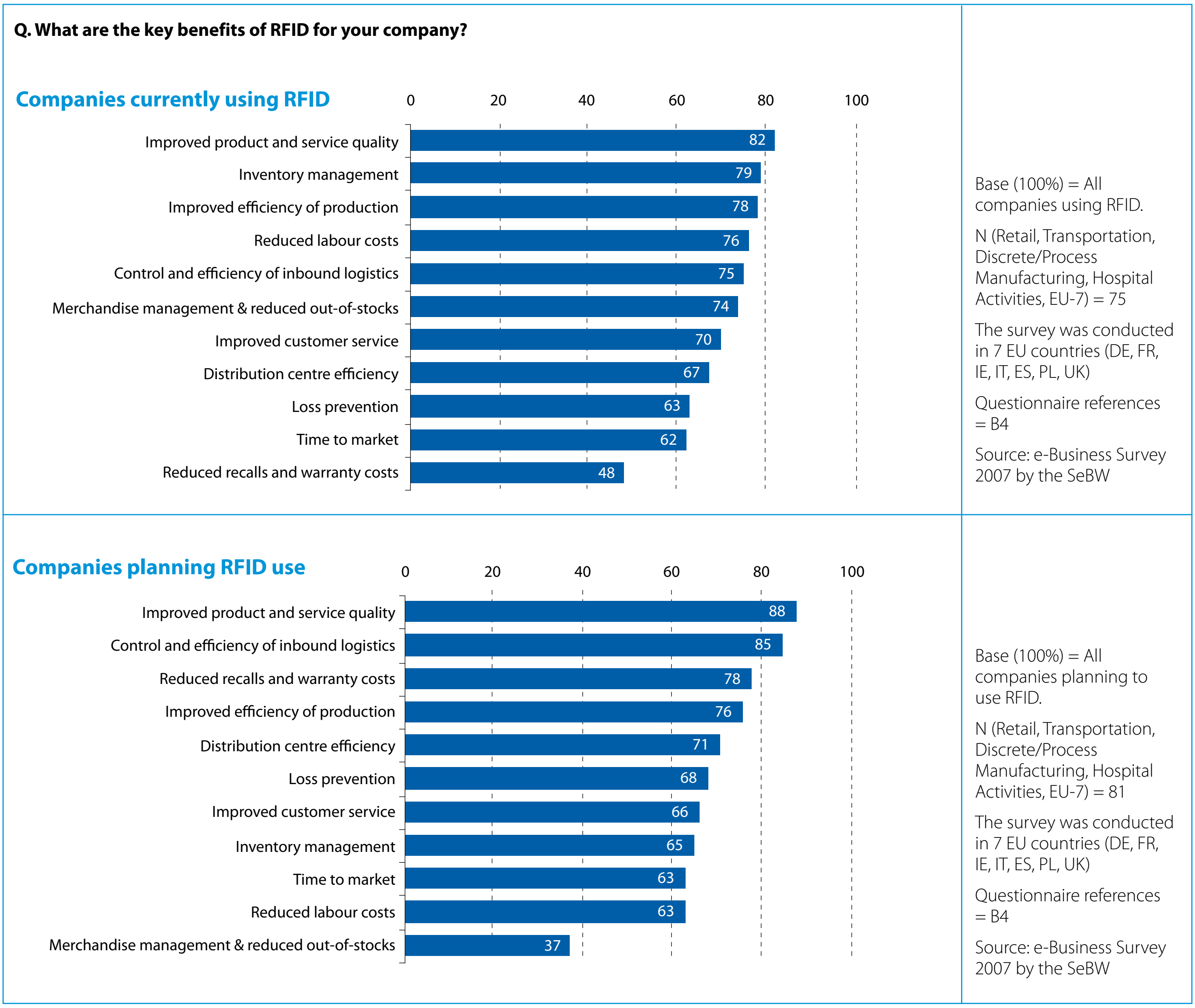
### *3.1.3 RFID benefits and business impact*

The key finding of the impact analysis, based on empirical evidence, is that the integration of RFID can enable labour and total factor productivity growth as well as innovation in the way enterprises conduct business. Specifically, RFID-enabled innovative activity on products, services, and within collaborative value networks positively affects the likelihood of a company reporting a turnover increase. As a result, the average payback period for RFID investments is estimated at 2-3 years, based on an average lifetime of 10 years for RFID implementations.

Moreover, RFID improves the transparency and "measurability" of business processes. This offers a huge potential to improve business intelligence capabilities and support to decision-makers. The available data enable a company to earlier sense business issues and to react more timely and effective to changing market dynamics.

Around 80% of respondents indicated improved product and service quality and inventory management enhancements as the key benefits of RFID (see Exhibit 3.1-5). Survey results also confirm that improved efficiency of production, reduced labour costs and optimised control and efficiency of inbound logistics can result from the integration of RFID, as discussed in Section 1.1.2.

*Exhibit 3.1-5: RFID benefits for enterprises (in % of respondents)*




However, it is important to note the following:

- Actual productivity improvements that are obtainable by enterprises depend upon a number of variables that are specific to the actual use case scenario. A phased implementation approach seems the most viable solution to enable quick ROI opportunities (e.g. 12-36 months) while ensuring the long-term strategic goals.
- The major cost component of the total value of an RFID project seems to be the cost of project implementation, system integration and business process re-engineering. The cost of RFID tags and readers is the second major component of the total investment, and software costs come third.
- Although the impact of RFID investments cannot be instantaneous, efficiency improvements are typically achievable in a relatively short time compared to other ICT investments.
- RFID-enabled innovations are correlated with company size. As opposed to large-scale enterprise implementation scenarios, RFID applications by SMEs tend to focus on enabling productivity improvements that have a positive business impact in the short-term.
- RFID has some skill-bias towards high- and medium-skilled labour. However, in some areas, the implementation of the technology does not change the labour process significantly (for example warehouse order picking).

IMPACT ON PRODUCTIVITY AND INNOVATION

The study concludes that RFID enables **innovation in collaborative value networks**, thus driving process efficiency for large enterprises. RFID automates the process of exchanging information between enterprises and optimises its accuracy. Moreover, RFID can drive new value creation through enabling **innovative business models**. More specifically, the study has explored the impact of RFID in the following sectors:

**Retail.** In the retail sector, the business process applications that allow the most relevant improvements are: cold/perishable goods chain management, supply chain pallet/case tracking, warehouse workflow (goods receiving, allocation, picking, store deliveries), product recall management, item tracking (clothing, books, high-value items), reducing out-of-stocks, returnable assets tracking, and freight tracking. Proven benefits are:

- 12-17% overall improvements in supply chain process efficiencies (METRO Group)
- Loss/theft shrinkage of 11-18% (METRO Group)
- Reduced spoilage of perishable goods (Schuitema)
- Electronic dispatch note: savings of up to €2.84 per note (METRO Group)
- 13% reductions of inaccurate understated perpetual inventory (WalMart)
- 10-60% reductions in out-of-stock situations (METRO Group, WalMart)
- Real-time supply chain visibility (Schuitema; HP)

**Hospital activities.** The business process applications that allow the most relevant improvements in healthcare are: drugs authenticity, medical equipment tracking, patient identification, and medical samples tracking (for example blood transfusion safety). Proven benefits include:

- Up to 100% reductions in transfusion errors (Istituto dei Tumori)
- Up to 90% reductions of FTEs assigned to inventory tracking activities (Motol Hospital and University Medical Center Tucson, Arizona)
- Wyane Memorial Hospital saved over USD 300,000 by reducing orders for infusion pumps

**Manufacturing.** The business process applications that may allow the most relevant improvements in manufacturing are: production process efficiency and quality management, product authenticity, distribution centre and order picking, inventory reduction, cold/perishable goods chain management and product lifecycle management. Proven benefits include:

- 15-20 seconds per pallet saved in order picking & pallet receiving (Gillette)
- Up to 20% improvement in WIP (HP)
- 20-25% improvement in production cycle times (HP and Honda)
- 28% reductions in inventory levels (HP)
- 90% reductions of inventory tracking Full Time Equivalents (FTE) (Futura Systems)
- 83% reductions in shipping errors (Futura Systems)

**Transportation.** The main business process applications are: mobile assets tracking (trolleys, in-flight and airport assets), cargo tracking, baggage tracking, maintenance management, returnable assets tracking, and mobile payment in the context of multimode transportation and passenger services. Proven benefits include:

- 17% productivity increase in airline baggage handling (Hong Kong airport – see case study on p. 180)
- Improved mobile assets visibility & utilisation rates (EuroPool systems)
- 90% improvement in reliability of delivery time windows (Dow Chemical Company, NYK Logistics)

IMPACT ON EMPLOYMENT AND WORKFORCE COMPOSITION

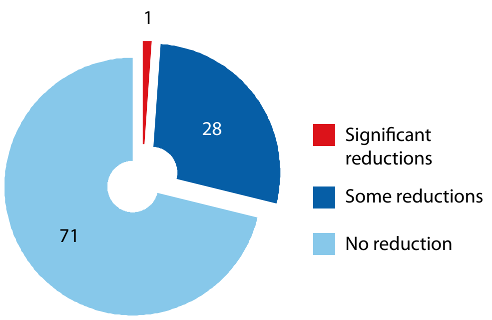
About 30% of companies already using RFID have experienced some workforce reductions. Companies piloting or planning to use RFID expect slightly higher reductions. According to surveyed companies already using RFID in their regular operations, less than 1% of respondents have significantly reduced their workforce, but 28% of respondents made some workforce reductions (see Exhibit 3.1-6). Expectations of companies piloting or planning to use RFID in the near future are slightly higher, as indicated by 32% of companies that are expecting some workforce reductions and 4% of respondents expecting significant reductions of their workforce. Workforce reductions generally derive from automated processes replacing manual processes that required human intervention. Furthermore, workforce reductions in RFID-enabled departments are often compensated for by a reallocation of the workforce to other business functions, for example quality management.

**Case Study: Airline baggage handling at Hong Kong international Airport**

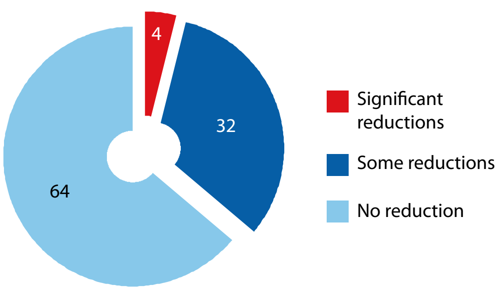
*Hong Kong International Airport (HKIA), also named Chek Lap Kok, has a very short history dating back to 1998 when it started its commercial operations. HKIA is the main airport in Hong Kong and a relevant regional trans-shipment centre, passenger hub, and gateway for destinations and transit in China, East Asia, and South-east Asia. Currently, around 75 airlines carry passengers to more than 150 destinations through 96 gates and around 700 flights per day. The implementation of RFID took place at its baggage handling area, paralleling an existing bar code system. The goals of the project included reducing manpower costs and short ship rates as well as baggage processing and transfer, in order to improve connection times. Symbol Technologies installed HKIA's RFID system, but many other IT vendors were involved, including SITA, Matrics Inc, Marubeni Corp, EMSD Corp and Lyngsoe Systems. RFID rolled out in 2005, without any previous pilot project, and full implementation is expected for January 2008. According to HKIA, the airport is experiencing productivity increases in: luggage sorting capacity, reduced manual labour, and increased passenger security.*

***Exhibit 3.1-6: Effects of RFID implementation on workforce reduction (in % of respondents)***

**Q. Has RFID implementation enabled your company to reduce the workforce?**




**Q. Do you think that there will be workforce reductions due to RFID in the future?**




The survey was conducted in 7 EU countries (DE, FR, IE, IT, ES, PL, UK).

Base (100%) = All companies using RFID for regular business. N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 44

Questionnaire references = B14 & B15

Source: e-Business Survey 2007 by the SeBW

Although it is difficult to assess whether an increasing use of RFID creates or destroys jobs, it may be deduced from empirical evidence that high and medium-skilled labour is required to maximise the impact of RFID implementations on productivity, both demand-side (e.g. within end-user organisations) and output-side (e.g. within technology vendor organisations). For example, 22% of respondents already using RFID have hired new personnel with RFID-specific technical skills and 15% of respondents are considering the recruitment of new personnel with such skills. In addition, 18% of respondents have already hired new personnel with specific expertise in business processes in RFID-enabled environments and 13% are considering hiring new personnel with such skills.

The impact of RFID on work organisations is also demonstrated by the fact that the majority of respondents (53%) developed training programs to re-qualify in-house personnel, while some 23% of respondents are considering the development of such a training programme in the future.

### RFID ROI

Return on Investment (ROI) is the single most important decision criteria to justify financial investments on RFID, and RFID ROI concerns represent the most important barrier to RFID adoption. Analysing RFID ROI should start by assessing the costs for RFID investment. RFID costs are divided into one-time start-up costs and variable expenses. Start-up costs comprise expenses for consulting and planning, hardware, software, system integration, process functional changes, an internal RFID programme team, EPC-global subscription fee (in the case of EPC-compliant applications), user training, and system documentation. Variable expenses include the cost of RFID tags and their attachments (including variable material costs and labour costs), annual system maintenance (typically 10-15% of the initial capital investment) and expenses related to the usage of RFID-collected data and reaction processes.

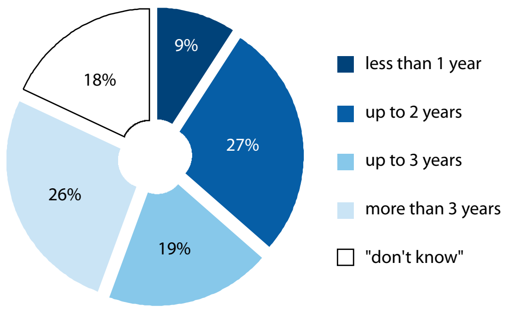
RFID will produce a long term ROI. Based on the analysis of case studies illustrated in Section 5 and on advisory board discussions, an average lifetime of at least 10 years emerges for RFID implementations. To enable quicker ROI opportunities, companies must evaluate their investments using a phased implementation approach. A practical and essential guideline to drive successful RFID programmes is the following:

- Initial creation of the business case, based on optimisation of identification
- Focusing business process optimisation efforts on the 5 to 10 most beneficial processes or product applications where RFID can make a significant impact on productivity and business performance
- Estimating the financial impact and payback period - capital budgeting methods such as Net Present Value (NPV) can provide more accurate estimates of the profitability of RFID investments. The theory of real options is an emerging alternative method to NPV.
- Ensuring that the identified business process optimisations are aligned with overall business strategy
- Conservative investment assumptions: after taking the decision to invest in RFID, enterprises can allocate approximately 15% of their total IT budget to the new investment in order to minimise risks.

Exhibit 3.1-7 shows how companies that already use RFID in their business estimate the payback period of their RFID investments. More than half of respondents (55%) expect that the payback period of RFID investment will be fewer than three years, and among those companies, 9% of respondents indicated expected payback period of less than one year, and 27% up to two years. However, about one quarter of respondents (25%) expected payback period of over 3 years. Research available in literature and empirical evidence from case studies validate survey findings, with an average payback period for RFID investments between 2 to 3 years.

***Exhibit 3.1-7: Estimated payback period of RFID investment (in % of respondents)***

**Q. What is the estimated payback period of your RFID investment?**




The survey was conducted in 7 EU countries (DE, FR, IE, IT, ES, PL, UK)

Base (100%) = all companies using RFID.

N (Retail, Transportation, Discrete/Process Manufacturing, Hospital Activities, EU-7) = 75

Questionnaire references = A4

Source: e-Business Survey 2007 by the SeBW

## 3.1.4 Outlook

Supply chain performance improvement is expected to remain the principal area of focus for future RFID implementations. However, the focus of RFID implementations is expected to move gradually from operational execution activities to the optimisation of business planning and intelligence capabilities. By applying RFID on value-creating processes, enterprises will most likely be able to achieve higher business predictability and reduced wastage, which in turn may spur productivity growth and innovation. Furthermore, extending supply chain visibility and performance objectives to the edges will be instrumental to maximise RFID ROI. Therefore, the recommendation is to move gradually from a closed-loop implementation scenario to include the extended boundaries. In the next three to five years, a significant trend towards using RFID to enable promotion effectiveness and real consumer value is expected in the retail and consumer product goods industries. In turn, product pedigree applications of RFID seem particularly relevant in the pharmaceutical industry and in high-value goods manufacturing (including aircraft, automotive, consumer electronics, fashion and luxury goods manufacturing).

The long term scenario in which RFID has become mainstream could lead to a situation where any wireless-capable device will benefit from autonomous and unstructured communications capabilities based on meshed communication networks, RFID, digital sensors and other wireless technologies. Other potential future developments of RFID include the self-service totally automated store; incorporation of RFID directly into products' packaging to improve the efficiencies of recycling disposable packaging; contact-less payments enabling speedier transactions for customers and enterprises in high-traffic, low-value transactions, making the retail industry the ideal candidate for this application scenario following early adoption in passenger transportation.

### 3.1.5 Policy implications

In the light of the current policy context for RFID, and considering the key barriers to RFID, as well as the expected impact on enterprise productivity, innovation, employment and workforce composition, the following political activities are suggested to the European Commission, national, and regional governments as well as to European and national industry associations:

- **Supporting RFID skills development**, for example by promoting entrepreneurial and managerial understanding of RFID applications and related potential benefits as well as the need to improve skills to make best use of these applications; supporting skills developments for individual companies, typically by means of providing grants for RFID training; providing information about RFID training and support to related decision-making through the sharing of good practices for the implementation of RFID within a specific industry, but also taking into account lessons learned in other industries.
- **Developing a long-term regulatory framework for radio standards** (beyond a period of 10 years), as present standards tend to be too fragmented and valid only up to a 10 years horizon. This will support enterprises by safeguarding RFID investments over time, as the typical lifetime of an RFID implementation can be 10-15 years, as well as driving productivity improvements and innovation opportunities.
- **Environmental issues arising from mainstream adoption of RFID.** The number of RFID tags that may be deployed in the next few years in Europe will be in the billion-range. As a result, more policy implications are to be found around the environmental impact of RFID components. Related activities aimed at supporting efficient recycling measures for RFID hardware components could include: promoting RFID recycling process recommendations and guidelines; identification and enforcement of clear responsibilities for all value chain actors (e.g. technology manufacturers, end-user enterprises and citizens); promoting public awareness.
- **Focusing Research & Development activity on wireless, mesh-network communications protocols**. In the long term scenario, item-level RFID implementations will most likely be deployed, due to RFID-tags cost reductions resulting from economies of scale. This may eventually lead to a situation where any wireless-capable device –RFID, digital sensors, cellular phones and other wireless devices– may benefit from autonomous and unstructured communications capabilities based on mesh mobile communication networks. Given the unstructured and convergent nature of wireless communications, a mesh-network approach is envisaged, e.g. each device may operate as an active node of the network and not only as an end-terminal, thus extending network capacity and range in an autonomous and fully distributed manner. This scenario would require further developments of a light-weight, standard-based communications protocol which allows interoperable communications and exchange of information or services among different wireless devices, within the framework of IEEE 802.11 standards. As a result, the development of a standard wireless mesh-network communications protocol is suggested within the current R&D policy framework for radio frequency technologies.

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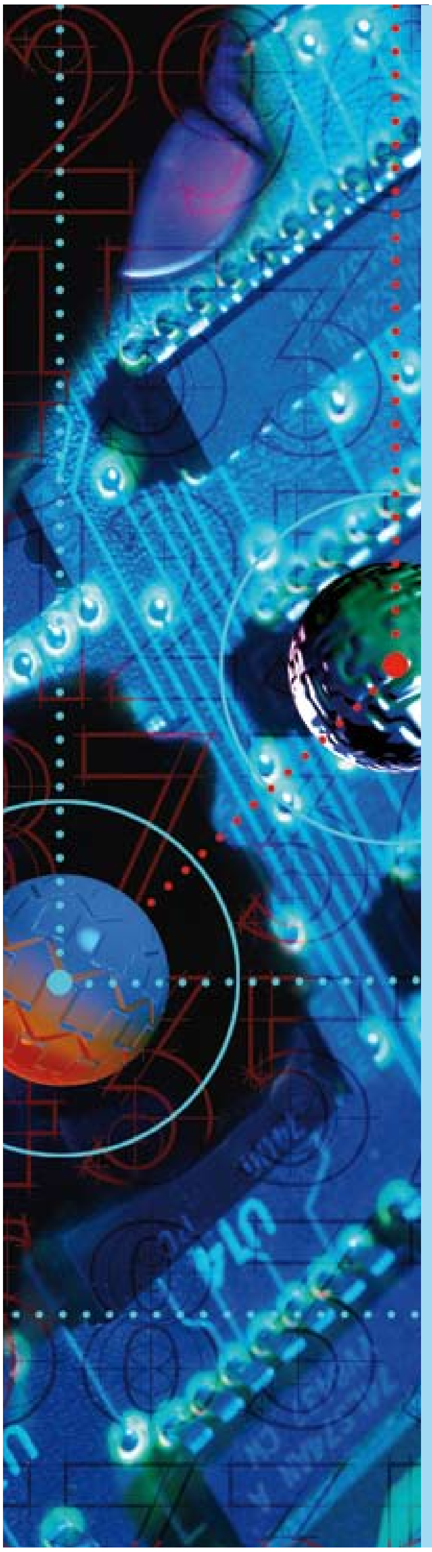
The study of the Sectoral e-Business Watch study on RFID activities was conducted by Ivano Ortis, EMEA Research Director, Global Retail Insights, an IDC Company. The study was supported by an Advisory Board, consisting of Andy Lee (Cisco), Antonio Lasi (Lombardia Informatica) and Jean-François Remy (HP). The study team would like to thank the Advisory Board members for their valued feed-back, contributions and recommendations. For more information about this study, please contact Ivano Ortis (***iortis@idc.com***).

# 3.2 IPR and competitiveness: challenges for ICT-producing SMEs

This study was conducted by Gabriella Cattaneo and Elena Vaciago of IDC EMEA Government Insights (***www.idc.com/Italy***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).



**Key findings**

***Intellectual property rights*** *(IPR) include copyrights, patents, trademarks and a number of other tools. IPR are widely recognised as a key driver of innovation in the ICT arena. ICT SMEs face greater barriers than large enterprises when adopting IPR because they have fewer resources and they lack specific expertise. IPR regulations are at the heart of some of the most heated competitive battles in the ICT industry. They apply to the existence and role of software patents, piracy and software counterfeiting, as well as the development of open standards. This study provides original evidence and data on the issue.*

***IPR adoption is increasing, but advanced users remain a minority.*** *ICT SMEs are increasingly adopting IPR, both formally and informally, and their IPR portfolios are more varied than what would usually be expected from SMEs. 29% of IPC users fall into the category of Low Profile Users, using only one - usually informal - type of IPR. 36% are considered as Mainstream IPR Users, as they adopt two or three different IPR tools (with copyright as the cornerstone of their IPR strategy). Only 23% can be described as Advanced IPR Users, boasting a portfolio of four to seven different IPR tools, including patents, copyright and other tools.*

***ICT SMEs use IPR for competitive advantage and innovation*** *to protect their research investments and defend their competitiveness in global supply chains. Many ICT SMEs have progressed beyond what the literature describes as the first stage of the IPR learning curve, that is, the purely defensive strategy. Many advanced ICT SMEs use IPR to attract investment capital, to exchange in cross-licensing agreements, to protect original knowledge within supply chains, business alliances and other networks, and to improve the company's image and competitive positioning.*

***The use of IPR is correlated with better business performance.*** *According to the survey data, IPR usage is positively correlated with turnover, market share and employment growth.*

***The impact of different types of IPR on competitiveness depends mainly on the firm's business model.*** *There are many emerging business models based on the generation and exploitation of IP where IPR are the source of revenues and of competitive advantage. Some of these are illustrated by the case studies in this report.*

***European ICT SMEs express no more than mild criticism of the IPR regulatory framework,*** *with many IPR users considering it "well-suited to their needs". The main criticisms come from patent holders, and relate to inefficiencies in the patent system, particularly costs and delays. However, all ICT SMEs say the system should be streamlined, with harmonisation between national and European regulation.*

***ICT SMEs live in a global digital "ecosystem" characterised by continuous innovation and built-in conflicts*** *where IPR may be and indeed are used as weapons as well as tools. The EU should take into account the legitimate concerns of smaller enterprises which fear being sidelined from the innovation development process because of aggressive IPR strategies by larger competitors.*

***The differing opinions on the software patents issue are entrenched.*** *Any resolution favourable to both sides is likely to be complex if it is to strike a delicate balance between the interests of all competitors.*

### 3.2.1 Context and background

SCOPE OF THE STUDY

This study analyses the use of intellectual property rights (IPR) by ICT SMEs. These enterprises are composed of fewer than 250 employees and are active in one of the three main segments of the ICT sector: ICT manufacturing, ICT services or software production. In total there are approximately 730,000 ICT SMEs in the EU25, which corresponds to about 4% of all European enterprises.[82] However, ICT SMEs deserve particular attention because of their significance for the dynamism and competitiveness of the European economy.

IPR are classified into two main groups: **formal** IPR (rights granted by the legal system) and **informal** IPR (where protection exists in practice but does not depend on a legal procedure). Firms may use both, in alternative or in complementary ways, to protect their know-how. This study assesses the role of both approaches for ICT SMEs, but focuses on formal IPR, and specifically on patents and copyrights.

TRENDS AND CHALLENGES

ICT SMEs must deal with increasing international competition, keep up with the pace of technological innovation, and adapt to the reorganisation of world supply chains. To do so, they must **develop original knowledge**, protect it and bring it to the market as fast as possible. Therefore they increasingly need to exploit the full range of formal and informal IPR tools, to help build and defend their competitiveness.

The development of the knowledge economy creates **greater demand for IPR tools**. The past two decades have seen a surge in patent applications and grants, particularly significant in knowledge-based industries such as ICT, biotechnology, nanotechnology or advanced chemicals. According to the EU's trademark agency, OHIM, registration demands for trademarks and industrial designs are also increasing rapidly. This is leading to the emergence of **new organisations engaged in the provision of services** for the use and exploitation of IPR, particularly patents (such as technology transfer offices, patent exchanges, IP market places, and patent value funds). These business models may be very important to support ICT SMEs in their use of IPR.

The main problems concern the **European Patent System**. The degree of harmonisation in the patent system is an influence on operating efficiency and quality. The European Commission believes that a single Community patent would be the most affordable and legally secure mechanism to reduce costs and improve effectiveness. It is promoting a compromise agreement on reform, based on the European Patent Litigation Agreement (EPLA) for a consolidated jurisdiction, and the London Agreement to reduce translation obligations and therefore costs.

But there is an ongoing conflict about the validity of **software patents** and their role in competition. European Union legislation does not recognise software patents as such, but tens of thousands of patents for Computer-Implemented Inventions (CII) have been granted in recent years in Europe, many of which protect software innovation. The main industry actors and industry associations such as EICTA approve of CII as a way of protecting innovation and of defending EU suppliers from competition from players in the US (where software patents are allowed). Supporters of the **Open Source Software (OSS)** movement (also known as FLOSS, Free/Libre/Open Source Software) argue that software patents favour established players over innovators, and aim at maximising profits, rather than spreading innovation and knowledge. CII patents create problems in this respect, especially for ICT SMEs which are actively developing software.

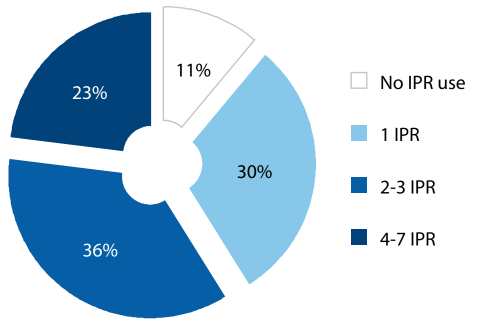
A similar conflict exists in the **ICT standards** arena, a key element of the fast-changing ICT ecosystem. The development of open source software and the growing need for interoperability at all levels has given increased relevance to standards development. The EU promotes the development of open standards to ensure the widest possible level of interoperability and to prevent user "lock-in" in proprietary systems. OSS supporters argue that patents are an obstacle to open standards. There is disagreement also among main players (IBM, Sun vs. Alcatel, Philips and others) about the definition of open standards and about how IPR should be dealt with in standards development. According to the SME association NORMAPME, **SMEs' inputs and interests are under-represented** in standards development.

82. This estimate is based on Eurostat SBS data, excluding banking and the public sector. No data for the new member states of Romania and Bulgaria available, therefore «EU25».

### 3.2.2 Profile of IPR users

ICT SMEs are following the general market trend, increasingly adopting IPR, both formal and informal. Their IPR portfolios are more varied than what would usually be expected from SMEs. This is coherent with the findings in the main sources that innovative ICT SMEs use IPR more often than other kinds of SMEs. Nonetheless, the most common tools remain informal IPR (confidentiality agreements are used by 69% of the study sample), followed by copyright (41%), trademarks (31%) and patents (25%).

**Exhibit 3.2-1: IPR portfolio size, both formal and informal, of ICT SMEs**




The survey covers 683 companies from 8 EU countries (AT, DE, ES, FR, IE, IT, PL, UK).

Note: "No IPR use" includes firms planning to use IPR in the future

Source: e-Business Watch Survey "IPR in ICT SMEs", September 2007

Only a minority of advanced IPR users are fully exploiting the potential of their portfolios. For example, the majority of ICT SMEs do not have a dedicated IPR department or manager and only a third of firms sampled use specialised external support. This suggests a lack of specialised knowledge about IPR management and a lack of technical skills to implement it. In addition, the majority of ICT SMEs spend less than 1% of their annual turnover on obtaining and maintaining IPR.

The problem is not a lack of general awareness of the role of IPR, but rather a lack of knowledge of the potential benefits of specific IPR tools and of the best way to exploit them for the firm's business strategy. For example, the majority of non-users declared that they do not need IPR for their business goals, and only a third mentioned the problem of high costs as relevant.

The reasons for using IPR are related to specific business opportunities. The profile of IPR users in ICT SMEs is differentiated less by structural aspects, such as companies' sector and size, and more by their business models and competitive positioning, which affect their IPR choices directly.

The study identified three main types of IPR users (see Exhibit 3.2-1) and found that the size of the IPR portfolio tends to grow with company size:

- **Low profile users** with only one type of IPR, usually an informal one (29% of ICT SMEs);
- **Mainstream IPR users** accounting for the majority of ICT SMEs (36%). They use two or three different IPR tools and are more present in the software and ICT services industries. Copyright is the cornerstone of their IPR strategy.
- **Advanced IPR users** taking advantage of the full range of IPR, both formal and informal, with a portfolio of four to seven different IPR tools (23%). These firms most frequently use copyright, patents, confidentiality agreements and Digital Rights Management (DRM).

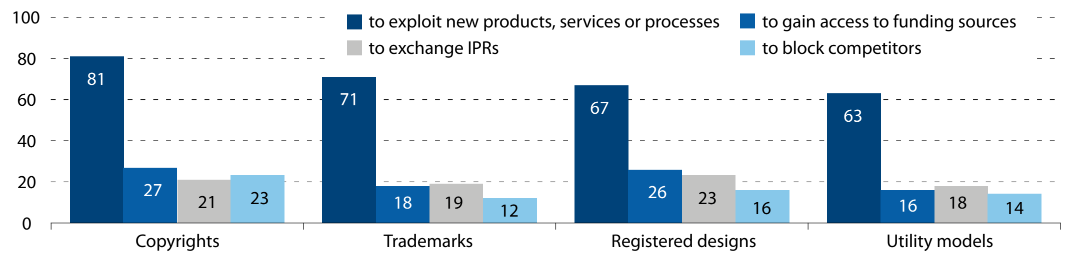
### 3.2.3 Use of IPR for competitive advantage and innovation

ICT SMEs are learning to use the full range of formal and informal IP tools to protect their research investments and to defend their competitiveness in global supply chains. Overall, it appears that many ICT SMEs have progressed beyond what the literature describes as the first stage of the IPR learning curve (a purely defensive strategy) towards using IPR to implement innovation and achieve competitive advantages.

According to the survey, the majority of ICT SMEs mainly use copyrights, trademarks, registered designs and utility models to exploit innovation in order to launch new products and services. Gaining access to funding by using IPR as a financial asset, a more sophisticated IPR strategy, is the second-ranking goal for copyrights and registered designs. Exchanging IPR, a common practice in business alliances, was quoted as the next most popular usage. The least important goal appears to be blocking competitors, but this may be related to the small size of these firms (see Exhibit 3.2-2).

Patents are used by the majority of ICT SMEs to exploit innovation. Almost half the enterprises surveyed use them to foster collaborations. The next most important objective is to attract investors, and many enterprises (31%) say they look for revenues from licensing new products. Blocking competitors is mentioned by only a third of the SMEs, and ranks fourth in the list of

*Exhibit 3.2-2 Goals of formal IPR use: % of ICT SMEs saying that they use copyrights / trademarks / registered designs / utility models in order to ...*




The survey was conducted in 8 EU countries. Weighting: by firms Base: 100%) = all companies. N=683 NOTE: No IPR currently includes also the firms which plan to, but do not have any currently

Source: e-Business Watch Survey "IPR in ICT SMEs", September 2007

goals. The case studies of advanced IPR users confirm this view (e.g., case study on Sensitive Objects) and provide evidence of IPR usage for the following goals:

- To attract investment capital and to access finance: the business model of some start-up companies is based on patents as their core assets;
- To protect original knowledge and research investments, and to raise barriers against competitors when entering new and international markets;
- To build a portfolio of patents in order to reduce the risk of litigation, using IPR as an investment or a currency to exchange in cross-licensing agreements;
- To protect original knowledge within supply chains, business alliances and other networks, particularly from large clients or partners (for example in production outsourcing deals);
- To improve company image and positioning through IPR tools ranging from patents to trademarks and registered designs.

### 3.2.4 IPR and business performance

The majority of ICT SMEs consider IPR to be important or even very important for their business model. However, assessing IPR relevance objectively, only 45% of ICT SMEs produce more than 10% of their revenues from IP-protected products and services. About a third of firms using IPR produce less than 1% of their revenues from IP-protected products and services. This confirms the division between advanced IPR users and other ICT SMEs for whom IPR are a marginal activity.

**Case study: Sensitive Objects, France: IPR as the key asset**

*Sensitive Objects is a good example of an IPR-based start-up business model. It was created in 2003 as a spin-off of the Wave and Acoustic Laboratory of the French National Science Research Centre (CNRS), to bring to the market a break-through technology in the field of man-machine interfaces.*

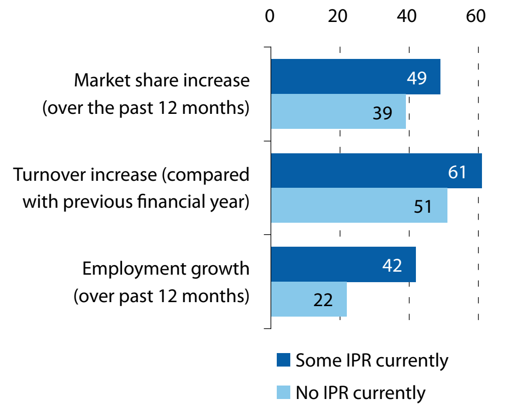
*Sensitive Objects used patent applications to gain funding from venture capital. The patents portfolio is defined as a key component of the value of the company, a core asset. Revenues were €1 million in 2007 but should rise quickly to several million in the coming years. Sensitive Objects is an American-style start-up, planning fast growth, bringing its technology to the market by including production as well as development in its activities. It is registering patents in all main international markets.*

*Revenues for this company will be from IPR-protected products, while direct revenues from IPR (such as licences) are not important. Therefore the ultimate impact of IPR on the company's business will be crucial but indirect. Sensitive Objects voiced few direct complaints about the patent system, except about delays in processing applications.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

Nevertheless, the survey indicates that IPR usage is positively correlated with company turnover, market share and employment growth (see Exhibit 3.2-3). While "only" 56% of low-profile IPR users (those with only one IPR measure in place) experienced a growth in company turnover, 63% of mainstream and advanced users and no less than 77% of the very advanced users (those with all IPR types in their portfolio) have seen their turnover increase. The composition of these companies' IPR portfolios suggests that firms with patents are more likely to grow, while firms with only informal IPR are even less likely to grow than firms without IPR.

*Exhibit 3.2-3: Business growth for ICT SMEs with IPR and without IPR (% of ICT SMEs)*




The survey covers 683 companies from 8 EU countries (AT, DE, ES, FR, IE, IT, PL, UK).

Source: e-Business Watch Survey "IPR in ICT SMEs", September 2007

## 3.2.5 *Impact of IPR on business strategies and competitiveness*

ICT SMEs increasingly use IPR as tools for their business strategies and to improve their competitiveness. The relevance and nature of the impact of IPR depends on the firm's business model, sector and size. There are many emerging business models based on the generation and exploitation of IP, where IPR are the source of revenues and of competitive advantage. For innovative ICT SMEs, the value of IPR is increasingly related to the company' networking and cooperation activities in globalised supply chains.

The evolution of the value chain in the ICT industry is leading its different actors to become increasingly specialised. Knowledge-intensive tasks such as R&D and design are increasingly outsourced to dedicated firms within complex global networks. This creates opportunities for emerging business models based on the creation and exploitation of IPR, essentially creating new market niches. These business models may be either "pure" IP–based models (where developed IP is the most important, if not the only, source of revenues), and other innovation models (where ICT SMEs use IPR to participate in supply chain networks).

The study shows that firms with innovative business strategies are more likely to be advanced IPR users. But ICT SMEs are also aware that it is difficult to maintain a first-mover advantage beyond 18 months, or two years at best, whatever the IPR protecting it. The critical challenges they face are therefore to win recognition as originators of this knowledge, and possibly to earn money from it, as soon as possible. The study confirms the correlation between IPR usage and company size, with micro-enterprises being less inclined to consider formal IPR (with the exception of pure IP players and start-ups). In practice, IPR exploitation requires sophisticated management capabilities that are often dependent on not just the size but also the culture of a company.

The emerging business models based on the creation and exploitation of IPR are:

- **Start-ups based on IPR** such as university spin-offs that use patents as core assets to attract venture capital and to succeed in the marketplace. The revenues of these firms come entirely from IP-protected products.
- **IP-based new technology firms** obtain all their revenues from licenses and royalties on IP sales. Three case studies conducted for this study – Array Technology-Denmark, Comsys-Israel, and DxO Labs-France (see case study summaries on p. 190) – fall into this category, focusing on design and development, and on outsourcing production. These firms are inherently exposed to high risks because they need to keep investing in R&D to remain ahead of the competition in technological innovation.
- **Cooperative innovation business models** depend on IPR as a competitive advantage and also obtain their revenues from IP-protected products and services. IPR allow these ICT SMEs to increase their sales and their market share in competitive global markets. The case studies on Eurotech, Net Insights and Vierling (see case study summaries on p. 190), all of them ICT manufacturing firms, fall into this category.

**Case Study: Eurotech, Net Insights, Vierling: the new niche leaders**

*Three of our case studies, Eurotech, Net Insights and Vierling, are large and rapidly growing ICT manufacturing firms. They have rich IPR portfolios and IPR is central to their business models. Their activities are best described by the cooperative innovation business model, since they play an important role in the globalised supply chains of the ICT market as specialised sub-suppliers to major vendors and suppliers.*
*Their positioning has evolved from the traditional 'specialised SME sub-supplier' role, as they have adapted to current needs for fast technological innovation and intense R&D. Compared to the past, they are however much less involved in direct production. Net Insights and Vierling already outsource production to lower cost countries and Eurotech is gradually following suit. They are global niche leaders; they focus on technological development and closely oversee their production partners in order to keep the quality of their products up to standard. By increasing the added value of their products through research and innovation, these ICT SMEs are remaining highly competitive.*
*In contrast to the business models of the IP-pure players, whose revenues derive directly from IP sales, these firms also sell IP-protected products and services. The main goals of their IPR strategies are to protect their R&D investments and to maintain the competitive advantage derived from their innovation. All these firms complain about the high costs and the inefficiencies of the current patent system.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

**Case study: IP-based business models: Comsys and DxO Labs**

*Comsys operates in the wireless networks market and DXO Labs in the multimedia market. Both sectors foster large patent families. Comsys is similar to many new-technology-based firms  based in Israel that end up being bought and incorporated by large firms. It thrives on a virtuous high technology development cycle based on high research investments. DxO, a French company with a similar business model, has 90% of its staff engaged in research. DXO has developed strong collaborations with a network of leading academic research centres and key individuals in applied mathematics.*
*These firms are typical of the recent evolution of the semiconductor industry. Today, up to 60% of a SOC design (System-on-a-chip, a computer or other electronic system fitted into a single integrated circuit) is estimated to consist of purchased IP. The SOC design process is evolving towards a model similar to software design - with independent developers, small firms, a lot of IP re-use, IP repositories and libraries, and specialized SOC design environments and tools.*
*The prevalent business model in this field is based on a combination of licence fees and royalties (on production) paid to the designers of the technology.*
*But pure-play IP providers, at least in the semiconductor industry, suffer from problems of economies of scale. These firms normally have limited budgets for research investments, while customers are asking for increasingly complex integrated circuits: for success, firms must have the capacity to meet up-front costs for the necessary IP, and be able to shoulder considerable risks. Current predictions are for increasing consolidation between IP firms (one example is the acquisition of Artisan by ARM), as many IP vendors are losing money. In conclusion, pure-play IP business models are inherently exposed to high risks, because of the need to keep investing in R&D and remain one step ahead of the competition in technological innovation. In addition, they must invest in the management and enforcement of their IPR portfolio.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

- **Open Source Software business model:** OSS firms obtain their revenues from a combination of licensing and services, so their revenues depend on IP-protected products with copyrights as the best option to protect IP. Two of our case studies, Fluendo and iMatix, are "pure" followers of the OSS movement, believing that patents are ill-suited to the ICT market. The case studies show that IPR management is also an issue for these firms because the licensing and copyright regime requires specific knowledge and skills. ICT SMEs in this area are concerned that patents are being used by larger competitors to block the market and to undermine competition, reducing the sector's potential for innovation.

### 3.2.6 Suitability of the IPR system for the needs of ICT SMEs

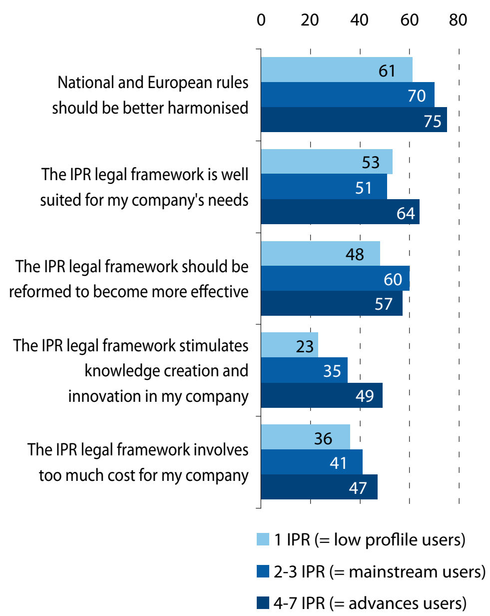
European ICT SMEs appear only mildly critical of the IPR regulatory framework, with many IPR users considering it "well-suited to their needs". The majority of criticisms are voiced by patent holders dissatisfied with the inefficiency of the patent system. ICT SMEs seem more concerned about the impact the IPR system will have on competition in market sectors such as software development, electronic components design and open standards development. With the exception of advanced users and (naturally) pure-IP players, ICT SMEs show little awareness or understanding of the need for IPR enforcement. Concerning the regulatory framework, a majority of ICT SMEs favour greater harmonisation between national and European legal frameworks (68%), and system reforms to improve their effectiveness (55%) – see Exhibit 3.2-4.

ICT SMEs in the category of advanced IPR users tend to be more satisfied with the suitability of the system, while low-profile and mainstream users are less so. The majority of ICT SMEs that use only informal IPR (confidentiality agreements and DRM) say the system is not well-suited to their needs, which may explain why they don't use formal IPR. Firms with patents are - surprisingly - more satisfied than others with the suitability of the system. Mainstream users, of which many use copyrights and confidentiality agreements or copyrights and patents, are more likely to favour a reform of the system.

Patent holders are mainly dissatisfied with costs of maintenance and litigation, and the complexity and delays involved in obtaining a patent. The majority of ICT SMEs are, by contrast, satisfied with the ability of the system to balance the interests of patent holders and users and the quality of patents. This might seem to conflict with the intense criticism of the patent system, including suspicions of unfairness towards smaller enterprises. However, the harshest critics of the patent system tend to come from the software industry that probably do not hold patents, while the respondents are patent users who have, by definition, accepted the logic of the system.

With respect to the enforcement of IPR and the risks of litigation, most ICT SMEs had observed no violation of their IPR over the past three years and had not been involved in legal disputes. There is little interest in pursuing violations. Many OSS supporters believe that pursuing violations is impossible, and even useless, since it is better to let innovation circulate. Patent holders are however more keen about defending their IPR.

**Exhibit 3.2-4: Opinions on the IPR legal framework, by user profile (% of ICT SMEs which agree to a statement)**




The survey sampled 683 companies across 8 EU countries (AT, DE, ES, FR, IE, IT, PL, UK).

Source: e-Business Watch Survey "IPR in ICT SMEs", September 2007

### 3.2.7 Policy implications

The development of the knowledge economy is changing the context for the use of IPR, making it more challenging and complex. IPR are becoming increasingly important as assets in networking and cooperation-competition alliances and in accessing funding. They are still used as technical tools to protect original knowledge as a basis for competitive advantage, but their role is no longer restricted to this activity.

The literature review points to a correlation between IPR usage and good innovation performance. But it also shows that the specific characteristics of the ICT sector (cumulative innovations with short product cycles) are less suited to traditional IPR, and in particular to patents. Recent findings with respect to high-tech SMEs are contradictory. Some work suggests that SMEs use less IPR than larger enterprises because they have fewer resources and skills - a situation that can lead to market failure. But the literature also suggests that SMEs make good use of their IPR, especially patents - so the potential market failure is perhaps not so relevant.

This study confirms these considerations, but shows that they are not so contradictory. Instead, distinct trends apply to different aspects of the ICT SMEs universe. The nature of ICT SMEs is complex and the role of IPR varies substantially depending on business strategy. The study confirmed the value of IPR for innovation strategies, competitiveness and business development of ICT SMEs Promoting IPR and removing the barriers to their adoption remains, in consequence, a valuable policy goal. However, it is not merely costs that present barriers to IPR adoption; the main causes are the cycle of adoption, implementation and maintenance of IPR.

The study also underlined the growing gap - between innovative and advanced ICT SMEs with sophisticated IPR portfolios, and more traditional ICT SMEs that limit their activities to informal IPR. Companies in the first group need sophisticated support services, while those in the second group still need support to build awareness and practical knowledge about the potential of IPR tools. Mainstream IPR users identified by the study may also evolve towards advanced use with the support of specialised consulting and services.

In conclusion, there is a need to revise the assumptions underlying IPR policies for ICT SMEs in order to take into account the new range of emerging needs, and to better articulate incentives and support measures. This study did not include the development of

**Case study: The special case of "patent trolls"**

*Patent licensing and enforcement companies (PLECs — or "trolls" to their detractors) are a specific case of the IP-based business model. For some of these organisations, fees from licensing are the only source of income. Supporters of patent trolls argue that these companies increase the liquidity of IPR by providing a ready market for patents that are unexploited by their inventors. Furthermore, these firms may facilitate legal access to IP by pooling (that is by licensing and aggregating) patents from different origins/inventors that cover a single technology. By activating "sleeping" patents, PLECs also increase the incentives and rewards for inventors, and therefore contribute to innovation development.*
*However, critics point out that patent trolls increase the level of royalties and licences that manufacturers and suppliers have to pay. This raises production costs, both by requiring intensified monitoring of patent databases to avoid intellectual property infringements, and by increasing payments.*
*Patent trolls can be successful companies that improve the functionality of the innovation market. They are, however, more inclined than other firms to initiate litigation or other legal action to protect their IP-based revenues. In this respect, they may constitute a potential threat to other ICT companies, especially when they find and resurrect older patents. One such example is IP Innovation, a firm that filed a lawsuit against RSA and Novell in October 2007 for violating three patents related to windowing user interfaces.*

***For more details about this case, see the full study report on www.ebusiness-watch.org***

specific policy recommendations, but the following sections describe the policy implications that flow from the main findings.

### PROMOTE BETTER SUPPORT SERVICES FOR THE USE OF IPR BY ICT SMES

According to a recent EC PRO-INNO Policy Benchmarking report, SMEs in Europe already benefit from a broad range of IPR support services. These include pro-active awareness raising activities, information provision services, training, customized in-depth consulting and advisory points/services, financial assistance, and legal framework services. The study identified a need to streamline and harmonise these support services. It also shows the importance of progressing beyond the current focus on patents, in order to promote wider IP protection strategies that take into account the full range of formal and informal IPR suited to the needs of SMEs.

This approach corresponds well with the findings of the present study about the needs of ICT SMEs, but it should be taken one step further. It is increasingly important for entrepreneurs, inventors, researchers, SMEs employees and business consultants to improve their knowledge of the IP system, so that they can manage their intellectual assets effectively and integrate their IPR strategies more effectively into their business strategies. In addition, the hidden costs of enforcing and litigating IPR are among the most important barriers to extending their use.

**To address the needs of innovative ICT SMEs:**

- Policy makers should carefully consider the business case for launching and/or contributing to specialized, value-added IPR consulting, enforcement and implementation services, possibly using web-based approaches dedicated to specific vertical market segments. These services should be marketed similarly to marketing, design or training services, managed by recognised professional experts (including for example lawyers). These services should allow ICT SMEs to find help to compete and cooperate in business chains with larger enterprises that dispose of greater means.
- SMEs should be required to pay for these services, which should eventually become self-supporting. The business case based on cost-benefit analyses should demonstrate their value for ICT SMEs. The services should be dedicated to specific market niches because the value added is connected with in-depth knowledge of technology and specific business problems. It is advisable to link these services with research networks and other technology development agencies and stakeholders, but they could also function independently.

**To address the needs of less innovative ICT SMEs:**

- Policy initiatives and support services should promote the diffusion of practical knowledge of the IPR system and of alternatives to acquire competitive advantages. These initiatives could be complementary to those for advanced ICT SMEs, but should still be sufficiently specialised to provide added value.
- Advanced awareness initiatives should include regular monitoring and comparative assessments of the advantages, disadvantages and suitability of different IPR tools (or alternative protection methods) from the point of view of the business strategies of ICT SMEs. As an ever-wider range of innovations become subject to some type of IPR regime, this initiative would help ICT SMEs benefit from their impact on competitiveness.

### PROMOTE GREATER INTEGRATION BETWEEN INNOVATION POLICIES AND IPR POLICIES

The last five years have seen growing convergence of the principal goals of policies on innovation and SME development. This has occurred at EU level within the framework of the Lisbon Strategy, and also at the national and regional level within local economic development policies[83]. Innovation policies recognize that research and knowledge development are the basis of competitiveness. Regional development policies look at technology clusters and networking as key elements to promote the growth of local high-tech SMEs. It is time for IPR policies to be perceived as more than a technical detail to be dealt with by technology transfer offices, and to be properly integrated into policies on innovation and regional development.

Institutions operating in the national innovation system should ensure that IP is adequately incorporated into the broader framework of support for entrepreneurs and SMEs and for the ICT industry, tak-

83. Confirmed by the analysis in "Policies for Innovative ICT SMEs in Europe" by IDC EMEA, Deliverable 4.2 of "Study on Innovative ICT SMEs in Europe (EU 25)", for DG Information Society, October 2007.

ing especially into account the main obstacles that entrepreneurs and SMEs face. These are not limited to seeking grant/registration of IPR, but cover the entire IP management cycle, including the commercial exploitation of IPR, the use of patent databases, the valuation of IP assets and the enforcement of IPR. And because research and innovation policies traditionally depend on government agencies that are not involved in policies on economic development and SME support, there is a risk of inadequate focus, policy overlap and lack of effectiveness.

### ANALYSE THE IMPLICATIONS FOR THE IPR SYSTEM OF IP-BASED BUSINESS MODELS

This study confirmed that emerging IP-based business models have increasing relevance in the new global supply chains of the ICT industry, particularly for start-ups and firms based on new technology. These ICT SMEs deserve to be supported as they are competitive companies that are growing fast. Our case studies presented some of the problems they face with the current IPR system, mainly the inefficiencies and high costs of the patent system.

IPR are also increasingly used in innovation networks and business alliances, and the IPR system does not take sufficient account of the problems and consequences this can encounter. For example, many of our case studies mentioned a minimum "threshold" IPR portfolio size before an SME can engage in cross-licensing practices, which is beyond the capabilities of many of these companies. But cross-licensing is an important and effective way to ensure balanced relationships in supply and innovation networks. Perhaps it is possible to find ways to enable ICT SMEs to use this practice more often. More in-depth analysis of the role of IPR in these business models is advisable to identify other problems to be solved and other implications to note for innovation and SMEs policies outside the area of IPR.

### IMPROVE THE SUITABILITY OF THE IPR SYSTEM FOR ICT THE NEEDS OF SMES

ICT SMEs urgently need greater harmonisation between IPR regulatory frameworks at the European and national level, particularly for patents. They require bureaucratic processes to be streamlined and harmonised, rather than a deep overhaul of the IPR regulatory framework, as only the patent system provokes strong criticisms. The adoption of a Community Patent granted by one central authority and subject to the same rules throughout the EU is the best solution for the inefficiencies of the European Patent system. It does, however, have some drawbacks, and should be encouraged only if the costs of obtaining, maintaining and translating such Community patents are to be affordable to all patent holders, including SMEs.

The problem of different legislation regimes for IPR enforcement also needs to be solved. This need should take precedence over concerns raised over the proposal for a specialised European court system for patent validity and patent infringement cases. Other useful measures could include the introduction of international databases in new technology and standardized international guidelines for examination, including the mutual recognition of application and examination findings.

ICT SMEs complain that patent costs are too high, but the best solution may not be to reduce costs exclusively for SMEs. The main burden is the translation costs linked to European patents, which are excessive for all companies. National IP offices – notably the Danish Patent and Trademark Office -have suggested that reducing patent fees for SMEs would not necessarily increase patent applications. Costs other than the official filing and processing fees may be more of an obstacle. The perception of high costs, complexity or ineffectiveness of the patent system, especially in terms of enforcement of patent rights, may be more of a limiting factor. Some experts also warn against lowering cost barriers, because of the risk of increasing the number of trivial or unused patents.

In conclusion, for ICT SMEs the cost of patents is only one of the potential barriers to an effective IPR strategy. To respond to their needs, the overall efficiency and timeliness of the European patent system should be improved and the burden of excessive translation costs should be reduced. Additional funding could be considered to support ICT SMEs struggling with patent costs until they start receiving revenues from their invention. Another practical measure could be for each country to evaluate the timeliness, efficiency and cost-effectiveness of initiatives to enhance wider and more effective use of the IP system. Pooling these efforts would develop benchmarks to compare different approaches, permitting the identification and promotion of best practices.

ENHANCE TECHNOLOGY TRANSFER AND KNOWLEDGE SHARING THROUGH BETTER USE OF IPR

From the point of view of the policy maker, improving the IPR system should improve technology transfer and knowledge sharing. It will reward inventors, but will also help leverage inventions at the level of the system. This is particularly important for the ICT industry and for ICT SMEs that develop their own innovations within the digital ecosystem, building on other enterprises' inventions and technology advances. To achieve this goal, policies should also encourage full usage of patents, and - above all - the licensing of unused patents, with measures to reduce the transaction costs of technology trade. Such measures may include the creation of standard contracts for technology trade, the facilitation of intermediating initiatives to help match buyers and suppliers (IP auctions) and the definition of standard technology prices (see also Gambardella A. et al., 2005).

Other possible measures include:

- Initiatives to develop practical tools for the valuation of IP assets. This approach would facilitate the development of a market for IP rights, and enable SMEs to better leverage their intangible assets;
- New taxation policies on innovation, including tax incentives for the protection or commercialisation of IP assets;
- Promoting technology transfer to the private sector from research institutes and universities, by establishing clear rules on IP ownership, royalty sharing and the commercialisation of university-owned IPR.

SOFTWARE PATENTS AND OPEN STANDARDS: REVIEW IMPLICATIONS FOR THE COMPETITIVENESS OF ICT SMES

As shown in the literature survey and the case studies in this report, the differing opinions on the software patents issue are entrenched. Any resolution favourable to both sides is likely to be complex, requiring a delicate balance between the interests of all competitors. Both sides of the debate present sound arguments. In the advanced ICT industry, the patenting regime is not well-suited to the short product cycles and the "open innovation" and "networked innovation" models. At the same time, inventors need protection – as stressed repeatedly by the ICT SMEs interviewed. In finding more flexible IP protection tools for these market areas, the EU should take into account the legitimate concerns of smaller enterprises which fear being sidelined from the innovation development process by the aggressive IPR strategies of larger competitors. Perhaps competition law should also be taken more into account in these issues.

ICT SMEs also advocated ensuring positive complementarities between IPR protection (particularly patenting) and standardisation and interoperability (particularly open standards). This study has also provided some additional evidence on how ICT SMEs cope with this issue in practice. It is recommended that the High Level Policy group on ICT standardisation - announced by European Commission Vice-President Günter Verheugen - should engage widely and take special notice of the issues of standardisation and IPR from the perspective of ICT SMEs, based on a practical review of the competitive issues for them in the areas of software and standardisation-interoperability.

### *3.2.8 References*

(The full list of sources used for the study is included in the full study report.)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## 3.3 ICT and energy use

This study was conducted by the Institute for Future Energy Consumer Needs and Behaviour (FCN) at RWTH Aachen University (***www.eonerc.rwth-aachen.de/fcn***).
The full study report can be downloaded from the e-Business Watch website (***www.ebusiness-watch.org***).

**Key findings**

***Mixed implications of ICT for energy consumption:*** *For the industrial sectors investigated in this study, electricity intensity is found to be reduced by communications devices, despite being increased by computers and software.*

***Lack of literature and evidence:*** *There is mixed and largely insufficient evidence in the literature backing the net benefit of ICT on energy consumption, and many research gaps, especially with regard to theory-guided empirical (quantitative) studies.*

***Positive impact of ICT on production efficiency:*** *Analysis of production factors such as ICT capital shows that ICT has an overall positive impact on company productivity, with computers and software accounting for more of this improvement than communications devices. The impact of ICT capital is generally less pronounced than that of the other production factors.*

***Output elasticities vary sharply between industrial sectors and input factors concerned,*** *making generalisations difficult. More research is also needed to tackle additional sectors of interest.*

***Energy monitoring and management systems help to mitigate energy consumption.*** *The three case studies conducted show that energy management and monitoring systems helped to significantly reduce energy consumption in companies from various industries.*

### *3.3.1 Context and background*

AIM AND SCOPE OF THE STUDY

This study by Sectoral e-Business Watch explores links between ICT adoption and energy consumption in different industrial sectors at the aggregate level. There is so far little economic research that employs quantitative analysis to determine the relationships between ICT and energy consumption. Qualitative studies have typically focused on energy efficiency potentials. In contrast to these mainly analytical-descriptive approaches, this study aims to empirically test several hypotheses derived from economic theory. The main motivation for undertaking this kind of analysis is to determine which effect dominates in European industries (i.e. the energy-saving or energy-increasing effect of ICT diffusion at the aggregate level), an issue of great importance in the light of global climate change and concerns over the security of future energy supplies.

In this study, in order to make use of a broad conceptual framework (see full report for details), a combination of methodologies is used.

**First, desk research** is undertaken to study and synthesise the literature on ICT and energy consumption (Section 3.3.2). As well as providing a useful overview, this section helps to identify gaps in current research, and to assess the contribution made by our research to the existing body of literature.

Second, an **econometric analysis** is undertaken (Sections 3.3.3 and 3.3.4) using state-of-the-art structural econometric modelling of the relationship between ICT and energy use. A set of theory-guided hypotheses regarding the impact of ICT on the above mentioned energy-related factors is formulated and econometrically tested. Due to data limitations, the econometric analysis is restricted to the chemicals, metals and transport industry. The outcomes of the empirical analyses are compared to insights from the literature, the Sectoral e-Business Watch 2007 survey and the case studies, before being used to derive policy implications. We also screened the Sectoral e-Business Watch survey data with respect to energy-related questions and their usefulness to corroborate (or invalidate) our hypotheses, and incorporated them into the report.

Third, three **case studies** were conducted based on face-to-face or telephone interviews that are preceded by an evaluation of written documentation of the companies investigated and in particular the role of ICT for reducing energy consumption (Section 3.3.5). Finally, we also performed some ***descriptive data analysis*** (Section 3.3.6).

DATA USED

**EU-KLEMS:** EU-KLEMS is an extensive database provided by the Groningen Growth Development Centre (GGDC). The aim of the EU-KLEMS research project is to create a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level (disaggregated into 63 subsectors) for all EU25 member states, as well as for the US, Japan and Canada from 1970 onwards. The data from the EU-KLEMS database used for our study comprise intermediate energy, materials and service inputs, labour, ICT and non-ICT capital. Depending on the sectoral aggregation level and the country concerned, the length of the time series data varies (the oldest figures included go back to 1970, while data for recent member states is available as from 1990). Note that the NACE classifications covered by our analysis are much broader than those addressed by Sectoral e-Business Watch. Unfortunate limitations on data availability made this unavoidable.

**Eurostat:** For the econometric analysis focusing on ICT usage and electricity consumption as well as some of the descriptive analysis, we also made use of EUROSTAT data of electricity consumption and electricity prices. Unfortunately, EUROSTAT's disaggregation of electricity consumption is more limited than other sources.

**e-Business Watch Survey:** We also screened the e-Business Watch Survey Data (CATI Sectoral e-Business Watch Survey 2007) for their coverage of energy use and ICT. This was covered only in the case of the Transport & Logistics sector (see Section 1.9.6).

### *3.3.2 Economic studies on the relation between ICT and energy consumption*

In this section, we provide a synopsis of the economic studies on ICT and energy consumption that were reviewed as part of the desk research conducted (for a more comprehensive literature survey, see the full study report on ***www.ebusiness-watch.org***). In the economics literature, there is a vast body of general studies on energy price, technical change and energy consumption. In contrast, few studies have so far dealt with the relationship between ICT and energy consumption. The most relevant of those economic studies are summarised in the following section.

As part of a broader study of the effect of energy prices on the development of new technologies for energy conservation or the provision of new energy sources, **Popp (1998)** used patent data to estimate the effect of new technologies on industrial energy consumption. He simulated the effect of a 10% energy tax on induced innovation and found that factor substitution plays a greater role than induced innovation in the short term. In the long term however, it has a much larger role than factor substitution, due to the cumulative nature of the research.

**Romm (2002)** observed that US GDP and energy consumption grew at an average rate of 3.2% and 2.4% each year in the "pre-internet era" (1992-1996), and 4% and 1% in the "internet era" (1996-2000). The decoupling of GDP and energy consumption growth is based on two different effects. First, the IT sector is less energy-intensive than traditional manufacturing. Second, the internet appears to be increasing energy efficiency in every sector of the economy. Hence the internet is driving energy efficiencies above the acceleration of electricity demand.

A study by **Laitner (2000)** suggests that the issue is clouded by the sheer complexity of the information society, and that a focus on direct energy requirements alone may not be the right approach to the problem. He does however conclude that small reductions in energy intensity can be brought about by a range of interrelated trends. He found that energy intensity was 4.4% in 1996, while for ICT sectors it amounted to only 0.8%. He argues that the deterioration of U.S. energy intensity over the past three years in the absence of any considerable price signals or policy initiatives could have been caused by a structural change encouraged by ICT. This structural change can enhance economic output and climate benefits.

**Takase and Murota (2004)** studied the impact of IT investment on energy consumption and $CO_2$ emissions in Japan and the US by means of an economic and an energy model both for a business-as-usual and a stimulated IT investment case. Their main findings were: (1) increasing IT lowers energy (and $CO_2$) intensity; (2) however, whether an increase or decrease in energy consumption depends on whether the income or the substitution effect is stronger; (3) by promoting IT, Japan could conserve energy, while the US would likely increase its energy use.

**Cho et al. (2007)** studied the impact of ICT investment and energy price on industrial electricity demands in South Korea (sampled over 11 business sectors) by means of a dynamic logistic growth model and data from 1991-2003. They found evidence that (1) ICT investment in electricity intensive manufacturing industries promotes factor substitution from labour to electricity; (2) ICT investment in some manufacturing sectors reduces electricity consumption, but in the service sector and most manufacturing sectors it increases electricity consumption; (3) electricity price critically affects electricity consumption in only half of the industrial sectors. As emphasised by **Carpintero (2003)**, the increased use of ICT causes higher efficiency. It is therefore possible to maintain the current pattern of economic growth without increasing its environmental costs by integrating more ICT into industrial economies. The background is that the service sector and ICTs use less energy and materials than traditional sectors such as industry and agriculture. The perceived boost in efficiency through ICT is substantiated by several factors outside the economic shift towards less energy intensive sectors; the diffusion of ICT into business processes seems to be the most important factor in improving efficiency (Romm 2002).

**Collard et al. (2005)** investigated the development of electricity use and ICT in the French service sector. They used a simple factor demand model (based on a nested CES constant returns to scale production function) to study the impact on the efficiency of electricity production of ICT capital goods (divided into computers and software on the one hand and communication devices on the other). The six sectors studied were: (1) bars, hotels and restaurants; (2) health and social services; (3) education and research; (4) sport, culture and other recreational activities; (5) offices and administration; (6) trade. By using a dynamic panel approach on a data set from 1986-1998 (6 x 13 = 78 obs.) they found that the electricity intensity of production increases with the increased use of computers and software, while it decreases with the diffusion of communications devices.

Finally, **Ishida and Yanagisawa (2003)** used a macro impact assessment model to forecast the impact of more intensive ICT use on energy consumption in the 10-20 years following 2003. They prepared a Base Case and an ICT Case that assumed a more ICT-oriented socio-economic structure (while economic growth was assumed to remain the same). The difference between the two cases permitted a calculation of the impact of intensified ICT bias. They concluded that primary energy supply in 2010 will diminish by 1.4% and final energy consumption by 1.9% in the ICT case. Based on this analysis, even with an extra economic growth of 0.3% per year substantiated by ICT, Japan's energy consumption is not expected to increase overall.

### *3.3.3 Econometric study on the impact of ICT capital goods on the efficiency of electricity use in production*

The main goal of this research is to determine the effect of ICT capital goods on the efficiency of electricity use in industrial production. Such efficiency increases in electricity use can be due to gains in production efficiency (i.e. better plant management) or structural gains (i.e. changes in market demand). Our analysis conducted here is mainly concerned with efficiency gains. The starting point of our analysis is the simple factor demand model introduced by **Collard et al. (2005)** for studying the relation between electricity consumption and ICT capital in the French service sector.

Based on theoretical considerations and empirical evidence from the literature (esp. Collard et al., 2005), we assume the following two research hypothesis:

- **H1:** Electricity intensity of production in the industrial sectors studied increases with the diffusion of computers and software and decreases with the diffusion of communications devices.

- **H2:** Communications devices exert a greater influence on electricity intensity of production in the industrial sectors studied than computers and software.

## MODEL SET-UP

Collard et al. (2005) derive a structural estimation equation from a simple factor demand model (eq. (1)) that is based on a (constant elasticity of substitution) production function with constant returns to scale. The endogenous change in the production process is modelled by electricity-augmenting technological progress, which is proxied by three variables and related estimation coefficients ($\theta_{CS}$, $\theta_C$, $\theta_{HA}$): computer devices & software ($K_{CS}$), communications devices ($K_C$) and heated area (*HA*)[84]. All three production input factors ($K_{CS}$, $K_C$, and *HA*) are normalised by the total capital stock (*K*). Moreover, a log-linear time trend ($\theta_T t$) that accounts for exogenous energy-saving technological progress is included. $\sigma$ is the coefficient of the price ratio $P_E/P$, denoting the elasticity of substitution between energy and the other input factors. Formally the model is specified as follows (estimable equation if an error-term is added):

$$\log\left(\frac{E_t}{Y_t}\right) = \sigma \log(\omega) - \sigma \log\left(\frac{P_{E,t}}{P_t}\right) \tag{1}$$
$$+(\sigma-1)\left[\theta_0 + \theta_t t + \theta_C \log\left(\frac{K_{C,t}}{K_t}\right) + \theta_{CS} \log\left(\frac{K_{CS,t}}{K_t}\right) + \theta_{HA} \log\left(\frac{HA_t}{K_t}\right)\right]$$

As can be seen from eq. (1) the variable ***E/Y*** (electricity intensity of production) is dependent on the term representing the electricity augmenting technological progress and on the ratio between the user price of electricity ($P_E$) and the production price (*P*). Hence, depending on the algebraic sign of the coefficients, the individual variables either have a positive or a negative effect on the demand for electricity. The estimation of the sign and size of the coefficients are the objective of the econometric analysis.

## DATA

As can be seen from eq. (1), the data needed to conduct the econometric analysis include electricity consumption (*E*), gross output of production (*Y*), electricity price ($P_E$), production price (*P*), computer devices & software ($K_{CS}$), communications devices ($K_C$), heated area (*HA*) and the total capital stock (*K*). Since not all these data are available from one single source, two data sets had to be matched (EU-KLEMS and Eurostat). Information on electricity consumption and prices is provided by Eurostat whereas all other data are extracted from the EU-KLEMS data base. Unfortunately the disaggregation of electricity consumption is restricted to the chemicals, metals and transport sector. Our initial intention to perform the analysis for the six sectors and eight different EU member countries addressed by Sectoral e-Business Watch had to be abandoned. Instead, our econometric analysis relies on data for three energy-intensive sectors (chemicals, metals and transport) and four countries (Denmark, Germany, Italy and the UK) from 1991 through to 2005. Since data for *HA* was not available for the countries and sectors studied, we used transport equipment (***TE***) instead to control for the size of operations, a variable contained in the EU-KLEMS data base.

## ESTIMATION

In our dynamic panel approach we use 15 annual observations (1991-2005) for four different EU member countries (i.e. 4 x 15 = 60 obs.) for three distinct industry sectors (chemicals, metals and transport). Following Collard et al., we estimate the vector of structural parameters $\Phi \equiv (\sigma, \theta_t, \theta_{HA}, \theta_C, \theta_{CS})$ from equation (1) and a constant by applying a nonlinear least squares (NLS) and a two-stage nonlinear least squares (2-stage NLS) regression method. The latter is conducted in order to correct for potential endogeneity of explanatory variables entering electricity-augmenting technical progress ($TE/K$, $K_C/K$, $K_{CS}/K$). In the adopted panel approach that combines the cross-section and time series dimension of the data, we account for fixed effects by estimating country-specific constant terms.

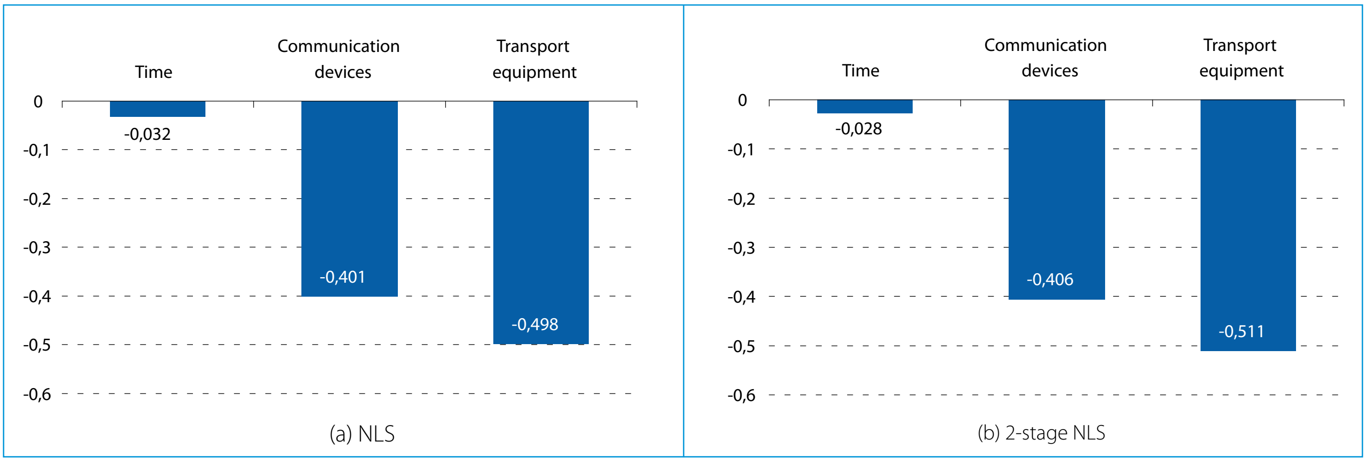
## RESULTS

### Chemicals industry

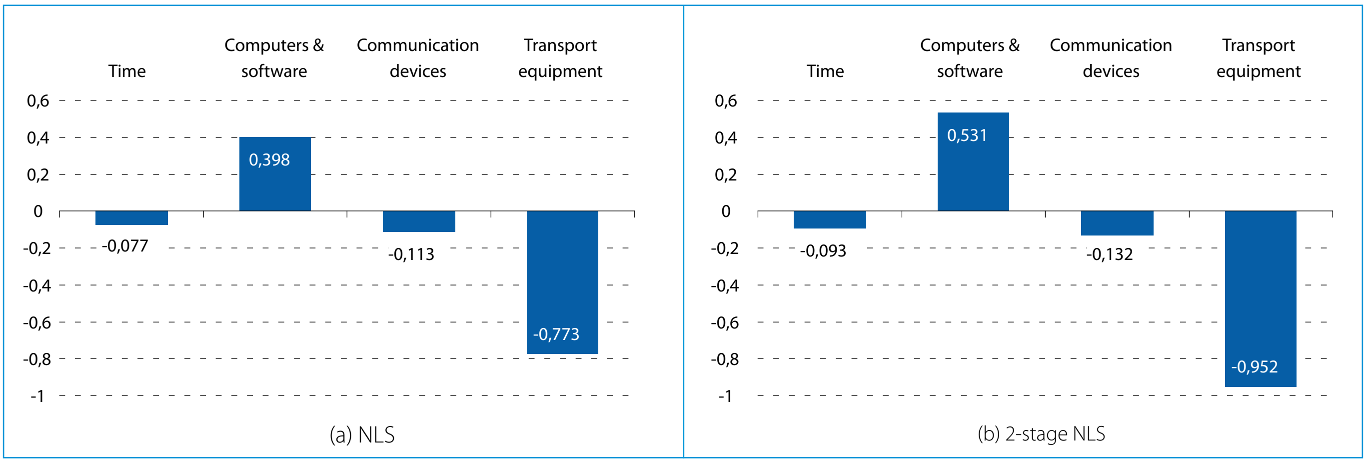
Exhibit 3.3-1 depicts the statistically significant output elasticities estimated for the chemicals industry using non-linear least squares (NLS and 2-stage NLS) for the explanatory variables computer & software (CS) and communications device (CD) capital (we eliminated variables whose coefficients were below a 10% threshold level). Exhibit 3.3-1 shows that within the ICT section, only communications devices have a statistically significant effect on electricity intensity. Computers and software capital is

84. The latter variable is used to control for changes in the production process that are uncorrelated with the diffusion of ICT.

### *Exhibit 3.3-1: Electricity intensity elasticities – chemicals industry*




### *Exhibit 3.3-2: Electricity intensity elasticities – metals industry*




found to be statistically insignificant and is therefore not included in Exhibit 3.3-1. The effect of technical progress is slightest (-0.03) and that of transport equipment is even stronger than that of communications devices (-0.5). The elasticities derived from the structural coefficients suggest that in the chemicals sector, for every 1% increase in the communications or transport equipment capital with respect to total capital ratio, electricity intensity will decrease by respectively 0.4% and 0.5%.

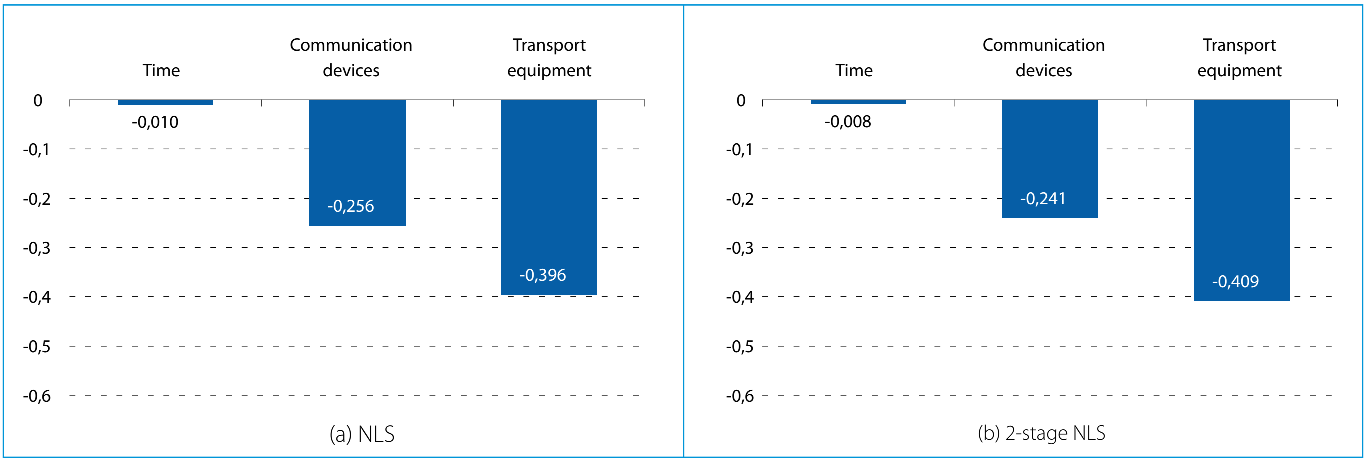
We conclude that for the chemicals industry: (1) We cannot identify a significant influence of computer devices and software on electricity intensity (the coefficient $\theta_{CS}$ is statistically insignificant); (2) Communications technology enhances the efficiency of electricity use in production processes ($\theta_C$ > 0); (3) There is evidence of electricity usage accelerating technological progress ($\theta_T$ > 0); (4) We find a negative[85] effect of transport equipment on the intensity of electricity use ($\theta_{TE}$ > 0), which suggests that other energy carriers are more significant and that the substitution effect might indeed be substantial.

**Metals industry**

Exhibit 3.3-2 summarises the analogous results obtained for the metals sector, both for the computers and software (CS) and the communications device (CD) capital. The results obtained with the two estimation techniques are very similar. Computers and software have a strong positive influence (0.4) whereas the influence of transport equipment is strongly negative (-0.8) and that of communications devices is also negative (-0.1), albeit to a lesser extent.

85. Note that negative refers to the sign of the coefficient (i.e. an increase in transport equipment is associated with a reduction of electricity intensity and thus consumption).

*Exhibit 3.3-3: Electricity intensity elasticities – transport industry*




We conclude that for the metals industry: (1) We find a negative influence of ICT on the efficiency of electricity use ($\theta_{CS} < 0$) that is in line with the results obtained in Collard et al. (2005) for the French services industry; (2) Communications technology has a positive influence on the efficiency of electricity in production processes ($\theta_C > 0$); (3) There is evidence of electricity usage accelerating technological progress ($\theta_T > 0$); (4) We find a negative influence of transport equipment on the intensity of electricity use ($\theta_{TE} > 0$), which suggests that other energy carriers are more important and that substitution among energy carriers may play an important role.

**Transport industry**

Exhibit 3.3-3 provides a synopsis of the estimation results with least-squares and 2-stage least squares estimation for computer and software (CS) and communications devices (CD) capital for the transport industry. Again, the elasticities obtained with the two estimation methods are very similar. They indicate a transport equipment elasticity of about -0.4, a communications devices elasticity of -0.25 and an electricity-augmenting technological change close to zero (-0.01). As computer & software (CS) capital is found to be statistically insignificant, the corresponding coefficient is not included in Exhibit 3.3-3.

From the analysis for the transport industry, we conclude that: (1) Electricity augmenting technological progress negatively correlates with electricity use ($\theta_T > 0$); (2) Communications technology has a positive influence on the efficiency of electricity use in the transport sector's production processes (elasticity of about -0.25); (3) There seems to be a negative correlation between transport equipment and electricity use ($\theta_{TE} > 0$), indicating that transport equipment is likely to depend on other energy carriers.

## DISCUSSION

For all three industrial sectors studied we can conclude that: (1) The results for the chemicals and transport industries are similar, whereas for the metals industry we find a positive impact of computers and software and an even stronger impact of transport equipment on electricity intensity (i.e. these input factors contributed to reducing the electricity intensity in these sectors); (2) For all three sectors studied, we find modest electricity-augmenting technological change. Although the results are not straightforward, we find overall some empirical support of the postulated hypotheses for all three sectors studied:

- **Ad H1:** On the one hand, the diffusion of communications devices exhibits a negative influence on electricity intensity in all three sectors. On the other hand, the impact of computers and software is statistically only significant in the metals industry, displaying as postulated a positive effect on electricity intensity.
- **Ad H2:** For the two sectors for which the impact of computer devices and software is statistically insignificant (chemicals and transport), communications equipment does indeed exert a greater influence on electricity intensity. However, for the metals sector the magnitude of the impact of computer devices and software greatly exceeds that of the communications technologies.

### 3.3.4 *Econometric study on the impact of ICT capital, energy, and other input factors on production output*

The objective of our second econometric approach is to empirically assess the relationship between various input factors and gross output. The input factor ICT capital is of particular interest. In this analysis we assume the following hypothesis:

- **H3:** The diffusion of ICT capital goods has a greater impact on gross output than the diffusion of non-ICT capital goods.

MODEL SET-UP

In economic theory the relationship between input factors and production output is usually described as a production function, the simplest of which is the Cobb-Douglas (CD) functional form. For our analysis, we specify the CD production function in double-logarithmic form. Constant returns to scale are assured by normalising inputs and output to total hours worked (*WH*). Our estimable equation can therefore be specified as:

$$\log(Y_t) = \alpha_0 + \beta_{E,t}\log(E_t) + \beta_{M,t}\log(M_t) + \beta_{S,t}\log(S_t) + \beta_{ICT,t}\log(ICT_t) + \beta_{NICT,t}\log(NICT_t) + \beta_T time \quad (2)$$

Eq. (2) states that gross output (*Y*) is dependant on various input factors and time, which all appear on the right hand side of the equation. Note that the double-logarithmic formulation allows us again to interpret the estimated coefficients ($\alpha_0$, $\beta_{i,t}$) directly as output elasticities. The output elasticities express the percentage change in output when the respective input is increased by 1%. $\beta_{ICT} = 0.3$ would indicate that if ICT capital increased by 10% output would increase by 3%, thus providing some evidence that the use of ICT capital actually helps to increase production output.

DATA

Data for gross output (Y), energy (E), material (M), and service (S) inputs, as well as ICT capital (ICT), non-ICT capital (NICT) and total hours worked by persons engaged (WH) are needed to estimate eq. (2). All these data are available from the EU-KLEMS data base for various industries and EU member countries over a sufficient time span. As EU-KLEMS provides these data in volume indices as well as in values, we have performed the analysis for both types of data. ICT data in values are provided by EU-KLEMS in a disaggregated form while data in volumes are only distinguishable by ICT and non-ICT capital. The ICT data in values are, as in the first part of the econometric analysis, further disaggregated into computer devices and software (CS) on the one hand and communications devices (CD) on the other hand. This allows us to account for possible differences in the direction and magnitude of the two ICT components. The drawback of using the data in values in the present case is the limited data availability. The capital input files containing the disaggregated ICT data are not available for all countries. The number of observations is therefore reduced for the data in values. The data included in this analysis span ICT companies in Austria, Denmark, Finland, France, Germany, Italy, Spain and the UK in 1980 -2004 (for the analysis with variables in values no data for France and Spain were available).

ESTIMATION

Eq. (2) (plus an error-term) is estimated using ordinary least squares (OLS) regression analysis, both with variables in volume and in value terms. Moreover, as the time series might contain unit roots, we estimate both data sets in first differences as well.[86] Statistically insignificant variables (beneath the 10% level of significance) were omitted from the estimation.

RESULTS (VARIABLES IN VOLUMES)

In what follows we present the results from estimating the Cobb-Douglas production function for the metals, chemicals and transport industries when the variables are expressed in volumes (in the full study report we also report on the results obtained when the variables are expressed in values, cf. ***www.ebusiness-watch.org***). While we attempted analogous estimations for the banking and retail sectors, results were often statistically insignificant or counterintuitive and were therefore excluded from this report.

**Chemicals industry**

Exhibit 3.3-4 reports on the results for the chemicals industry. Interestingly, non-ICT capital turned out to be statistically insignificant and was therefore removed, while the time trend reflecting technological change could be kept. Note that for the chemicals

86. All regressions in levels reveal a disturbingly low Durbin-Watson statistic, possibly indicating spurious regressions.

***Exhibit 3.3-4: Output elasticities – chemicals industry (volumes)***

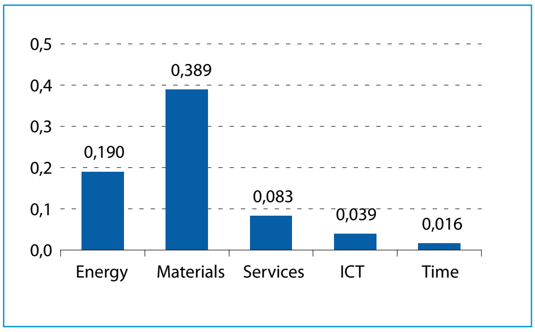



***Exhibit 3.3-5: Output elasticities – metals industry (volumes)***

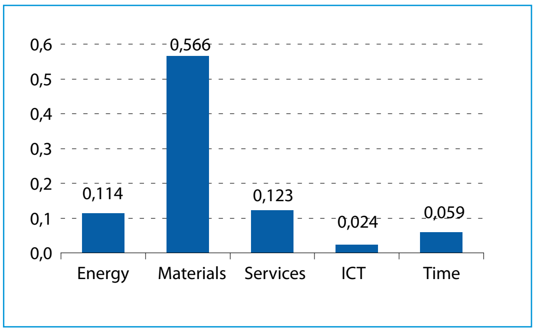
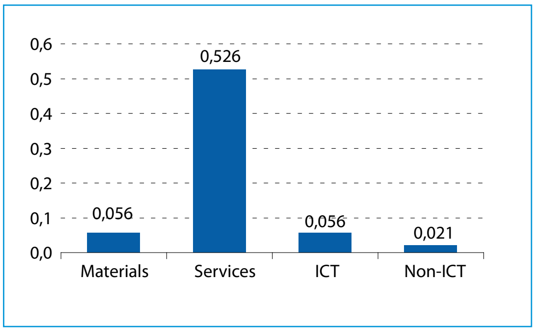



***Exhibit 3.3-6: Output elasticities – transport industry (volumes)***




industry, production output reacts most sensitively to material inputs (0.39), about half as sensitive to energy inputs (0.19), and much less to service inputs (0.08) and ICT capital inputs (0.04).

**Metals industry**

Exhibit 3.3-5 shows the analogous results for the metals industry. All estimated output elasticities turn out to have a positive sign. Material inputs again exhibit the largest elasticity (0.57), followed by services (0.12) and energy inputs (0.11), then by non-ICT capital inputs (0.06) and last capital inputs (0.02). Note that the time trend turned out to be insignificant and hence was eliminated. We conclude from this result that changes in the use of ICT capital only play a minor role in explaining changes in gross production output in the metals industry, while material inputs play a dominant role.

**Transport industry**

Exhibit 3.3-6 shows the results for the transport industry. Service inputs exhibit the highest elasticity values (0.53), while the impacts of ICT capital and materials inputs (both 0.06) are considerably smaller, and non-ICT capital are as low as 0.02. Note that both the time trend and the variable for intermediate energy inputs had to be removed because they were insignificant.

Exhibit 3.3-7 provides a qualitative summary of the results obtained. From this it becomes obvious that the value models often perform better but cover fewer countries and tend to produce implausible results for less energy-intensive sectors such as banking and retail.

## DISCUSSION

As previously mentioned, comparisons between results from the volumes and values estimations have to be treated with caution because the number of countries included differs. Moreover, the model specifications are not the same on account of the disaggregation of ICT capital in the values data. Overall the estimations in values as well as in volumes reveal a high impact of intermediate material inputs on gross output for the chemicals and metals industries on the one hand, and a high impact of intermediate service inputs on gross output in the transport industry on the other hand. This comes as no surprise since the metals and chemicals industries belong to the manufacturing sector while the transport industry belongs to the service sector. When estimated with volumes data, energy has a positive impact in all cases except for the transport industry. With the exception of communication devices in the transport industry, the values data show that ICT has a significant impact on all estimations, although its effect is never large. Regarding the postulated hypothesis we can conclude that:

- **Ad H3:** A comparison between the effects of ICT and non-ICT on gross output does not reveal a clear result concerning statistical significance and magnitude.

Output elasticities vary widely with respect to the various input factors, both across the input fac-

*Exhibit 3.3-7: Summary of the statistical significance and plausibility of input factors of primary interest (Cobb-Douglas model)*

| | Industry | Chemicals | | Metals | | Transport | | Banking | | Retail | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volumes** | Levels | Energy Δ | | Energy Δ | | Energy O | | Energy Δ (-) | | Energy O | |
| | | ICT Δ | | ICT Δ | | ICT Δ | | ICT O | | ICT O | |
| | Differences | Energy Δ | | Energy Δ | | Energy Δ | | Energy O | | Energy Δ | |
| | | ICT O | | ICT Δ | | ICT Δ | | ICT O | | ICT O | |
| **Values** | Levels | Energy Δ | | Energy Δ | | Energy Δ | | Energy Δ (-) | | Energy Δ | |
| | | CS Δ | CD Δ | CS Δ | CD Δ | CS Δ | CD O | CS O | CD Δ | CS Δ (-) | CD Δ |
| | Differences | Energy Δ | | Energy Δ | | Energy Δ | | Energy O | | Energy Δ | |
| | | CS O | CD O | CS O | CD O | CS O | CD O | CS O | CD Δ | CS O | CD O |

**Nomenclature: CS**: Computer devices & software; **CD**: Communications devices; **ICT**: Information and communications technology; **E**: Energy; **(-)**: negative coefficient (implausible); **Δ**: Statistically significant; **O**: Statistically insignificant (at the 10% level).

tors and also across sectors. Nearly all estimated models showed a significant positive impact of ICT capital on productivity. The effect of computers and software exceeds the effect of communication technologies in all industries considered. Further analysis, using, for example, improved data and covering additional sectors, is needed to check the robustness and validity of these results and to identify common patterns among comparable sectors (such as energy-intensive sectors in manufacturing). From our investigation of the chemicals and metals industry, we also find that the elasticity of ICT capital tends to be considerably lower than for input factors such as materials, energy and non-ICT capital, indicating that ICT capital is not the most important input for influencing production output.

Overall, this research project offers the potential to enrich our understanding of the implications of ICT on energy consumption. It has modelled current trends in ICT by means of production functions and delivered some interesting new insights and ideas for future research. At the same time the modelling approach is very specific. There are many interesting questions that it cannot tackle. Limitations in the data at the sectoral level often make it impossible to investigate results more deeply. Expected future extensions of the databases available (EU KLEMS, Eurostat) will enable extensions to the analyses undertaken in the present study with very limited resources.

### *3.3.5 Case studies*

As a complementary source of evidence, three case studies on ICT and energy consumption were conducted.

**Case study: Coop, Switzerland: energy management system in retailing and benefits of standardisation**

*Switzerland's second-largest retailer set up an energy management system in an attempt to reduce electricity and heat consumption and to meet its commitments under the national climate policy. The system combines data collection from its 950 food retail stores with a comprehensive building management system that ensures compliance with target limits for temperature, fuel, electricity and water consumption. It also oversees the recovery of energy from the cooling system, which has reduced heat energy demand by close to 60%.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case study: Erdemir, Turkey: energy management system in steel manufacturing**

*Erdemir is the largest iron and steel producer in Turkey. Being one of the country's largest domestic energy consumers (the firm accounts for 1.7% of Turkey's entire energy consumption) and self-supplier, Erdemir has been working hard on energy-saving activities since 1982. The company used IT applications to gather all its control systems under one switch and provide an on-screen plant information system to monitor energy consumption. This has resulted in energy savings of up to 5% and has provided an early-warning system for anomalies within the production system such as pressurised air leakages. In 2007, the power and steam supply systems were fitted with a plant information system. The goal for 2008 is to implement an optimisation policy for the existing infrastructure in order to control power and steam production, furnaces, turbines and by-product gases more effectively.*

***For more details about this case, see full study report on www.ebusiness-watch.org***

**Case study: Jacob Fruitfield, Ireland: energy management system and staff motivation**

*Irish food producer Jacob Fruitfield is one of the major producers of biscuits, sauces, jams and preserves in Ireland, with extensive production facilities close to Dublin. In 2004, it set up an energy monitoring system to tackle deficiencies identified in an energy audit. The system has helped reduce gas consumption by 9%, provided better understanding of consumption patterns, and instilled greater energy awareness among staff. One of the key lessons learned from this case study is that energy education is crucial for the successful assimilation of energy monitoring applications in business organisations.*

***For more details on this case, see full study report on www.ebusiness-watch.org***

### 3.3.6 Descriptive data analysis

#### PERCEIVED IMPACT OF ICT ON ENERGY CONSUMPTION IN THE TRANSPORT INDUSTRY

The data from the Sectoral e-Business Watch Survey 2007 offers few insights into company perception of the impact of ICT on energy consumption. The only question addressing the topic asked interviewees from the transport and logistics industry in seven EU member countries whether "ICT has a high, medium, low or no impact on transport and logistics". The results of the survey are shown in Exhibit 3.3-8. Only 18% of participants consider ICT to have a high impact; 26% consider it has a medium impact, 24% low impact, a remarkable 24% no impact and 8% answered 'I do not know'.

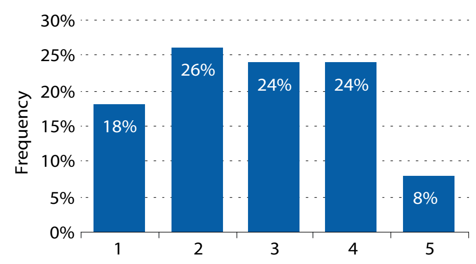
#### ENERGY AND ELECTRICITY INTENSITIES OF ICT

In the following section we present descriptive analyses of the data that offer some insight into the relationship between ICT and energy consumption. One way to study this relationship is to compute the ratio of energy intensity relative to the level of ICT capital services used. Exhibit 3.3-9 shows this ratio for all industries combined between 2003 and 2004 and for the chemical industries as a specific example.

The electricity consumption over ICT capital services ratio varies substantially among EU countries. In the chemical industries it is considerably higher in some countries than in others, producing no clear pattern. By looking over all industrial sectors, it transpires that companies in Finland, France, Germany, Italy and Spain are above the EU average in terms of their electricity intensity, while Austria, Denmark and the UK are below. The French chemical industry is less energy intensive than the EU average.

Exhibit 3.3-10 depicts how the ratio of intermediate energy inputs over ICT capital has evolved for the metals industry in eight EU countries (Austria, Denmark, Spain, Finland, France, Germany, Italy and the UK) since 1980. Denmark and the UK have seen the most significant drops, followed by Austria, France and then Spain (where the ratio flattens out much earlier). Germany, Finland and Italy have experienced considerable fluctuations and a slower overall development.

*Exhibit 3.3-8: Frequency distribution of the impact of ICT on energy consumption in transport systems, selected EU countries (France, Germany, Italy, Spain, Sweden, Poland and the UK)*




*Likert scale:*
1 = high impact,
2 = medium impact,
3 = low impact,
4 = no impact,
5 = do not know

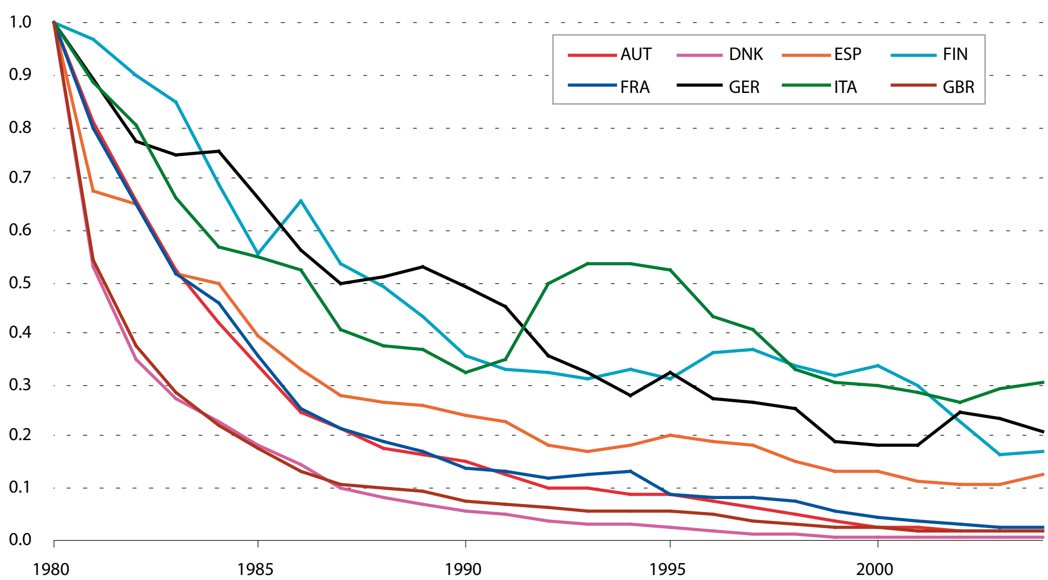
Source: Data from SeBW Survey 2007, own calculations

*Exhibit 3.3-9: Ratio between electricity consumption and ICT capital services, total and chemical industries, selected EU countries (index ratio 1995 = 1)*

| | Total industries | | Chemical industries | |
|---|---|---|---|---|
| | **2003** | **2004** | **2003** | **2004** |
| Austria | 0.31 | 0.30 | 0.31 | 0.31 |
| Denmark | 0.23 | 0.21 | 0.17 | 0.14 |
| Finland | 0.55 | 0.53 | 0.57 | 0.55 |
| France | 0.53 | 0.51 | 0.45 | 0.39 |
| Germany | 0.41 | 0.40 | 0.51 | 0.52 |
| Italy | 0.49 | 0.48 | 1.41 | 1.82 |
| Spain | 0.61 | 0.60 | 0.60 | 0.63 |
| UK | 0.30 | 0.28 | 0.35 | 0.34 |
| **EU 15** | **0.40** | **0.38** | **0.50** | **0.49** |

Source: Data from EU-KLEMS and Eurostat, own calculations

*Exhibit 3.3-10: Ratio of energy inputs over ICT capital in the metals industry of selected EU countries, 1980-2004, (data in volumes, indexed ratio, 1980=1)*




Source: Data from EU-KLEMS, own calculations

### 3.3.7 Outlook

Based on the limited and aggregate data available, this research on the relationship between ICT and energy (electricity) consumption has identified some key trends and gained new insights regarding the relative importance of ICT and non-ICT capital to curb consumption and increase productivity. The analysis shows that such research should be extended to sectors not covered by the present Sectoral e-Business Watch study.

The sectoral data used is aggregate data from national statistics offices and can provide only a crude overall picture for individual industries. It yields no insights at the company level, but the descriptive analysis of this data has so far shown some interesting trends, and unexplained departures from trends (as is the case for Italy and the UK), that require some explanation. ICT also leads to a number of structural commercial changes such as online bookstores and new behavioural patterns such as online shopping that make it difficult to assess its overall impact on energy intensity or consumption.

Given the limited scope of the present analysis, further work is clearly needed on all four lines of research pursued (desk research, case studies, econometric modelling, descriptive data analysis). Although there is a clear trade-off between the number of observations that can be used for the econometric analysis and the number of countries that can be covered, the study would benefit from a broader sample of data covering additional sectors of the economy and, if possible, more EU countries. Since new areas of activity are not always put into practice and the impact of ICT is therefore visible only in data spanning long periods, there is a clear trade-off between increasing the number of countries studied and maintaining sufficiently long time series to identify sluggish developments.

Finally, the limitations of research in this area must be made clear and final conclusions should be formulated in a way that makes the limited scope of the research undertaken clear to policy makers. It may be that conclusions are specific to certain industries or countries, or that the data available do not comprise all facets of a situation.

### 3.3.8 Policy implications

Due to data limitations the analysis could be conducted for only a fraction of the industries and countries initially targeted. Three key industrial sectors, namely the chemicals, metals and transport sectors, are nonetheless sufficient to show that the influence of ICT on energy intensity and productivity varies greatly across industries. We also find enough similarities to derive some insights that have allowed us to formulate four key policy implications. The following implications are based on the assumption that both a reduction of energy intensity and an enhancement of productive efficiency are desirable policy outcomes:

- Nearly all estimations reveal a negative effect of communication technologies on electricity intensity (ICT reduces electricity intensity) and a positive effect on productivity (ICT increases productivity). **Promoting the diffusion of communication technologies** seems to be worthwhile regarding electricity intensity of production as well as productivity.
- Computer and software technologies seem to have an ambiguous influence on energy intensity and productivity. Only one of the three industries assessed displayed a statistically significant effect of computer and software technology on energy intensity, revealing a positive impact. On the other hand, the effect on productive efficiency is positive in all industries considered, always exceeding the effect of communication technologies. Because of this **trade-off**, recommendations **concerning the support of computer & software technologies** depend on the relative preferences of policy makers regarding the reduction of energy intensity and the enhancement of productivity.
- At first glance, the findings from the three case studies conducted seem to contradict the results of the econometric analysis. According to the companies' own statements, the implementation of energy management systems (EMS) that rely primarily on computers and software technologies lead to lower energy intensity. A possible explanation is that the computer and software capital engaged in such systems is only a fragment of the total computer and software capital. Hence, the **promotion of EMS** could be a way of targeted support for energy-reducing ICT.

- As mentioned, the limitations on data availability and disaggregation presented an obstacle to conducting broader empirical analyses. Preferably, such analyses should take into account a larger number of EU countries, especially new EU member states, and a larger number of economic sectors. In some parts of the analysis only the impact of ICT and non-ICT capital could be distinguished, making it impossible to investigate the relative impact of computers, software and communication technologies. An improved data base would be needed to undertake further econometric analysis, both in terms of countries covered and disaggregation by sectors and capital input factors. Funding **improved data bases** would assure a more reliable and extensive quantification of economic interrelations, providing the basis for more solid and concrete policy consultations.

An important point to mention is the need to look at "embedded" ICT. An increasingly broad range of goods such as cars have a high ICT content using for example micro-processors in their engine system. These are not included in the data on ICT capital stock and hence cannot be detected by the modelling approach followed here. In order to obtain policy implications that can be better put into operation, the picture also needs to be completed further and the limitations to the methodological approach chosen. The data available for this kind of research and the conclusions that can be drawn from it need to be emphasised clearly so as not to mislead policy makers.

The study of the relationship between ICT and energy consumption at the aggregate industry level has proven to be an innovative and fruitful area of research from which many new insights can be gained. Supporting ICT is however just one of many ways of tackling energy efficiency. The general aim should be to decouple economic growth from growth in energy consumption as part of the EU's overall move towards a sustainable, knowledge-based society.

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(The full list of sources used for the study is included in the full study report – see ***www.ebusiness-watch.org***)


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## 3.4 ICT standards in the health sector: current situation and prospects

**Key findings**

***Serious interoperability problems in the health sector:*** *Interoperability of ICT systems in the health sector is a serious problem. This implies a compromised quality of healthcare and unnecessarily high costs in the health system.*

***Conflicting standards and lack of "right" standards:*** *There is a lack of e-health standards being widely used, often resulting in a conflict of standards. There is also a lack of well-developed ICT standards for concrete use cases.*

***Barriers to e-health standards adoption*** *are many and can be broken down by stakeholders and their rationales: governments, Standards Development Organisations, industry, and ICT users.*

***No powerful harmonisation activities yet,*** *but recently there has been a major advance towards harmonising e-health standards: a collaborative group of CEN, ISO and Health Level 7 which may be influential in the future.*

***Common strategy and roadmap advisable:*** *Considering recent e-health standardisation activities by the US government, the EC and the Member States may be well advised to develop a common strategy and roadmap for e-health standards to prevent developments unfavourable for the EU.*

### *3.4.1 Context and background*

A SEVERE LACK OF ICT INTEROPERABILITY IN THE HEALTH SECTOR

Interoperability of ICT systems in the health sector is a serious challenge. Health service providers use ICT from different manufacturers, from different technology generations, and, in a European context, from countries with different health systems and different languages. In short, they use ICT systems operating with different and often conflicting standards. The consequence is that information systems in the health sector are very often fragmented and unable to exchange data. For example, the computerised exchange of laboratory data of a particular patient between two hospitals may be impossible because the systems operate with conflicting ICT standards. To the extent that EU Member States seek cross-border health services and, in the long run, an internal market for health services, such interoperability problems need to be solved on an international level. The lack of ICT systems interoperability and of widely accepted standards directly implies compromised quality of healthcare and unnecessarily high costs of the health system.

OBJECTIVES AND SCOPE OF THE STUDY

The objective of this study is to provide a structured overview of key ICT standards in the health sector and to understand related needs of the ICT producing and user industries. Standardisation processes, as well as economic impacts, are analysed and policy implications are derived thereof. The study pays particular attention to standards for electronic health records. Since the field of ICT standards in the health sector is very wide and difficult to overview, it focuses on key standards, key trends in standardisation, and important implications. The findings are based on literature evaluation, expert interviews, and results of an international online survey of e-health experts.

This study takes an industry perspective and therefore "ICT standards in the health sector" is an appropriate term. However, it is often abbreviated to "e-health standards".

DEFINING STANDARDS AND THEIR IMPORTANCE

Standards are defined here in a general, functional sense as "technical specifications". From an institutional perspective one can distinguish four types of standards: official standards which are mandatory to use, voluntary standards, proprietary standards defined by industry, and open standards. Standards are of enormous economic importance: by determining both the requirements producers have to fulfil and the expectations of the customer, standards reduce problems of risk, transaction costs and issues of interoperability. For the European Commission (EC), standardisation remains a voluntary, consensus-based, market driven activity. The EC promotes standardisation because it considers standardisation as a priority issue for the competitiveness of a number of industries in Europe, including ICT manufacturing.

### *3.4.2 Overview of ICT standards and standardisation in the health sector*

#### SKETCH OF THE CURRENT SITUATION OF E-HEALTH STANDARDS

The current situation of e-health standards may be summarised as follows: Firstly, there is a lack of standards that are widely used, often resulting in a conflict of standards and interoperability problems.. Many of the conflicting standards are proprietary. There may also be different or flawed ways of implementing the same standard that are not interoperable. In some cases even different versions of the same standard may conflict. Secondly, there is also a lack of the "right" e-health standards, i.e. well-developed standards for particular applications and concrete use cases. Available standards are often designed for general purposes and unsuitable for specific applications.

For health service providers such as general and specialised practitioners, hospitals and community health centres, this situation may imply that computerised systems remain stand-alone and unable to exchange data with each other either in-house or externally. Health service providers may have to invest considerable funds to make systems that operate with different standards interoperable.

#### BARRIERS TO E-HEALTH STANDARDS ADOPTION AND PROMOTION

There are many reasons for the currently problematic situation in e-health standards. They can be broken down by stakeholders and their rationales, i.e. the reasons for the way they act: governments, Standards Development Organisations (SDOs), industry, and ICT users:

**Political barriers**: On the one hand, there are many different national and also regional health systems with different standardisation approaches and standards implemented across Europe. On the other hand, there is low governmental support for developing prominent e-health standards, and the level of governmental incentives to communicate electronically - which may spur on the use of standards – is also low.

**SDO barriers**: There are a large number of SDOs developing e-health standards. The main reason why they do not simply agree on common standards or harmonise their standards is that standards development is an expensive investment, and SDOs wish to realise positive returns.

**Company barriers:** Just like SDOs, ICT firms seek to realise returns from their standardisation efforts. Furthermore, manufacturers may not be willing to adopt commonly used standards because these are very complex and thus expensive to implement. Finally, a situation of numerous conflicting standards may be favourable to companies that sell middleware or services to make systems interoperable.

**ICT user barriers:** On the part of health service providers such as general practitioners, community care centres and hospitals, barriers to adopt widely used e-health standards are mainly related to cost: e.g. search costs for systems with the most suitable standards, costs of converting data to new standards and the costs of software upgrades which may be necessary before adopting standards.

#### ACTIVITIES TO HARMONISE STANDARDS

Currently there is no powerful process to harmonise existing standards. However, recently there has been a major advance in such activities. In August 2007, a collaborative e-health standards harmonisation group was formed between the European Standardisation Committee (CEN), the International Standardisation Organisation (ISO), and Health Level 7 (HL7). This initiative may potentially be very influential in the future.

All in all, the stakeholders involved in e-health standardisation are increasingly becoming aware of a need to develop the market for standards, and therefore becoming more and more active in this respect. The Member States' e-health large-scale pilot planned to start in 2008, being funded by the ICT Policy Support Programme (PSP), is expected to become a further catalyst in this respect.

STANDARDISATION OF ELECTRONIC HEALTH RECORDS

Introducing electronic health record (EHR) systems and defining related standards is an important topic on the agenda of many European countries and the EC. EHR applications are available for an increasing number of institutions. However, solutions are often isolated without data exchange and interoperability, and they have implemented early and limited EHR versions. Contributing to the delay of more sophisticated EHR implementations is a lack of EU-wide standards for the collection, coding, classification and exchange of clinical and administrative data.

The European Commission currently prepares a draft Recommendation on interoperable electronic health record systems. The Recommendation is intended to support the premise that connecting people, systems, and services is vital for the provision of good healthcare in Europe, and contributes significantly to the establishment and functioning of the internal market by ensuring the free flow of patients' and e-health products and services.

KEY STANDARD DEVELOPMENT ORGANISATIONS AND STANDARDS

Five principal standardisation organisations, a promising open source initiative and a major interoperability initiative can be expected to play a leading role in the further development of e-health standards:

- **ISO,** the International Organisation for Standardisation, as the largest developer of world-wide standards;
- **CEN**, the European Committee for Standardisation, as the principal SDO in Europe;
- **IHTSDO,** the International Health Terminology SDO, as the developer of the fairly widely adopted SNOMED-CT terminology standard;
- **HL7,** Health Level 7, as the developer of the most widely used standards for electronic messages in healthcare;
- **DICOM,** Digital Imaging and Communications in Medicine, as a de facto standard for electronic medical imaging;
- **OpenEHR** as a promising open source activity for electronic health records,
- **IHE**, Integrating the Healthcare Enterprise, as a major e-health systems interoperability initiative.

Understanding the objectives, rationales and constraints of these organisations may help to form viable alliances for harmonising and consolidating standards. However, such a list is necessarily incomplete because e-health is a very complex as well as a fast and constantly changing field.

### *3.4.3 Results of an online survey of e-health experts*

OVERVIEW OF SURVEY METHODS AND KEY FINDINGS

In November 2007, empirica conducted an online survey of e-health experts from ICT industry, user organisations, public authorities, university and research, SDOs, and consultants. 94 experts responded. In general, survey participants confirm a considerable lack of widely used ICT standards in the health sector and negative impacts thereof. Harmonisation of standards is seen as a possible way to improve the current situation. Stronger involvement of representatives from many different stakeholders may, in the opinion of the respondents, improve the e-health standards development process.

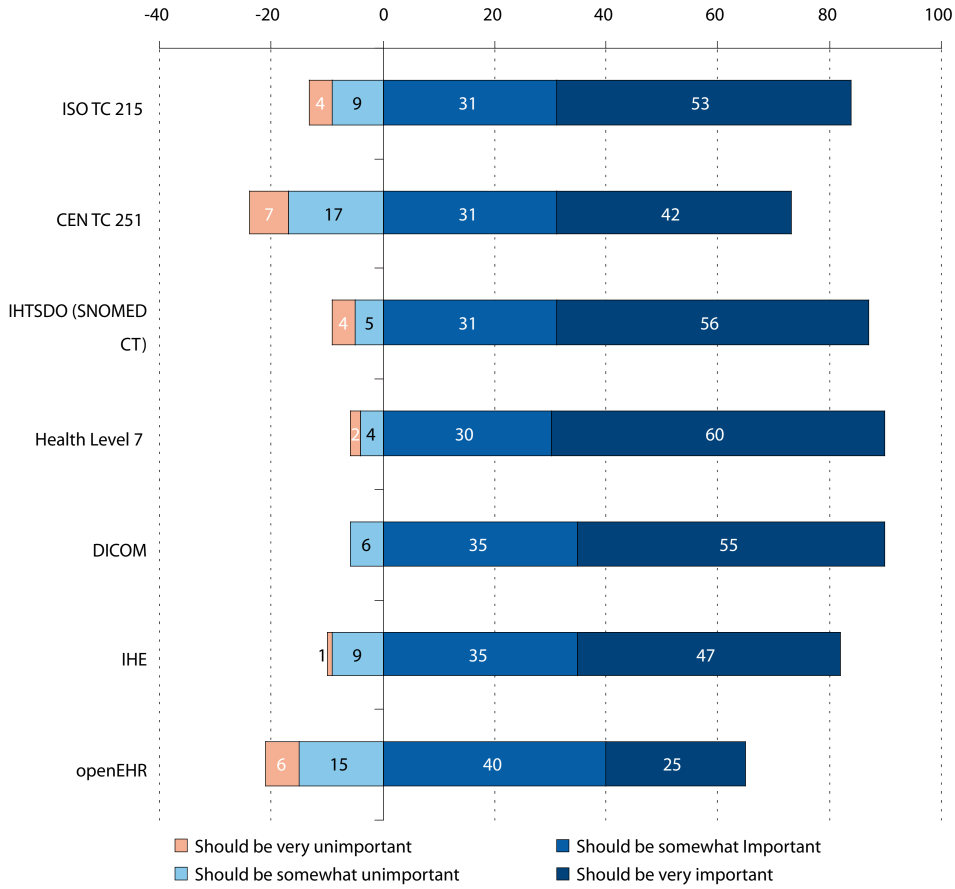
FUTURE IMPORTANCE OF STANDARDS DEVELOPMENT SDOS

The majority of respondents agreed that all seven e-health SDOs mentioned (ISO, CEN, IHTSDO, HL7, IHE, DICOM, openEHR) should be important in the future (see Exhibit 3.4-1). The highest level of importance was attributed to HL7 (60% "very important" and 30% "somewhat important"), followed by DICOM (55% "very important" / 35% "somewhat important") and IHTSDO (56% "very important" / 31% "somewhat important"), ISO (53% "very important" / 31% "somewhat important"), and IHE (47% "very important" / 35% "somewhat important"). Somewhat behind were CEN (42% "very important" / 31% "somewhat important") and openEHR (25% "very important" / 40% "somewhat important").

CURRENT SITUATION IN E-HEALTH STANDARDS

The interviewees were asked to indicate their level of agreement to six statements about the current situation of e-health standards. For all six statements, the majority agreed, but the levels of agreement differed

*Exhibit 3.4-1: Desired future importance of selected e-health standards organisations (in %)*




n = 94 respondents.

Figures do not add up to 100% because of answers of "no response".

Source: e-Health Expert Survey 2007 by the SeBW

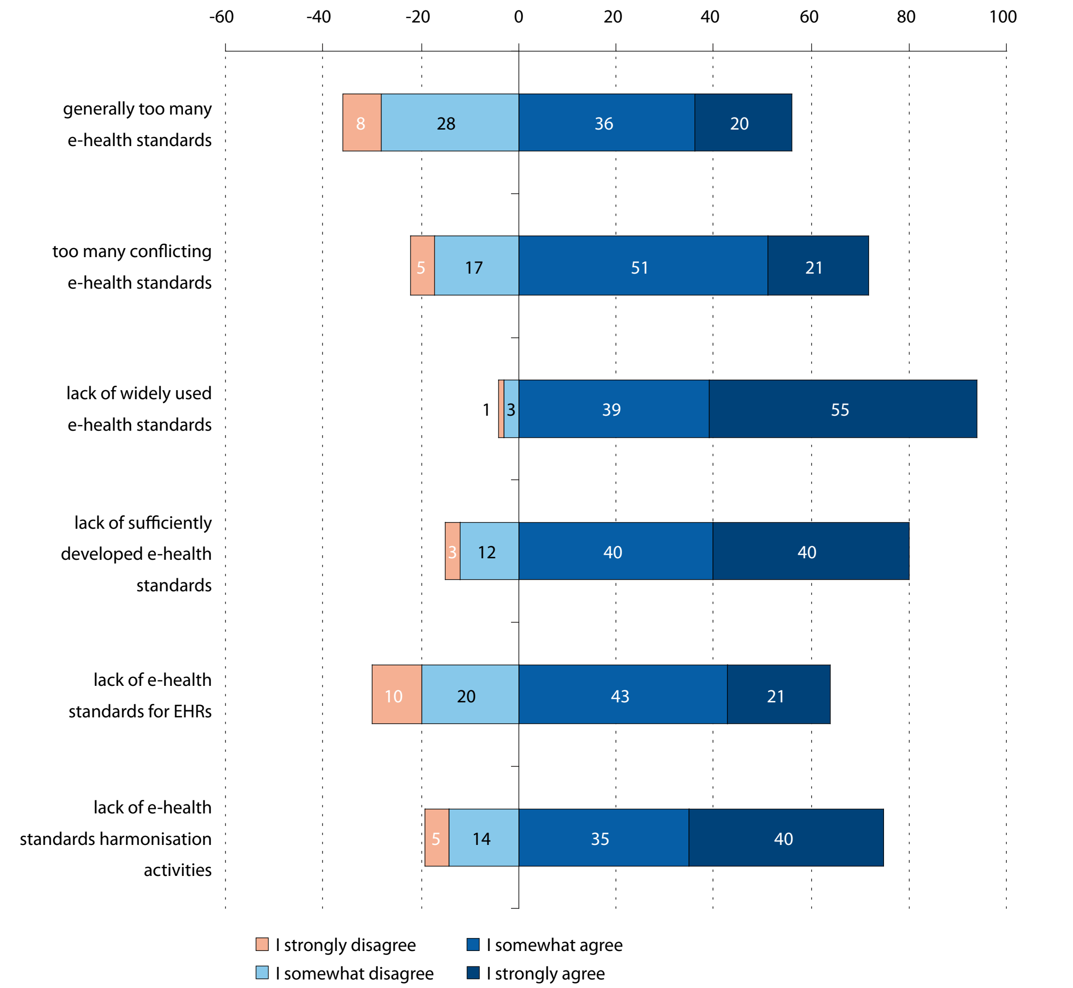
(see Exhibit 3.4-2). Nearly all interviewees agreed that there is a lack of widely used e-health standards (55% "agree strongly" / 39% "agree somewhat"), confirming the basic assumption on which this study was carried out. There was also a high level of agreement that there is a "lack of sufficiently developed e-health standards" (40% "agree strongly" / 40% "agree somewhat"), a "lack of e-health standards harmonisation activities" (40% "agree strongly" / 35% "agree somewhat") and that there are "too many conflicting e-health standards (21% "agree strongly" / 50% "agree somewhat"). A "lack of standards for electronic health records" was strongly agreed by 21% and somewhat agreed by 43%. The smallest level of agreement – but still agreed by the majority – supported the statement that there are "generally too many e-health standards" (20% / 36% ).

There were not many differences between the responses of the various sub-groups. One of the more striking results was that a majority of four of the six SDO representatives disagreed that are "generally too many e-health standards".

## IMPACTS OF THE CURRENT E-HEALTH STANDARDS SITUATION

The survey participants were asked to assess whether the overall situation with respect to e-health standards is supportive in enabling interoperability among health service providers at various institutional levels. It turned out that the level of distance (internal, between several providers, national, cross-border) determines the assessment of how supportive the situation of e-health standards is. The support declines gradually with the more "borders" that have to be crossed to exchange clinical information, from interoperability between several health service providers, within one national health system and in cross-border cases (see Exhibit 3.4-3). Thus there may be a particularly strong need to foster international interoperability of standards. The opinion that the e-health standards situation is favourable for systems interoperability within a single organisation may be due to the fact that single organisations often use proprietary standards or that problems with conflicting standards are manageable.

*Exhibit 3.4-2: Assessment of the current situation in e-health standards (in %)*




n = 94 respondents.

Figures do not add up to 100% because answers of "no response" are included but not shown.

Source: e-Health Expert Survey 2007 by the SeBW

Furthermore, the majority of participants indicated that the current situation is unsupportive for competitiveness of European ICT-for-health companies.

### CURRENT SITUATION IN E-HEALTH STANDARDISATION PROCESSES

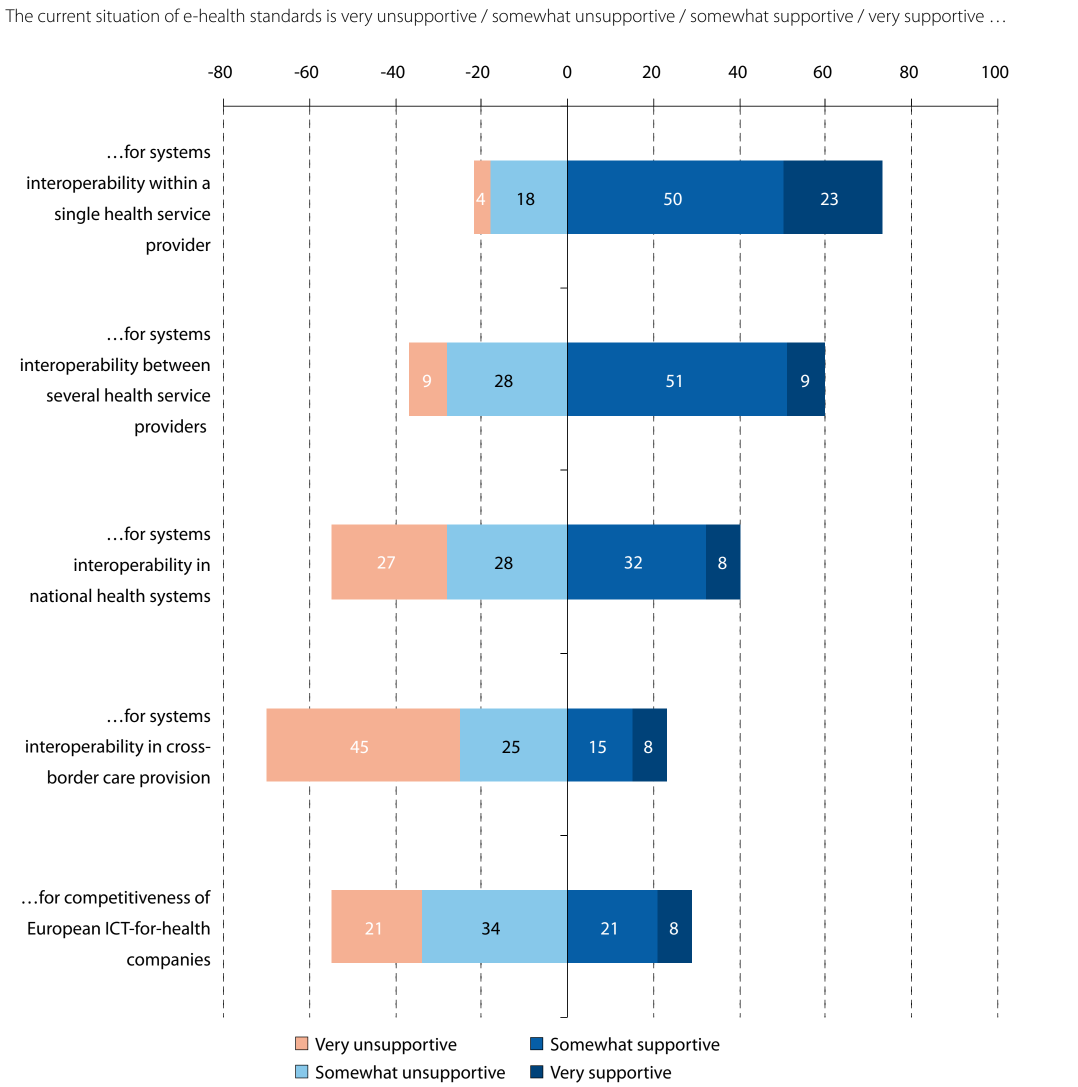
The survey participants were also asked for their opinions about the current situation in e-health standardisation processes. The respondents favoured a stronger involvement in e-health standardisation from many different organisations. More than four fifths of the respondents agreed that e-health standards development processes should be supported more strongly by national governments, should have stronger involvement of ICT user organisations (for example from hospitals), should have a stronger involvement of national competence centres, and that e-health standards development processes are currently too slow (see Exhibit 3.4-4). Stronger support from the European Commission and a stronger industry involvement was favoured by more than two thirds of the respondents.

Corresponding to these answers, only a minority of the respondents supported the statement that e-health standardisation processes currently involve too many players. Furthermore, the majority of respondents supported the statement that e-health standardisation should be more focused on specific applications. This supports the view that e-health standards development should be more orientated towards concrete use cases.

### BARRIERS TO ADOPT COMMON E-HEALTH STANDARDS IN HOSPITALS

This last part of the survey tried to answer the question as to how the survey participants assess the hospital IT managers' knowledge and understanding

**Exhibit 3.4-3: Impact of the current e-health standards situation (in %)**




n = 94 respondents. Figures do not add up to 100% because of answers of "no response".

Source: e-Health Expert Survey 2007 by the SeBW

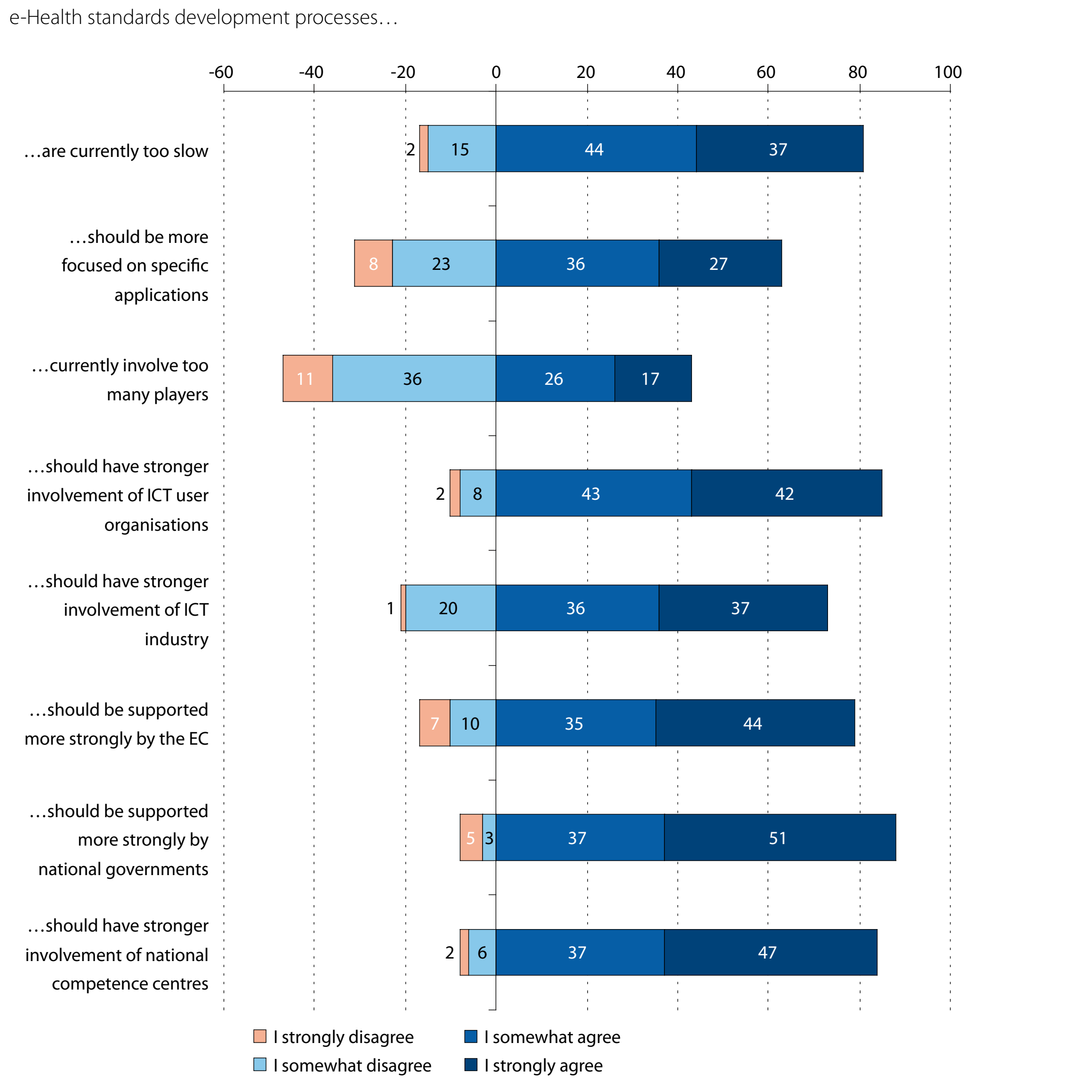
of e-health standards. The hospital CIOs are typically the decision makers when it comes to system procurement and adherence to standards. The statement that was supported most was that "hospital IT managers may find internal process functionality more important than commonly used standards" (see Exhibit 3.4-5). This supports the view that electronic communication with other health service providers is supposedly of little importance to hospitals. However, the respondents did not blame hospital IT managers for this: they agreed that the managers miss financial incentives to electronically exchange information with other health service providers. More than three quarters of the respondents supported the statement that hospital IT managers "find many IT standards too complex", do "not see sufficient benefits of commonly used e-health standards" and "find a lack of authorised certification for e-health standards". Furthermore, the majority of respondents found that hospital IT managers do "not know about the existence of particular e-health standards".

## 3.4.4 Implications for economic performance and policy

### ECONOMIC IMPLICATIONS OF THE CURRENT SITUATION IN E-HEALTH STANDARDS

The lack of interoperability also implies a lack of economic growth and a lack of competitiveness of European ICT manufacturers versus their competitors in other parts of the world. Business analysts

*Exhibit 3.4-4: Current situation in e-health standardisation process (in %)*




n = 94 respondents. Figures do not add up to 100% because of answers of "no response".

Source: e-Health Expert Survey 2007 by the SeBW

assess the market for health information systems in Europe as being huge and largely untapped. However, interoperability problems may be one reason why hospitals and other health service providers hold off investment in ICT. Consequently, growth in companies supplying ICT for the health sector is smaller than it could be. Furthermore, economic growth related to standardisation may develop predominantly in the country or part of the world where a standard has been developed.

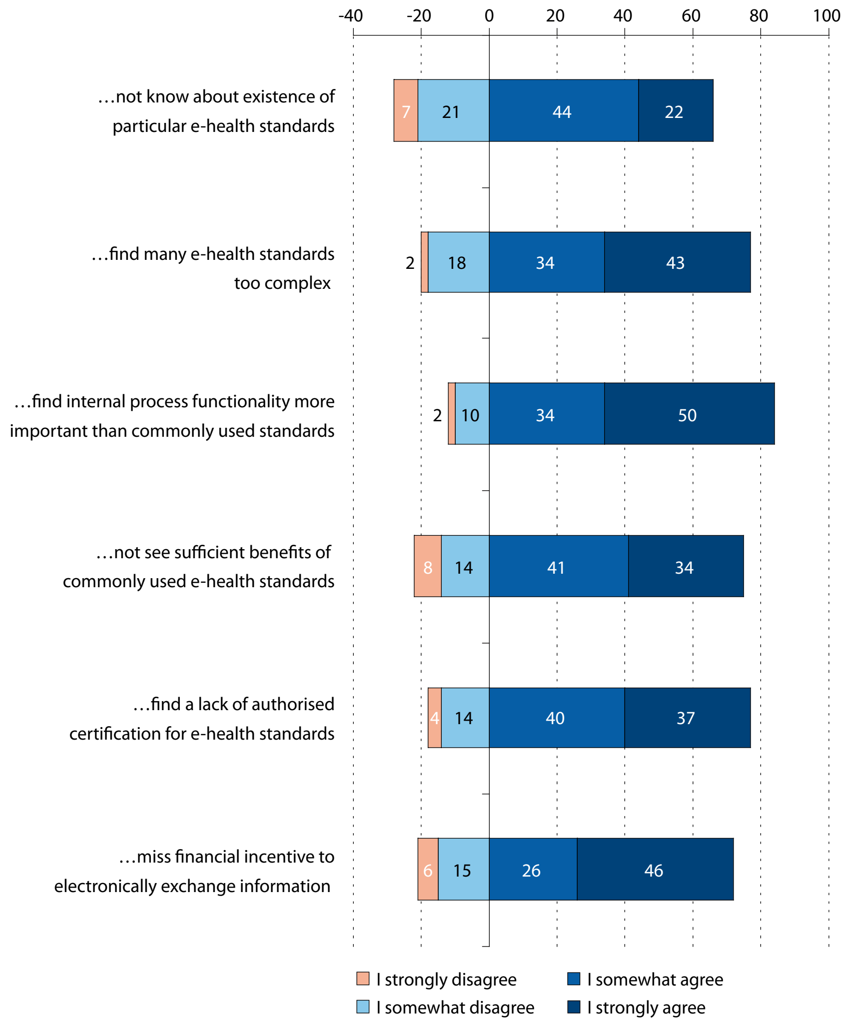
Further economic implications of a lack of commonly used e-health standards are lost opportunities for cost reduction and compromised quality of healthcare. As regards costs, due to a lack of commonly used standards, opportunities for streamlining health service processes and for delivering activity data for more effective accounting and controlling, are lost. As regards health care quality, a lack of information systems integration may prolong physicians' and nurses' access to patient data. Benefits of interoperability would include better care for chronically ill citizens, better quality surveillance and control, improved public health services or benefits for education, training and research.

## POLICY IMPLICATIONS FOR FURTHER DEVELOPING E-HEALTH STANDARDS

In January 2008, the US Department of Health and Human Services recognised certain interoperability standards for health ICT which federal agencies have to include in procurement specifications for certain

*Exhibit 3.4-5: Barriers to adopt common e-health standards in hospitals*

Hospital IT managers may…




n = 94 respondents. Figures do not add up to 100% because of answers of "no response".

Source: e-Health Expert Survey 2007 by the SeBW

fields of health. This could be a step towards mandatory use of a confined number of standards for principal e-health applications. Such a regulation by the US government could have considerable impact in the EU. In order to prevent unfavourable developments, the EC and the Member States may be well advised to develop a common strategy and roadmap for e-health standards development.

A solution for the interoperability challenge in e-health may be the common use of a more confined and harmonised number of well-developed standards. Related efforts by the EC and national governments should involve the following **objectives**:

- Promote an EU-wide agreement on priority standards. Promote an increased uptake of prominent standards, for example those developed by ISO, CEN and HL7, and thereby increase the network benefits of the use of standards.
- Promote the development of standards in applications areas in which there is currently a lack of well-defined standards.
- Promote the harmonisation of key standards that conflict with each other.

In order to achieve these objectives, the following **means** may be used:

- In order to achieve the objectives mentioned, stronger involvement of stakeholders and a closer co-operation between the different SDOs is indispensable. A sound and enduring mechanism for e-health standards life cycle management and consolidation should be established. The collaboration initiative of ISO, CEN and HL7 should be strengthened.

- Stronger involvement of industry and user groups as well as national or regional infrastructure institutions and Competent Authorities in the standardisation process, thereby ensuring that the outcome of the standardisation efforts is highly relevant for them.
- Member States and their national Competent Authorities should become more committed to international e-health standardisation. Currently there is a certain tendency towards focusing on national standardisation activities.

The EC and Member States should implement a **roadmap** for further development of e-health standards. The large-scale pilots for patient summaries and e-prescribing planned to take place in Member States should be further extended to other key applications. The following sequence of applications is suggested here:

- Patient summaries, emergency data sets and e-prescribing which are the subject of the large-scale pilot prepared in the EC's Competitiveness and Innovation Framework Programme.
- Laboratory results may be the next step because they constitute one of the most important parts of patients' medical records and because the development of related standards is quite well developed.
- Medical image management may be another step because it constitutes an important part of medical records and related standards are also quite well developed.

Each step may take three to five years. Consequently, the development of standardised solutions for EHR and e-messaging systems and other advanced applications may take between 10 to 15 years. In parallel it will be mandatory to also develop standards for a European e-health infrastructure. Considering the linguistic and cultural diversity of the Union, standards for securing a certain level of semantic interoperability with respect to priority use cases will also be mandatory in the short term.

### 3.4.5 Key resources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e-Business W@tch

# Foreword by the editors

The Sectoral e-Business Watch cooperates both formally and informally with distinguished professionals and experts from the business, policy-making and research communities. The editors gratefully acknowledge their significant contributions, notably as members of the various Advisory Boards. Their comments on the study reports, their participation and presentations at workshops and their guiding recommendations are particularly appreciated. Therefore, as in previous editions of the European e-Business Report, we invited the Advisory Board members of 2007/08 to present some of their work in the field of e-business in a brief contribution to this report. Furthermore, we invited members of the eBSN Steering Group[87] to present their activities, recognising the success of the eBSN and its valuable contribution to e-business developments in Europe.

In total, about 80 individuals and organisations were invited to contribute expert opinions and articles about their activities to this report. Eighteen statements were received. They reflect policy, industry and research perspectives on e-business and are well balanced in terms of their geographic distribution. The contributions are grouped into three categories: policy (Section 4.1), industry perspectives (Section 4.2), and research on e-business developments (Section 4.3). Within each section, contributions are alphabetically arranged by country (in Section 4.1), by industry (4.2) or by the name of the author (4.3).

The policy initiatives presented in Section 4.1 are examples of how Member States promote the uptake and good use of ICT in businesses, notably among SMEs. This collection is in no way complete and does not claim to be representative of the whole of Europe. However, the sample of activities in seven EU countries, described by members of the **eBSN Steering Group**, is illustrative of the different approaches that countries take in this policy area. The focus of these contributions is on national programmes targeting e-business take-up. There are also plenty of regional development initiatives in Europe which include e-business related actions; it would be beyond the scope of this report to present those as well. However, the design of regional programmes and the instruments used can be expected to be similar.

In order to provide a broader picture and at least briefly mention important initiatives in other countries not covered by the contributions from the eBSN Steering Group, Section 4.1.1 summarises results of a recent eBSN study that focused on sectoral e-business policy approaches and identified good practices in these initiatives.[88]

The contributions received from **Advisory Board members** are presented in Sections 4.2 and 4.3. The majority of these contributions are linked to sectors and topics covered by the Sectoral e-Business Watch since 2006 and highlight a specific issue from the author's perspective. Several of this year's contributions focus on industry-led standardisation initiatives in manufacturing sectors. Another main theme is the implication of the Single Euro Payment Area (SEPA) for the banking sector and for financial services in Europe, a topic which is also discussed in the respective sector study on banking. The following individual contributions were received:

**Dave Wallis** describes how e-commerce standards gain global traction in the oil and gas industry. This sector has not yet been studied by e-Business Watch, but it is strongly linked with the chemical industry. In fact, the industry-led e-business initiatives in these sectors by PIDX (the Petroleum Industry Data eXchange) and CIDX (the Chemical Industry Data eXchange, see sector study of 2008) are also closely related. The author maps the development of current e-commerce standards in the industry. The discussion includes insights into the role of industry organisations in developing and diffusing e-commerce standards.

**Henry Ryan** illustrates how papiNET, another industry-led standardisation development organisation, facilitates e-business implementations in the paper industry. This article is a follow-up to an earlier e-Business Watch sector study on the pulp and paper industry (2006). It highlights the importance of technological interoperability in business-to-business (B2B) relationships, where standardisation can be a fruitful approach to solving problems arising in typical B2B relationships.

**Freddy De Vos** from Arcelor-Mittal Gent, Belgium, describes the perspectives of the European Steel Industry Data Exchange Language (ESIDEL). ESIDEL is an e-business standard that was initiated by the European Confederation of Iron and Steel Industries in order to enable new cooperative business practices. However,

87. The Steering Group of the e-Business Support Network consists of about 40 members, representing all EU Member States, candidate and EEA countries as well as e-business experts from international organisations. See ***www.e-bsn.org***

88. Sectoral e-Business Policies in Support of SMEs. Innovative approaches, good practices and lessons to be learned. A study by empirica, Databank and IDATE on behalf of DG Enterprise and Industry (2007).

further development of the standard was abandoned. The article suggests that the European Commission could promote the idea of further development.

The contribution from **Maria José Nunez** describes the e-business efforts of the technological institute for the furniture, wood and packaging sector in Spain (AIDIMA). These efforts support the diffusion of e-business among small and medium-sized firms in Spain. The focus of the article is a solution called "FunStep" detailing the various applications available. The article concludes that standard compliant systems are a suitable method for driving information visibility in the furniture value chain.

**Reinhard Pfliegl**, Managing Director of AustriaTech, the Federal Agency for Technological Measures, shows how ICT can contribute to the creation of a sustainable transport system. He argues that the development and implementation of Intelligent Transport Systems (ITS) has significant potential in this regard, while at the same time serving the mobility demands of industry and individuals.

**Pietro Evangelista** from the University of Naples presents empirical evidence from a survey of 153 small Italian third-party logistics service providers. The contribution describes the types of ICT used by the small logistics providers and it illustrates issues such as barriers to ICT adoption. The article concludes that the level of logistics innovation in the small Italian third-party logistics providers is quite low, but that ICT can help these firms achieve differentiation by innovation.

**Tatiana-Eleni Sinodinou**, an attorney in Greece, reviews the EU directive 91/250/EEC on software copyright protection and computer programs created by employees. The article is especially interesting for SMEs as it provides recommendations on how to approach software copyright issues in cases where software is created by employees.

**Barry O'Mahony,** an Ireland-based independent e-business consultant, elaborates on the importance of the Single Euro Payment Area (SEPA) and the Payments Services Directive (PSD) as catalysts for change. In the future, payment processes will be open to non-banks, which may fundamentally change financial markets. While many companies have already largely automated their physical supply chains, the automation of financial supply chains should now be on the agenda.

**Peter Potgieser** and **Carlo R.W. de Meijer,** from Market Infrastructures ABN AMRO Bank, Netherlands, point out that electronic invoicing is an essential step in dematerialising business processes. Currently there are barriers – including technical complexity, legal uncertainty and operational constraints – to widespread uptake of cross-border e-invoicing solutions. An expert group of the European Commission is currently working on a framework solving these problems.

The **Observatory for the Greek Information Society** has carried out a survey based on the methodology of the Sectoral e-Business Watch. This enables the observatory to benchmark ICT adoption among Greek companies from different sectors against the situation in other countries. The article presents some results of the survey in Greece. It concludes that the business climate for ICT and for the ICT industry in Greece is showing signs of significant improvement since observation first began.

**Bernard Aebischer** from the Centre for Energy Policy and Economics (CEPE) in Switzerland explores the effects of ICT on energy consumption and future electricity demands. In his article, Dr. Aebischer illustrates ICT and energy consumption using real-life examples, discussing effects in the manufacturing and building automation areas among others. The article concludes that Spreng's (1993) time-energy-information triangle is a suitable approach for studying the effects of ICT on energy demands.

Providing a platform for networking and exchanging ideas with international experts has become increasingly important for the work of the Sectoral e-Business Watch. The articles presented in this chapter should be seen as an expression of this ambition. We hope that the cooperation with the authors, as well as with all the other experts that have contributed to our work in the past, can be continued in the framework of the forthcoming work period, which is planned to start in September / October 2008. The editors would like to thank all contributors for sharing their expertise and taking the time to provide the articles.

*Stefan Lilischkis, Hannes Selhofer, Maria Woerndl (empirica GmbH), Hasan Alkas (DG Enterprise and Industry)*

## 4.1 e-Business policy initiatives in the EU

### *4.1.1 Good practices in sectoral e-business policy approaches*

In recent years, several EU Member States, including France, Germany, Italy, Portugal and Spain, have launched initiatives to promote e-business exchanges within specific sectors. A key objective of these initiatives is to strengthen the participation of small and medium-sized enterprises (SMEs) in larger firms' digital supply chains.

As documented in this report (see summaries of sector studies), large companies are increasingly streamlining and integrating their procurement and supply-chain processes. Smaller firms in lower tiers of the value chain risk elimination if they cannot comply with their customers' technical requirements – with negative effects for regional or national economies. Policy initiatives aim to counteract this digital divide, arguing that intervention will create a win-win situation for all players and positive overall effects. Against this background, the e-Business Support Network (eBSN)[89] of DG Enterprise and Industry issued a study in 2007 to assess sectoral policy approaches and to identify best practices in these initiatives.[90] This section summarises the main findings of this study.

SECTORAL POLICY APPROACHES RECOMMENDED

A key question for this eBSN study was whether sectoral e-business initiatives were more effective than other programmes. The study rejects a simple "yes" or "no", as this would not do justice to the complexity of the underlying topic. It points out that initiatives with a sectoral focus are not necessarily successful or superior to other approaches. However, the study concludes that sector-focused approaches in e-business programmes can be recommended. The policy initiatives analysed were in many ways innovative and contained several good practice elements and lessons to be learned. The sectoral focus was found to have two main advantages:

- the improved **involvement of stakeholders**, notably the strong commitment and support from industry associations; and
- its suitability for addressing **advanced e-business** goals (such as data exchange models for specific value chains), where there is inevitably a trade-off between depth and scope.

A sectoral focus is nevertheless neither a guarantee of nor a condition for success. The decision to focus on specific industries must derive from the objectives of the initiative. Initiatives which focus instead on the deployment of specific ICT-based processes, irrespective of the sector, have also given rise to success stories. The study also found challenges to the sectoral approach, in particular the typically **cross-sectoral characteristics of value chains**. Most SMEs trade with different sectors. "Sectoral" projects therefore need to operate in two layers, with intra-sectoral nodes and cross-sector nodes. The harmonisation of data exchange models across sectors will probably be one of the key ICT-related issues in the future.

THE MOST SUITABLE TARGET SECTORS

Another question for this study was to assess which industries would be most susceptible to sectoral e-business support programmes, i.e. where programmes would be most effective. Many of the existing policies focus on **manufacturing** sectors, and in particular on the textile and automotive industries. This is no coincidence. e-Business has great potential in manufacturing sectors with deep and well-structured supply chains, in particular if there is still substantial scope for ICT adoption (e.g. in the textile industry). Moreover, the use of **standards for data exchange** (such as electronic catalogues and transaction standards) is generally less advanced in manufacturing sectors than in, for instance, retail.

SPECIFIC RECOMMENDATIONS FOR FUTURE INITIATIVES

The study recommends that sectoral programmes should continue, taking into account the cross-sectoral dimension, if necessary. In addition, the following specific points should be taken into account when planning e-business policies:

1. **Recognise the importance of general management skills.** The next generation of policy initiatives

89. The European e-Business Support Network for SMEs (eBSN) was established in 2003 by the European Commission, in response to high-level political focus on the important role of ICT in boosting the competitiveness of the overall EU economy. Particular attention has been paid to the role of SMEs, as well as to improving the effectiveness of public SME policies in fostering competitiveness by promoting the productive use of ICT.

90. Sectoral e-Business Policies in Support of SMEs. Innovative approaches, good practices and lessons to be learned. A study by empirica, Databank and IDATE on behalf of DG Enterprise and Industry (2007).

should focus more on the effective and efficient use of ICT and e-business among SMEs. Consideration should be given to enhancing non-technical ICT-related skills such as organisational planning and process management. Planning and decision-making on e-business strategies in SMEs is first and foremost the responsibility of the management, not of the IT department, even where one exists.

2. **Ensure ease of participation – but demand documentation of results.** Programmes should take great care to avoid complex administrative requirements which can discourage SMEs from participating - or even from applying. However, where SMEs benefit from a grant, they should share their experiences, documenting their projects, and including information on the challenges they faced and an assessment of the outcomes.
3. **Focus on harmonising data exchanges - within and between sectors.** The essence of e-business is the substitution of paper-based processes with automated or semi-automated digital processes. European support should continue to help SMEs develop this capability, which is crucial for participating in global supply chains. There is a role here for policy, as well as for business advisors, SME support networks, chambers of commerce and trade associations.
4. **Enhance knowledge sharing and cooperation.** Positive attitudes towards cooperation among SMEs should be encouraged. Cooperation in networks, at regional level or industry-specific, should be promoted. It is important, however, that these networks are coordinated and moderated by experienced, unbiased and ICT-neutral advisors. A good benchmark for manufacturing sectors in this respect could be the tourism industry, where the joint marketing of whole regions has long been common practice.
5. **Use modular approaches in policy design.** The complexity of more advanced e-business goals (e.g. value-chain projects) requires longer programmes with higher funding. To retain flexibility and adaptability to new developments, a modular approach is recommended (e.g. implementation in 2-3 phases). Several initiatives analysed for the study reported that the two-phase approach they used offered significant advantages.
6. **Consider cross-border and European dimensions.** Most of the current initiatives have a regional or national focus. However, as most of them deal with the use of internationally accepted standards for data exchange, the effects will not be restricted to exchanges within national markets. If a single e-business market is to be successfully developed, it is important to identify and address the issues that will make it possible.

## GOOD PRACTICES

The following examples of best practices refer to specific activities within the 15 policy initiatives analysed for the study. They are not exhaustive; more good practices, and information about the conceptual framework used to identify good practices, are available in the study report.

The study found a trend towards **larger initiatives** that are more selective in their approach, but that pursue a replication of activities in different regions or sectors, based on a single chosen approach. These initiatives function at micro level, but under an umbrella of central coordination that aims at achieving replicable outputs and outcomes. Another emerging characteristic of these initiatives is increased responsibility of the participating organisations.

In longer-term or even open-ended initiatives, a **modular structure of the programme** allows flexibility. The modular concept can be applied in a sequential or synchronous way: programmes can be implemented in a series of successive phases, or they can offer different types of services in parallel. Both approaches facilitate the adaptation to new requirements.

The possibility of involving a broad range of actors and gaining from networking was a component of many of the policies analysed. The sectoral focus is a facilitator in this respect, as it "naturally" drives the involvement of industry stakeholders and experts with sectoral background and reputation. It also makes it easier to involve industry associations and chambers of commerce in the promotion and dissemination phase. These organisations often play an important role as intermediaries, for example in resolving conflicts of interest or removing concerns about competition.

Several initiatives demonstrate how to successfully **involve and network with research organisations**. It is widely recognised that the knowledge transfer from universities and research centres to

SMEs is an important driver and enabler of innovation; the critical factor is to establish the right platforms and channels that enable this transfer.

The empirical evidence on the impact of e-business implementation projects is often not well documented. Many initiatives that provide grants to companies pay little or no attention to the evaluation and documentation of the outcomes and the challenges experienced. This neglect is a mistake, because the information is essential for a better understanding of success factors and for optimising the design (and effectiveness) of similar initiatives in the future. In addition, investments in ICT-enabled process improvement must increasingly be justified by demonstrable payback within acceptable timeframes.

A good-practice element is therefore to assess or even measure the **return-on-investment**, with **documentation of project results**, which can then be used as show-cases. Several initiatives reported that showcasing effects are even more

**Good practice example**

*The approach adopted by the **DDTA** initiative[91] in Italy is innovative in the Italian context, with its organisational model combining top-down and bottom-up approaches. This model is based on the central (government) coordination of activities implemented at district level. Central coordination allows increased efficiency and facilitates collaboration with international stakeholders, e.g. in the field of standardisation.*

**Good practice examples**

*The **"Digital Netherlands"** initiative (see article in this chapter) successfully uses a kind of "cafeteria model", which, broadly speaking, could be equated with a modular programme. Instead of a monolithic structure, services are offered as a broad suite of stand-alone programmes, permitting participants to select those that best fit their needs.*

*The **"Digital SME"** programme in Portugal (see article in this chapter) was split into two phases, each with specific objectives and activities. During the first phase, sector-specific support networks were established for reaching a large group of firms; in the second phase, projects specific to firms were supported at three levels of e-business sophistication.*

**Good practice examples**

*The **ALFA** initiative[92] in France successfully leveraged "regional leadership": implementation has benefited from the active involvement of local/regional promoters who are well connected with regional business networks and have good contacts with CEOs or owners of the targeted SMEs. These local "ambassadors" managed the regional implementation of ALFA projects.*

*In Slovenia, the **eSLOG** initiative[93] aimed at specifying document standards for B2B e-commerce in Slovenia, with special consideration of SME needs. This required a long consensus-building process among many private- and public-sector stakeholders. To achieve consensus, the consultations sometimes lasted several months; however, once targets were agreed upon, their execution was simple and fast.*

91. DDTA – Digital Districts in the Textile and Clothing Sector (see ***www.ddta.it***)
92. ALFA – Improvement of Business Relations in the Automotive Industry (see ***www.galia.com***)
93. eSLOG – e-Commerce in the Slovene Economy (***www.gzs.si/e-poslovanje***)

pronounced if delivered in a peer-to-peer context. The exchange and dissemination of **best practices** (and of learning points from less successful projects) emerged as a best practice element that benefits the community at large. This is crucial for expanding the range of potential beneficiaries, as cultural constraints and inhibitions can thus be overcome.

**Good practice examples**

*The **buildingSMART** initiative[94] in Norway, which focuses on ICT usage in the construction industry, is supported by research organisations and academic institutions such as Sintef Byggforsk (SINTEF Building and Infrastructure) and NTNU (the Norwegian University of Science and Technology). These organisations not only contribute expertise and project resources, but also support the dissemination and promotion of activities through their own networks.*

*An innovative feature of the Finnish **VERSO** technology programme[95] is the internationalisation of the business activities of Finnish companies. VERSO supports firms' growth beyond their regional and national domains and opens their business towards the global market, not only to increase the export of their products and services, but also to foster international cooperation.*

*The concept of the German **TASK** pilot projects[96] – to work on architectures for "software supply chains" – is rooted in work of the regional research association PRIMIUM, which brings together about 20 universities, research organisations and companies in Baden-Württemberg. The project was well embedded within regional technology transfer programmes and networks.*

**Good practice examples**

*Several initiatives presented in this booklet are benchmarks when it comes to documenting SME e-business project results, and to linking this process with the provision of grants.*

*The French **ICT-SME 2010** initiative (see p. 21), for instance, is strictly results-oriented. The French Ministry supports industry projects on condition that their results will impact the competitiveness of SMEs and the overall economic sector. The programme manager explains: "Of course, there is no certainty whether a project will really have an impact, at least not before it is completed. However, it is possible to prevent a project that is not effective from starting at all, or at least from going too far when there are indications of ineffectiveness." To this end, milestones were defined for each selected project. The funding of subsequent project phases is delayed or even cancelled if the requirements are not met.*

*The German **PROZEUS** initiative[97] is an outstanding example in its focus on showcasing SME e-business projects. The projects are not only documented in detail on the initiative's website (**www.prozeus.de**), a possibly unique source of unbiased information about e-business projects; they are also presented at events, and, whenever possible, by senior representatives of participating firms. PROZEUS also cooperates with multipliers (e.g. the competence centres) in the wide dissemination of good practice examples and lessons learned.*

*A special case is the Canadian **Supply Chain Logistics Metrics project**[98] in Canada, where the key project goal was establishing a benchmarking method for assessing supply-chain efficiency.*

94. see **www.buildingsmart.no**
95. VERSO – Vertical Software Solutions (see **www.tekes.fi/verso**)
96. TASK – Programme for Establishing Software Supply Chains (see **www.doit-task.de**, **www.task.de.com**)
97. PROZEUS – Processes and Standards (see **www.prozeus.de**)
98. see **www.strategis.ic.gc.ca/logistics**

### 4.1.2 *France: enhancing competitiveness through ICT*

**by Marc Moreau**

*Marc Moreau is Head of the Information Society and Security Office at the French Ministry of the Economy, Industry and Employment, General Directorate for Enterprise. He is responsible for the definition and implementation of innovative policies to promote and develop ICT usage in the business sector. He is the National Delegate to eBSN – the European eBusiness Support Network for SMEs.*

OUR MISSION AND OBJECTIVES

The role of the General Directorate for Enterprise is to prepare and implement French policy to enhance business competitiveness, stimulate innovation, and develop the information society within a European and international framework. ICT and e-business solutions are considered as key factors for the competitive position of companies, but the adoption of ICT by the French economy was assessed to be lagging behind that of other European countries and the USA.

The Directorate is implementing sector-focused policies in cooperation with professional organisations such as the "TIC&PME 2010" action plan, as well as technology-oriented actions which focus for example on RFID, GNSS and mobile services. The primary targets of these policies are the SMEs, because they suffer most from limited understanding of ICT, limited budgets for ICT investments and difficulty in recruiting ICT professionals.

OUR CURRENT ACTIVITIES

The most well-known action is the **TIC-PME 2010 initiative** (see ***www.ticpme2010.fr***). It aims to support co-operative initiatives by actors at distinct levels in the value chain who have the potential to improve performance and competitiveness and to focus on processes and exchanges that take place within the value chain or sector. The first step was to support sectoral projects to develop best practices and standards for implementation in specific value chains/sectors. Two call for projects were launched in 2005 and 2006. The second step is the regional deployment to promote the adoption of the sectoral solutions and standards among companies, with the support of regional stakeholders and the network of Regional Directorates for Industry.

Another current initiative is the "**Businessmen, choose the digital economy**" action plan, which has been designed to:

- carry out a communication campaign on radio and in newspapers to promote the advantages of the digital economy for SMEs and very small enterprises;
- introduce and explain the new uses of information technologies to managers of small enterprises, through thematic modules. Three modules is the minimum requirement to obtain the "Passport for the Digital Economy".
- promote the emergence of offers adapted to the needs and expectations of small enterprises in terms of equipment, counselling and funding.

The objective is to introduce new ways of using ICT to at least 200,000 micro and small enterprises within two years.

**Other activities** include dedicated calls for projects to support research, development and innovation focused on key technologies like GNSS (***www.telecom.gouv.fr/uliss***) and RFID (***www.telecom.gouv.fr/rfid***).

SECTORS IN FOCUS

All sectors can benefit from using ICT, whether as a tool for supply-chain optimisation, for planning and management, in production, or to support trade. We believe that the key success factor is the willingness of company managers to accept change in the way they do business. In the TIC&PME 2010 action plan, projects have been launched in agriculture, forestry, fisheries, confections, footwear, watch making, furniture, automotive, aeronautics and aerospace, electric and electronic components, wood and paper, packaging, transport services and logistics, finance, toys, perfumes and cosmetics, optical and medical instruments, biotechnologies, construction and public works.

### 4.1.3 Ireland: mainstreaming e-business among SMEs – activities of Enterprise Ireland

**by Eoin O'Siochru**

*Eoin O'Siochru is Manager at the eBusiness Unit of Enterprise Ireland, a State Development Agency.*

#### OUR MISSION AND OBJECTIVES

Enterprise Ireland's eBusiness Unit is deeply committed to mainstreaming ICT adoption and e-business within its client base of indigenous companies. To that end, Enterprise Ireland undertakes a wide range of activities, including the following:

- Embedding ICT management skills in SMEs;
- Knowledge events;
- Building awareness of the impact of new technologies on businesses;
- Promoting the use of ICT as marketing and sales channel;
- Conducting ICT reviews with client companies as part of overall business reviews;
- Improving access for SMEs to top-class ICT business consultants

#### OUR CURRENT ACTIVITIES

As part of its existing funding offer to clients, Enterprise Ireland introduced the eBusiness Management Initiative (eBMI) in 2006. This builds on the success of previous e-business support initiatives funded by the Information Society Action Fund and supported by the Department of Enterprise, Trade and Employment.

The objective of the programme is to improve the productivity and competitiveness of SMEs through the absorption of appropriate Information and Communication Technologies and the development of ICT management skills. As of the end of 2007, more than forty clients have received support under the eBMI, resulting in a commitment of over €500,000.

#### SECTORS IN FOCUS

Enterprise Ireland raises awareness and disseminates knowledge about the impact of ICT developments at a business level, through its dedicated eBusiness website (***www.openup.ie***) and electronic newsletter (eBusiness Live). As part of an ongoing campaign, Enterprise Ireland highlights security and business continuity as core issues for senior managers, given the potential impact on core operations and customer service if there are weaknesses in these areas. The website currently has an average of 1,800 visitors a week and there are over 4,000 subscribers to the eBusiness Live electronic newsletter.

#### EMERGING TRENDS AND CHALLENGES

The eBusiness Unit in Enterprise Ireland promotes to client companies the marketing and sales opportunities presented by new technologies. Enterprise Ireland is a partner in the European initiative: eMarketservices. This is a web-based service providing information and specialist knowledge on e-marketplaces. e-Marketplaces are web-based B2B trading platforms that are increasingly being used for international sourcing and sales. There are currently over 800 e-marketplaces listed on the eMarketservices web site, with services including directories, classifieds, RFT service, reverse auctions, on-line ordering and on-line payments. These trading platforms can be a cost-effective and efficient way of establishing new international business relationships and can provide easy access to the technology that makes on-line trading possible.

The eBusiness Unit in Enterprise Ireland regularly organises knowledge events and in October 2007 hosted an e-Marketing Workshop in Croke Park Conference Centre, attended by 110 clients. The main focus of this event was to highlight the importance of best-practice promotion of on-line presence as a way of entering international markets. Two scaled-down versions of this seminar are planned for 2008 and will be held in regional locations.

### 4.1.4 Malta: promoting e-commerce

**by Karl Herrera**

*Karl Herrera works for the Malta Enterprise Corporation, a government agency promoting industrial development in Malta. He helps develop incentives to support the growth of SMEs. These include tools to encourage enterprises venturing towards ICT, and business solutions as a means to business innovation and expansion.*

#### OUR MISSION AND OBJECTIVES

Malta Enterprise (***www.maltaenterprise.com***) is a government agency responsible for the promotion of foreign investment and industrial development in Malta. Its mission is to sustain Malta's overall competitiveness by creating measures to develop successful enterprise in Malta. Malta Enterprise also offers assistance and advice to enterprises seeking to learn more about business and investment opportunities available. Malta Enterprise develops and administers a number of support measures to sustain the development and growth of enterprises. These measures are designed to address general economic growth without causing any distortion to competition.

#### OUR CURRENT ACTIVITIES

Malta Enterprise strongly believes that ICT and e-business are tools which enterprises can utilise in order to develop their innovative capacity and eventually improve their competitiveness and their position in the market. In recent months Malta Enterprise has launched a tax incentive to support enterprises investing in e-commerce solutions. This should lead to more products and services being made available to consumers on-line, reducing transaction costs for both the enterprise and the consumer. The incentive is aimed mainly at existing small businesses that might find it difficult to justify the cost and associated risk of venturing into e-commence.The incentive supports small and medium-sized enterprises by providing a tax credit on pre-approved e-commerce projects. The tax deduction is based on the costs incurred for the purchase of hardware and software and the development of e-commerce solutions, and may be utilised by the enterprise against any tax due. Malta Enterprise is also supporting enterprises in building up their internal ICT capacities, by providing employees and individuals with the opportunity to attend ICT-related courses and claim back their costs through the tax system. People on general academic or industry-led courses are eligible for this support. The aim is to increase human resources capacities in the ICT field, and to provide enterprises with easier access to the knowledge and resources they need to develop ICT and e-business solutions. Malta Enterprise also promotes the use of ICT and e-business through other schemes, since enterprises seeking support are expected to include IT as part of any proposed projects.

#### SECTORS IN FOCUS

Malta Enterprise focuses its support mainly on manufacturing, related services and other high-value-added activities such as research & development, ICT, eco-innovation and biotechnology. We believe that ICT can have a positive impact in all sectors. Most companies in the manufacturing industry have experienced an increase in global competition and have found new players competing for their established markets. To survive in this scenario, enterprises must constantly invest in innovation; ICT provides a key tool to support the development of innovative products and processes.

Additionally, sectors of industry that are known to provide higher-value services such as healthcare, education, financial services, logistics and maritime services are increasingly dependent on ICT as a key element for improving quality and efficiency and for reducing cost in their business operations. ICT can have a major economic impact if small operators, especially in manufacturing, start developing or adopting ICT solutions that support the development of their business. By doing this, small manufacturing enterprises can develop networks and clusters (even when they are geographically dispersed) that support participants in achieving or retaining competitiveness.

#### EMERGING TRENDS AND CHALLENGES

ICT can have a significant impact when implemented across value chains. This allows enterprises to work more closely together, and to reduce costs and time for development and turnaround. The strength of future developments in e-commerce and e-business lies in the capacity of industry players to consolidate diverse and geographically distant markets into single virtual marketplaces, accessible from anywhere, at any time, by using standardised tools and interoperable platforms. This may be facilitated within a European context through the support and development of various industries standards.

### 4.1.5 Netherlands: promoting digital value chains

**by Jan Julianus**

*Dr. Jan Julianus is Senior ICT-policy advisor in the Dutch Ministry of Economic Affairs. He is involved in the implementation of the action plans on SMEs & ICT, on e-invoicing and on Open Standards and Open-Source Software. He is the National Delegate to eBSN – the European eBusiness Support Network for SMEs.*

#### OUR MISSION AND OBJECTIVES

The Ministry of Economic Affairs promotes SME innovation with ICT through its action plan entitled "*Netherlands Digital in Connection 2007-2010*". The action plan aims to raise awareness about digital value chains by conducting and up-scaling pilot-projects in different sectors. Complementary to this initiative is another action plan with a focus on e-invoicing to the government in public procurement procedures. The goal is that 10% of invoices to the government (i.e. approximately 3.5 million invoices per year) should be received and processed electronically by 2010. Our overall objective with these action plans is for The Netherlands to keep its position among the leading adopters of e-business in Europe. The European e-Business Readiness Index of 2007, for example, ranks The Netherlands second in "ICT-usage" and fifth in "ICT-adoption". The underlying rationale for our policy is that we observe some market failure in the usage of ICT by SMEs, due to a lack of transparency of ICT-markets and awareness about ICT-developments and opportunities. We expect that our focus on supporting digital value chain projects in the "Netherlands Digital in Connection" action plan will help counteract this, for example by lowering the transaction costs for SMEs. Moreover, we expect that the activities will contribute to increasing labour productivity.

#### OUR CURRENT ACTIVITIES

The main policy initiatives in the field of e-business are the following two action plans:

- "Netherlands Digital in Connection 2007-2010" ("Nederland Digitaal in verbinding" – Ndiv, see ***www.syntens.nl/ndiv***) uses a mix of instruments, such as workshops, the dissemination of information material and the up-scaling of ongoing pilot-projects. The main stakeholders involved are Syntens (an agency of regional innovation advisors catering to SMEs), SenterNovem (an agency of the Ministry of Economic Affairs promoting innovation), Media Plaza (organising the workshops), trade associations, and of course the targeted beneficiaries – the SMEs.
- The action plan on e-invoicing to the government has as its main stakeholders government purchasing departments, suppliers and software vendors. The activities aim at reducing uncertainties (e.g. which standards to use, legal issues) by conducting pilot projects.

#### SECTORS IN FOCUS

In principle, the Ndiv action plan is open to companies from any sector. A market survey showed that there is a great untapped potential for e-business notably in building and construction, agriculture, food, flowers and bulbs, transport services, retail, shipbuilding, and business services. The action plan on e-invoicing will involve several agencies of the Dutch government and their main suppliers. One of the pilot projects will involve the tax office and the temporary work agencies, where invoices for working hours of temporary workers will be sent according to the open standard hr-XML.

#### EMERGING TRENDS AND CHALLENGES

We expect that in the coming years the greatest e-business-related challenge for SMEs, but also the greatest opportunity, will be to get connected in the emerging digital value chains. This overall challenge can be broken down into three main areas:

- in terms of business processes, we believe that key issues in the next few years will be **e-procurement** (including public e-procurement) and **e-invoicing**;
- in terms of framework conditions, it will be important to promote **open standards** and interoperable ICT-systems without a vendor lock-in, and to take measures to ensure **trust**[99] and **safety** in a digital environment;
- In terms of technology development, we see two main emerging trends: first, the use of **RFID** for advanced tracking and tracing options; second, the use of **open-source software** for open innovation solutions.[100]

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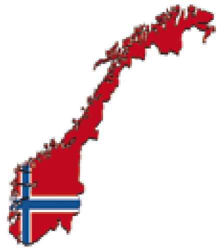
99. For example with regard to using electronic certificates (entity authentication, date confidentiality, data integrity, non- repudiation, privilege management).
100. See for example the evaluation of OASE, an open-source software stimulating programme OASE 2002-2007, available at ***http://ec.europa.eu/enterprise/e-bsn/policies/national/netherlands/documents/pdf/evaluation_oase.pdf***.



### 4.1.6 Norway: the National e-Business Programme – ready for knowledge-sharing

**by Roald Magne Johannessen**

*Roald Magne Johannessen is Senior Adviser in the Department of Industry and Technology at Innovation Norway, a state-owned company founded in 2001, promoting nationwide industrial development. He is manager of the BIT Programme, which is run by Innovation Norway.*

#### OUR MISSION AND OBJECTIVES

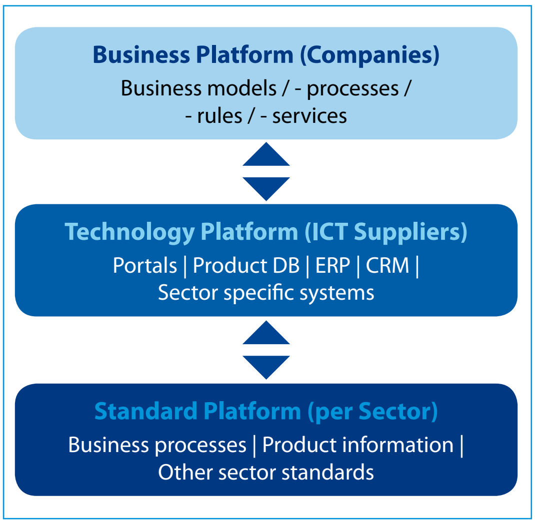
The mission of Innovation Norway is to promote nationwide industrial development. This has to be achieved in a way that it is profitable to both the business economy and Norway's national economy, and that helps realise the potential of different districts and regions. Specific objectives within this broader context are to support innovation activity, internationalisation and the promotion of Norwegian enterprises.

Innovation Norway is a state owned company with more than 700 employees. The head office is located in Oslo, but it has offices in all the counties of Norway and in more than 30 countries worldwide. Our core group of clients are Norwegian companies, predominantly SMEs.

#### OUR CURRENT ACTIVITIES

One of the major Norwegian initiatives to develop business innovations based on strategic use of ICT-technology is the "BIT-Programme" (Business intelligence technology enabler), a national programme governed by Innovation Norway. Its purpose is to develop more efficient and strategic business processes and concepts within specific industries.

*Exhibit 4.1-1: The BIT platform model*




Since the BIT Programme was established in 1997, over 500 projects have been launched, most of them managed by national industry organisations. Projects include companies from about 50 sectors, and have generated significant results and know-how. Knowledge transfer is now increasingly becoming international. The 500 BIT projects have been targeting internal and external business processes for SMEs in sectors that are important to the Norwegian economy. Their common goal is to secure and improve the competitiveness of these SMEs, both nationally and internationally. The level of ambition is reflected by accumulated projects which have a scope of about € 160 million.

The BIT Programme has developed a specific approach for ICT adoption, branded as the «BIT approach». BIT argues that two strings of development have to be promoted in parallel in order to enable sustained and beneficial use of ICT. On the one hand, companies need to integrate their technology platforms internally to optimise their value-chain and process efficiency. On the other hand, companies need to agree on shared industry standards. To achieve this goal, the BIT Programme has developed a platform model which is used throughout the BIT projects (see Exhibit 4.1-1).

#### SECTORS IN FOCUS

The BIT programme has focused on the tourism, furniture and building industries. For instance, to meet increasing demands for internationalisation in the furniture sector, both from foreign retail chains in Norway and from Norwegian manufacturers operating abroad, electronic communication with the international marketplace is essential. To ensure efficient market information, the emphasis is on easier monitoring, improved payment and improved ordering processes. To maximise the impact on the marketplace, "virtual stores" have been established where suppliers' showrooms are fused with the chain stores on the basis of mutual agreements.

#### EMERGING TRENDS AND CHALLENGES

In the next three-year period (2008–2010), the BIT Programme aims to focus on knowledge transfer, building on the momentum created by established BIT projects. Specifically, BIT aims to intensify the dialogue with European national governments and representatives about possible cooperation projects. Project resources will become more accessible internationally through compendiums and digital platforms. Four issues have been identified as particularly relevant for knowledge transfer and further action:

- **The role of government:** The BIT programme has shown that companies will not be able to perform or influence standardisation on their own. Government has a role as a neutral moderator in these processes.
- **The business intelligence dimension:** BIT will increasingly focus on the more sophisticated use of ICT and complex e-business approaches along sector value-chains. Trade organisations will manage projects in their own sector and be strategic partners for Innovation Norway to support the market transfer.
- Finally, in terms of organising the BIT Programme, four project types have been developed and proven successful: **(i) company projects** that are mainly concerned with solutions to improve the companies' internal business processes; **(ii) value-chain projects** with the emphasis on solutions covering the entire value chain from production to market; **(iii) cross-border projects** with the emphasis on standardisation to improve market access; and **(iv) cross-sector activities** that cannot be assigned to a single company.

### *4.1.7 Portugal: establishing a national e-Business Support Network*

**by José António Feu**

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#### OUR MISSION AND OBJECTIVES

The mission of DGAE is to foster and develop a more favourable environment for business competitiveness and innovation, to support the design, diffusion and assessment of policies for manufacturing, trade, tourism and services, and to assure coordination of international relationships in areas of MEI responsibility.

The specific objectives of DGAE in this field, and more particularly, of the Department for Innovation and Business Competitiveness, are:

- to foster ICT uptake and the adoption of new technologies by industry, trade, tourism and services;
- to encourage the development of systemic insight into the business environment, concerning technological innovation, skills acquisition, business organisation and management, marketing of products and services, adoption of good practices, and creation of innovative enterprises;
- to monitor the results of programmes and initiatives under sectoral policies, assessing their impact either on business or on the economic environment, and proposing the necessary adjustments for improved efficiency.

#### OUR CURRENT ACTIVITIES

We continue implementing the national eBSN contacts' network, and fostering better awareness of eBSN issues and participation of new stakeholders. In 2007, two new Portuguese members were approved to join the European eBusiness Support Network for SMEs:

- Digital Partners, Lda. (***www.digitalpartners.pt***)[101]
- ACEP – Associação de Comércio Electrónico em Portugal (see ***www.comercioelectronico.pt***)[102]

Within the National Strategic Reference Framework (NSRF) 2007-2013, an incentive scheme for the qualification of SMEs has been established, geared towards the creation and/or adjustment of SMEs' own support infrastructure. The scheme aims to facilitate their integration into the digital economy and (if needed) the development of new business models, which enable SMEs to establish more effec-

101. Contact: ***rui.patricio@digitalpartners.pt***
102. Contact: ***acep@comercioelectronico.pt***

tive business processes and improved relationship with clients and suppliers through ICT usage.

## SECTORS IN FOCUS

The sectors particularly relevant for this organisation are: industry, trade, tourism and services. The main ICT users are in the services sector, in particular banks and insurance companies, and in trade. The Eurostat Survey on ICT Usage by Business (2007) shows the following results for ICT adoption by Portuguese companies:

Concerning e-commerce in non financial enterprises, it was confirmed that e-commerce adoption is linked with firm size. Among SMEs, about 10% received and about 12% placed orders online; among large enterprises, 28% received and 24% placed orders online.

## EMERGING TRENDS AND CHALLENGES

The initiative "Ligar Portugal", an action programme of the Portuguese Technological Plan in the section for "Economic development, employment and social issues" has identified concrete goals to be reached by 2010.

*Exhibit 4.1-2: ICT uptake by business size (%)*

| Number of workers | Computer | e-Mail | Internet | Broadband | Website |
|---|---|---|---|---|---|
| **Total** | **95** | **90** | **90** | **77** | **42** |
| 10 – 49 | 94 | 89 | 88 | 74 | 38 |
| 50 – 249 | 99 | 98 | 98 | 89 | 66 |
| 250 and more | 100 | 100 | 100 | 97 | 87 |

*Exhibit 4.1-3: ICT users by economic activity (%)*

| Economic Activities | | Computer | e-Mail | Internet | Broadband | Website |
|---|---|---|---|---|---|---|
| **Total** | | **95** | **90** | **90** | **77** | **42** |
| D | Manufacturing | 97 | 89 | 89 | 72 | 37 |
| F | Construction | 88 | 81 | 81 | 65 | 31 |
| G | Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods | 98 | 96 | 95 | 87 | 45 |
| H | Hotels and restaurants * | 99 | 94 | 97 | 89 | 87 |
| I | Transport, storage and communication | 91 | 91 | 91 | 89 | 60 |
| J | Financial intermediation | 99 | 99 | 99 | 95 | 86 |
| K | Real estate, renting and business activities | 97 | 94 | 97 | 81 | 60 |
| O | Other community, social and personal service activities ** | 100 | 100 | 100 | 99 | 54 |

* 55.1+55.2 ** 92.1+92.2

*Exhibit 4.1-4: ICT related goals specified by the "Ligar Portugal" action programme*

| Assessment level | Indicator | Status in 2004 | Goal for 2010 |
|---|---|---|---|
| Employment | Workers in the ICT sector | 2.1% | 3.0% |
| ICT uptake by SMEs | Workers using computers with internet access in their jobs | 19% | 40% |
| e-commerce | Persons placing online orders for goods and services supply | 3% | 25% |
| e-government | Basic public services fully available online | 40% | 100% |

### 4.1.8 Spain: PYME Digital – promoting e-business solutions for SMEs

**by Félix Serrano Delgado**

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#### OUR MISSION AND OBJECTIVES

The mission of the Directorate of Enterprises for the Information Society is to strengthen the competitiveness of Spanish enterprises, in particular by achieving productivity growth through ICT. A specific objective in this context is to promote the adoption of ICT-based solutions for e-business and e-invoicing among small and medium-sized enterprises.

**"PYME Digital"** ("Digital SME") is the key initiative to achieve this goal launched by the Spanish Ministry of Industry, Tourism and Trade. PYME Digital includes e-skills and e-business promotion programmes for SMEs and employees in SMEs. PYME Digital is part of the "**Plan Avanza**", an umbrella programme to support the shift towards a digital economy in Spain. Plan Avanza was designed to fulfil the Lisbon objectives and to drive the development of the information society in Spain. The goal is for ICT uptake and information society development in Spanish regions to converge with the level in Europe by 2010. The plan is based on joint activities between private and public agents, at local, regional, national and European levels.

#### OUR CURRENT ACTIVITIES

Plan Avanza includes several support programmes with substantial funding for projects that promote ICT adoption by citizens and enterprises. Support schemes for enterprises include

- a programme to improve **e-skills ("Avanza Formación**") with 2008 funding of about €25 million in grants,
- a programme for **research and development** on ICT ("**Avanza I+D**") with 2008 funding of about €104 million in grants and €1 92 million in loans,
- an **e-business** programme for SMEs ("**Avanza PYME**") with 2008 funding of about €43 million in grants.

In 2007, the Avanza PYME programme approved 123 projects for e-business adoption, directly or indirectly involving more than 41,000 SMEs. In total, these projects were supported with grants of about €43 million. In Avanza Formación, 149 projects were approved to support the development of e-skills and e-learning opportunities for about 245,000 employees in Spanish SMEs. These projects received grants of about €27 million.

To further support ICT adoption in SMEs, a **loan programme** ("Préstamo TIC"), launched in 2006, will run until 2010. It addresses micro enterprises in particular. In total, loans of €1.28 billion for ICT adoption are available to enterprises. The interest-free loan, without endorsements, is awarded in a fast and simple process, avoiding bureaucratic burdens for enterprises. Loans are limited to €50,000 per company per year. In 2007, close to 29,600 companies have requested a loan under the Préstamo TIC programme. The average loan granted was €10,200 per company. Both Avanza PYME and Préstamo TIC receive funding from the European Regional Development Fund and are subject to the ***de minimis*** aid limits. Avanza Formación receives funding from the European Social Fund.

#### SECTORS IN FOCUS

Our PYME Digital programmes are not focused on specific sectors, but we monitor and analyse the sectoral characteristics of the projects that the programmes finance. Our latest statistics show that in the Préstamo TIC programme, 27% of the loans go to the services sector and about 26% to retail. Among manufacturing sectors, textiles (9%) and the paper industry (6%) are well represented among loan beneficiaries. About 6% of loans have been issued to SMEs in the construction industry.

In the Avanza PYME programme, about 25% of all projects are not sector-specific. Out of those that address specific industries, many are focused on the food industry (10%), on retail (10%) and on transport services (10%). Other services sectors account for 22% of projects, and other manufacturing sectors for 10%. So SMEs from service sectors, together with small retailers, are currently the most active users of our ICT- and e-business-related programmes. Companies from primary sectors such as agriculture and energy and water supplier are less represented in these (SME-focused) programmes.

## EMERGING TRENDS AND CHALLENGES

Experience in our programmes to promote ICT and e-business usage by SMEs suggests that the following challenges have to be addressed:

- A widespread lack of confidence among smaller companies with regard to technology in general, and ICT service providers in particular.
- A "day-by-day" philosophy: long-term benefits of technology are not regarded as relevant because only short-term benefits are considered.
- Structural challenges – too many small companies in Spain, and too many that are too small: there are about three million SMEs, of which 1.5 million are one-person enterprises; 94% of all enterprises are micro-firms with fewer than 10 employees. This implies difficulties for any public promotion programme addressing a significant number of SMEs.

There is also an administrative challenge. Current public-aid management procedures and controls in Spain are cumbersome. The delay between request and receipt of a grant can be more than six months, reducing the incentive for smaller companies and other stakeholders to take part in such programmes. Possible actions to address these challenges include:

- Involve more professional agents and stakeholders.
- Develop a "quality tag" or similar trust mark for technology suppliers.
- Employ independent consultants to assess programmes for SMEs to get an unbiased view and "vendor independent" recommendations on which ICT solutions to use.
- Focus on the service rather than the product.
- Promote the development of simple, easy-to-use ICT solutions for SMEs ("plug and play").
- Simplify procedures in grant schemes, especially for small projects with grants of less than €10,000.

## 4.2 Industry perspectives on e-business

### *4.2.1 The oil and gas industry: The PIDX e-commerce standards for the industry*

**by Dave Wallis**

*Dave Wallis is the Europe Africa Middle East Representative for OFS Portal. On behalf of OFS Portal's membership, Dave liaises with numerous Oil Companies (Majors, NOCs and Independents), eCommerce market places, suppliers and standards bodies within Europe, Africa, Middle East and Asia. Dave is on the Executive Committee of PIDX Europe, an API PIDX committee which supports developing electronic business standards for the oil industry. He also chairs two of the PIDX workgroups, and interacts with a number of European Commission supported workgroups on e-commerce. He was member of the Sectoral e-Business Watch Advisory Board for the study on the chemical industry in 2007/08.*

INTRODUCTION

The upstream Oil & Gas industry comprises a large, globally diverse community: it is estimated that exploration, development and production of oil and gas will account for a spend of between $350 billion to $360 billion in 2008 (Citigroup Industry Research Dec 2007). While many of these companies work globally, a company can still being a multi-billion dollar enterprise even if they restrict themselves to one region, or even just one country. Given such a large, global and complex industry, it is truly amazing how rapidly this industry has adopted industry wide e-commerce standards that define business processes, transactional standards, product/service descriptions as well as other electronic e-commerce data or content.

While not always viewed as such, the industry is highly innovative and is constantly striving to develop and apply new technology to find and extract oil and gas reserves more efficiently and with less impact on the environment. However, in terms of back-office processes, such as "Procure to Pay", the industry's global footprint, its remote operations, high levels of outsourced services and use of non-explicit purchases have resulted in business processes and practices that are very different to, and somewhat more challenging than other industries. In many cases millions of dollars are committed over the telephone by a buyer for a solution to a problem on a rig. The technology, products and processes to complete the solution will be selected by the service company and may change during the course of drilling operations. The results may not be known for 30 to 60 days and the invoice for the services and products used could well reach a total of a dozen pages of detailed information. The buyer orders a solution and the service company delivers a mixture of complex service and products to find that solution. The invoice's approval process within the buyer's organisation is by default somewhat unique at present. Although many industries feel they are a special case or different, the Oil and Gas Industry really is different!

When it came to adopting new technologies and business processes to improve the efficiency of "procure to pay" processes, the industry recognised that it needed to work together to develop a set of standards that would provide the benefits of interoperability while meeting the unique requirements of the industry.

WHICH STANDARD?

The custodian of the effort to develop and drive these e-business standards in Oil & Gas is the API's Committee on Electronic Business, PIDX (Petroleum Industry Data eXchange ***www.pidx.org***). For twenty years now, oil companies, their customers, suppliers and other business partners have collaborated on scores of PIDX projects. These projects have re-engineered entire business processes and operations for greater efficiency and profitability, originally through the implementation of Electronic Data Interchange (EDI), and now by embracing e-business technologies such as the internet and XML. Given the nature of complex products and services and the current population of large ERP systems, a completely automated approval of the non-explicit solution purchase (see above) is not feasible. However, PIDX has been making progress of supplying business processes to automate as much as is practical to the satisfaction of the buyer and supplier community.

Today, the volunteer-driven PIDX organisation is an active and vibrant organisation with global reach. Its open e-business standards have become the de facto e-business standard in Oil & Gas, with many of the industry's largest companies contributing to the development as well as implementing the organisation's business processes and electronic message formats.

In the first years of the 21st century, adoption of the latest e-business standards utilising XML were first seen in North America and then Western Europe, then globally, by one or two of the mega-major operators. Further, in these early years, buyers usually selected just one of the steps in the overall Procure to Pay (P2P) sequence of transactions (see chart at end of this article). This was usually motivated by the portion of the P2P process identified which offered the most process efficiency and / or cost base improvement for the buyer in the trading relationship.

In the early heady days of the 'dot-com' boom for the Oil & Gas industry, the first forays into e-business were by the buyers attempting to collate suppliers catalogue materials behind their own firewall to make sourcing and procurement decisions. It very soon became apparent to all trading parties that catalogue material from the suppliers was not consistent within a large supplier (the same solution at the rig could be delivered by a different mix of technology, service and products), let alone between competing suppliers with comparable products. The supplier community, predominantly, took the initiative to focus around the PIDX standards (a natural choice) and create a committee to start to develop a classification, dictionary and schema for products in the Oil & Gas industry. A starting point was selected, this being the UNSPSC codeset, that was determined to be a strong basis, but with insufficient depth to satisfy industry needs, thus a PIDX Product Classification was born. This was followed by the same PIDX workgroup, with work on improving descriptions for complex services by taking UNSPSC segment 71 and vastly improving it to far more closely match the reality in our industry. The results were also accepted for re-incorporation back into the next version of the UNSPSC codeset.

## THE FIRST TRANSACTION STANDARD ON OIL AND GAS

From a high level overview of some of the trading relationships and buying processes in the industry, most of the buyers decided to next settle on targeting the e-invoice as the first element of the P2P process to be converted to an automated document movement, from the supplier to the buyer. A PIDX workgroup called Business Process mapped out a consensus-developed standard business process between the trading parties to cover all envisaged scenarios and then the Business Messaging workgroup of PIDX took the processes and developed all the required XML documents and protocols to satisfy these processes.

During the period 2003-2007 many of the large integrated Oil & Gas companies (and some of the more adventurous smaller ones) undertook a wide range of pilots to launch e-commerce using the invoice submission and approval steps in the P2P process. Probably 85% of this activity was concentrated in North America and Western Europe, with a notable exception where major companies took their projects globally to challenging countries such as Nigeria, Papua New Guinea, Argentina, Angola etc.

As these companies became more confident and the technologies used (middleware and 3rd party marketplaces / hubs / exchanges) became more stable and robust, focus started to move to other components of the P2P process.

A strong supporter of the PIDX principles and standards throughout the last 8 years has been the non-profit upstream supplier trade association called OFS Portal LLC (***www.ofs-portal.com***) which was created with the sole purpose of assisting trading partner relationships in setting up e-commerce implementations for its members, through offering good practices advice to buyers embarking on the development of a e-commerce strategy. One key area of good practice can be summarised as adherence to PIDX standards.

## THE STANDARD SPREADS INTERNATIONALLY

At the beginning of 2007, a major Latin American Oil & Gas producer approached one of the member companies of the OFS Portal to advise them of their plans to launch into e-commerce with the supplier community, whereby the supplier was to log in to the buyer's portal and download purchase orders (Pos) and then return to key-enter invoice information back into the portal. The supplier was a technically advanced company with a mature ERP system.

To comply with the buyer's request would have resulted in the supplier having a significant increase in administrative workload through double key entry of all the invoice information, and a recipe for data entry errors. In order to encourage the buyer to consider implementing their processes for the connectivity of their larger / more advanced supplier community, the selected supplier recommended the introduction of OFS Portal into the discussions. OFS Portal was able to bring a neutral voice to the table but, with significant experience and supplier volume behind it. OFS Portal suggested the adoption of better practices, and the utilisation of PIDX standards. For those suppliers who could supply information in XML format direct from their internal applications, plans were put in place to allow direct connections to the buyer's ERP. A pilot has therefore been designed with the first supplier, with all processes and documentation being tracked and in many cases facilitated by OFS Portal, who could then relay to the remainder of the OFS Portal membership very efficiently, thereby reducing the adoption time to 'on-boarding'. OFS Portal's members represent a significant proportion of the buyer's annual spend (exploration and production budget). As the process of implementation progresses, which currently includes PIDX developing a new Latin American style tax report related to the invoice revenue, the buyer has identified approximately a reduction of 1- 1 ½ year in their overall e-commerce implementation through dealing with OFS Portal to address their membership and, importantly, by adopting PIDX standards. The estimation is that this reduction in time and the associated earlier introduction of business process efficiencies will save tens of millions of dollars.

### THE GLOBAL ROLL-OUT CONTINUES…

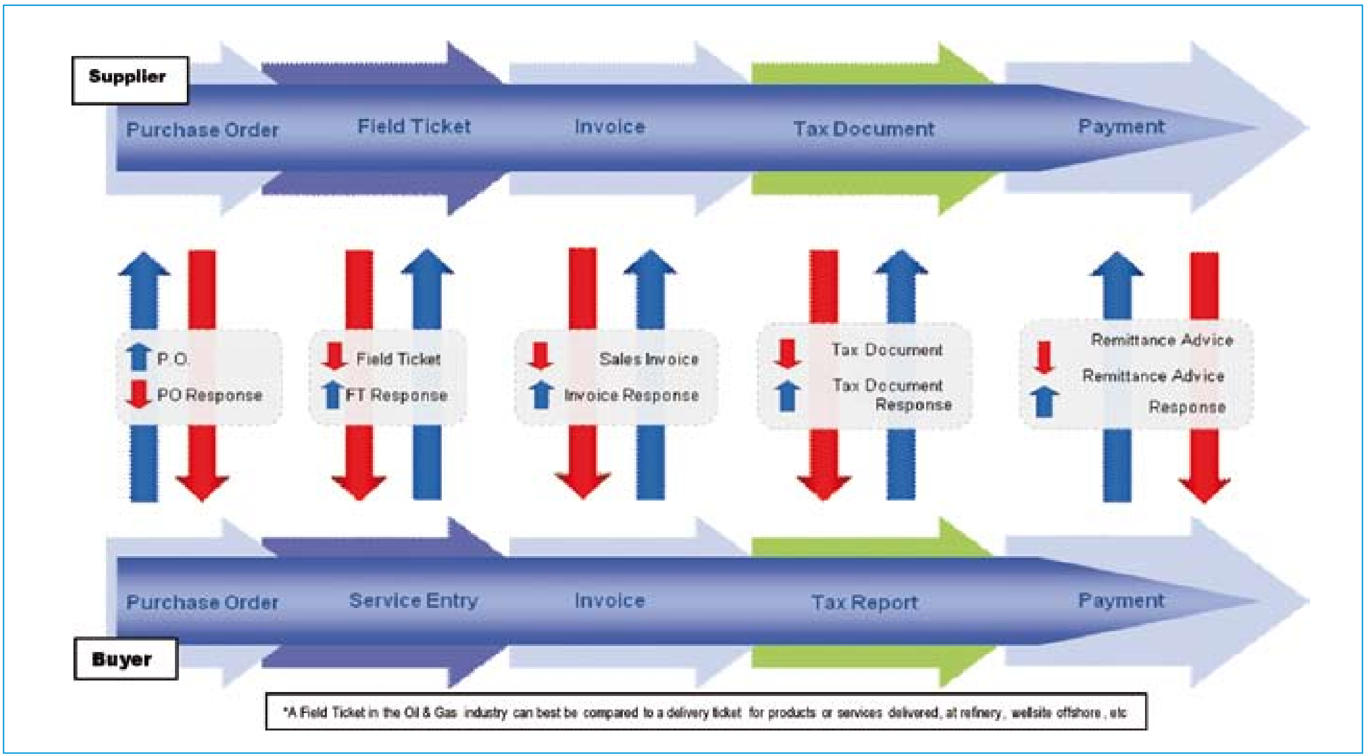
PIDX for some time now has been aware of the significant shift in Oil & Gas activity to the international arena away from North America. In May 2007, a Forum was held in Dubai, with the purpose of introducing PIDX to the major and smaller operators in the Middle East. From that event, and some subsequent correspondence, one of the National Oil Companies in the Arabian Gulf invited OFS Portal to discuss e-commerce strategies and good practices with their management. After concluding an e-procurement pilot which had been initiated some time before the PIDX Forum event, this NOC agreed that the adoption of PIDX standards for its document transfer to its trading partners made the most sense, and is writing it into its major eCommerce implementation roadmap. A further NOC in the Middle East has also recently decided to replace its obsolete maintenance software application and at the same time has decided it will re-write its product descriptions to the PIDX standard.

Meanwhile back in North America during 2007 one of the major integrated Oil & Gas companies took a long hard look at their products descriptions in their Material Master of their integrated and mature ERP system. They spent more than 6 months internally evaluating all possible product description standards, from the base set of a UNSPSC codeset, a proprietary German based system, an e-commerce marketplace's own product description structure, the incumbent ERP's own approach, and naturally PIDX. After a careful review, which included the cost of adoption and maintenance of each of the standards, they selected PIDX as the only natural choice. Thereafter they commenced the year long process of taking all their descriptions from their various business units and legacy systems and re-writing them to the latest PDX standard.

Based on this recent very positive experience in Latin America PIDX have planned a Forum in Buenos Aires, Argentina in May 2008, much like Dubai's 2007 Forum to explain who PIDX are and what the benefits of adoption of their standards would be, to all interested Oil and Gas companies on the continent.
With PIDX developing a plan to make presentations in South East Asia in the same Forum format as previously held in Dubai and Buenos Aires, they have sincere hopes to make their PIDX standards for e-business in the Oil & Gas industry nearly global. Their final challenges will then be to repeat their successes in both Russia and China, to become truly global.

Rapid adoption of an industry-wide standard as we have experienced in the Oil and Gas Industry is motivated by clear benefits. While the importance of the benefits to an Integrated Oil Company (IOC) and a National Oil Company (NOC) may be different, there are clear justifications to all, with the ability to have visibility of spend (to manage spend), savings in costs of goods, process efficiencies throughout the supply chain, and transparency of transactions amongst the key benefits.

*Exhibit 4.2-1: The full P2P process in 'Paper Commerce' in the Oil & Gas industry*



## 4.2.2 The paper industry: The papiNet XML open standard framework practice

**by Henry J. F. Ryan**
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### EXECUTIVE SUMMARY

The article argues that business-to-business (B2B) standards development organisations and their stakeholders should play active mutual roles in the implementation and assessment of the global roll-out and uptake of their standards. It cites, as an example of good practice, the activities of papiNet in providing extensive implementation guidance material, in actively engaging stakeholders in surveys on papiNet implementation, and the more recent efforts directed towards conducting papiNet centred industry readiness research audits and related studies. In conclusion, the article references and supports the drive for B2B interoperability test-beds as envisaged by the European Committee for Standardization's e-Business Interoperability Forum (CEN/eBIF) and the European Telecommunications Standards Institute (ETSI), along the lines adopted by NIST (USA) and KorBit (Republic of Korea).

### BACKGROUND

The full strategic business benefits of standardisation, along B2B supply chains in the internet era, materialise only when market relevant standards are effectively implemented on a global scale. In this context dynamic standardisation whereby companies can take their lead from one another and actively contribute to collaborative implementation actions within their industry sector are essential. For this to happen, individual companies and their staff must face reality and then make the right decisions based on that reality. Stated bluntly, a dedicated focus on implementation and use - ideally on a team basis under the banner of the relevant originating standards development organisation (SDO) - is essential.

Nonetheless, at present many formal SDOs are not directly and actively committed to the implementation and use of their standards. Apart from espousing some general conformity assessment principles, many of these SDOs consider it is sufficient to set out the provisions and to depend on the market to roll-out the implementation of their standards. The acid tests are clear: do they directly and regularly survey users (and potential users) to assess the level of satisfaction with implementation of existing B2B standards, and do they actively engage in standards implementation services such as issuance of proven interoperability guidelines, conducting cross-industry interoperability testing and seeking ways to engage small and medium-sized enterprises (SMEs) in adopting their work? While the ***laissez faire*** approach is consistent with the definition of standardisation (EN 45020; and ISO/IEC) as the "activity of establishing with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context" such a hands-off approach has major drawbacks in a B2B context. It fails to capitalise on the collaborative goodwill and power of the standards developers at a critical stage in the standards life cycle, and it reduces roll-out momentum and speed. The net effect is an unnecessary decrease in the sought for community wide industrial competitiveness and role of standards as key community assets.

It is no surprise therefore that 'Towards an increased contribution from standardisation to innovation in Europe', the communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee adopted on 11th March 2008[103], emphasises the need for EU policy to better address those barriers which hinder the actual implementation and effective use of standards. These barriers include their lack of visibility, their complexity, the uncertainty about conformity to the standards, inappropriate timing of their development or the existence of competing standards which introduces uncertainty. It also includes the lack of a clear continuity between the different phases in a standard's life cycle and the consequent loss of a powerful opportunity for synergy between the parties originally engaged in developing the standards in leading the way and mutually benefiting from maintaining collaborative momentum.

The key to simultaneously achieving standardisation and innovation in any sector is for all stakeholders to embrace open standards and view their widespread

103. ***http://ec.europa.eu/enterprise/standards_policy/standardisation_innovation/index.htm***

implementation as a mutually non-differentiating opportunity. Differentiation will be realised in other more customer focused activities. As stated by W.E. Deming "We must use standards as the liberator that relegates the problems that have already been solved to the field of the routine, and leaves the creative faculties free for the problems that are still unsolved."[104]

A brief summary of the kind of approach being practiced by papiNet is proposed for consideration by policy makers and standards practitioners in industry and in the public sector. As papiNet has already been described in some detail in a previous eBusiness Watch report[105] only a brief description of the open standards framework is included. For more information see ***http://www.papinet.org/***.

### PAPINET XML STANDARD FRAMEWORK

The papiNet standard - developed by customers, suppliers and other trading partners involved in the paper and forest industry to serve their global e-business needs - enables enterprises to conduct the business of paper manufacturing, printing, and publishing with each other through the exchange of XML based messages. XML is the "language of the internet" and as such can open the e-business door to all companies and customers regardless of their size and location.

The basic standard defines the communication mechanisms and a complementary package of 35 messages (content and format) ranging from the most basic commonly used messages (i.e. delivery message, purchase order, order confirmation, invoice) to messages associated with, for instance, product performance and automatic replenishment. This papiNet standard framework meets the needs of different market segments (i.e. book, fine paper, label stock, packaging, publication paper, pulp, recovered paper, timber/lumber, and forest wood supply).

Implementation of its standard is and always has been a major goal of the papiNet membership. Now that the papiNet standard is more or less fully developed, the focus of papiNet has increasingly shifted to promoting its adoption and use, maintaining a robust standard, and working to extend it within market segments in the paper and forest products industry and their supply chains. This collaborative and research driven implementation focus is shown in several important ways.

**1. Segment Implementation Guidance**

papiNet provides comprehensive segment implementation guidance to help support the implementation process between trading partners. This guidance material also helps to ensure uniform implementations in diverse geographic regions, between different companies and across different market segments. The main components of the guidance material are:

| Components | Purpose |
|---|---|
| **Message documentation**<br>(contains an overview of the XML schema, scope, processing, business rules and business scenarios, and includes a set of common electronic formats and terminology) | Designed to facilitate application-to-application information exchange |
| **Interoperability guidelines** | Designed to facilitate system-to-system information exchange |
| **Stylesheets**<br>(currently through version 2.10) | Designed to facilitate human understanding of message content |
| Implementation Guidelines | Designed to facilitate rapid use |
| **Case Studies** (Business Scenarios) | Answers to common situations |
| Sample XML | What the XML would look like |

**2. Common Format Envelope**

papiNet provides a common format envelope that trading partners can use to communicate both papiNet and non-papiNet transactions. The most recent comprehensive documentation in this regard was issued in May 2008, and is available from the papiNet website.

104. Deming, W.E. Quality, Productivity and Competitive Position. Massachusetts Institute of Technology, Cambridge, Mass. 1982.

105. ICT and e-Business in the Pulp, Paper and Paper Products Industry. eBusiness Watch Sector Report No. 3/2006 available from ***http://www.ebusiness-watch.org/studies/sectors/paper/documents/Paper_2006.pdf***.

**3. papiNet Implementation Survey 2008**

papiNet supports and conducts research on the implementation status of its standards. After a gap of several years the previous survey has been revived and has been freely available for companies to download and return. The deadline for submission of data is effectively May 2008 and therefore the information for this year is just being analysed. As in previous years the anonymised data will be made available on the papiNet website. The level of detail being sought is similar to the 2004 survey:

- Information on which of the 35 messages have been implemented, or are expected to be implemented either within the next 6 months (short term) or within the next 7-18 months (long term)
- Information on which communication standard is being used (i.e. AS2, Biztalk, ebXML, Ponton, web methods, others) as well as the names of the associated partner companies, the number of site locations (by continent, or country if preferred), and information on what version of the papiNet standard releases (i.e. v0.99, v1.00, v1.10, v2.10, v2.11, v2.20, v2.30 and v2.40) is/are being used for each message and partner groupings
- During the confidential analysis the data will be normalised (to cater for multiple duplications necessitated by the survey approach), and the cumulated data anonymised prior to release.

This survey will considerably extend the current level of information regarding the roll-out of papiNet and most likely surface issues that may need to be resolved in the maintenance of the standard. Whatever the results of the survey, it will represent a valid current snapshot of the extent of the collaboration and interplay between companies in the paper and forest industries.

Anecdotal evidence suggests that it takes about five-years to embed a standards framework in an entire industry value chain. Accurately assessing the papiNet implementation status is difficult due to the fact that papiNet is freely available and as an XML based standard it can be readily adopted and used in a variety of exchanges unknown to the papiNet community. Thus while the survey numbers are important indicators, the most valuable result will be to demonstrate increasing industry roll-out and take-up of the standard in identified instances and estimates of the plans and potential opportunities for further efforts.

**4. B2B Integration Readiness with emphasis on papiNet**

Following a competitive assessment process, IDEAlliance has engaged Liaison Technologies to lead a cross industry assessment of business-to-business (B2B) integration capabilities and business process readiness.[106] This effort will focus on all aspects of B2B integration with a targeted emphasis on papiNet. The resulting assessment is intended to be the catalyst for establishing a cross-industry B2B infrastructure to encourage transaction and business process efficiencies, while lowering overall supply chain costs – industry-wide. The main result of this initiative will be the availability of a plan to individual businesses laying out specific opportunities that can be executed in support of improving overall supply chain integration efficiencies. The analysis will include a consulting assessment of up to twenty companies in the printing and publishing supply chain. The assessment is open to all IDEAlliance members.

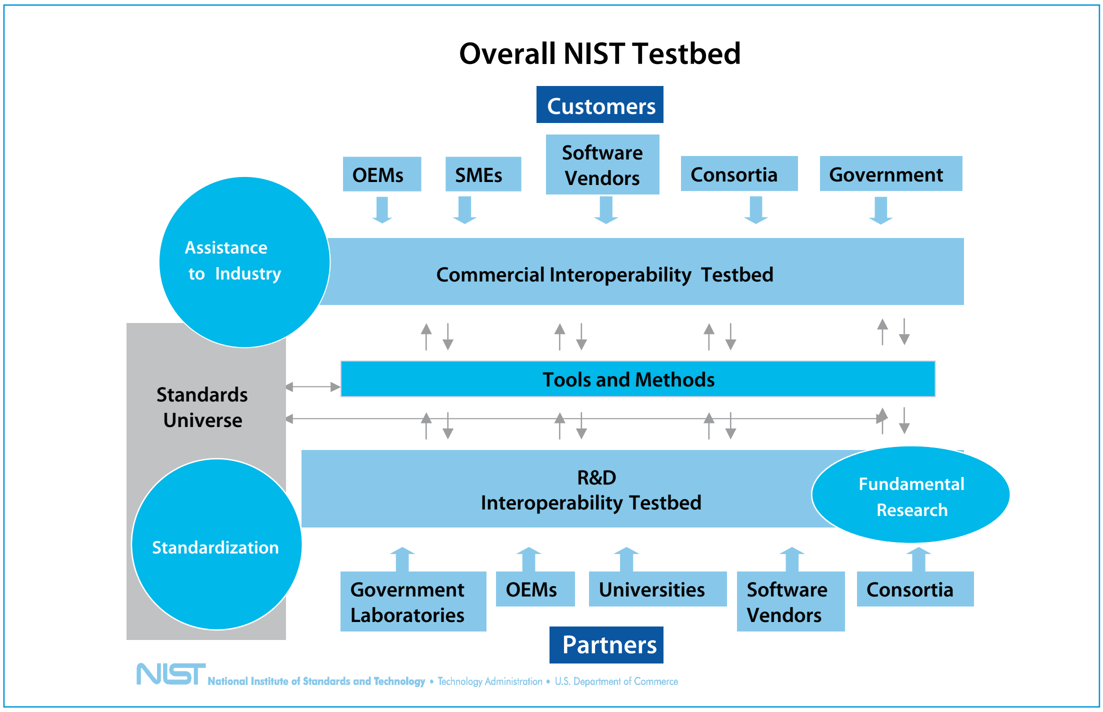
## GENERALISED INTEROPERABILITY TEST BEDS

papiNet has a pragmatic focus on micro-level implementation issues and strategies. Its surveys and other assessment studies also ensure that it has a clear grasp on the reality of its standards macro-fit to the market needs. These implementation and interoperability focused strategies and other issues combine with the emphasis on gathering information on the status of papiNet roll-out in a natural evolution of sector based standards creation. However the issue is not that simple in a multi-sectoral approach to e-business standards. In that more general context the growth and diversity in B2B standards and enabling messaging technologies, generate a pressing need for demonstrating and testing the practical interoperability of these more diverse solutions in order to accelerate the adoption of B2B standards among trading partners.

When the demonstration software infrastructure needs to be repeatedly assembled from the start, and when the participants need to re-invent procedures and rules of conduct that support demonstration, and when similar organisational roadblocks that were once removed need to be dealt with again and

106. For more information see ***http://www.idealliance.org*** and ***http://www.liaison.com***

*Exhibit 4.2-2: Overall NIST Interoperability Testbed*




again it is evident that with an extra effort, the right organisational mix could re-use the same demonstration infrastructure to perform much needed testing of different aspects of B2B interoperability. A proposed proof of concept for such a facility has already been approved[107] by the European Commission services, and is awaiting implementation. Subject to successful realisation of a fully fledged and fully commissioned service, any single customer or vendor would be able to utilise existing or other participants application installations rather than investing in these applications on their own to test interoperability of their e-business applications in the B2B setting. The objective is of a distributed, living European test bed allowing customer-driven interoperability over a comprehensive range of B2B infrastructures such as ebXML, papiNet, RosettaNet etc. The ultimate vision is of an international and multi-regional collaborative test bed with methods and tools designed to serve industry and research needs for testing advanced interoperability capabilities and standards performance in e-business and e-administrations. The NIST schematic for this level of service is shown in Exhibit 4.2-2 (Overall NIST Interoperability Testbed[108]). A similar schematic could be drawn for the KorBit (Republic of Korea) interoperability test beds.

## CONCLUSIONS

There is a growing need, as part of a structured risk mitigation strategy and an increased focus on standards implementation issues, to minimise the costs of demonstrating/testing interoperable B2B solutions. The obvious approach is to maximise industry collaboration and cost sharing and where necessary ensure global interoperability though enhanced international collaboration between regional interoperability test beds. As stated in the Sectoral eBusiness Watch Special Report (September 2005) "e-Business Interoperability and Standards: a Cross-Sector Perspective and Outlook", Europe has a role to play, primarily to ensure that the needs and requirements of the European SMEs are met as quickly and as efficiently as possible: "Europe too must contribute its fair share to the international initiatives on standards convergence and interoperability testing".[109]

107. Committee on Standards and Technical Regulations (98/34 Committee). Progress report on the 2007 ICT Standardisation Work Programme (28 February 2008). ***http://www.ipq.pt/backfiles/relatorio_programa_TIC_2007.pdf***

108. For more information see ***http://www.mel.nist.gov/msid/b2btestbed/b2btestbedslides-2003-11-24.ppt***

109. e-Business Interoperability and Standards: a Cross-Sector Perspective and Outlook. eBusiness W@tch Special Report 3 (September 2005) available from ***http://www.ebusiness-watch.org/studies/special_topics/2005/documents/TR_2005_Interoperability_III.pdf***

### 4.2.3 *The steel industry: ESIDEL – the e-business standard of the steel industry*

**by Freddy De Vos**

*Freddy De Vos is Support Manager Accounting and Controlling at ArcelorMittal Gent, Belgium. He was member of the Sectoral e-Business Watch Advisory Board for the study on the steel industry in 2007/08.*

THE DEVELOPMENT OF THE STANDARD

The main objective of e-business is to make business systems integration possible, so as to leverage supply chain performance by reducing administrative costs and improving supply chain management. Aware of the growing acceptance of e-commerce B2B based on the internet, and keen to enable new co-operative business practices, Eurofer (the European Confederation of Iron and Steel Industries) decided in early 2002 to give top priority to the development of a XML (eXtensible Markup Language) standard for the European steel industry. The standard was to allow the global use of electronic information in an interoperable, secure and consistent manner for all parties involved. During 2002 – 2004 the Edifer Committee of Eurofer, with the support of the European steel companies, developed the EUROFER XML standard called ESIDEL (European Steel Industry Data Exchange Language) and the first version of ESIDEL was published in 2004 on the Eurofer web site (***www.Eurofer.org***).

The ESIDEL guidelines provide the definition of the commercial transactions or business documents (orders, dispatch advices, invoices) exchanged between steel trading partners either point-to-point or via an integration hub. The usage of the business documents and the interaction between the business documents is presented in the business process guides. The implementation guidelines consist of three different layers of information:

- A business document specification guide, which covers the business document in a syntax-neutral way and uses the Unified Modelling Methodology (UMM) as a design notation (class diagram),
- the corresponding XML schema supported by resource files of the business document,
- the supporting implementation documents to facilitate the integration of the ESIDEL standard messages in the ERP systems.

Based on change requests received from users –Arcelor, VoestAlpine, EUROMETAL (the European federation of associations of steel, tube and metal merchants) and ASI (the Australian Steel Institute)– as well as from potential users, the Edifer Committee published in early 2006 the ESIDEL version 1.1, in order to keep the ESIDEL standard operational and in line with the needs of the European steel industry and its customers.

An enquiry conducted by the Director General of Eurofer at the end of 2006 resulted in major participating companies (ArcelorMittal, ThyssenKrupp, Salzgitter and Voest) in the Edifer Committee informing Eurofer that they were no longer willing to the ESIDEL standard and to create in collaboration with ASI the version 2.0, aligned with the UN/CEFACT – XML specifications and based on cross-industry developments beyond 31 December 2006. This decision was based several years it would require to create an ESIDEL version 2.0 fully aligned with the UN/CEFACT XML standard messages. The related investments appeared to be larger than the perceived benefits.

THE USAGE OF ESIDEL

In 2004, the e-business platform STEEL24-7 endorsed the ESIDEL standard to deliver integration services to its business partners. An Arcelor proprietary e-business platform implemented ESIDEL electronic messages to manage ERP-to-Platform messaging. Arcelor and Voestalpine successfully started new integrated ordering systems with a number of customers for whom the use of the traditional EDI and the EDIFACT standard is too complex and too costly. These first applications of the ESIDEL standard were very successful and showed that the present users are interested to broaden their B2B exchanges towards other process. In 2005, the ESIDEL standard was selected by the Australian steel industry as the basis of the ASI e-business work. This selection was based on the following reasons:

- the perception of generally similar processes and metric units in use for steel business in Europe and Australia,
- the proven track record in development and application of ESIDEL version 1.0,
- evidence of work on expanding ESIDEL version 2.0 and its commitment to ensuring convergence with common international standards through collaboration with the United Nations Centre for

Trade Facilitation and Electronic Business (UN/CEFACT).

Based on the ESIDEL standard, Australian steel companies implemented e-business processes covering the ordering, order confirmation, advance ship notice and invoices. Today, the implementations of the ESIDEL standard by the Australian steel companies have resulted in business process automation that is considerably simplified and easier to implement and extend than the previously-used EDI applications. The standard has enabled automated dispatch and receipt of orders, order confirmations, advance ship notices and invoices to hundreds of SMEs. At the receiving company, automated pre-population of inbound receipt data based on advance ship notices significantly reduces inbound logistics data entry. Eliminating the need for manual data entry has also increased the accuracy of inventory data for the receiving company.

The success of the adoption of ESIDEL to adequately meet the ordering process particularities of the Australian steel industry may, it is hoped, encourage more European steel enterprises to use the ESIDEL standard. It is envisaged as useful case material to enable European steel industry associations and policy makers to encourage and promote the use of the ESIDEL standard both inside and outside Europe. Although the maintenance of the ESIDEL standard was stopped at the end of 2006, the e-Business Watch survey 2007 shows that ESIDEL is more largely used by a number of US steel firm than by the European steel industry.

### IS THERE A FUTURE FOR ESIDEL?

The ASI experience in implementation of the ESIDEL standard is that SMEs are not strongly motivated to participate in e-business solutions. This experience confirms the findings of the European steel industry that it is sometimes very difficult to set up e-business solutions with SMEs. The reason for this reluctance is that the SMEs often do not have the necessary technology installed, or lack skilled and experienced staff required for e-business implementations. For instance, SMEs must implement a standard software technology for transmission or receipt of electronic documents and ensure that this integrates with their own SME computer systems. In addition, e-business implementation requires trained IT personnel within the SMEs. If staff in such key positions leave, it can result in a situation where there are no other trained personnel ready or in place to maintain the use of the e-business systems.

To overcome this barrier for SMEs, a convergence of the ESIDEL standard with a global standard, i.e. standard that is used world-wide and across industries, could ensure systems interoperability with suppliers and customers in other industries, not only within the steel industry. Inclusion of such a world-wide standard in software packages would make the use of e-business cheap and simple for SMEs.

Looking back to the 2006 decision by Eurofer to stop the maintenance and further development of the ESIDEL standard towards the UN/CEFACT XML standard, it was at that moment a correct decision. But today there is a need to review this decision, taking into account the positive experience of the Australian and US steel firms and the progress made over recent years by UN/CEFACT on the world-wide XML standard.

Based on the ASI experience, the European Commission could promote the idea of further development of the ESIDEL standard amongst Eurofer and the European steel companies as well as their customers and suppliers. The world-wide steel industry should renew its co-operation with standardisation bodies such as UN/CEFACT and the European standardisation organisation, CEN, in order to integrate the specific needs of the steel industry into the UN/CEFACT XML standard.

Last but not least, the European Commission could initiate and co-fund European projects to implement e-business solutions based on the ESIDEL standard or the UN/CEFACT standard. The project should particularly focus on SMEs because they tend to adopt e-business and their standards due to the related investment costs and lack of knowledge.

## 4.2.4 The furniture industry: Innovative e-business solutions for SMEs

**by Maria José Nunez**

*Maria José Nunez is Director of the Information Technology department at AIDIMA, the Technological Institute for the Furniture, Wood and Packaging sector in Spain. As Head of the TC184 Spanish Delegation (Industrial automation systems and integration) and SC4 (Industrial data) she promotes STEP standards in Spain and across the world. She was member of the Sectoral e-Business Watch Advisory Board for the study on the furniture industry in 2007/08.*

### INTRODUCTION

AIDIMA is a Spanish non-profit private research association, founded in 1984. Its main aim is to contribute to the enhancement of competitiveness in the furniture, wood, packaging and related industries. It focuses on quality, training, information, health & safety, knowledge, market analysis, environmental issues, as well as on promoting innovation for better business management in the fields of design, production and processes, transferring RTD and technological innovation to the Spanish wood and furniture related companies.

The activities of the Information Technology department at AIDIMA are mainly focused on the development of ICT solutions which facilitate data exchange among different furniture related software applications. A key aspect of this work is to concentrate on research, training and development of ICT solutions related to software interoperability.

Over the years, one of the most difficult tasks for the department has been to show industry and small and medium-sized enterprises (SMEs) in particular, the great benefits that can be derived from adopting e-business solutions for all actors involved with any e-business process.

### FUNSTEP

FunStep is an initiative born in 1998 around the ISO funStep Standard for data exchange in the furniture and interior design industries, formally known as ISO 10303-236 "Industrial automation systems and integration – Product data representation and exchange – Part 236: Application Protocol: Furniture catalogue and interior design". The main benefit of adopting the ISO funStep Standard data model is the increased efficiency that results from sharing data between different ICT systems seamlessly, without the need for re-entering information, bringing additional benefits, such as reducing the potential for human errors and reduced end-to-end transaction time (lead-time). Most of the current activities of the IT department at AIDIMA centre on this International Standard aiming to make it available to any company that wants to adopt it.

As examples of ICT implementations at AIDIMA, the CATe software and solutions for catalogue definitions with 3D models are presented in the following sections

### THE CATE SOFTWARE

CATe is a software for managing virtual electronic furniture catalogues with the possibility of generating virtual catalogue product images with different textures. It also incorporates the option to do e-business between manufacturers and their clients (retailers) for commercial transactions. As a result of several years of research in the ICT field, AIDIMA has developed an application to help the furniture manufacturers in publishing their own product catalogues. This tool is unique in the sense that manufacturers can build their own product data catalogue information. Involvement of external companies is not necessary.

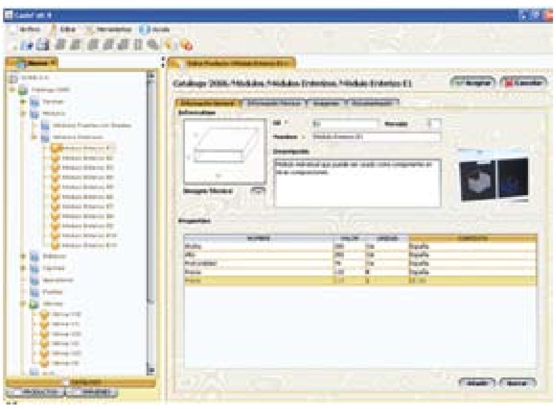
CATe complements traditional paper-based catalogues which include price lists, pictures and a wide collection of fabrics and/or finishing. Nowadays it is not a substitution for paper catalogues but it supports the presentation of every possible combination for every product in every texture wanted. Furthermore, CATe allows the user to generate real-time virtual images, by applying different textures (fabrics) and/or wood finishing according to the user's likings. CATe enables every company user to efficiently manage product e-catalogues and enhancing added-values.

Besides the use of modern programming techniques, a deep knowledge of the sector has converted the application in a vital tool for surviving in the today's competitive world. Continuous improvements have been added to the application along its life: orders management, claims issuing, e-mail of commercial e-documents, ISO 10303-236 standard compliance, visualisation of catalogues of several and different manufacturers, Web publication etc. The addition of all these improvements has been possible due to the continuous interaction between AIDIMA and its clients, the furniture

*Exhibit 4.2-3: Virtual catalogue images for bedroom furniture*

*Exhibit 4.2-4: Virtual catalogue images for bathroom furniture*

*Exhibit 4.2-5: Example of catalogue definitions with 3D models*



manufacturers, taking into account all new functionalities the final clients (retailers) are asking based in the final consumer preferences. The experience and know-how of AIDIMA has of both the sector needs and the current limitations of the technology have made CATe to still be a point of reference with respect to electronic and multimedia cataloguing. Exhibits 4.2-3 and 4.2-4 show some examples of virtual catalogue images for different types of furniture.

### SOLUTIONS FOR CATALOGUE DEFINITIONS WITH 3D MODELS

This specific tool associates 3D models with textures and 3D characteristics through providing an interface capable of handling and displaying standardised data. It permits the association of 3D files with the product information, associating product parts with the different layers defined inside the 3D file. With all the catalogue information in funStep standard format, the tool allows the generation of HTML pages for browsing the catalogue data without any further work. Exhibit 4.2-5 shows an example of this tool.

### OTHER EXAMPLES OF ICT APPLICATIONS USED

- Web-based solutions for data exchange and e-business facilities.
- Open solutions for interoperability checking using the ISO 10303-236 funStep. Software vendors applying funStep in their software have the possibility to check their implementations.
- "GdP": an ERP system solution specifically for SMEs in furniture sector.
- Services for multi-language support for semantic interoperability in order to understand exactly what information enterprises are exchanging.
- Development of standard-based solutions for integration with interior decoration software applications and virtual augmented reality (VAR) solutions.

### CONCLUSION

Using standard compliant systems mean that, for example, suppliers can provide full technical information about their products to manufacturers who, in turn, can provide comprehensive product information to retailers, publish catalogues, operate e-commerce systems, manage stock control systems or supply data to interior designers. All these functions and processes can be performed having to enter only once throughout the entire chain: customer orders placed with retailers can be communicated back up the supply chain immediately, enabling components, materials and manufacturing resources to be allocated at the earliest opportunity. Engaging in these continuous software developments have permitted AIDIMA to be at the forefront of the R&D and innovation in the furniture sector.

### 4.2.5 *Transport services: "e-Traffic" – the key application for a sustainable transport system?*

**by Reinhard Pfliegl**

*Reinhard Pfliegl is Managing Director of AustriaTech, the Federal Agency for Technological Measures Ltd, which was set up in 2005 by the Austrian Ministry of Transport, Innovation and Technology. AustriaTech aims to stimulate the development and deployment of ITS ("Intelligent Transport Systems").*

An efficient transport system on road, rail, waterways, maritime and air is the backbone of prosperous economic development in Europe. Over the last 50 years, 1% economic growth has stimulated 2% traffic growth (tonne miles). About 80% of total transport in Europe is by road.

The efficiency of transport depends on the provision of sufficient infrastructure capacity by national administrations, through directing tax revenues to construction/maintenance. This can be defined as the key factor in European and national transport policies that will ensure economic growth and an increase in national GDP.

Europe faces a dramatic paradigm shift in this regard. Its inadequate infrastructure capacity has become evident over the last decade. Insufficient tax revenues are available, citizens resist land-use changes for transport infrastructure, and $CO_2$ emissions – particularly from road transport – have become critical issue. The traditional concepts for construction of transport infrastructure are outdated, but new concepts (such as Public Private Partnerships or the imposition of tolls) have had little impact and hold out limited prospects for solutions.

The use of Intelligent Transport Systems (ITS) does, however, offer some real prospect of bringing benefits to the overall transport system, through rapid and comprehensive deployment of telematics[110] applications to vehicles and infrastructure

#### HOW CAN ITS DEPLOYMENT CONTRIBUTE? HOW CAN A POSITIVE BENEFIT/COST RELATION BE DEMONSTRATED FOR THE NECESSARY INVESTMENT?

ITS is expected to allow better utilisation of existing infrastructure capacity (more vehicles through a given infrastructure) and to provide greater safety to persons and goods in transit (fewer fatalities and injuries), greater efficiency (less congestion, less stop/go traffic) and more environmental friendliness (less $CO_2$, $SO_x$, $NO_x$, noise, emissions).

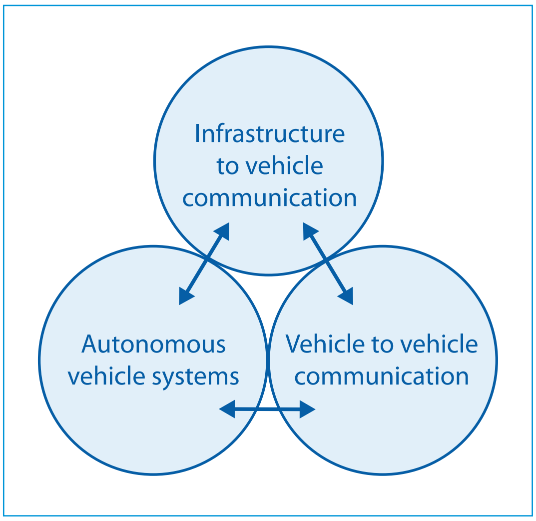
The benefits depend on investment in deploying sensors that can collect high-precision traffic data (e.g. video cameras, loops, toll gates), in establishing a communications infrastructure (to transmit data from sensors to central processing facilities and back to the infrastructure (e.g. variable message signs), and in suitably-equipped traffic control centres.

#### CO-OPERATIVE TRAFFIC MANAGEMENT

For some five years now, activity around the world has been focused on developing more efficient traffic management applications. Significant R&D funds have already been spent, for instance in Japan for the VICS programme[111] and for the VII programme in the US[112]. In Europe, projects such as Car to Car Consortium, COOPERS[113], SAFESPOT[114], CVIS[115] or GST[116] have been funded from the European framework programmes for research and technological development (FP6 and FP7). More recently, Europe has focused these R&D activities within FP7 under the term **co-operative traffic management,** which is now the accepted terminology for this advanced research topic. Co-operative traffic management has three ITS/ICT application areas (see Exhibit 4.2-6): infrastructure to vehicle communication, autonomous vehicle systems, and vehicle-to-vehicle communication.

110. "Telematics" is an artificial word consisting of telecommunication, automation (sensors) and informatics, and combines a wide area of ICT applications and components to monitor, control and manage traffic in a safe, efficient and environmentally sustainable manner.
111. Vehicle Infrastructure Communication System, ***http://www.vics.or.jp/english/index.html***
112. Vehicle Infrastructure Integration, ***http://en.wikipedia.org/wiki/Vehicle_infrastructure_integration***
113. COOPERS – Co-operative Systems for Intelligent Road Safety, ***http://www.coopers-ip.eu***
114. SAFESPOT – Cooperative vehicles and road infrastructure for road safety, ***http://www.safespot-eu.org***
115. CVIS – Cooperative Vehicle-Infrastructure Systems, ***http://www.cvisproject.org***
116. GST – Global Systems for Telematics, ***http://www.gstforum.org***

***Exhibit 4.2-6: Key application areas of ICT for co-operative traffic management***




This trend is now evident in all transport modes, and Europe could achieve world leadership in the field within the next decade.

EXAMPLES

In rail transport, the **European Train Control System (ETCS)** will make use of all three of these elements in a basic form, in the ETCS level 3 specification. This will need to be extended in future by additional functionalities to ensure efficient co-operative traffic management. ETCS is supported by EU legislation and EU funding (through the TEN-T programme[117]), and harmonised via TAF-TSI[118] from UIC[119].

In inland waterways transport, **River Information Services (RIS)** –integrating the co-operative traffic management concept– have been developed and successfully deployed in Europe on 2,000 km of the River Danube. Installations are now underway on the Rhine, Scheldt, Seine and other rivers. RIS is supported at a European level by EU legislation[120] and by EU funding (through the NAIADES programme).[121]

In air transport, the EU and its member countries have agreed the **Single European Sky Air Traffic Management Research Programme (SESAR)** to put in place an efficient and reliable air transport scheme on the basis of co-operative traffic management of the heavily overburdened air transport corridors in Europe.[122]

In maritime transport, the **Vessel Traffic Management System (VTMS)** applies co-operative traffic management principles, especially in short sea shipping and harbours, allowing more efficient use of limited infrastructure capacity.[123] For deep-sea transport, the long-range Automatic Identification System (AIS) application will support seamless traffic management port-to-port across oceans.

In road transport, the development of co-operative traffic management now starts on motorways by integration of autonomous ICT applications in vehicles, V2V[124] communication and I2V[125] communication. Consistent results will be available by 2010. Large scale field tests and deployment can start immediately afterwards (COOPERS, CVIS, SAFESPOT, COMeSafety[126]).

The harmonised and synchronised deployment of ICT for co-operative traffic management in the transport system in Europe is well supported at EU level by action plans (ITS Action Plan, Logistics Action Plan, Greening Transport Action Plan) and TEN funding (NAIADES, EasyWay[127], SESAR, ETCS). Necessary European legislation has to follow as an essential basis to assure a harmonised deployment across the 27 Member States (see Exhibit 4.2-7).

117. TEN-T – Trans European Transport Network.
118. TAF-TSI – Technical Specification for Interoperability for Telematic Applications for Freight.
119. UIC – Union International Des Chemins De Fer / International Union of Railways, ***http://europa.eu/scadplus/leg/en/lvb/l24458.htm***; ***http://www.ertms.com/2007v2/what.html***
120. Directive EC 2005/44.
121. NAIADES – Programme for promoting inland waterway transport in Europe, ***http://ec.europa.eu/transport/iw/prospect/index_de.htm***) and harmonised by PIANC RIS guidelines, ***http://www.via-donau.at***
122. ***http://www.sesar-consortium.aero***
123. ***http://www.marnis.org***
124. V2V – Vehicle to vehicle.
125. I2V – Infrastructure to vehicle.
126. COMeSafety – Communication for eSafety.
127. EasyWay – International project for the coordinated implementation of ITS on the high-level road network in Europe funded under TEN-MAP 2007-2013.

The deployment of ITS/ICT allows the collection of a huge volume of reliable, accurate and high-quality data in real time, with a high degree of automation. These data can be used for:

1. Efficient capacity management of the infrastructure
2. Better utilisation of infrastructure capacity
3. Reliable and precise traffic forecasting (for any size of section of the network)
4. Reliable travel time calculation and prognosis
5. Route based information services for the individual traveller
6. Decision-support in choice of transport modes
7. Changes in mobility behaviour
8. Encouragement of intermodality[128]
9. Optimum allocation of transport demand to available infrastructure capacity

This advanced approach for integrated co-operative traffic management can maximise the use of existing infrastructure capacity and permit action on an important political goal: **changing travel behaviour and demand in favour of sustainable mobility of persons and goods.** Attaining a switch from traditional mobility (today 80% of transport taking place by road) to an 'informed and intelligent' mobility decision (before the journey and during it) is a key factor in reducing the negative impact of limited infrastructure capacity on economic development and industrial growth.

## VISION

Taking full account of the possible impact of widespread ITS/ICT deployment will lead to profound changes in logistics and transport planning, as reliable real-time traffic information and significant traffic/travel forecasting could be "automatically" imported into companies´ route planning applications. This would constitute a major part of an e-logistics transport platform for SCM, fed by an e-traffic services platform (STEP 1 in Exhibit 4.2-8).

In the longer term (STEP 2), the e-transport platform managing short-term transport demand can serve an e-traffic platform, allowing early identification of potential bottlenecks in the infrastructure. With this information, the updated e-transport platform has the potential to allocate demand optimally to available infrastructure capacity (road, rail, and waterway) with an intermodal perspective.

***Exhibit 4.2-7: Transition from traditional traffic management (by individual modes) towards integrated co-operative traffic management***

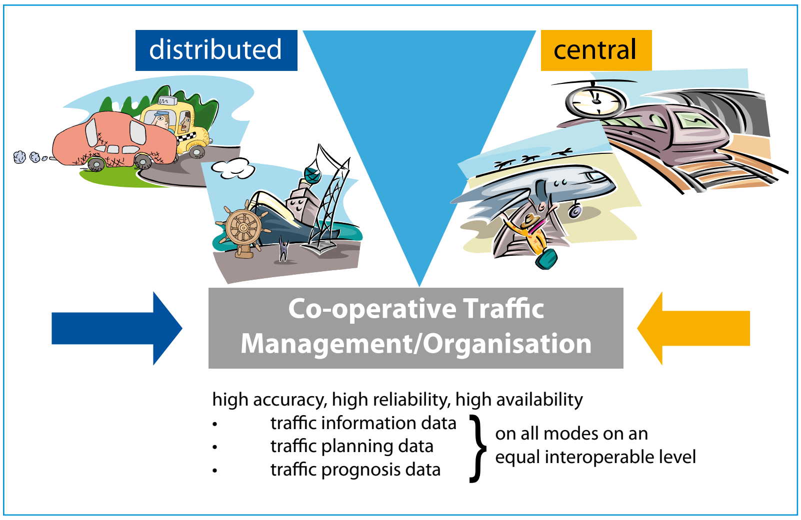
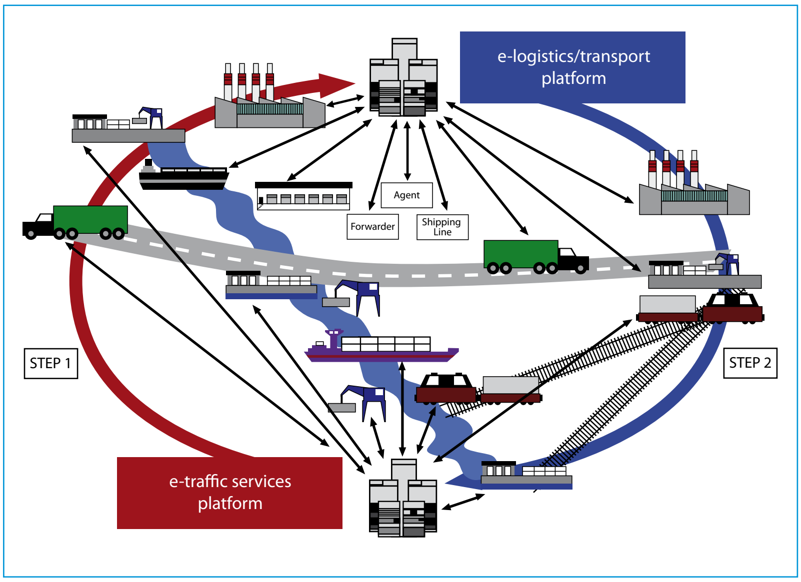



***Exhibit 4.2-8: Interaction between e-traffic platform and e-transport platform***




## SUMMARY

The implementation of ITS/ICT in road, rail, waterways, and maritime modes has impressive potential to support a sustainable transport system as well serving the mobility demands of industry and individuals with intelligent information, planning and management services. It will also improve the ability of transport infrastructure operators to allocate transport demand in light of available capacities.

128. Intermodality in transport involves more than one mode of transport.

## 4.2.6 Logistics services: The role of ICT and e-business in innovating logistics services

**by Pietro Evangelista**

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In today's highly dynamic markets, innovation is considered a strategic component to achieve business success. Innovation allows companies to achieve sustainable competitive advantage through increasing profit margins and sales growth and reducing pressures coming from competitors. Traditionally, the concept of innovation has mainly been analysed in the context of technology and manufacturing environments, while the impact of innovation in services organisation has been underestimated. Over the last few years, innovation in services attracted the attention of an increasing number of scholars and practitioners and the critical role played by information and communication technology (ICT) in service innovation (EU Commission, 2007) is being recognised. This is particularly true in the field of logistics service where there is a lack of investigations aimed at assessing the role of ICT and e-business in transport and logistics service companies. This article summaries some of the result derived from an empirical survey questioning small and medium-sized Italian third-party logistics companies (3PLs). It analyses how ICT and e-business are used to support logistics innovation and the factors inhibiting or facilitating ICT and e-business usage in such companies.

### LOGISTICS INNOVATION AND ICT IN THE 3PL INDUSTRY

For 3PLs, closeness to customers is critical to the development of logistics innovation and improvement in growth and profitability. A key element feeding innovation processes is information. Capturing and analysing customer information and sharing such information with other partners, requires 3PLs to handle an increasing number of electronic links along the supply chain. To manage this complexity, large logistics companies have invested significant financial and human resources in ICT. However, little has been written about the role of technology in logistics innovation of small 3PLs (Evangelista, et al. 2007). This is reflected in the existing gap in the literature where the role of ICT in improving innovative capabilities of small 3PLs has received little attention. Following a brief overview of the existing literature on the subject, this article presents selected findings concluding that the level of logistics innovation in the sample firms is quite low.

### LOGISTICS INNOVATIONS: AN OVERVIEW

A first issue is how to define logistics innovation. Flint et al. (2005, p.114) define logistics innovation as "…… any logistics related service from the basic to the complex that is seen as new and helpful to a particular focal audience. This audience could be internal where innovations improve operational efficiency or external where innovations better serve customers". Such definition includes both, radical and incremental innovation as well as every possible solution between the two extremes. Furthermore, it highlights the two areas of improvement on which innovation may impact (internal efficiency and customer service). Flint et al. (2005) suggest a theoretical model of the logistics innovation process describing the potential path for logistics innovation and new service development processes. The emphasis is on the importance of capturing customer views in order to design new services that are consistent with the current and future customer needs.

Nagarajan and White (2007) analyse multiple aspects of innovation in the U.S. logistics service industry. The authors tried to assess the innovative activity in the sector through a study of patent data combined with interviews with managers of top logistics firms. The study shows that logistics innovation in the U.S. logistics industry is essentially driven by customers. The work of Soosay and Hyland (2004) analyses factors that stimulate innovation in distribution centres in Australia and Singapore using a case study approach. The authors set up a model in which there are external and internal factors. Similarly Chapman et al. (2003) recognise the need for logistics companies to anticipate and to innovate services to meet customers' evolving needs. The authors then identified technology, knowledge and relationship networks as the main factors influencing innovation in the logistics service industry. The paper of Pedrosa et al. (2007) explores the linkages between these two elements analysing the case of three large logistics companies. This analysis establishes a framework comprising process and content dimensions of service innovation in an integrated way. Two common issues emerge from the works reviewed above: firstly, the logistics innovation process in the 3PL sector is customer driven and, secondly, ICT and e-business are considered key enablers in this process allowing new service design and implementation. With reference to the logistics service industry, the critical importance of ICT and e-business for 3PLs relies upon the opportunities to differentiate and/or develop logistics services in a customised supply chain context (Sauvage 2003; Van Hoek, 2002). Hence, the role of ICT in the logistics innovation process of 3PLs is strongly linked to the achievement of the company's competitive advantage. For this reason, it is interesting to investigate the factors influencing the adoption of new technology by logistics companies.

### ICT IN SMALL 3PLS INNOVATION: SOME EMPIRICAL EVIDENCES

Some of the findings emerging from questioning 153 small Italian 3PLs are presented (Evangelista, Sweeney, 2006). The following classification of small 3PLs has been used for data analysis: Full Haulage Providers - FH (those companies for which transport activities represent 100% of turnover); Basic Logistics Providers - BL (those companies for which transport and warehousing together comprise over 50% of turnover); and Advanced Logistics Providers - AL (those companies for which transport and warehousing together comprise less than 50% of turnover). The evidences presented are referred to as: a) the role of ICT and e-business in supporting the customisation/differentiation of services; and, b) the factors influencing the adoption of ICT and e-business.

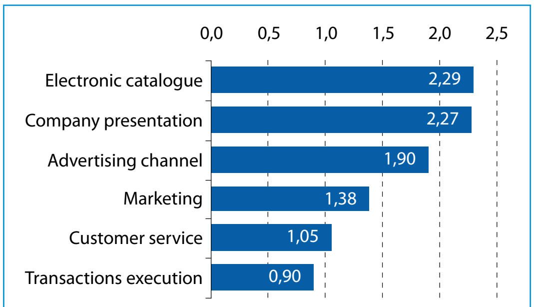
### THE ROLE OF ICT AND E-BUSINESS IN SUPPORTING THE CUSTOMISATION AND DIFFERENTIATION OF SERVICE

Operating a website is one of the most important ICT tools and its effective use provides the potential to reduce costs and improve customer service. Based on the entire sample, it emerges that 105 (69%) of the 153 firms have a website, while 48 companies (31%) do not. The level of company website adoption across the different provider types is: 61% for FH; 72% for BL, and 73% for AL. This suggests that this tool is now reasonably established in small Italian 3PLs.

Considering website adopters, data shown in Exhibit 4.2-9 reveals that the most important functionality associated with website usage is in the areas of electronic service catalogues, company presentation and advertising channels. This means that adopters are not very innovative in the use of their website. Reasons cited for non-adoption of websites have also been considered. The main reasons are: website deemed unnecessary for their businesses; customers do not require internet services; and, website start-up costs. These results suggest that companies underestimate the potential value of websites in improving their businesses and as an instrument to customise/differentiate the services supplied.

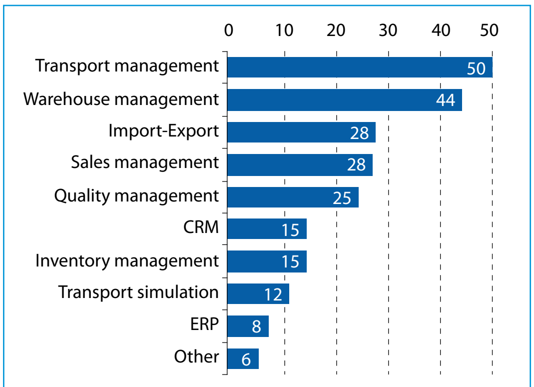
Data about the software usage indicates that 138 companies (90%) adopt software, while 15 companies (10%) do not use software to customise their services. Exhibit 4.2-10 reveals that software for transport management is the most widely used among adopters (60%). Warehouse management software is also quite widely used (44%). Software to manage import-export processes (28%), sales (28%) and quality management (25%) are also popular within these companies.

***Exhibit 4.2-9: Importance of website functionality***




Scale: 0 = no importance; 3 = very important

***Exhibit 4.2-10: Type of software used by the sample firms***



Nevertheless, software that has the greatest potential in terms of service customisation and interaction with customers (i.e. CRM and ERP) is not widely used.

Finally, the capability of the sample firms to supply tracking and tracing (T&T) services to their customers has been analysed. According to data in Exhibit 4.2-11, the majority of the 150 respondents (61%) do not provide this type of service. This confirms the low level of capability of the sample firms in the supply of customised services of this kind. However, there is a highly significant difference between the T&T capabilities of AL in comparison with BL and FH (Chi2=12.32, p=2.1%). This suggests that advanced providers are more oriented towards the customisation of their services.

### FACTORS INFLUENCING ICT AND E-BUSINESS ADOPTION

Among the factors that stimulate the use of ICT (Exhibit 4.2-12), the most significant difference emerges with reference to the improvement of information exchanged with supply chain participants. AL attribute greater importance to this factor than BL and FH (p=1.2%, F=4.56). A significant difference also exists with reference to the improvement of customer satisfaction (p=14.8%, F=1.92) and to the enlargement of customer base (p=12.0%, F=2.13).

With regard to the factors inhibiting ICT adoption, the analysis carried out on the entire sample (Exhibit 4.2-13) provides an interesting picture. The most important reasons for non investment in ICT are related to financial factors. The size of investment and the implementation costs, together with running costs, are considered the most influential factors inhibiting ICT investment. Human resources and the supply of ICT products and services represent further constraints on the adoption of technology.

### CONCLUSIONS

Considering the above results, it appears that the level of logistics innovation in the sample firms is quite low as reflected by the relatively low level of ICT and e-business usage. A more detailed analysis indicates that ICT offers a means of achieving differentiation by innovation. This changing role is influenced by closeness to the customer. Accordingly, AL companies, which generally have a closer and direct relationship with customers, adopt a longer term strategic view of the use of ICT. BL companies have the potential to reinforce their technological capability to support the service improvement and differentiation, but this potential has not been fully exploited. Finally,

***Exhibit 4.2-11: Tracking and tracing services***

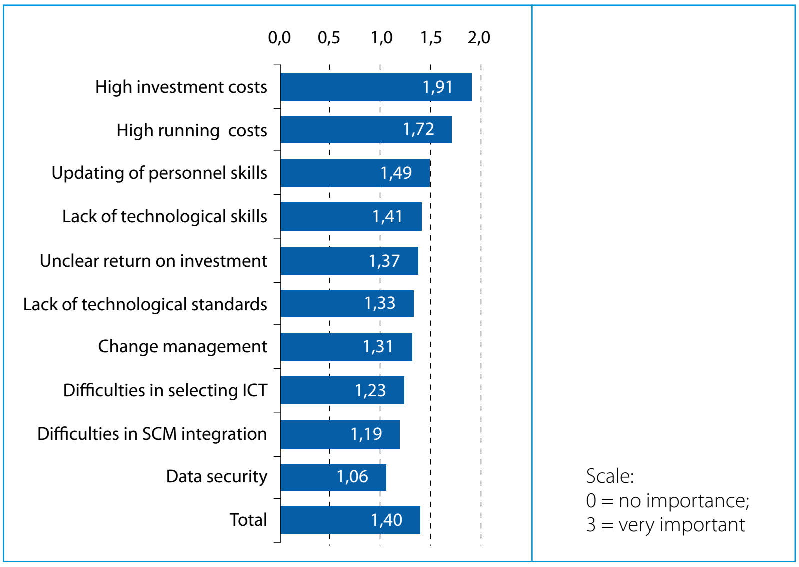
| | **The company does not offer T&T services** | | **The company does offer T&T services** | | **Total** | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Full Haulage | 29 | 80.6% | 7 | 19.4% | 36 | 100% |
| Basic Logistics | 43 | 64.2% | 23 | 34.3% | 66 | 100% |
| Advanced Logistics | 21 | 43.8% | 27 | 56.3% | 48 | 100% |
| **Total** | **93** | **60.8%** | **57** | **38.9%** | **150** | **100%** |

***Exhibit 4.2-12: Factors stimulating ICT and e-business usage***

| | **Full haulage** | | **Basic logistics** | | **Advanced logistics** | |
|---|---|---|---|---|---|---|
| | **Mean (n=36)** | **S.D.** | **Mean (n=67)** | **S.D.** | **Mean (n=50)** | **S.D.** |
| Higher in-company integration | 1.69 | 1.17 | 2.05 | 1.08 | 1.92 | 0.94 |
| Improve customer satisfaction | 1.78 | 1.02 | 2.06 | 1.09 | 2.23 | 1.02 |
| Improve info exchange with customers/3PLs | 1.47 | 1.08 | 2.03 | 0.97 | 2.08 | 1.01 |
| Enlarge customer base | 1.00 | 1.07 | 1.37 | 1.04 | 1.44 | 0.97 |
| Improve company competitiveness | 1.78 | 1.2 | 1.78 | 0.99 | 1.90 | 1.13 |
| Improve company's brand perception | 1.25 | 1.22 | 1.49 | 1.11 | 1.65 | 1.10 |

Scale: 0 = no importance; 3 = very important the role that ICT may play in FH appears very limited. FH providers seem to have little interest in developing innovative actions and this increases the risk of these companies remaining providers of 'commodity' services. The analysis of factors influencing ICT adoption supports this interpretation. For AL firms "external" factors (industry fragmentation and ICT supply side issues) are the main ICT inhibitors. For companies in the BL category cost factors are preventing technology innovation initiatives. For FH companies the role of technology remains unclear. It seems that the use of more sophisticated information systems predominantly depend from the capacity of the technology supply side (both ICT vendors and truck companies) to stimulate these companies through simple technologies for which it is easier to evaluate the impact on costs/productivity.

***Exhibit 4.2-13: Factors inhibiting ICT and e-business adoption***

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### 4.2.7 The software industry: Directive 91/250/EEC – a review of the legal framework and recommendations for SMEs in the field of software protection

**by Tatiana-Eleni Sinodinou**

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#### THE IMPORTANCE OF THE SOFTWARE SECTOR IN THE IPR POLICY OF THE EU

Software protection is very important for enterprises. In the ICT sector, this statement is even more valid: software production is one of the most important and fruitful branches, while software constitutes a valuable immaterial asset.

The adoption of rules concerning the protection of software has always been a priority for the highly developed regions of the world. In Europe, software copyright protection has been harmonised by the Directive 91/250/EEC on the legal protection of computer programmes.[129] This Directive was the first European Community's measure on copyright issues. Community authorities took into consideration the fact that development of computer programs requires the investment of considerable human, technical and financial resources, while computer programs can be copied at a fraction of the cost needed to develop them independently. This Directive, which is one of the most significant pieces of intellectual property legislation already in place in the EU[130], has been implemented by all Member States. One of the issues that are harmonised is the creation of computer programs by employees.

#### THE IMPORTANCE TO PRESERVE THE VALUE OF SOFTWARE IN THE BUSINESS

For SMEs, it is a high priority to preserve the value that software represents: the possibility to proceed to the internal use or the unimpeded commercialisation of software created by employees without legal obstacles is crucial; especially considering that SMEs are often deprived by in-business legal advisors. SMEs should therefore ensure that employment contracts include detailed specific terms about the transfer of economic rights over computer programs created by the employee to the SME. However, this is not always the case and serious problems may arise by a lack of appropriate contractual terms or misunderstanding of the legal framework. Legal battles against ex-employees or piracy by ex-employees are two of the most significant issues which impede the full and in-time commercialisation of the IPR value created by software SMEs. It is therefore very important for SMEs to understand the EU legal framework for the creation of software by employees in order to better organise the acquisition of economic rights over software created by their employees.

#### THE SPECIAL EU COPYRIGHT REGIME FOR SOFTWARE CREATED BY THE EMPLOYEES

Article 2 par. 3 of the Directive 91/250/EEC, establishes a special rule about the attribution of copyright over computer programs which are created by employees. Its objective is to facilitate the exploitation of the computer program by the enterprise which invests significant sums for the creation: where a computer program is created by an employee in the execution of his duties or following the instructions given by his employer, the employer exclusively shall be entitled to exercise all economic rights in the program so created, unless otherwise provided by contract. This provision has been implemented in the copyright laws of all Member States.[131] This special derogatory regime can be applied only for computer programs which are created in the frame of an employment contract. It is not possible to extend the application of the rule to other types of contracts: it does, for example, not apply if the computer program results from a commission (contract for services). In that case, the exclusive rights initially belong to the author and

129. Council Directive 91/250/EEC of 14 May 1991 on the legal protection of computer programs, Official Journal L 122 ,17/05/1991 p. 42 - 46.
130. Vinje T., Harmonising Intellectual Property Laws in the European Union : Past, Present and Future, EIPR (8).1995. 361.
131. Report from the Commission to the Council, the European Parliament and the Economic and Social Committee on the implementation and effects of Directive 91/250/EEC on the legal protection of computer programs (COM/2000/0199 final).

parties may provide for transfer of economic rights to the commissioner.[132] Another example is computer programs created by a trainee. In that case, a contract of transfer of economic rights must be signed.

National laws determine employment contract conditions between authors and SMEs: the existence of an employment relationship requires, in general, a relationship of submission between the author and the enterprise. According to the Directive, two cases, which lead to the attribution of the economic right over the program to the employer, can be distinguished. The first one is the creation of the program in the execution of the duties of the employee. The second one is the creation following the instructions of the employer. What falls within the scope of the employment duties will depend upon the nature and terms of the job and the relation of the work to it.[133] A program is created by an employee in the execution of his duties if its creation is the direct object of the obligation of the employee according to the employment or if it is closely connected to the obligations of the employee deriving by the employment contract.

It is crucial to determine the exact object and the content of the obligations of the employee. If they are not directly derived by the employment contract, they can be deducted by other elements, such as the object of the activity of the employer, the position of the employee within the enterprise, the professional specialisation of the employee, and the professional customs in the sector etc. The rule does not always apply if the employee is a computer scientist particularly as there are different disciplines and specialisations in computer science. For example, a Web designer is a computer scientist, but the creation of software is not normally covered by his professional specialisation. In those kind of cases, it might be preferable from an SME perspective to explicitly transfer the economic rights[134] to the enterprise.

### OCCASIONS WHEN THE RULE DOES NOT APPLY

Article 2 par. 3 of the Directive 91/250/EEC does not apply if a computer program is created freely by the employee out of the circle of his duties or on the occasion of the employment contract. A computer program can be considered a creation on the occasion of the employment contract if it is created by the employee on his own initiative out of the circle of his duties, as they can be defined by the employment relationship. This can be the case where a computer program is created on the installations of the SMEs and by using equipment or know-how provided by the SME, but out of the scope of the obligations of the employee.

It is therefore important to define who is responsible for initiating the creation and if the creation can enter the circle of duties of the employee. The location where the creation takes place (offices of the employer or other), the time of creation and the ownership of the means which are used for the creation (equipment, notebook etc) are secondary elements which can also be taken in consideration in some cases. For example, a case of creation of software on the occasion of the employment contract could be when a computer program of automatic translation from one language to another is created by a computer scientist who works in the marketing department of a financial services company on his own initiative in the installations of the enterprise and during working time.

However, the facts are not always clear cut: for example, if a computer program is created on the initiative of the employee in the offices of the employer whose activity is the production of software even out of working time, it will not be easy to establish that the creation of software took place out of the circle of the duties of the employee. In some instances, even if the creation of the software takes place in the home of the employee and out of working time these can be considered to be inside the circle of his duties if it is the direct object of the employee's duties according to the employment contract. One should not underestimate the cases of creation of computer programs on the occasion of the employment contract. In many of these cases, the employer could have a great interest in having economic copyright over the software[135] transferred to the enterprise.

132. Bently in Dreier/Hugenholtz, European Copyright Law, Kluwer Law International, 2006, p. 219.

133. Cornish W. & Llewelyn D., Intellectual Property : Patents, Copyright, Trade Marks and Allied Rights, Thomson, Sweet&Maxwell, 2007, p. 503.

134. Soreau A., Définition de «auteur de logiciel», ***http://www.droit-logiciel.com***

135. A remarkable example of creation of a work of mind on the occasion of the employment contract is the creation of the computer game Tetris. Tetris, which is one of the most widely known computer games, was created by Russian scientists at the Moscow Academy of Science's Computer Center out of the circle of their duties but on the occasion of the employment contract. See: Original Tetris: Story and Download, Story told by Vadim Gerasimov: ***http://vadim.oversigma.com/Tetris.htm***

### CASE OF CREATION OF SOFTWARE BY FOLLOWING THE INSTRUCTIONS OF THE EMPLOYER

On the occasion where software is created following the instructions of the employer, it is difficult to define the circumstances for which the rule applies. First of all, it should be understood that this is a case of creation of computer program out of the circle of duties of the employee. The creation of software following the instructions of the employer covers the case when the software is created by an employee out of his normal duties as they can be initially defined by contract or other facts, due to the extension of his duties after receiving a special order or instruction by the employer. The circle of obligations of the employee is extended after a special assignment given by the employer. The creation of software can be regarded as an additional new obligation of the employee. This could be the case when the employer assigns the employee to accomplish a specific new task or mission,[136] which is the creation of the computer program or at least includes the creation of the computer program, and which is out of his normal duties. The rule could cover cases when the computer program is created or co-created by an employee who is not computer scientist for the facilitation of the exercise of his duties under proposal and assignment of his employer, for example, if a computer program is created by a doctor (e.g. computer program of medical applications) for the needs of the medical institution which employs him after the instruction of the employer.

These circumstances are generally rare for enterprises in the ICT sector, especially for enterprises whose activity is the creation of software. But one could probably apply to the rule in cases of extension of the activity of the company, for example, in case a company specialised in the production of hardware or Web design extends its activity to the software production. In these cases of creation following the instructions of the employer, it is wise for enterprises to keep proofs preferably in writing about the assignment of the additional mission to the author.[137]

### WHAT THE LEGAL RULE OF THE DIRECTIVE MEANS FOR SMES

The Directive does not require Member States to make SME employers "owners" of copyright or authors of the work. In this way, the Directive avoids disrupting principles of those copyright systems which treat author's rights as non transferable.[138] The rule is that the employer must be entitled to exclusively exercise all the economic rights. The way the SMEs are entitled to exercise economic rights depends on the different national legislations.

In cases where an SME is "ipso jure" transferred the economic rights (that happens when the national copyright law directly provides for that), the transfer is permanent and valid even after the end of the employment relationship. Unless otherwise provided by contract, the author-employee does not receive any special additional remuneration for the creation of the software. The wage is considered to be the payment that the author receives for the creation.[139]

136. Strowel A./Derclaye E., Droit d'auteur et numérique: logiciels, bases de données, multimédia, Droit belge, européen et comparé, édit. Bruylant, Bruxelles, 2001, p. 209.
137. Soreau A., Définition de «auteur de logiciel», ***http://www.droit-logiciel.com***
138. Bently, p. 219.
139. Lucas A., in Lucas/Devéze/Frayssinet, Droit de l'Informatique et de l'Internet, PUF Droit, Paris, 2001, 328.

## 4.2.8 *Financial services: Supply chain automation – SEPA is the catalyst for change*

**by Barry O'Mahony**

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### SEPA AND PSD RESULT IN A STRONG MARKET DISEQUILIBRIUM

Many of the forward-thinking, well-organised businesses and public administrations across Europe are currently in the process of developing their own SEPA Strategy. The leaders of these organisations have recognised at an early stage that SEPA – the Single Euro Payments Area – is a catalyst for change, and that its impact must be considered in a wider context which also includes the Payments Services Directive (PSD).

SEPA and the PSD will result in the most fundamental market change experienced in any key European economic infrastructure for decades. Up to now, payments have been provided only by banks. That will now change as the PSD provides for new participants in the market, and the payments infrastructure must now be opened up to non-banks. The market changes emerging will push out many suppliers, i.e. banks, and the new infrastructure will be driven by economies of scale –making payments predominantly a volume business. The massive volumes across Europe will be processed through a few clearing houses. Payments will be commoditised, and might no longer be a fundamental ingredient in a banking relationship.

The changes will be gradual and will not be readily identifiable until after 2009, when the PSD is implemented. And while this state of disequilibrium is not as dramatic as the global credit crisis, it is every bit as significant, and presents real opportunities for those who use the payments system.

Much of the focus of discussion and attention to date has been supply-side driven, and that is understandable. However, not enough has emerged from the demand side – the community that uses payment services. This article is intended to touch on that side of the discussion and focus on the application of technology to the wider financial supply chain – not just the payments element.

Detailed descriptions and assessments of SEPA and the PSD are not the focus of this piece. Instead it explores the use of this disequilibrium to extract costs from activity in which we all engage at some level – making or receiving payments. Furthermore, for businesses large and small, as well as public administrations, payments are just one element in the financial supply chain – and not necessarily the most expensive.

SEPA and the PSD require our attention. We should use that imperative as a catalyst to address the entire financial supply chain.

### FINANCIAL SUPPLY CHAIN AUTOMATION

Automation of the financial supply chain provides the key to unlocking the considerable costs unnecessarily tied up in that aspect of economic activity. There are numerous businesses with very high degrees of automation in their physical supply chains, while their financial supply chain is characterised by vast quantities of paper and high levels of manual intervention.

Yet technology solutions are available to extract the costs tied up in this element of commerce, and the SEPA migration era will deliver further solutions to a broader audience.

One such emerging solution with which I am engaged is being developed not by a bank, but by individuals with experience of the inefficiencies in this area and driven by a desire to deliver low-cost alternatives to anybody with internet access. That solution – being developed by EDGE International – provides for the modules that comprise the central elements of the financial supply chain: procurement, invoicing, payments, and financing. These modules will be provided on an outsourced shared service basis, available to anybody with internet access.

**e-Procurement** - the first step. Why not automate the process by electronically generating a quote, leading to an order, and its confirmation? This does not require inventing a wheel – the technology exists. But widespread deployment does require a focus on delivering common open standards.

**e-Invoicing** - the prize is €243 billion. How much of that is yours? The cost of processing an invoice is estimated at €30 – and much more if there is a dispute. In Europe every year 28 billion invoices are issued. With the opportunity of saving between 60% and 80% of the cost of invoicing by implementing an electronic solution, the business case for NOT implementing such a solution must be challenging!

**e-Payments** - SEPA and PSD will aid the delivery of this element, and the new "Payment Institutions" – as defined within the PSD – will add some spice to the competition in the market. A good place to start is the consolidation of all Eurozone payment accounts, and many pan-European enterprises are already well-advanced in creating their own payments factories.

**e-Financing** - the logical progression is the use of all of the electronically generated data to facilitate a streamlined factoring and invoice discounting product. The estimates of the potential savings in the cost of factoring may be sufficient to open up this source of working capital to businesses that did not previously make use of it – on cost grounds.

Integration with internal accounting systems will then deliver end-to-end Straight Through Processing (STP), which is much sought after, especially by large organizations.

The difficulty with e-business and e-government development in Europe is not that the tools have not been invented – it is that the tools are not being applied. The European Commission has recognised this and is putting very substantial funds at the disposal of the economic players in Europe, through a variety of schemes. New tools will also be delivered in the coming years – including services from banks that need to replace lower payments income with new service offerings to their customers.

The period of disequilibrium presents considerable opportunity for the fleet of foot. And the fleetest of foot will capture the largest share of that €243 billion!

## 4.2.9 *Financial services: e-Business, interoperability and SEPA*

**by Carlo R.W. de Meijer and Peter Potgieser**

*Carlo de Meijer is senior researcher at the Market Infrastructures department of ABN AMRO Bank. Main areas are the payments, cards and securities environment and its development.*

*Peter Potgieser has been working for ABN AMRO – Market Infrastructures since May 2007. One of his major areas of attention involves how standardization contributes to the bank's portfolio of products and services for its customers. He is chairman of the 'Netherlands Board on E-business Standardization' (NeBES), the 'Web Services Association' (WSA), and the international CEN/ISSS 'eBusiness Interoperability Forum'.*

### SAVING OPPORTUNITIES THROUGH SEPA AND ELECTRONIC INVOICING

i2010, the strategic Action Plan of the European Commission for e-business, rightly presents interoperability as a prerequisite for enhancing the European information society. The Action Plan targets include the set up of an agreed interoperability framework to support the delivery of pan-European e-services. It also envisages the corporate sector, including banks, developing interoperable e-business solutions. In this context, the Single Euro Payment Area (SEPA) is of great help if it also spurs electronic invoicing. According to the European Commission, €238 billion could be saved through electronic invoicing, on top of other potential savings of more than €123 billion that SEPA offers in the EU payment markets in the next six years.

### DEMATERIALIZATION

Some of the drivers towards increased e-business application can be found in the desire to streamline the flow of information in the value chains, in order to reduce inefficiencies, improve certainty and reduce cost, using electronic means for information transfer. This so-called dematerialization of business processes will contribute to improving the certainty of the environment in which they operate, which makes them more competitive. Starting with the dematerialization of a single link, more benefits can be obtained if more interaction between adjacent links in the value chain becomes electronic ("dematerialised"). e-Invoicing is seen as an initial step, as it is an essential part of an efficient financial supply chain and it links the internal processes of enterprises to the payment systems.

### DEVELOPMENT OF E-BUSINESS PROCESSES

To be able to reap the full benefits of e-business, a certain degree of interoperability of business processes is required: companies are therefore increasingly linking these processes, using information and communication technologies, based on compatible standards for data exchange between computer systems, i.e. on technical interoperability. In this way, interoperability with their suppliers and customers and partners is achieved, for (international) cooperation with these business partners as well as with their banks. Despite the growing shift from business to e-business (B2B, B2C and B2G), there is, however, still significant fragmentation of e-business practice across Europe. This has much to do with the many barriers (legal and operational) that still exist, leading to the existence of differing standards for information exchange, each from its own context or background and meeting its own explicit business requirements. Business partners must nevertheless be able to read and interpret correctly each others' data. Today, many cannot do this without special manual intervention or compatibility programmes.

### INTEROPERABILITY

The lack of interoperability is indirectly but basically the single most important hurdle for business trying to do business electronically and has for a long while prevented the successful uptake of e-business services. Interoperability is key to promoting further developments in e-business in Europe, as it facilitates value-chain efficiency, allowing information to be presented in a consistent manner between business systems, regardless of technology, application or platform. Interoperability is not only required between internal processes, but also (and that is where the real "e-business" comes in) between suppliers and customers and for cooperation with business partners and banks.

### MAIN STREAMS OF STANDARDIZATION

The widespread use of different specifications creates obstacles to interoperability. To overcome this efficiently requires seamless automatic cooperation, based in part on compatible standards for information exchange between computer systems. The main developments in standardization are nowadays centered around UBL, ISO 15000, ebXML (UN/CEFACT) for corporations and around UNIFI and ISO 20022 for the banking sector. UNIFI and ISO 20022 mainly concern interbank data exchange for the support of SEPA. The European Payment Council has decided that UNIFI messaging schemes will be compulsory in the bank-to-bank domain.

### INTEROPERABILITY WITH ALL INDUSTRY SECTORS

While interoperability within the financial industry is intended to permit efficient e-business (with SEPA as an example), interoperability with (and between) all industry sectors for e-business, i.e. between financial institutions and their clients from other industries, is not optimal. Corporations' expectations and financial institutions' demand for value-added services will, however, continue to rise. This means that the interfaces between them are becoming increasingly important. These interfaces have not yet been implemented in their final form, and most of them have not even been defined in detail yet (in terms of standards). Here developments in standardization can take place that go beyond the original requirements. This demands close collaboration between distinct international standardization organizations like UN/CEFACT and ISO. They should be encouraged to develop their respective standards bearing in mind that maximum interoperability should be achieved such that (for instance) the European e-Invoice Framework (EEI) and services that will be introduced as logical next steps can be supported simply by compatible ISO 20022 and UN/CEFACT standards.

### SEPA AND E-BUSINESS

The rise of e-business in Europe also induces developments in the way payments are initiated and processed. The major development in the financial supply chain is the creation of SEPA, with the goal of creating a dynamic and efficient European market for electronic payments that should allow substantial economies of scale to the benefit of all. SEPA is not a goal by itself, but one of the available means to leverage the targets that have been described in the "Single European Electronic Market" (SEEM), i2010, and other initiatives. The supporting systems (infrastructures) are to deliver an important part of the benefits intended by the introduction of SEPA. This is where "reachability" and "interoperability" for payments have their centre of gravity.

### SEPA AND E-INVOICING

At present barriers including technical complexity, legal uncertainty and operational constraints stand in the way of a widespread uptake of interoperable cross-border e-invoicing solutions. The European Commission has therefore set up an expert group on e-invoicing with the task of establishing a European Electronic Invoicing Framework by 2009. Such a framework would bring benefits to EU business, government procurement and citizens alike, by promoting the creation and development of open and interoperable e-invoicing services across Europe. European moves towards adopting SEPA are logically linked to the business processes that give rise to most Business-to-Business and Business-to-Government payments. SEPA offers an ideal launch-pad for a successful Europe-wide e-invoicing initiative. The rules of the European Payments Council governing the development of SEPA focus on the payment elements in the financial supply chain. EBA, the Euro Banking Association,[140] is considering the creation of a rulebook for the e-invoice part of the financial supply chain. As e-invoicing could be an important catalyst for the adoption of SEPA it is essential that uptake and standardization, followed by development and implementation of services, is adequately conducted to achieve the appropriate mutual reinforcement.

140. The Euro Banking Association is an association consisting of 190 European banks. It serves as a forum for the European payments industry and plays a major role in the development of payment infrastructure solutions at a pan-European level. The EBA is a key contributor to the creation of SEPA.

## 4.3 Research perspectives

### 4.3.1 ICT and energy: methodological issues and Spreng's triangle

**by Bernard Aebischer**

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Technological innovations have transformed society in the past and will continue to do so. The steam engine opened the way to the industrial society and the aeroplane revolutionised travelling. From the telephone to the internet, ICT is putting us on the path to a fully interconnected and radically different world. But the question "what is the impact of ICT?" or "how would it be without ICT?" has no easy answer. What would society look like without the ability to communicate by phone (or internet) almost instantaneously around the world?

Even (or all the more so?) the question regarding the impact of ICT on energy is extremely complex. The present article considers different aspects and different methods to approach an answer. The results presented emphasise trends rather than portray selected precise figures. Hence, the conclusion is that Spreng's (1993) triangle, discussing the substitutability (factor mobility) of energy, time and information.

WHAT TO INCLUDE IN ICT (WHEN CONSIDERING ELECTRICITY DEMAND OF ICT)

ICT is usually thought of as computers, other office equipment, entertainment electronics, telephones and similar electronic equipment. The infrastructure needed to use this end-use equipment is neglected most of the time. But exactly this hidden infrastructure (e.g. the servers that provide internet services and the radio antennas necessary to make mobile phone calls) is becoming an increasingly important component in ICT electricity requirements.

Even if we consider all this end-use equipment and the related infrastructure, we catch only a small fraction of all microprocessors produced and used somewhere in industrial processes, buildings, appliances or cars. "…only 2 percent of the approximately 8-billion microprocessor units produced last year ended up in computers." And "…there could be as many as 10,000 telemetric devices per person in the industrialised countries by 2010." And "Within a decade more things will be using the internet than people. As Michel Mayer, the head of IBM Pervasive Computing recently noted" (Rejeski, 2002). "…the average middle-class American household includes over 40 embedded processors. About half are in the garage…. Your transportation appliance probably has more chips than your internet appliance… New cars now frequently carry 200 pounds of electronics and more than a mile of wiring" (Turley, 2003).

These observations are important for the estimation of the energy demand of ICT and essential for evaluating the impact of ICT on society's energy demand. And whenever investment figures for ICT are used, it should be clearly stated what categories of ICT these investments include.

DIRECT ELECTRICITY DEMAND OF ICT

Usually, a bottom-up approach of the following type is used:

$$\mathbf{Energy(t) = \Sigma_{ijk}\, n_i(t) * e_{ij}(t) * u_{ijk}(t)}$$

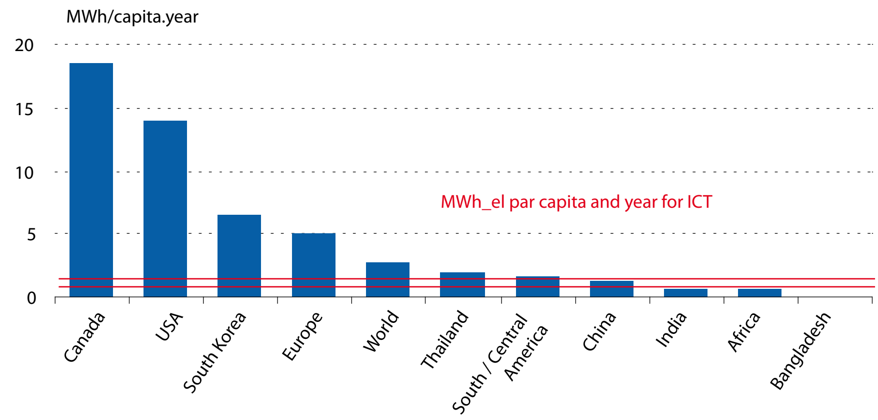
with
n: number of equipment of type i
e: electric power load in functional state j
u: intensity of use by user k

Considering common end-use equipment like computers, other office equipment, entertainment electronics, telephones and the infrastructure needed to use this end-use equipment (servers, routers, switches for the internet and base station switching units and others for the telecommunication), one typically gets for an industrialised country an energy demand of about 5% of total electricity demand.

Knowing that the majority of microprocessors are used outside of the actual equipment considered, we assume a doubling of the electricity demand for ICT. The resulting 10% is of the order of 1 mega watt hour (MWh) per capita and year. This is of course a very rough estimate, but the order of magnitude should be correct and its accuracy is good enough on which to base the qualitative considerations in this paper.

One MWh of electricity per capita and year is a considerable amount of electricity in an industrialised country and it is more than what is used altogether in many countries in the Southern hemisphere (see Exhibit 4.3-1).

*Exhibit 4.3-1: Total yearly electricity demand per capita in different countries and yearly electricity for ICT per capita in CH and USA (Aebischer/Roturier, 2007)*




Scale:
0 = no importance;
3 = very important

*Exhibit 4.3-2: Electricity demand 2001 and 2010 in Germany of ICT, by "end-use" in households and offices and by "infrastructure" in households, offices and public infrastructure (Cremer, Aebischer et al., 2003)*

| | | 2001 | 2010 | 2001→2010 | 2001 | 2010 | 2001→2010 | 2001→2010 |
|---|---|---|---|---|---|---|---|---|
| | | **TWh/a** | **TWh/a** | **TWh/a increase** | **% total** | **% total** | **% increase** | **%/a increase** |
| **End-use appliances** | in households | 19.1 | 24.5 | 5.3 | 50% | 44% | 28% | 2.8% |
| | in offices | 7.8 | 7.6 | -0.2 | 21% | 14% | -2% | -0.2% |
| **Infra-structure** | in households | 3.4 | 6.4 | 3.0 | 9% | 12% | 89% | 7.3% |
| | in offices | 5.4 | 11.1 | 5.7 | 14% | 20% | 105% | 8.3% |
| | public | 2.3 | 5.8 | 3.6 | 6% | 10% | 158% | 11.1% |
| **Total** | ICT | 38.0 | 55.4 | 17.4 | 100% | 100% | 45% | 4.3% |

Only recently has greater attention been paid to the importance of the infrastructure of ICT. In a study for the German Government, Cremer, Aebischer et al. (2003) discussed the electricity demand of ICT in 2001 and possible future demand in 2010 separately for end-use appliances and for the infrastructure (Exhibit 4.3-2). Taken together the share of total infrastructure relative to the total electricity demand from ICT rises to 29% in 2001, an estimate very close to the one derived by Roth (2002, 2005) for the US. The share rises to 42% in 2010 (in 9 years!). The rate of growth of electricity demand in various subgroups of infrastructure ranges from 7% per year for home-use to 11% for public elements of infrastructure. This rise is due in large parts to digital television technology, which requires descramblers and adapters, as well as the diffusion of third-generation wireless telephones (UMTS) through public infrastructure. Faist, Emmenegger et al. (2003) confirm this observation for mobile telecommunication: the fraction of infrastructure in total energy demand for a land line call is of the order of 40% but increases for a mobile phone call to 75% (GSM-technology and efficient charger for the handy) and 90% (UMTS-technology working at partial capacity). In the "service sector infrastructure" sub-group, servers represent the most significant part of the growth in demand. Koomey (2007) checked this result with empirical data and found that electricity demand for servers was increasing from 2000 to 2005 even faster than predicted by Cremer: +94% in the US, +121% in Western Europe and +176% in Asia Pacific. The increasing importance of the infrastructure is discussed in more detail in Aebischer/Roturier (2007) and Souchon et al. (2007).

### IMPACT OF ICT ON ENERGY DEMAND

Having discussed the energy demand of ICT the even more complex and relevant question regards the impact ICT might have on the overall energy demand of a country. To do so, one has to consider:

1. energy demand over the life cycle of different types of equipment, i.e. in addition to the direct energy demand discussed before, the energy for producing, distributing and refurbishing or recycling this equipment;
2. efficiency improvements in technical and economic processes; of vehicles and mobility in general; and of buildings, appliances and other energy-consuming activities;
3. structural changes of and within the economy, substitution between services, dematerialisation of the economy;
4. and acceleration of economic growth thanks to acceleration of labour productivity gains and rebound effects.

### COMMON APPROACHES TO STUDYING ICT EFFECTS ON ENERGY DEMANDS

Two approaches are possible (Exhibit 4.3-3):

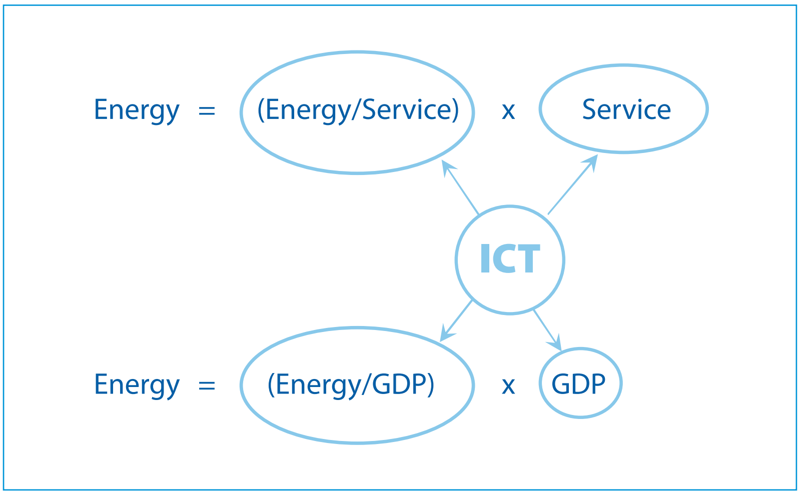
- a microeconomic approach consisting of a bundle of case studies, where the impact of ICT on specific services and on the energy intensity of this service is analysed; and
- a macroeconomic approach where the impact of ICT on the economic growth and on the energy intensity of the economy is investigated.

Most of the case studies to date investigate one of the following fields:

- manufacturing or technical processes
- building automation and intelligent homes
- traffic management
- e-economy with e-commerce, e-work, e-learn and e-governance.

Manufacturing and technical processes is the only domain where (almost) all studies agree that ICT substantially reduces energy input. "Microelectronic control is not only widely used to control the energy used in processes but, more importantly, also controls processes to make them faster, more accurate and better coordinated. The result of this is a revolution in manufacturing. The impact on energy

***Exhibit 4.3-3: Two approaches to studying the impact of ICT on energy demand on a national economy***




demand is a large savings per unit output. The savings are mostly not the result of measures specifically intended to control energy use, but significant indirect savings result from the control of processes in general" (Spreng, 1993).

Automation in buildings clearly has a huge potential to use energy more efficiently – particularly in large and complex buildings in the service sector. Information systems are implemented and used in modern buildings, but we know of many examples where the many thousands of data gathered and stored are hardly used to optimise energy use. In single family houses "intelligence" leads today in most cases to an increase in energy services and to a corresponding increase in energy demand (Aebischer and Huser, 2000, 2003).

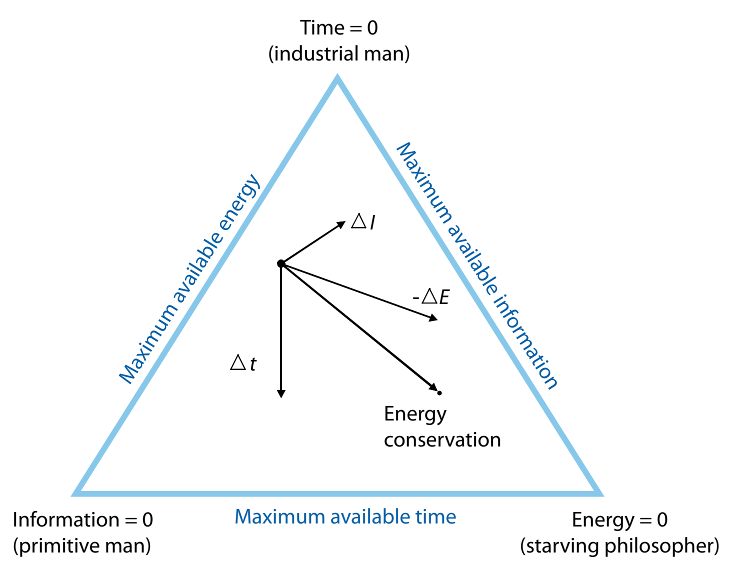
Much time and energy is wasted in traffic jams. ICT can make traffic more fluid but at the same time it increases traffic flow – as when building a new road in order to decongest an existing one. More comprehensive solutions -- including innovative public transport systems, information-systems and incentives fostering an optimal combination of public and private transport and new urban and regional planning strategies -- are needed in order to get a net positive impact of ICT in transport energy demand.

Most of the case studies investigate the impact of increased use of ICT in specific sectors of the economy. New organisational forms (e-work, e-commerce) and new products (e-paper, e-governance) are compared to traditional services and processes. Most of the studies do not question whether there is really a substitution between the traditional and the "intelligent" service and/or whether time and money saved by these new processes and services may lead to new energy consumption possibly balancing or even negating the original savings.

Several authors discuss this topic and propose a framework "the three-order-effects of ICT" (Berkhout/Hertin, 2001; Fichter, 2003; Yi/Thomas, 2007, p. 845) for investigating these questions in a comprehensive way.
The three main types of effects identified are:

- first-order impacts: direct environmental effects of the production and use of ICTs
- second-order impacts: indirect environmental impacts related to the effect of ICTs on the structure of the economy, production processes and distribution systems; the main types of positive environmental effects are dematerialisation …, virtualisation … and 'demobilisation' …
- third-order impacts: indirect effects on the environment, mainly through the stimulation of more consumption and higher economic growth by ICTs ('rebound effect'), and through impacts on lifestyles and value systems" (Berkhout/Hertin, 2001, p.2).

*Exhibit 4.3-4: The time-energy-information triangle (Spreng, 1993)*




The third-order impacts are especially difficult to evaluate. Therefore, it is quite straightforward to try to evaluate the total impact of ICT by a top-down macro approach, relating investments and/or stocks of ICT to energy demand of an economic sector or of a national economy. Madlener (2008) discusses some examples of macro evaluations. A rather comprehensive review of micro- and macro-studies was done by Yi/Thomas (2007). They conclude: "…traditional assessment approaches are insufficient to accommodate the digital technology revolution and cannot accommodate the challenge of measuring the impacts of ICT on environmental sustainability. New innovative methods need to be created to fill this gap. An artificial neural network based more predictive and empirical model was proposed to extend the traditional impact study methods."

### AN ALTERNATIVE APPROACH: SPRENG'S (1993) TRIANGLE

An alternative conceptual framework to examine the question of the impact of ICT is Spreng's (1993) triangle. Spreng describes all economic activities in terms of time, energy and information. The precondition is that there is perfect substitutability between the three factors. Then information can be used to replace time, accelerating innovation cycles and increasing productivity without increasing energy demand; or just as easily information can substitute for energy (or natural resources) without increasing the time, labour or capital input. But in reality time-saving (or increase in productivity) by more information tends to increase energy demand, whereas more rational use of energy thanks to information may demand more time (Exhibit 4.3-4).

"The importance of new information technology, NIT, in respect of future energy use can hardly be overstated. However, NIT can do two things. It can be used to substitute time by information or to substitute energy by information. NIT can, in other words, both be used to speed up the pace of life (work and leisure), thus promoting a society of harried mass consumers, or it can be used to conserve precious natural resources (energy and non-energy) by doing things more intelligently and improving the quality of life without adding stress to the environment. It is up to the society as a whole, politics of course included, to decide which of the two roads are taken" (Spreng, 1993).

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## 4.3.2 The e-Business Survey in Greece

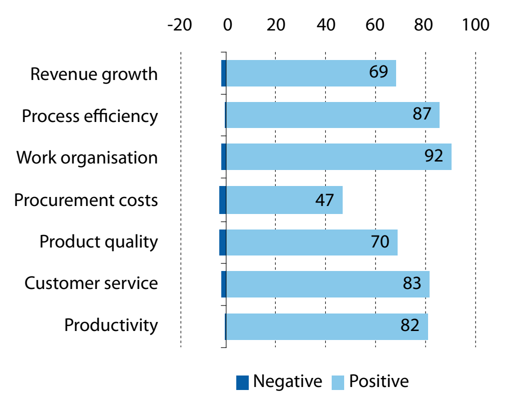
**A contribution by the Observatory for the Greek Information Society**

*The Observatory for the Greek Information Society (IS) is a non-profit organisation placed under the supervision of the Ministry of Economy & Finance. The vision of the Observatory for the Greek IS is to become the key point of reference for accurate and up-to-date information on Information Society indicators, as well as one of the main institutions that contribute to the ICT policy formulation processes.*

### INTRODUCTION

In 2006 and 2007, the Observatory for the Greek Information Society (IS) has conducted an e-Business Survey in ten sectors of the Greek economy covering 1.600 enterprises. The aim of the survey was to monitor the adoption, development and impact of e-business practices in different sectors in Greece. Furthermore, four case studies from different sectors have been conducted. Case studies are examples of real life e-business activity. The methodological approach used for the e-Business Survey (such as questionnaires, interviews, weighting principles) follows a similar structure as the surveys carried out by the Sectoral e-Business Watch,. Some of the survey results are presented in this article.

**Exhibit 4.3-5: Perceived impacts from ICT**

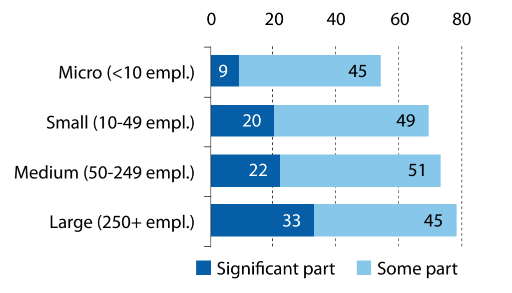



Read: Firms representing …% of employment in the sectors surveyed observe a positive / negative impact of ICT on revenue growth / process efficiency / …

Base: 10 sectors.

N = 1600.

**Exhibit 4.3-6: Perceived e-business relevance**




Read: % of companies in the sectors surveyed saying that e-Business constitutes "a significant part" or "some part" of the way they operate.

Base: 10 sectors

N = 1600.

### PERCEIVED ICT IMPACT REPORTED BY GREEK BUSINESSES

The firms which participated were asked to describe how ICT affected their business processes and operations, in other words to assess the impact of ICT on their own business. The "work organisation" and "efficiency of business processes" are the areas where most companies have experienced positive effects (see Exhibit 4.3-5). About 90% of the firms report observable positive effects. Customer service and productivity are two other areas where many companies (about 80%) observe positive effects from the use of ICT. 70% of the firms interviewed report positive product quality effects. Only a minority of a few percent report (or admit) negative effects in any of the business areas surveyed. The remaining firms have not observed any effects or are unclear on the effects of ICT.

### E-BUSINESS MATTERS

About 80% of large enterprises regard e-business as relevant for their day-to-day operations. One third of the firms even say that it constitutes a "significant part" of their activities. About 70% of small and medium-sized companies say that e-business plays a role in their operations (see Exhibit 4.3-6).

### DRIVERS FOR E-BUSINESS

The opportunity to gain competitive advantage is the most powerful driver for e-business developments in Greek firms. This is true for all sectors. About 60% of firms also state that pressure from customers has been an important reason for their e-business engagement in most sectors. By comparison, supplier power appears to be rather limited as a driving force for ICT and e-business (see Exhibit 4.3-7).

### E-BUSINESS INDICATORS

Some of the key e-business indicators comparable to Sectoral e-Business Watch findings include the following:

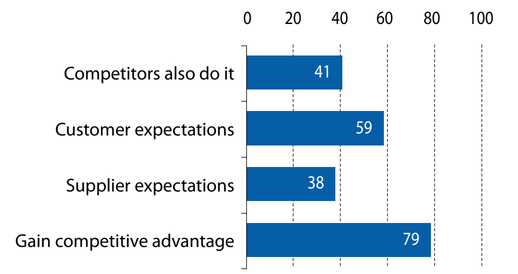
**Internet access and connection type:** Greek firms do not lag behind in terms of basic ICT infrastructure for e-business. Nearly all enterprises (98%) in the sectors examined have access to the Internet. DSL is now the most popular technology for accessing the Internet although diffusion rates differ among sectors. Almost 67% of companies in the ten sectors examined use DSL with little variation in the level of take up between small, medium, and large firms.

**Regular ICT training of employees:** One out of three firms of the examined sectors regularly send their employees to ICT training seminars. The overriding preference, even among large firms, is for traditional methods of training rather than electronic methods, such as eLearning.

**Outsourcing of ICT services:** Outsourcing is popular among all firms, irrespective of size bands: about 46% of small companies and about 42% of large firms outsource some or all of their ICT activities.

Companies accepting orders from customers online: A small number of firms (26%) sell online. For the majority of firms, online sales represent less than 5% of their total sales. Furthermore, most

*Exhibit 4.3-7: Anticipated future ICT impact*




Read: % of firms saying that… was an "important reason to engage e-business".

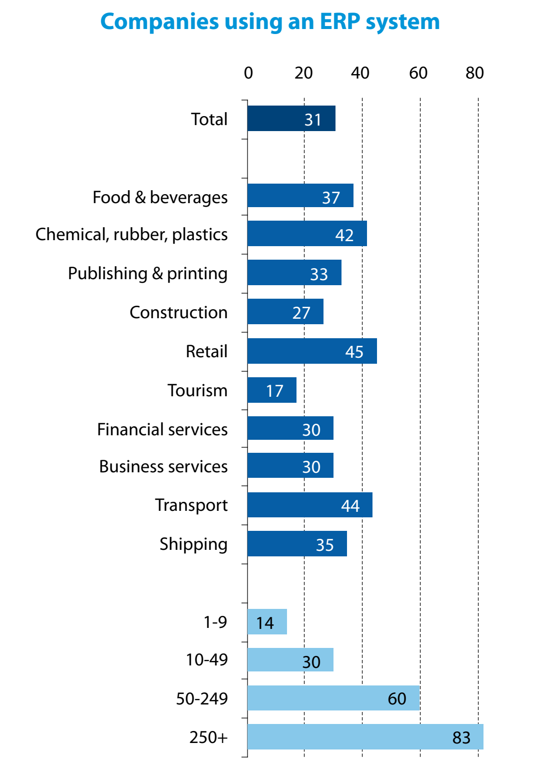
Base: 10 sectors.

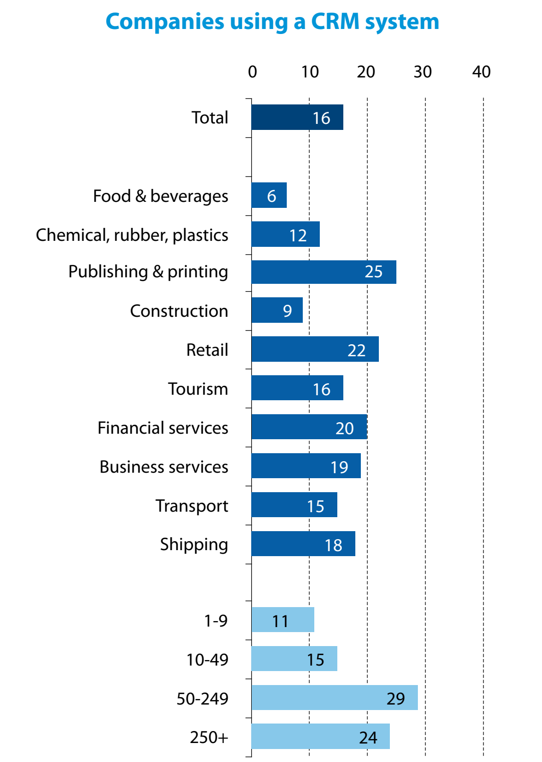
N = 1600.

Greek firms sell their products and services mainly to individual consumers than to other companies: 56% of employees work in companies that sell their products online to individual consumers as compared to only 16% who work in companies engaged in B2B sales.

**Companies using specific ICT solutions** to support business processes including marketing and

*Exhibit 4.3-8 and 4.3-9: % of companies using ERP and CRM systems*




Survey question: "Does your company use … an ERP system, that is Enterprise Resource Planning System?"

Survey question: "Does your company use a CRM system, that is a specific software suite for customer relationship management?"

Base: All enterprises that use computers from the 10 sectors covered.

N = 1600.

sales: About 10% of firms reported the use of specific software solutions for supporting marketing and sales activities. 31% of firms for example use Enterprise resource planning (ERP) solutions while 16% of firms use customer relationship management solutions (Exhibits 4.3-8 and 4.3-9).

## PROSPECTS OF THE ICT SECTOR IN GREECE

With empirical data gathered by the Observatory for the Greek IS, an effort has been made to assess the current developments and the prospects of the domestic ICT sector during the next couple of years. In other words: growth prospects of the ICT sector during 2008-2009 are relatively optimistic. This assessment is based on the gradual weakening of effects originating from long-established obstacles in the domestic ICT sector (concerning both, demand and supply); and on the reinforcement of the positive parameters that are also evident in the sector. Although firms recognise existing difficulties in the sector, they are quite optimistic about future growth. Technological developments in telecommunications are considered the driving force of the ICT sector's growth. The convergence between fixed telephony, internet, and TV has already created substantial mobility in the market and has been visible to the consumers. As new added-value products and services are better "communicated" to the market, the potential client base will be widening. Furthermore, the sector is innovative: three out of four firms that participated in the field research of the study, state that they launched a new or significantly improved product/service during the last two years. Employment in the ICT sector shows an increase of 4.5% in 2007. These results are in conjunction with the findings of other business' surveys performed in the ICT sector.

## CONCLUSIONS

In summary, the business climate for ICT and for the ICT industry in Greece has significantly improved since last year:

- The macroeconomic environment is still favourable, since the Greek economy is growing with a high growth rate. However, this alone does not constitute a necessary and mandatory condition for the sectors' growth.
- Domestic demand is strengthening, while firms tend to exploit the growing external demand to a greater extent. A significant number of large and medium-sized firms in the country adopt ICT tools, comparable to those of other developed countries. As these firms cooperate throughout their value chain with numerous smaller firms, the latter will be forced to collaborate, in order to maintain their position in the relevant market. At the same time, younger and more intense ICT users, who are entering into economic activity, are increasing. Furthermore, public sector demand has also increased and it provides more online and sophisticated public services to citizens and businesses.
- Supply reform changes have been multiplied, aiming at the consolidation of the market and the specialisation of personnel. The need for additional restructuring activities, mergers and acquisitions, has been stressed as a necessary growth precondition ensuring the rationalisation of the sector. There is progress towards that direction as significant mergers and acquisitions have taken place during the last couple of years so as to provide integrated services. Even retail chains have made strategic alliances with their suppliers and external partners, so as to provide integrated services after the sales, while important telecommunication service providers choose the development of their autonomous retail distribution network.

Greece has over 1,800 enterprises (S.A. and Ltd) operating in the ICT sector (87% in Information Technology and 13% in Telecommunications), with approximately 80% of these firms located in Attica. Almost 60% of the ICT firms were established during the last decade, while 82% employ up to 49 employees. The ICT sector's contribution to GDP was 3.8% in 2006.

## METHODOLOGICAL NOTES

### Scope and interview method

The e-Business Survey consisted of 1,600 telephone interviews with decision-makers in enterprises from 10 sectors. Interviews were carried out in June and July in years 2006 and 2007 (800 + 800 = 1600 firms) using computer-aided telephone interview (CATI) technology. The decision-maker in the enterprise targeted by the survey was normally the person responsible for ICT within the company, typically the IT manager. Alternatively, particularly in small enterprises without a separate IT unit, the managing director or owner was interviewed.

### Sectors covered by the e-Business Survey 2006-07

| Sector | No. of interviews |
|---|---|
| Food & beverages | 167 |
| Chemical, rubber & plastics | 120 |
| Publishing & printing | 120 |
| Construction | 202 |
| Retail | 244 |
| Tourism | 244 |
| Financial intermediation | 121 |
| Business services | 157 |
| Transport | 112 |
| Shipping | 113 |
| **TOTAL** | **1600** |

### Population coverage and sampling

The survey included only companies that used computers. Thus, the population was the set of all computer-using enterprises which were active within the Greek territory, and which had their primary business activity in one of the 10 sectors specified on the basis of NACE Rev. 1.1. The survey was carried out as an enterprise survey, i.e. with a data collection and reporting focus on the enterprise, defined as a business organisation (of one or more establishments). The sample drawn was a random sample of companies from the respective sector population, with the objective of fulfilling strata with respect to company size class.

Samples were drawn from a well-known business directory (Hellastat).

The questionnaire used in the current survey is an extended (enriched) version of the questionnaires used in the latest e-Business Watch surveys for 2006-7.

The survey field work was performed by MRB Hellas while it was coordinated by Foundation for Economic and Industrial Research.

MORE INFORMATION

More detailed information about the e-Business Surveys 2006-7 and the ICT sector is available at the Greek IS Observatory website (***www.observatory.gr***). In the "eData Bank" section under the "Study of the ICT sector in Greece: Current Situation and Future Trends" are the reports, while in the "Online Statistics" section dynamic presentation and extraction of statistical data is available.

e-Business W@tch

# Annex I
# Glossary of technical terms

This glossary provides short definitions and explanations of technical and economic terms which are used in this report. The glossary contains, on the one hand, ICT-related terms and acronyms and, on the other hand, economic terms which are used in the analysis of ICT impact. Sector specific terms which are not related to ICT have not been included; these should be introduced and explained in the respective study. The definitions proposed in this glossary have been extracted from different sources available online and adapted or shortened, if needed. The main sources used are:

- ***http://epp.eurostat.ec.europa.eu*** – Eurostat, the Statistical Office of the European Communities, is the leading European statistical authority and responsible for definitions of key terms used by national statistical offices.
- ***http://www.oecd.org*** – Especially the statistical service of the Organisation for Economic Co-operation and Development (OECD) shows great efforts in harmonising definitions among information society surveys.
- ***http://www.ieee.org*** – The Institute of Electrical and Electronics Engineers (IEEE), a New York based non-profit organisation, has high competences in technical standards. Many key terms concerning this topic are explicates in a glossary of terms.
- ***http://whatis.techtarget.com*** – Whatis.com is an online ICT encyclopaedia and learning centre operated by TechTarget, a US based company that supports information technology marketers in reaching targeted communities of IT professionals and executives.
- ***http://en.wikipedia.org*** – The internet-based encyclopaedia Wikipedia was used if appropriate references were provided.

Definitions that have been taken from other sources than those are referenced.

| Term | Definition |
|---|---|
| **Access** | The ability to retrieve information and to communicate online through the use of digital information and communication technologies. |
| **B2B** | Business to Business. Electronic transactions between companies. |
| **B2C** | Business to Consumer. Electronic transactions between companies and consumers. |
| **Bandwidth** | The physical characteristic of a telecommunications system that indicates the speed at which information can be transferred. In analogue systems, it is measured in cycles per second (Hertz), and in digital systems in binary bits per second. (Bit/s). |
| **Broadband** | High bandwidth internet access. In Sectoral e-Business Watch studies reports, broadband is usually defined as the capacity to transfer data at rates of 2 Mbit/s (megabits per second) or greater. |
| **Business processes** | Business processes are operations that transform the state of an object or a person. This can, for example, be an order placed via the internet. Ordering an object or a service creates a liability for the supplier to deliver, and initiates the transfer of property rights from one entity to another. The electronic handling of processes is likely to speed them up and to introduce new processes in the realisation of the same transaction. |
| **CAD** | Computer-aided design (CAD) is the use of computer technology to aid in the design and especially the drafting (technical drawing and engineering drawing) of a part or product, including entire buildings. It is both a visual (or drawing) and symbol-based method of communication whose conventions are particular to a specific technical field. Drafting can be done in two dimensions («2D») and three dimensions («3D»). |
| **CAM** | Computer-aided manufacturing (CAM) is the use of computer-based software tools that assist engineers and machinists in manufacturing or prototyping product components. CAM is a programming tool that allows users to manufacture physical models using computer-aided design (CAD) programmes. CAM creates real life versions of components designed within a software package. CAM was first used in the 1970s for car body design and tooling. |

| Term | Definition |
|---|---|
| **Channel** | In communications, a physical or logical path allowing the transmission of information; the path connecting a source and a receiver. |
| **CIDX** | Chemical Industry Data Exchange (CIDX) (***www.cidx.org***). |
| **CRM** | Customer Relationship Management. Software systems that promise the ability to synthesize data on customers' behaviour and needs and thus to provide a universal view of the customer. |
| **Digital divide** | «Digital Divide» refers to the gap between those who benefit from digital technology and those who do not (***http://www.digitaldivide.org***). It includes the imbalances in physical access to technology as well as the imbalances in resources and skills needed. It may refer to people (e.g. old and young), companies (e.g. small and large), regions or countries. |
| **Digital signature** | An electronic signature that can be used to authenticate the identity of the sender of a message or the signer of a document, and to ensure that the original content of the message or document that has been sent is unchanged. Digital signature usually refers specifically to a cryptographic signature, either on a document, or on a lower-level data structure. |
| **DMS** | A document management system (DMS) is a computer system (or set of computer programmes) used to track and store electronic documents and/or images of paper documents. |
| **DRM** | Digital rights management. DRM is a system of IT components and services, along with corresponding law, policies and business models, which strive to distribute and control intellectual property and its rights. Product authenticity, user charges, terms-of-use and expiration of rights are typical concerns of DRM. |
| **DSL** | Digital Subscriber Line. A family of technologies generically referred to as DSL, or xDSL, capable of transforming ordinary phone lines (also known as «twisted copper pairs») into high-speed digital lines, capable of supporting advanced services. ADSL (Asymmetric Digital Subscriber Line), HDSL (High data rate Digital Subscriber Line) and VDSL (Very high data rate Digital Subscriber Line) are all variants of xDSL |
| **e-Business** | Electronic business. (Automated) business processes, both intra- and inter-firm, over computer mediated networks (OECD). e-Business is thus not restricted to exchanges between different organisations, but also relates to digital information flows within a company, for example between departments, subsidiaries and branches. (→) e-Commerce refers to external transactions in goods and services. |
| **ebXML** | Electronic business using XML. A proven framework and unified set of internationally agreed upon technical specifications and common XML semantics designed to facilitate global trade. |
| **e-Catalogue** | An organised descriptive list of products or services made available by suppliers to potential buyers via the Internet (***https://services.txt.it/sets/public/Glossary%20Ver%200.4.doc***). |
| **e-Commerce** | Electronic commerce. Broad definition: An electronic transaction is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line. The narrow definition includes only sales over the internet (OECD). |
| **EDI** | Electronic Data Interchange. A way for unaffiliated companies to use networks to link their businesses by using a common technical standard for exchanging business data. While electronic mail between companies is common, electronic data interchange passes bigger bundles that replace large paper documents such as bills and contracts. |
| **EDIFACT** | Electronic Data Interchange For Administration Commerce and Transport. See UN/EDIFACT |
| **EDM** | Electronic Document Management. The management of different kinds of documents in an enterprise using computer programmes and storage devices. An EDM system allows an enterprise and its users to create a document or capture a hard copy in electronic form, store, edit, print, process, and otherwise manage documents. See also "DMS" |
| **e-Invoicing** | Electronic invoicing. A business-to-business transaction in which invoices are generated, delivered (and normally paid) electronically, replacing the equivalent traditional paper-based invoicing processes. |

| Term | Definition |
|---|---|
| **e-Learning** | e-Learning means supporting training with learning material in electronic format, for example material that is available on the intranet or the internet. e-Learning applications can be used for ICT-related training, but also for sector-specific or even company-specific training content. |
| **EHR** | Electronic Health Record. It contains all possible health relevant data of a person, includes e.g. wellness, food-related and other health related information, always established beyond an institutional framework (regional, national, global), web-based, and includes participation of citizen in creating the record (***http://www.medrecinst.com/uploadedFiles/MRILibrary/StatusReport.pdf***).<br>However, the term Electronic Health Record is inconsistently used and may refer to any kind of less sophisticated electronic files containing patient data. |
| **e-Marketplace** | Electronic trading platforms on the internet where companies can sell and/or buy goods or services, either to/from other companies or to consumers. They can be operated by a single buyer or seller or by a third party. Many marketplaces are industry-specific. Some marketplaces require registration and membership fees from companies that want to conduct trade on them. |
| **e-Procurement** | Electronic procurement is the business-to-business or business-to-consumer purchase and sale of supplies and services through the Internet as well as other information and networking systems, such as Electronic Data Interchange and Enterprise Resource Planning. It is sometimes also known as "supplier exchange". (***http://searchcio.techtarget.com/sDefinition/0,,sid182_gci214418,00.html***, also ***http://en.wikipedia.org/wiki/E-procurement***) |
| **ERP** | Enterprise Resource Planning. A software system that helps to integrate and cover all major business activities within a company, including product planning, parts purchasing, inventory management, order tracking, human resources and finance. |
| **ESIDEL** | The European Steel Industry Data Exchange Language (ESIDEL) was developed for electronic communication in the steel industry. The standard is used to e.g. facilitate the automation of order processes. |
| **EPC** | Electronic Product Code. EPC is a family of coding schemes created as an eventual successor to the bar code. The EPC was created as a low-cost method of tracking goods using RFID technology. |
| **Extranet** | A network using internet protocols that allows external organisations (for example customers or suppliers) access to selected internal data. Essentially it is an Intranet which gives external users restricted access (often password protected) to information through the firewall. |
| **Firewall** | A firewall is a set of related programmes that protects the resources of a private network from users from other networks. The term also refers to the security policy that is used with the programmes. |
| **Human capital** | 1. The stock of knowledge and skill, embodied in an individual as a result of education, training, and experience, that makes him or her more productive. 2. The stock of knowledge and skill embodied in the population of an economy<br>(***http://www-personal.umich.edu/~alandear/glossary/***) |
| **ICT** | Information and communication technology. ICT includes networks, computers, other data processing and transmitting equipment, and software. The application of ICT in business processes leads to e-business. |
| **ICT capital** | ICT capital is a sub-category of capital which is one of three primary production factors beside labour and land (natural resources). As a primary factor it is not used up in production, although it may deteriorate with use. ICT capital comprises computing equipment, communications equipment and software<br>(***http://www-personal.umich.edu/~alandear/glossary/***) |
| **Internet** | The world's largest computer communication system, with an estimated 700 million users worldwide (according to Global Reach, ***www.glreach.com***). The internet is a loose confederation of principally academic and research computer networks. It is not a network but rather the interconnection of thousands of separate networks using a common language. |
| **Interoperability** | The technical features of a group of interconnected systems (includes equipment owned and operated by the customer which is attached to the public telecommunication network) which ensure end-to-end provision of a given service in a consistent and predictable way. |

| Term | Definition |
|---|---|
| **Intranet** | An internal internet, that is an internal network running using TCP/IP, which makes information available within the company. Most Intranets are connected to the internet, and use firewalls to prevent unauthorised access. |
| **IT** | Information technology. IT includes hardware (computers, other data processing and transmitting equipment) and software. |
| **Knowledge management** | The systematic gathering, organising, sharing, and analysing of information in a company. There are specific software solutions to support this objective, typically involving data mining and some method of operation to push information to users. |
| **LAN** | Local Area Network. The most common way of connecting computers in a small area (typically inside a building or organisation) for sharing databases and communication facilities. The two most common versions are Ethernet and Token Ring. Implementation is based on coaxial cables or plain wires. Speed achieved ranges from 10 Mbps to 100 Mbps. |
| **m-Commerce** | Mobile commerce. E-commerce that takes place using mobile connection devices and through data transmission via technical standards for mobile communication. |
| **Micro enterprise** | A company with fewer than 10 employees. |
| **MRO goods** | Maintenance, repair and operating goods. Supplies which companies need to maintain their operations, for example office supplies, in contrast to «direct production goods» which are components of the goods and services the company produces. |
| **MRP** | Material Requirements Planning (MRP) is a software based production planning and inventory control system used to manage manufacturing processes. These systems are often extended to Manufacturing Resource Planning (MRP II), which are a method for the effective planning of all resources of a manufacturing company. ERP (Enterprise Resource Planning) can be considered an evolution of MRP and MRP II systems. |
| **NACE** | Nomenclature Générale des Activités Economiques dans les Communautés Européennes; Classification of Economic Activities in the European Community |
| **OSS** | Open source software refers to computer software under an open source license. An open-source license is a copyright license for software that makes the source code available and allows for modification and redistribution without having to pay the original author. |
| **Outsourcing** | Performance outside a firm or plant of a production activity that was previously done inside. (***http://www-personal.umich.edu/~alandear/glossary/***) |
| **Productivity** | Output per unit input, usually measured either by labour productivity or by total factor productivity. Labour productivity refers to the value of output per unit of labour input (e.g. hours worked). Total factor productivity is a measure of the output of an industry or economy relative to the size of all of its primary factor inputs. The term, and its acronym TFP, often refers to the growth of this measure, as measured by the "Solow residual". (***http://www-personal.umich.edu/~alandear/glossary/***) |
| **Product lifecycle management (PLM)** | The process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal. PLM software helps companies effectively and efficiently innovate, for example by managing descriptions and properties of a product starting from conception and development. |
| **Proprietary standards** | Proprietary standards are owned by one or more companies and are normally protected by one or more of the following: patents, copyrights, and trade-secrets. (***http://www.ieee.org/portal/cms_docs_iportals/iportals/education/setf/tutorials/baseline/1what-7pro.html***) |
| **Remote access** | The ability of a company computer network's transmission points to gain access to a computer at a different location. |
| **RFID** | Radio Frequency Identification. A wireless technology which is used to uniquely identify an object, animal, or person. RFID is coming into increasing use in industry as an alternative to the bar code. The advantage of RFID is that it does not require direct contact or line-of-sight scanning. |

| Term | Definition |
|---|---|
| **SCM** | Supply Chain Management is the process of planning, implementing and controlling the supply-chain operations of a company (upstream to suppliers and downstream to buyers) as efficiently as possible. This includes all material and information flaws related to the movement and storage of raw materials, semi-finished and finished goods, from point-of-origin to point-of-consumption. SCM software modules helps businesses in managing these processes. SCM software is normally used in conjunction with the ERP system. |
| **Secure server technology** | Secure server technology means that data exchange between computers is based on certain technical standards or protocols, for example «Secure Sockets Layer» (SSL). |
| **SDO** | A Standard Developing Organization (SDO) is an organisation, committee, company, governmental agency or group that develops standards. The most important SDOs are the International Standardization Organisation (ISO) and, on a European level, the European Committee for Standardisation (CEN). |
| **SME** | Small and medium-sized enterprises with 0-249 employees. To be classified as an SME, an enterprise has to satisfy the criteria for the number of employees and one of the two financial criteria, i.e. either the turnover total or the balance sheet total. In addition, it must be independent, which means less than 25% owned by one enterprise (or jointly by several enterprises) falling outside the definition of an SME or a micro-enterprise, whichever may apply. The thresholds for the turnover and the balance sheet total will be adjusted regularly, to take account of changing economic circumstances in Europe. |
| **SSL** | Secure Sockets Layer. A commonly-used protocol for managing the security of a message transmission on the internet. SSL has recently been succeeded by Transport Layer Security (TLS), which is based on SSL. |
| **Standard** | A standard is a technical specification approved by a recognised standardisation body for repeated or continuous application, with which compliance is not compulsory. |
| **Transaction** | Exchanges between two business partners (→ B2B, B2C). Transactions can be subdivided into several steps, each of which initiates a process. There are pre-sale (or pre-purchase) phases, sale and after-sale phases. The ISO definition of a business transaction is "a predefined set of activities and/or processes of parties which is initiated by a party to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved parties even though some of the recognition may be implicit" [ISO/IEC 14662:2004]. |
| **UMTS** | Universal Mobile Telecommunications Service. A third-generation (3G) digital standard for mobile communication, enabling packet-based transmission of voice, text and video at data rates up to 2 megabits per second (Mbps). |
| **UN/EDIFACT** | United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport ***http://www.unece.org/cefact/*** |
| **Value chain** | Following Michael Porter's definition, a value chain logically presents the main functional areas ("value activities") of a company and differentiates between primary and support activities. These ***are "not a collection of independent activities but a system of interdependent activities"***, which are ***"related by linkages within the value chain".*** Chains beyond single companies are referred to as "value systems". |
| **Value added** | Gross output minus intermediate inputs. It is valued at producers' prices and includes all indirect taxes, but excludes VAT and subsidies. |
| **VMI** | Vendor Managed Inventory (VMI) is a business model in which the buyer of a product provides certain information to the supplier of that product and the supplier takes full responsibility for maintaining an agreed inventory of the material, usually at the buyer's consumption location (usually a store). |
| **VoIP** | Voice over Internet Protocol (IP). The use of telephony services over internet networks, by means of digitised voice transfer technology. |
| **VPN** | Virtual Private Network. A way to use a public telecommunication infrastructure, such as the internet, to provide remote offices or individual users with secure access to their organisation's network. |

| Term | Definition |
|---|---|
| **Web 2.0** | A concept of using web technology for information sharing and collaboration among communities of interest. In particular, Web 2.0 relates to web-based tools such as social-networking sites, wikis and blogs. The business model of many Web 2.0 applications is based on the principle that the content is mostly contributed by the users themselves (i.e. by the community), while the service providers establish and maintain the technical platform and control that it is not abused. The term should not be misunderstood as a «technical upgrade» to a new version of the web in terms of technical specifications. |
| **Website** | A collection of World Wide Web files that includes a beginning file called a home page. |
| **Wireless LAN** | Wireless Local Area Network (W-LAN). An implementation of a LAN with no physical wires, using wireless transmitters and receivers. It allows a mobile user to connect to a LAN or WAN through a wireless (radio) connection. A standard, IEEE 802.11, specifies the technologies for wireless LANs. |
| **WWW** | World Wide Web. The collection of pages in HTML format which reside on web-servers. Although WWW and the internet are different, the terms are increasingly becoming interchangeably used. |
| **XML** | Extensible Mark-up Language. A standard to describe the contents of a page or file. XML is a way to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere. |

# Annex II
# The e-Business Survey 2007 - methodology report

## BACKGROUND AND SCOPE

The Sectoral e-Business Watch collects data relating to the use of ICT and e-business in European enterprises by means of representative surveys. The e-Business Survey 2007, the fifth in a series of surveys conducted in 2002, 2003, 2005 and 2006, was based on 5,325 telephone interviews with decision-makers from five industry sectors in nine EU countries and the USA. Interviews were carried out from August to October 2007, using computer-aided telephone interview (CATI) technology. The overall survey was divided into four separate projects (each using a separate questionnaire) focussing on different sectors and specific topics (see Exhibit A.II-1).

***Exhibit A.II-1: Components ("projects") of the e-Business Survey 2007***

| Survey project | Focus | Sectors covered | No. of interviews |
|---|---|---|---|
| 1 | e-Business in manufacturing | ▪ Chemical, rubber and plastics<br>▪ Steel<br>▪ Furniture | 2121 |
| 2 | e-Business in retail, transport & logistics | ▪ Retail<br>▪ Transport & logistics services | 2248 |
| 3 | RFID adoption | ▪ Manufacturing sectors<br>▪ Retail<br>▪ Transport services<br>▪ Hospitals | 434 |
| 4 | Intellectual Property rights in ICT SMEs | ▪ ICT manufacturing<br>▪ ICT services<br>▪ Software publishing | 683 |

## QUESTIONNAIRE

The questionnaires for **Projects 1 and 2** contained about 70 questions which were structured into the following modules:

- A: ICT Infrastructure and e-Business software systems
- B: Automated data exchange (Project 1) / e-Business with customers and suppliers (Project 2)
- C: e-Standards and interoperability issues (Project 1)
- D: Innovation activity of the company
- E: ICT Skills requirements and ICT costs
- F: ICT Impacts, drivers and inhibitors
- G: Background information about the company

Some of the questions were the same or similar to those used in previous surveys in order to highlight trends in the answers (notably in previously surveyed sectors such as the chemical and retail industries). Other questions were introduced or substantially modified, in order to reflect recent developments and priorities. The survey placed special focus on the degree of process automation in companies, i.e. to what extent paper-based and manually processed exchanges with business partners had been substituted by electronic data exchanges. Some questions were filtered, such as follow-up questions dependent on previous answers, and no open questions were used.

The questionnaires for **Project 3** contained about 40 questions on RFID usage by companies, including modules such as the RFID implementation status and plans, RFID application areas and factors determining RFID investment. The survey addressed companies that used or planned to use RFID as well as companies that did not use this technology. Non-users were asked to give reasons why they chose not to make use of it.

The questionnaire for **Project 4** contained about 40 questions on intellectual property protection and innovation practice, IPR objectives, awareness issues and reasons for not using IP protection.

The questionnaires of all e-Business Watch surveys since 2002 can be downloaded from the project website (***www.ebusiness-watch.org/about/methodology.htm***).

POPULATION

**Projects 1 and 2:** As in 2005 and 2006, the survey considered only companies that used computers. For the first time, a cut-off was introduced with regard to company size. When surveying the manufacturing sector in Project 1, only companies with at least 10 employees were interviewed. For the retail and transport sector in Project 2, the population also included micro-companies with fewer than 10 employees, reflecting their important contribution (see Exhibit A.II-2). Sector totals are therefore not directly comparable between the two projects. The highest level of the population was the set of all computer-using enterprises (and, in Project 1, with at least 10 employees) that were active within the national territory of one of the eight countries covered, and whose primary business activity was covered by one of the five sectors specified in the NACE Rev. 1.1.[141] Evidence from previous surveys shows that computer use can be expected to reach 99% or more among medium-sized and large firms across all sectors.

**Project 3:** The survey covered medium-sized companies and large companies, i.e. firms with at least 50 employees. It included seven EU countries (France, Germany, Ireland, Italy, Poland, Spain and the United Kingdom) and covered four sectors (see Exhibit A.II-2).

**Project 4:** The survey covered micro, small and medium-sized companies in the range from 3 to 249 employees. It included eight EU countries (Austria, France, Germany, Ireland, Italy, Poland, Spain and the United Kingdom) and covered the ICT industries (see Exhibit A.II-2). To qualify for the survey, in addition to the characteristics specified above, companies needed to protect or plan to protect intellectual property. If this was not the case, the company needed to have developed products, services or processes that were new to the market within the past three years. If non of these criteria applied, the interview was terminated.

***Exhibit A.II-2: Population coverage of the e-Business Surveys 2007***

| No. | Sector name | NACE Rev. 1.1 activities covered | Population definition | No. of interviews conducted |
|---|---|---|---|---|
| | | **Project 1 – Manufacturing** | | |
| 1.1 | Chemicals, rubber & plastics | 24, 25 | Companies which have at least 10 employees and use computers | 911 |
| 1.2 | Steel | 27.1-3, 27.51-52 | | 449 |
| 1.3 | Furniture | 36.12-14 | | 761 |
| | | **Project 2 – Retail and transport** | | |
| 2.1 | Retail | 52 | Companies that use computers | 1,151 |
| 2.2 | Transport services and logistics | 60.10, 60.21+23+24 63.11+12+40 | | 1,097 |
| | | **Project 3 – RFID adoption** | | |
| 3.1 | Manufacturing | 15, 18, 19 , 24.4, 30, 31, 32, 33, 34 | Medium to large sized companies (50+ employees) | 163 |
| 3.2 | Retail distribution | 52 | | 94 |
| 3.3 | Transportation | 60.1, 60.2, 62.1, 62.2 | | 82 |
| 3.4 | Hospital activities | 85.11 | | 95 |
| | | **Project 4 – IPR for ICT-SMEs** | | |
| 4.1 | ICT manufacturing activities | 30.02, 32.1, 32.2, 32.3, 33.2, | Micro to medium sized companies (3 to 249 employees) | 261 |
| 4.2 | Software publishing | 72.2 | | 282 |
| 4.3 | Telecommunications and IT services | 64.2, 72.1, 72.3 | | 140 |

141. NACE Rev. 1.1 was replaced by the new version NACE Rev. 2 in January 2008. Nonetheless when the survey was conducted, sectors still had to be defined on the basis of NACE Rev. 1.1 because business directories from which samples were drawn were based on the older version.

### *Exhibit A.II-3: Strata by company-size in Projects 1 and 2*

| Size-band | Target quota specified | |
|---|---|---|
| | **Project 1** Manufacturing | **Project 2** Retail & transport |
| Micro enterprises (up to 9 employees) | -- | up to 30% |
| Small companies (10-49 employees) | up to 40-50%* | at least 30% |
| Medium-sized companies (50-250 employees) | at least 40-45%* | at least 25% |
| Large companies (250+ employees) | at least 10-15%* | at least 15% |

* depending on sector

### *Exhibit A.II-4: Institutes that conducted the fieldwork of the e-Business Survey 2007 and number of interviews conducted per country (total for Projects 1 and 2)*

| Country | Institute conducting the interviews | Total achieved |
|---|---|---|
| France | IPSOS Insight Marketing, 75628 Paris | 551 |
| Germany | IPSOS GmbH, 23879 Mölln | 555 |
| Italy | Demoskopea S.p.A., 20123 Milano | 553 |
| Poland | IQS and Quant Group Sp.z.o.o, 00-610 Warszawa | 546 |
| Spain | IPSOS Spain, 28036 Madrid | 549 |
| Sweden | GfK Sverige AB, 22100 Lund | 542 |
| UK | Continental Research, London EC1V 7DY | 548 |
| USA | Market Probe International, Inc, New York, NY 10168 | 525 |
| **TOTAL** | | **4,369** |

## SAMPLING FRAME AND METHOD

For each sector, the sample was drawn randomly from companies within the respective sector population of each of the countries surveyed. The objective of this approach was to fulfil minimum strata with respect to company size-bands per country-sector cell (see Exhibit A.II-3, showing the strata specified for Projects 1 and 2 as an example).

Samples were drawn locally by fieldwork organisations based on official statistical records and widely recognised business directories such as Dun & Bradstreet (used in several countries) or Heins und Partner Business Pool.

The survey was carried out as an enterprise survey: data collection and reporting focus on the enterprise, defined as a business organisation (legal unit) with one or more establishments. Due to the small population of enterprises in some of the sector-country cells, the target quota could not be achieved (particularly in the larger enterprise size-bands) in each country. In these cases, interviews were shifted to the next largest size-band (from large to medium-sized, from medium-sized to small), or to other sectors.

## FIELDWORK

Fieldwork was coordinated by the German branch of Ipsos GmbH (***www.ipsos.de***) and conducted in cooperation with its local partner organisations (see Exhibit A.II-4) on behalf of the Sectoral e-Business Watch. Pilot interviews prior to the regular fieldwork were conducted with about ten companies in each sector in Germany in August 2007, in order to test the questionnaire (structure, comprehensibility of questions, average interview length).

The two sector surveys (Projects 1 and 2) had a total scope of 4,369 interviews, spread across eight countries and five industries. In each of the eight countries, all five sectors were covered. The target was to spread interviews as evenly as possible across sectors; however, due to the comparatively small population of companies in the steel and (in some countries) in the furniture industries, some interviews had to be moved either between countries (within a sector) or between sectors (i.e. from steel or furniture to larger sectors such as the retail industry). Exhibit A.II-5 shows the final distribution of interviews across sectors and countries.

**Non response:** In a voluntary telephone survey, in order to achieve the targeted interview totals, it is always necessary to contact more companies than the number targeted. In addition to refusals, or eligible respondents being unavailable, any sample contains a proportion of "wrong" businesses (e.g., from another sector), and wrong and/or unobtainable telephone numbers. Exhibit A.II-6 shows the completion rate by country (completed interviews as percentage of contacts made) and reasons for non-completion of interviews for Projects 1-2. Higher refusal rates in some countries, sectors or size bands (especially among large businesses) inevitably raise questions about a possible refusal bias: that is, the possibility that respondents differ in their characteristics from those that refuse to participate. However, this effect cannot be avoided in any voluntary survey (whether telephone- or paper-based).

*Exhibit A.II-5: Interviews conducted per sector and country – Projects 1-4*

| Sector Country | DE | ES | FR | IT | PL | SE | UK | USA | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Project 1 - Total** | **305** | **290** | **235** | **303** | **254** | **170** | **264** | **300** | **2,121** |
| 1.1 Chemical | 100 | 120 | 135 | 105 | 120 | 105 | 126 | 100 | **911** |
| 1.2 Steel | 100 | 50 | 20 | 87 | 24 | 30 | 38 | 100 | **449** |
| 1.3 Furniture | 105 | 120 | 80 | 111 | 110 | 35 | 100 | 100 | **761** |
| **Project 2 - Total** | **250** | **259** | **316** | **250** | **292** | **372** | **284** | **225** | **2,248** |
| 2.1 Retail | 120 | 131 | 166 | 126 | 151 | 184 | 148 | 125 | **1,151** |
| 2.2 Transport | 130 | 128 | 150 | 124 | 141 | 188 | 136 | 100 | **1,097** |

| Sector Country | DE | ES | FR | IT | PL | UK | IE | AT | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Project 3 - Total** | **110** | **60** | **70** | **57** | **40** | **70** | **27** | **--** | **434** |
| 3.1 Manufacturing | 44 | 19 | 30 | 17 | 14 | 25 | 14 | - | **163** |
| 3.2 Retail | 22 | 16 | 9 | 11 | 11 | 16 | 9 | - | **94** |
| 3.3 Transportation | 16 | 13 | 9 | 17 | 9 | 16 | 2 | - | **82** |
| 3.4 Hospitals | 28 | 12 | 22 | 12 | 16 | 13 | 2 | - | **95** |
| **Project 4 - Total** | **90** | **90** | **92** | **91** | **90** | **106** | **54** | **70** | **683** |
| 4.1 Manufacturing | 33 | 37 | 37 | 37 | 37 | 45 | 12 | 23 | **261** |
| 4.2 Software | 38 | 41 | 36 | 36 | 30 | 36 | 31 | 34 | **282** |
| 4.3 IT services | 19 | 12 | 19 | 18 | 23 | 25 | 11 | 13 | **140** |

*Exhibit A.II-6: Interview contact protocol, completion rates and non-response reasons – Projects 1-2*

| | | DE | ES | FR | IT | PL | SE | UK | US |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **Sample (gross)** | **6188** | **6435** | **6538** | **3071** | **10642** | **3016** | **8246** | **15862** |
| 1.1 | Telephone number not valid | 541 | 31 | 53 | 299 | 645 | 38 | 611 | 1811 |
| 1.2 | Not a company (e.g. private household) | 82 | 209 | 6 | 36 | 327 | 2 | 57 | 431 |
| 1.3 | Fax machine / modem | 19 | 0 | 72 | 9 | 300 | 33 | 69 | 389 |
| 1.4 | Quota completed → address not used | 973 | 2018 | 1531 | 101 | 2492 | 84 | 1087 | 193 |
| 1.5 | No target person in company | 992 | 267 | 264 | 129 | 975 | 101 | 662 | 821 |
| 1.6 | Language problems | 4 | 0 | 6 | 1 | 77 | 6 | 6 | 72 |
| 1.7 | No answer on no. of employees | 0 | 8 | 0 | 1 | 9 | 1 | 6 | 24 |
| 1.8 | Company does not use computers | 35 | 75 | 32 | 76 | 35 | 5 | 110 | 398 |
| 1.9 | Company <10 employees (manufacturing only) | 90 | 30 | 7 | 0 | 78 | 0 | 670 | 21 |
| 1.10 | Not targeted sub-sector (transport only) | 0 | 16 | 0 | 3 | 4 | 3 | 14 | 24 |
| | **Sum 1.1 – 1.10** | **2076** | **2654** | **1971** | **655** | **4942** | **273** | **3292** | **4184** |
| **2** | **Sample (net)** | **4112** | **3781** | **4567** | **2416** | **5700** | **2743** | **4954** | **11678** |
| 2.1 | Nobody picks up phone | 65 | 462 | 1061 | 0 | 440 | 147 | 112 | 2280 |
| 2.2 | Line busy, engaged | 0 | 0 | 37 | 0 | 54 | 479 | 82 | 99 |
| 2.3 | Answering machine | 0 | 0 | 1022 | 0 | 168 | 14 | 86 | 1655 |
| 2.4 | Contact person refuses | 1546 | 0 | 136 | 435 | 2207 | 236 | 1960 | 2242 |
| 2.5 | Target person refuses | 1666 | 2540 | 932 | 351 | 338 | 573 | 1558 | 3363 |
| 2.6 | No appointment during fieldwork period possible | 63 | 0 | 97 | 70 | 392 | 477 | 352 | 0 |
| 2.7 | Open appointment | 170 | 88 | 692 | 988 | 1384 | 261 | 140 | 1514 |
| 2.8 | Target person is ill / cannot follow the interview | 1 | 0 | 13 | 3 | 33 | 2 | 4 | 0 |
| 2.9 | Interview abandoned | 46 | 142 | 17 | 17 | 138 | 4 | 112 | 0 |
| 2.10 | Interview error (→ interview cannot be used) | 0 | 0 | 9 | 0 | 0 | 8 | 0 | 0 |
| | **Sum 2.1 – 2.10** | **3557** | **3232** | **4016** | **1864** | **5154** | **2201** | **4406** | **11153** |
| **3** | **Successful interviews** | **555** | **549** | **551** | **553** | **546** | **542** | **548** | **525** |
| | **Completion rate (= [3]/[2])** | **13.5%** | **14.5%** | **12.1%.** | **22.9%** | **9.6%** | **19.8%** | **11.1%** | **4.5%** |
| | **Average interview time (min:sec)** | **20:16** | **20:12** | **19:50** | **16:51** | **20:417** | **18:17** | **18:21** | **21:25** |

### FEEDBACK FROM INTERVIEWERS

No major problems were reported from the field-work with respect to interviewing (comprehensibility of the questionnaire, logical structure). The overall feedback from the survey organisations was that fieldwork ran smoothly and that the questionnaire was well understood by most respondents. The main challenge was the fulfilment of the quotas, which was difficult or impossible in some of the sectors, in particular among the larger size-bands. More specific comments from fieldwork organisations, which point to difficulties encountered in the local situation, are available in the detailed field-report from Ipsos, which can be downloaded from the e-Business Watch web-site, ***www.ebusiness-watch.org/about/methodology.htm***.

### WEIGHTING SCHEMES

Due to stratified sampling, the sample size in each size-band is not proportional to the population numbers. If proportional allocation had been used, the sample sizes in the 250+ size-band would have been extremely small, preventing any reasonable presentation of results. Thus, weighting is required so that results reflect the structure and distribution of enterprises in the population of the respective sector or geographic area. The Sectoral e-Business Watch applies two different weighting schemes: by employment, and by the number of enterprises.[142]

- **Weighting by employment**: Values that are reported as employment-weighted figures should be read as "enterprises comprising x% of employees" (in the respective sector or country). The reason for using employment weighting is the predominance of micro-enterprises over other kinds of firms. If the weights did not factor in the economic importance of different sized businesses, the results would be dominated by the percentages observed in the micro size-band.

- **Weighting by the number of enterprises**: Values that are reported as "x% of enterprises" show the share of firms irrespective of their size, i.e. a micro-company with a few employees and a large company with thousands of employees both count equally.

### THE USE OF FILTER QUESTIONS IN INTERVIEWS

In the interviews, not all questions were asked to all companies. The use of filter questions is a common method in standardised questionnaire surveys to make the interview more efficient. For example, questions on the type of internet access used were only asked to companies that replied affirmatively to having internet access. The question of whether a company has internet access thus serves as a filter for follow-up questions.

The results for follow-up questions can be computed on the basis of enterprises that were asked the question (e.g. "in % of enterprises with internet access") or on the basis of all companies surveyed. In this report, both methods are used, depending on the indicator. The basis (as specified in footnotes of tables and charts) is therefore not necessarily identical to the set of companies that were actually asked the filter question.

### STATISTICAL ACCURACY OF THE SURVEY: CONFIDENCE INTERVALS

Statistics vary in their accuracy, depending on the kind of data and sources. A 'confidence interval' is a measure that helps to assess the accuracy that can be expected from data. The confidence interval is the estimated range of values on a certain level of significance. Confidence intervals for estimates of a population fraction (percentages) depend on the sample size, the probability of error, and the survey result (value of the percentage) itself. Further to this, variance of the weighting factors has negative effects on confidence intervals.

Exhibit A.II-7 gives some indication of the accuracy that can be expected for EU-7[143] industry totals (based on all respondents) according to the weighting scheme used for Projects 1-2. The confidence intervals differ depending on the industry and the respective value; on average, they represent a 5 percentile fork around the results (in both weighting schemes). Confidence intervals for employment-weighted data are highest for the steel industry, due to the small number of observations and because this sector's structure makes it more sensitive to data weighting (i.e. large firms dominate in a comparatively small population). Employment-weighted data for this industry therefore have lower statistical accuracy than for the other sectors.

The calculation of confidence intervals is based on the assumption of (quasi-) infinite population universes. In practice, however, in some industries and in some countries the complete population of businesses consists of only several hundred or even a few dozen enterprises. In some cases, every enterprise within a country-industry and size-band cell was contacted and asked to participate in the survey. This means that it is practically impossible to achieve a higher confidence interval through representative enterprise surveys in which participation is not obligatory. This should be taken into account when comparing the confidence intervals of e-Business Watch surveys to those commonly found in general population surveys.

142. In the tables of this report, data are normally presented in both ways, except for data by size-bands. These are shown in % of firms within a size-band, where employment weighting is implicit.

143. The EU-7 are composed of those countries which were covered by the survey. To ensure data comparability, only interviews from these countries are included in the aggregated «total» values.

### *Exhibit A.II-7: Confidence intervals for the sector surveys of Projects 1-2 (EU-7)*

| | | Confidence interval | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Survey result** | **if weighted as "% of firms"** | | | **if weighted by employment** | | | **unweighted** | | |
| **Sectors (aggregate, EU-7)** | | | | | | | | | | |
| Chemical, rubber and plastics | 10% | **8.0%** | - | **12.4%** | **6.5%** | - | **15.0%** | **8.4%** | - | **11.9%** |
| Steel | 10% | **7.5%** | - | **13.2%** | **4.8%** | - | **19.6%** | **7.7%** | - | **13.0%** |
| Furniture | 10% | **8.0%** | - | **12.5%** | **7.1%** | - | **14.0%** | **8.2%** | - | **12.1%** |
| Retail | 10% | **7.0%** | - | **14.0%** | **7.0%** | - | **14.1%** | **8.6%** | - | **11.7%** |
| Transport & logistics | 10% | **7.0%** | - | **14.1%** | **7.4%** | - | **13.4%** | **8.5%** | - | **11.7%** |
| **Sectors (aggregate, EU-7)** | **30%** | | | | | | | | | |
| Chemical, rubber and plastics | 30% | **26.8%** | - | **33.5%** | **24.0%** | - | **36.8%** | **27.4%** | - | **32.7%** |
| Steel | 30% | **25.8%** | - | **34.5%** | **20.3%** | - | **42.0%** | **26.1%** | - | **34.2%** |
| Furniture | 30% | **26.7%** | - | **33.5%** | **25.0%** | - | **35.5%** | **27.1%** | - | **33.0%** |
| Retail | 30% | **25.0%** | - | **35.6%** | **24.9%** | - | **35.7%** | **27.7%** | - | **32.4%** |
| Transport & logistics | 30% | **24.9%** | - | **35.7%** | **25.7%** | - | **34.7%** | **27.7%** | - | **32.4%** |
| **Sectors (aggregate, EU-7)** | **50%** | | | | | | | | | |
| Chemical, rubber and plastics | 50% | **46.3%** | - | **53.7%** | **43.0%** | - | **57.0%** | **47.1%** | - | **52.9%** |
| Steel | 50% | **45.2%** | - | **54.8%** | **38.2%** | - | **61.8%** | **45.6%** | - | **54.4%** |
| Furniture | 50% | **46.3%** | - | **53.7%** | **44.3%** | - | **55.7%** | **46.8%** | - | **53.2%** |
| Retail | 50% | **44.2%** | - | **55.8%** | **44.1%** | - | **55.9%** | **47.4%** | - | **52.6%** |
| Transport & logistics | 50% | **44.1%** | - | **55.9%** | **45.1%** | - | **54.9%** | **47.4%** | - | **52.6%** |
| **Sectors (aggregate, EU-7)** | **70%** | | | | | | | | | |
| Chemical, rubber and plastics | 70% | **66.5%** | - | **73.2%** | **63.2%** | - | **76.0%** | **67.3%** | - | **72.6%** |
| Steel | 70% | **65.5%** | - | **74.2%** | **58.0%** | - | **79.7%** | **65.8%** | - | **73.9%** |
| Furniture | 70% | **66.5%** | - | **73.3%** | **64.5%** | - | **75.0%** | **67.0%** | - | **72.9%** |
| Retail | 70% | **64.4%** | - | **75.0%** | **64.3%** | - | **75.1%** | **67.6%** | - | **72.3%** |
| Transport & logistics | 70% | **64.3%** | - | **75.1%** | **65.3%** | - | **74.3%** | **67.6%** | - | **72.3%** |
| **Sectors (aggregate, EU-7)** | **90%** | | | | | | | | | |
| Chemical, rubber and plastics | 90% | **87.6%** | - | **92.0%** | **85.0%** | - | **93.5%** | **88.1%** | - | **91.6%** |
| Steel | 90% | **86.8%** | - | **92.5%** | **80.4%** | - | **95.2%** | **87.0%** | - | **92.3%** |
| Furniture | 90% | **87.5%** | - | **92.0%** | **86.0%** | - | **92.9%** | **87.9%** | - | **91.8%** |
| Retail | 90% | **86.0%** | - | **93.0%** | **85.9%** | - | **93.0%** | **88.3%** | - | **91.4%** |
| Transport & logistics | 90% | **85.9%** | - | **93.0%** | **86.6%** | - | **92.6%** | **88.3%** | - | **91.5%** |

Reading example: If 10% of the steel firms surveyed said that they conduct a certain activity (e.g. selling online), this percentage should be interpreted in a way that the actual percentage may be between 7.5% and 13.2%.

Confidence intervals at α=.90

# Annex III
# Econometric analysis methodology

## COMMON STOCHASTIC PRODUCTION POSSIBILITY FRONTIERS APPROACH

The production possibility frontier approach, in contrast to the more traditional production function approach, makes it possible to disentangle the overall productivity growth (see e.g. Acemoğlu et al., 2003) into two components: the rate of technological progress of the frontier, and the movements of single entities from inefficient usage towards the efficiency frontier (see Exhibit A.III-1).

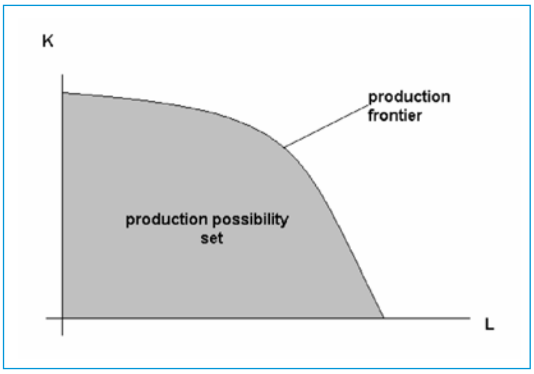
If, given the factor input set, the produced output level stays below the potential maximum level, then the respective inefficient use of resources indicates indirectly that the whole production system or, at the micro level, the single producer faces an inability to match the best available practice. Farrell (1957) was the first to distinguish between technical and allocative efficiency. Technical efficiency reflects the ability of a firm to obtain maximal output from a given set of inputs. Allocative efficiency is used for the ability of a firm to use the inputs in optimal proportions, given their respective prices. The combination of both gives a measure of the total economic efficiency.

Assuming log-linear production function where i countries produce their output given the technological parameter ***ß***, the stochastic production possibility frontier is now determined by two types of random errors. The always positive inefficiency random variable $u_i$, and the new random error term $v_i$, which has the usual properties of identical independent normally distributed errors with a mean value of zero and a constant variance $\sigma_v^2$.

$$\ln(y_i) = \beta_0 + \sum_{j=1}^{m} x_{ij} \cdot \beta_j + v_i - u_i \qquad \text{for} \qquad i = 1,\dots,N$$

The production frontier is therefore determined by the deterministic part plus a stochastic part consisting of a mixture of two probability distributions: a non-negative one, for instance a positive truncated normal distribution, and the usual normal distribution of the error term. Estimating a stochastic production possibility frontier therefore involves estimating the parameters of the two probability distributions simultaneously.

***Exhibit A.III-1: Production possibility set and frontier***




The stochastic frontier function is accordingly bounded from above by

$$\ln(y_i) = \beta_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot \beta_j + v_i \qquad \text{for} \qquad i = 1,\dots,N \; .$$

The model equation can be estimated by using standard maximum-likelihood methods.This approach requires explicit assumptions on the underlying probability distributions of the two random variables. However, the estimation function cannot be derived explicitly, so the ML[144]-function has to be optimised numerically. This is achieved in our paper by the Frontier 4.1 program (see Coelli, 1996). For the exact specification of the ML-function see Battese and Corra (1977). They showed that the ML-estimators are consistent and asymptotically efficient (Aigner, Lovell, Schmidt, 1977).

The model is not limited to a Cobb-Douglas function estimation; it could easily be adjusted to a more flexible functional form of a translog production function.[145]

$$\ln(y_i) = \beta_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot \beta_j + \sum_{j=1}^{m} \sum_{k=1}^{m} \beta_{jnk} \cdot \ln x_{ik} \cdot \ln x_{jk} + v_i - u_i \qquad \text{for} \qquad i = 1,\dots,N$$

144. ML - Maximum Likelihood.

145. In our econometric analysis translog specifications were estimated but the results are not included in this report due to limited space. They will be published separately in a forthcoming working paper. By incorporating the cross-terms of a translog function or other flexible functional form one is able to determine variable substitutions elasticities between the different factor inputs. Assuming a Cobb-Douglas specification one assumes constant unity substitution elasticities between all different factor inputs.

One-sided generalised likelihood-ratio-tests for such estimators were derived in later research (Coelli, 1995).

In the current paper we use this stochastic production possibility frontier approach to measure the degree of inefficiency between industries in different countries. Since we do not estimate a single frontier for each country's industry separately but instead assume a common production possibility frontier, this approach is referred to as a common stochastic production possibility frontiers approach (see e.g. Berger, Humphrey 1997). The production possibility frontier approach does not explain the causes of the inefficiencies studied. It only indicates that a certain combination of factors is used inefficiently. Organisational or institutional failures are not revealed as they are not explicitly included in the estimation of the stochastic production possibility frontiers.

In our analysis we use a panel-data approach because of the modest number of countries sampled. The only way a cross-section approach could be used would be by pooling industry and country data. Further trends can be drawn from the stochastic production possibility frontier model although a complete analysis is beyond the scope of this paper.

To incorporate intermediate inputs in our analysis we use the gross production value, gpv of the respective industry instead of the gross value added, gva, as the output variable. This enables us to estimate the output elasticities[146] for intermediate inputs.

$$\ln(gpv_i) = \beta_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot \beta_j + v_i - u_i \quad \text{for} \quad i = 1,\ldots,6$$

$$\text{with} \quad x_{j.} \in \{imi, ict, nict, hswh, mswh, lswh\}^{147}$$

Combining the industries' production possibility frontiers for each country to one common production possibility frontier for an industry across all countries, we obtain a multi-country data panel with a common stochastic production possibility frontier.

$$\ln(gpv_{j,i}) = \beta_0 + \sum_{j=1}^{m} \ln x_{ijj} \cdot \beta_j + v_i - u_{j,i} \quad \text{for} \quad i = 1,\ldots,6 \quad \text{and} \quad j = 1,\ldots,12$$

To impose constant returns to scale we normalised the production possibility frontier by subtracting the natural logarithm of total working hours from both sides of our equation. This normalized common production possibility frontier equates the gross production value labour productivity in working hours on the left hand side with respective factor intensities such as ICT-capital intensity on the right hand side.

$$\ln(gpv^*_{j,i}) = \beta^* + \sum_{j=1}^{m} \ln x^*_{ij,i} \cdot \beta^*_j + v_i - u_{j,i} \quad \text{for} \quad i = 1,\ldots,6 \quad \text{and} \quad j = 1,\ldots,12$$

To include Harrod-neutral technical change in the multi-country industry common production possibility frontier a time trend variable is also included. The respective parameter value $\beta_7$ measures the average TFP-growth rate. The long-term rate of Harrod-neutral technological progress therefore determines the outward shift attributed to a steady technical change in the common production possibility frontier.

$$\ln(gpv^*_{j,i}) = \beta' + \sum_{j=1}^{m^*} \ln x^*_{ij,i} \cdot \beta^*_j + \beta^*_7 \cdot t + v_i - u_{j,i} \quad \text{for} \quad i = 1,\ldots,6 \quad \text{and} \quad j = 1,\ldots,12$$

## DATA SOURCES

**EU KLEMS database:** The aim of the EU KLEMS research project is to create a database on measures of economic growth, productivity, employment creation, capital formation and technological change in the European Union's industrial sector since 1970. The database breaks industries down into 63 categories. It covers the EU (25) Member States, the US, Japan and Canada and provides data going back to 1990 for new EU Member States.

**ZEPHYR** is an information solution containing M&A, IPO and venture capital deals with links to detailed financial company information. There is no minimum deal value so all deals can be analysed in detail, irrespective of the transaction size. All information is translated into English and the deals are verified by a senior researcher before being published on ZEPHYR to ensure consistently high quality information. The

146. An output elasticity is a dimensionless measure for the ratio of marginal percentage changes of output with regard to a particular input variable, i.e. a 1% increase in the input variable changes the output variable by x%.

$$e_{o,x} = \frac{\partial \ln o_t}{\partial \ln x_t} = \frac{\partial o_t}{o_t} \Big/ \frac{\partial x_t}{x_t} = \lim_{\Delta \to 0} \frac{\Delta o_t}{o_t} \Big/ \frac{\Delta x_t}{x_t}.$$

147. The symbols used denote the following: imi - intermediate inputs, ict – ICT-capital stock, nict – non-ICT capital stock, hswh – high-skilled total working hours, mswh – medium-skilled total working hours, lswh - low-skilled total working hours.

database offers five years of global coverage and includes deals involving European or American companies going back to 1997.

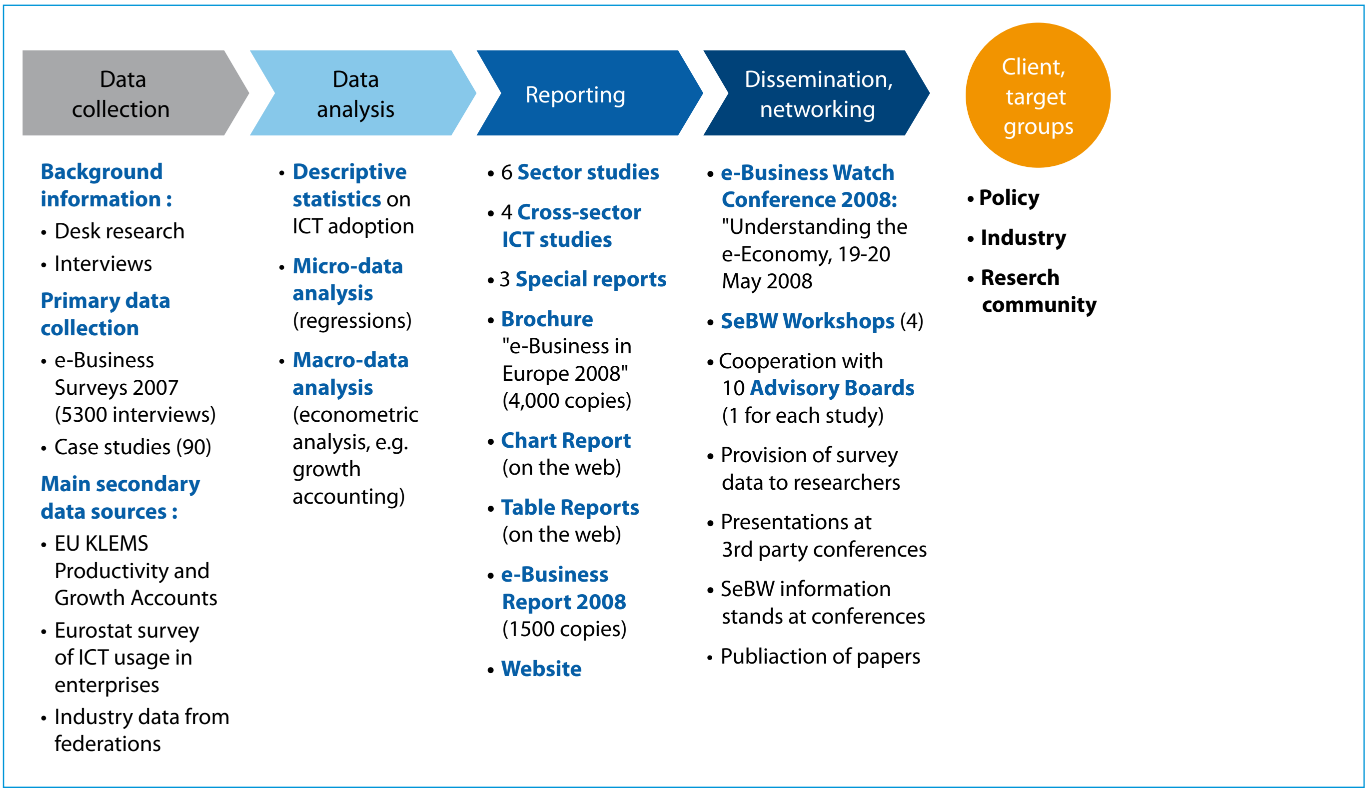
The **European Restructuring Monitor** (ERM) provides up-to-date news and analysis on company restructuring activities in Europe and their employment consequences. It offers information on individual restructuring cases and allows for the compilation of statistics comparing countries, sectors and types of restructuring. All information is based on the analysis of daily newspapers and the business press in the EU27 and Norway. The database covers restructuring activities from 2001. To date 6,991 restructuring cases from most industry sectors have been collected.

| **Data sources by subject of study** | | | | |
|---|---|---|---|---|
| Productivity | Employment | Innovation | Market Structure | Value Chain |
| EU KLEMS | EU KLEMS | EU KLEMS/Zephyr** | EU KLEMS/Zephyr** | EU KLEMS/ERM*** |
| * ***http://www.euklems.net/*** , ** ***zephyr.bvdep.com/*** , *** ***http://www.eurofound.europa.eu/emcc/index.htm*** | | | | |

# Annex IV
# Sectoral e-Business Watch activities in 2007/08

This Annex summarises the activities of the Sectoral e-Business Watch in the period from January 2007 to September 2008.[148] Activities can be grouped into four categories, which constitute at the same time the main project phases (see Exhibit A.VI-1): **primary data collection** (with the e-Business Survey 2007 and the case studies as the cornerstones of this activity), **data analysis** (including micro and macro data analysis), **reporting**, i.e. the presentation of results in publications, and finally **dissemination and networking** activities, which include the organisation of events and the cooperation with the Advisory Boards.

*Exhibit A.IV-1: Research, reporting and dissemination activities of the Sectoral e-Business Watch in 2007/08*




## A.IV.1 Data collection

The Sectoral e-Business Watch combines quantitative and qualitative methods to collect primary and secondary information about the sectors and topics studied (see Exhibit A.IV-2). Qualitative information, i.e. individual assessments of facts, stems from interviews (with sector experts, industry and company representatives) and from case studies. This evidence serves as context information and has a descriptive, explanatory and illustrative function. On the other hand, quantitative data gathered through surveys and from secondary statistical sources delivers the indicators on ICT adoption and the basis for the economic analysis of ICT impact. Data collection is complemented by a literature review. Reports issued by industry federations are of particular importance as they deliver background information and data about the sector at stake and explain the industry's perspective on specific issues and challenges.

148. The Sectoral e-Business Watch is based on a framework contract between DG Enterprise and Industry and empirica GmbH, running from January 2007 until the end of 2010. The first specific contract concluded under this framework contract comprised the services summarised in this Annex. It covered the period from January 2007 to September 2008.

*Exhibit A.IV-2: Matrix of data sources used*

| | Quantitative data | Qualitative information |
|---|---|---|
| **Primary data** | e-Business Survey 2007 | Case studies<br>Expert interviews |
| **Secondary data** | Eurostat databases<br>Data from industry federations | Literature evaluation ("desk research")<br>Business examples (e.g. customer case studies by ICT service providers) |

### THE E-BUSINESS SURVEY 2007

A good deal of the data presented in the Sectoral e-Business Watch studies and in this synthesis report are results of the e-Business Survey 2007, a decision-maker survey about the adoption of ICT and e-business among more than 5,400 enterprises from nine EU countries and the USA. It was the fifth in a series of surveys conducted in 2002, 2003, 2005 and 2006. Interviews were carried out from August to October 2007, by Ipsos GmbH (***www.ipsos.de***) in cooperation with its local branches and partners, using computer-aided telephone interview (CATI) technology. The overall survey was divided into four separate projects: (i) e-business in manufacturing, (ii) e-business in retail, transport & logistics, (iii) a survey on RFID adoption in different sectors, and (iv) a survey on the use of intellectual property rights by ICT SMEs. More information about the survey is available in Annex II.

### CASE STUDIES

In 2007/08, the Sectoral e-Business Watch conducted about 90 company case studies in 38 countries worldwide. 55 case studies describe e-business strategies of large companies, 34 are about SMEs. Case studies are examples of real-life e-business activity in firms from the sectors studied. The research objective is to complement the quantitative picture of e-business adoption from the e-Business Survey 2006, and to illustrate the impact of e-business activity on enterprises. They also provide evidence about barriers to e-business use such as employees resistance and reservations on the part of consumers.

All case studies are based on personal interviews with company representatives, complemented by information such as annual reports, company brochures and information available on the company website. The interviews were conducted face-to-face or by telephone (if travel costs would have been disproportionally high), either by study team members or by local correspondents from the wider network of service providers. To this end, correspondents had received detailed guidelines how to identify and collecting cases. The selection of cases was made by the study team responsible for the respective study, in coordination with DG Enterprise and Industry.

Case studies have been published as part of the study reports of 2008 and, in addition, on the case study section of the website (***www.ebusiness-watch.org/studies/case_studies.htm***). A synopsis of the main findings is presented in Section 1.2 of this report.

### EUROSTAT SURVEYS ON ICT USAGE IN ENTERPRISES

The Sectoral e-Business Watch used results of the Eurostat Community surveys on ICT usage in enterprises (in the following the "Eurostat surveys"), notably from the surveys of 2005 and 2006. The Eurostat surveys have a major advantage – their huge scope. More than 65,000 enterprises had to fill in the questionnaire in the participating EU member states (2006). The Eurostat surveys exclude enterprises with less than 10 employees. A disadvantage is that data from the Eurostat survey are only available in aggregated form; breakdowns are available for certain aggregations of business activities ("sectors") and for size-classes, but not for size-classes within a sector. In parallel to the standard Eurostat survey, pilot surveys on ICT usage in the financial services sectors were conducted in 2005 and 2006. The survey covered enterprises from the EU with 10 or more employees in the NAVE Rev. 1.1 classes 65.12, 65.22 and in Division 66 (except for 66.02), i.e. the banking and insurance sectors. Results of these surveys were used in the Sectoral e-Business Watch study on the banking industry (see Section 2.6), more than the results of the standard Eurostat survey, because the banking industry was not covered by the e-Business Survey of the Sectoral e-Business Watch.

## A.IV.2 Data analysis

For data analysis, the Sectoral e-Business Watch used in most of the studies a combination of descriptive and analytical statistical methods.

DESCRIPTIVE STATISTICS

The discussion of trends in ICT adoption is mostly based on descriptive cross-tabular presentations of simple frequencies, typically percentages of enterprises (e.g. using a certain technology or performing a certain e-business activity). This constitutes the first and most basic step in data presentation. The requirement for this step is that micro-data have been aggregated and that weighting has been applied. Weighting is an important issue for data presentation, but –unfortunately– it is not well understood by many users of data. Weighting is necessary, as due to stratified sampling the sample size in each size-band is not proportional to the population numbers. If proportional allocation had been used, the sample sizes in the group of large companies (with more than 250 employees) would have been extremely small, not allowing any reasonable presentation of results.

ANALYTICAL STATISTICAL METHODS

Descriptive presentation is limited in its power to explain ICT impact, as it can only deliver information about perceived impacts.[149] Analytical statistics, including macro data analysis (e.g. by means of growth accounting) and micro-data analysis (e.g. by means of regressions) were used to gain better evidence on the economic impact of ICT. The analysis focuses on links between ICT adoption on the one hand and productivity growth, industry growth, innovation dynamics and market characteristics on the other. Micro-data analysis (using data from the e-Business Survey 2007) was used to better understand the impact on individual companies, macro-data analysis (using the EU-KLEMS Growth and Productivity Accounts) to explore the impact at industry level.

## A.IV.3 Publications of 2007/08

All studies of the Sectoral e-Business Watch are published. The comprehensive study reports (typically with a scope of 100-200 pages) are published electronically on the website. Summaries of the studies are also available in printed format in various publications such as the brochure and in this report.

STUDY REPORTS

The main publications of the Sectoral e-Business Watch in 2008 –apart from this synthesis report– are ten e-business study reports, including six **sector studies** and four **ICT studies** on horizontal (cross-sectoral) issues. Summaries of these studies are presented in this report in Section 1.3 and in Sections 2 and 3. In addition, the Sectoral e-Business Watch has conducted there **special briefings** (i.e. studies with a smaller scope) on the following issues:

- ICT standards in the health sector (see Section 3.4)
- Pilot study of an e-Business Index for the transport services & logistics industry
- A cost-benefit analysis of intellectual property rights for ICT companies

All studies can be downloaded in full from the website (***www.ebusiness-watch.org***, under "eBiz studies"). Printed copies are not available.

SYNTHESIS PUBLICATIONS

The main synthesis publications of the Sectoral e-Business Watch in 2007/08 are the **e-Business Report 2008** and the **brochure** "e-Business in Europe – 2008". Printed copies of these publications can be ordered from the Sectoral e-Business Watch or from DG Enterprise & Industry. In addition, a **Chart Report** (in MS Powerpoint format) and various **Table Reports** (in MS Excel format) which summarise the survey results are available on the website (***www.ebusiness-watch.org/statistics/table_chart_reports.htm***). Charts or tables from these reports can be freely used, provided that the sources is acknowledged.

WEBSITE

The Sectoral e-Business Watch website (***www.ebusiness-watch.org***) was launched back in 2002. It was redesigned in 2006 in order to comply with the then newly established style guide of the DG Enterprise and Industry website. The site is the **main archive** of the programme, providing users with free access to all publications and workshop proceedings available since the launch of the initiative. The website had about **28,000 visitors per month** in 2008 (monthly average).

## A.IV.4 Dissemination and networking activities

One of the objectives of the Sectoral e-Business Watch is to provide a **forum for debate** of ICT-related issues with stakeholders from industry and policy institutions, and thus to support policy formu-

149. Companies are directly asked to assess the impact which ICT or a certain activity has on their business.

lation in this field. Therefore, dissemination and networking activities are an important part of the work. They constitute the logical next segment in the "value chain" of the initiative after data collection, analysis and reporting (see Exhibit A.IV-1). To provide a forum for debate, the Sectoral e-Business Watch organised a 2 days **conference** and five half-day **workshops** in 2007/08. Furthermore, the cooperation with **Advisory Boards** was expanded compared to previous years. **Dissemination** activities included the mailing of e-newsletters, the provision of micro-data from e-Business Watch surveys to researchers for statistical analysis purposes, and project presentations at 3rd parties events.

### WORKSHOPS

In 2007 and 2008, the Sectoral e-Business Watch organised five workshops (see Exhibit A.IV-3) to discuss interim study findings with stakeholders from industry, policy and research. The main objective of these events is to validate the research findings (typically on the basis of interim reports). Proceedings of the workshops, and a synopsis of main results and conclusions from the discussion with participants, are available on the website at ***www.ebusiness-watch.org/events/proceedings.htm***.

### E-BUSINESS WATCH CONFERENCE 2008

The main event in this period was the conference "Understanding the eEconomy – e-Business Trends and Impacts", which was held on 19/20 May 2008 in Brussels, organised by empirica in cooperation with GOPA-Cartermill. The conference was attended by more than 100 participants from across Europe, mostly e-business policy makers (at the European, national and regional levels), industry representatives (from federations, ICT service providers or ICT using companies), researchers (notably economists), business advisors and consultants.

The first part of the programme focused on trends in ICT adoption and e-business usage in different industries, including manufacturing and services sectors. The second part focused on horizontal ICT-related issues, such as "e-skills" challenges, the links between ICT and innovation, and how to measure ICT impacts on productivity. The conference concluded with a discussion among policy makers about policy implications of e-business and about effective instruments to address the identified challenges. The conference confirmed the continued need for an analysis of the ICT impact at the firm, industry and economy level, because of the short innovation cycles in ICT usage and, consequently, the potential of emerging technologies. It also confirmed that ICT continues to be a relevant issue for industrial and innovation policy, but that more advanced instruments need to be applied because e-business activity has matured. Proceedings and a summary of the presentations and discussion is available at ***www.ebusiness-watch.org/events/conference-2008.htm***.

### COOPERATION WITH THE ADVISORY BOARD

To validate study results, the Sectoral e-Business Watch seeks regular exchange and debate with international experts on ICT, e-business and from the sectors covered. For each of the ten main studies conducted in 2007/08, an Advisory Board was established. This way, about 50 industry representatives, researchers and business consultants contribute as members to the work. They provide comments on interim reports and specific inputs to the research work. Their services are gratefully recognised.

***Exhibit A.IV-3: Sectoral e-Business Watch workshops in 2007/08***

| Date | Place | Workshop title and content |
|---|---|---|
| 23-10-2007 | Milan | **Perspectives and impacts of RFID adoption in European supply chains.**<br>Organised in cooperation with IDC as part of IDC's conference on Supply Chain Management |
| 29-11-2007 | Brussels | **ICT and e-business in the transport and logistics services sectors.**<br>Organised by Altran |
| 07-02-2008 | Brussels | **ICT implications for energy consumption.**<br>Organised by GOPA-Cartermill |
| 14-03-2008 | Berlin | **Drivers and impacts of ICT adoption – a sectoral perspective.**<br>Organised by DIW Berlin and empirica. |
| 04-06-2008 | Paris | **Intellectual property rights (IPR) for competitiveness: challenges for European ICT SMEs.**<br>Organised by IDC |

*Exhibit A.IV-4: Advisory Board members of 2007/08*

| Advisory Board member | Company / organisation | Appointed for study on | Country * |
|---|---|---|---|
| Ms Fazilet Cinaralp | ETRMA - European Tyre & Rubber Manufacturers | Chemical | EU |
| Mr Herbert Fisch | BASF AG eSolutions | Chemical | Germany |
| Mr Henry Ryan | Lios Geal Consultants | Chemical | Ireland |
| Mr Dave Wallis | Self-employed consultant - liaison with CEN/ISSS | Chemical | UK |
| Mr Freddy De Vos | Arcelor Mittal Gent | Steel | Belgium |
| Mr Enrico Gibellieri | Advisor to European Metalworkers Federation | Steel | Italy / EU |
| Mr Martin Grösschen | DGV German Foundry Association / European Foundry Association | Steel | Germany / EU |
| Mr Roel de Jong | Corus IJmuiden | Steel | The Netherlands |
| Mr Georges Kirps | Eurometal | Steel | EU |
| Mr Cesare Bergamini | Federlegno-Arredo | Furniture | Italy |
| Mr Bart de Turck | European Furniture Manufacturers Federation | Furniture | EU |
| Mr Frederik Lauwaert | European Furniture Industry Confederation | Furniture | EU |
| Ms Ma Jose Núñez | Asociacion de Investigacion y Desarrollo en la Industria del Mueble y Afines (Aidima) | Furniture | Spain |
| Mr Ultimino Politi | Federazione nazionale dei negozi d'arredamento (Federmobili) | Furniture | Italy |
| Mr Enrico Colla | CERIDICE International Research Centre for Retail and e-Commerce | Retail | France |
| Mr Kai Hudetz | Institute for e-Commerce Research, University of Cologne | Retail | Germany |
| Ms Cécile Grégoire | EuroCommerce | Retail | EU |
| Mr Paul Brackel | Independent consultant | Retail | The Netherlands |
| Mr Pietro Evangelista | National Institute for Transport and Logistics (NITL) | Transport | Italy |
| Mr Javier Mendez | Madrid Chamber of Commerce | Transport | Spain |
| Mr Reinhard Pfliegl | AustriaTech | Transport | Austria |
| Mr Dolf Tuinhout | Independent consultant | Transport | The Netherlands |
| Ms Anna Arbussà | University of Girona, Department of Business Economics and Product Design | Banking | Spain |
| Mr Barry O'Mahony | ML Consultancy | Banking | Ireland |
| Mr Peter Potgieser | ABN AMRO | Banking | The Netherlands |
| Mr Antonio Lasi | Lombardia Informatica - IT arm of Regione Lombardia, local government authortity | RFID | Italy |
| Mr Andy Lee | Cisco | RFID | USA/EU |
| Mr Joerg Pretzel | GS1 | RFID | EU |
| Mr Jean-Francois Remy | Hewlett-Packard | RFID | USA/EU |
| Mr Leo Baumann | EICTA - European Information, Communications and Consumer Electronics Industry Technology Association | IP protection | EU |
| Mr Pieter Hintjens | FFII - Foundation for a Free Information Infrastructure | IP protection | EU / Internat. |
| Mr Carlo Piana | Tamos Piana & Partners | IP protection | Italy |
| Ms Eleni-Tatiana Sinodinou | FFII - Foundation for a Free Information Infrastructure | IP protection | EU |
| Mr Bernard Aebischer | CEPE Centre for Energy Policy and Economics, ETH Zurich | ICT & energy | Switzerland |

| | | | |
|---|---|---|---|
| Mr Lorenz Hilty | Empa, Technology and Society Lab, St. Gallen | ICT & energy | Switzerland |
| Mr Petteri Repo | National Consumer Research Centre | ICT & energy | Finland |
| Mr Ronald Batenburg | Utrecht University / Dialogic | ICT impact | The Netherlands |
| Mr Tony Clayton | UK Office for National Statistics | ICT impact | UK |
| Mr Najib Harabi | University of Applied Science Northwest Switzerland | ICT impact | Switzerland |
| Mr Heinz Hollenstein | KOF Swiss Economic Institute, ETH Zurich | ICT impact | Switzerland |
| Mr Florian Koch | BITKOM | ICT impact | Germany |
| Mr Philipp Koellinger | Erasmus University Rotterdam | ICT impact | The Netherlands |
| Ms Brigitte Preissl | ZBW - German National Library of Economics | ICT impact | Germany |
| Mr Graham Vickery | OECD | ICT impact | EU / Internat. |
| Mr Martin Wörter | KOF Swiss Economic Institute, ETH Zurich | ICT impact | Switzerland |

### OTHER DISSEMINATION ACTIVITIES

Members of the Sectoral e-Business Watch study team **presented findings** at various international conferences in 2007 and 2008. Examples include presentations at the 37th Entrepreneurship, Innovation and Small Business (EISB) Conference in Ljubljana (14 September 2007), at the eBSN Workshops "e-Business Standards and Solutions for SMEs" in Berlin (24 May 2007) and "Achievements and Challenges in Sector Specific e-Business Policies" in Oslo (3 December 2007), the 6th eTourism Futures Forum at the University of Surrey, Guildford, UK (26 March 2007) and at the "e-Day" of the Austrian Chamber of Commerce on 1 March 2007. In addition, the project was represented with **information stands** at the 21st Bled eConference "eCollaboration – Overcoming boundaries through multi-channel interaction", 15-18 June 2008, and at the IFIP WG 9.5 Conference in Lueneburg, 1-2 July 2008.

The Sectoral e-Business Watch aims to contribute actively to the **international debate on e-business measurement** and to working groups on e-business related issues, for example by participating in workshops on these issues and exchanging resources with related initiatives, such interoperability initiatives. Examples of this exchange are the participation of Sectoral e-Business Watch representatives in the workshop "ICT impact assessment by linking data from different sources" in Budapest, 22 May 2008, organised as part of a Eurostat funded project, and at the 3rd eBIF Conference in Utrecht, 15-16 November 2007.

The Sectoral e-Business Watch grants researchers and students **access to the micro-data** of the e-Business Surveys conducted since 2002 for research purposes, for instance for carrying out further empirical analysis on the economic impacts of ICT and e-business use in enterprises. In several cases, results of such research has been submitted to academic journals for publication. A successful example is a paper by Philipp Koellinger on "The relationship between technology, innovation, and firm performance" (Research Policy, in press, expected for 2008). Members and former members of the Sectoral e-Business Watch study teams also use survey results as a source for further research and publishing articles.

The Sectoral e-Business Watch sends out quarterly **electronic newsletters** to its subscriber base and to industry associations and federations across the EU. e-Newsletters provide information about new publications and forthcoming events.

Last but not least, the Sectoral e-Business Watch frequently acts as a "**help desk**" for e-business related questions from all over the world. The number of such individual requests has steadily increased over the years. This reflects the increased recognition of e-Business Watch as a source of information on related issues. Examples are requests for specific types of analysis from companies or business consultants, requests for background information (e.g. about the survey), questions on specific findings in reports, students who contact the Sectoral e-Business Watch in the context of their master or PhD thesis, orders for publications, companies who wish to exchange links, and many other types of requests.

# Annex V
# ICT and e-Business – key terms and concepts

## A DEFINITION OF ICT

This study examines the use of information and communication technology (ICT) in European businesses. ICT is an umbrella term that encompasses a wide array of systems, devices and services used for data processing (the information side of ICT) as well as telecommunications equipment and services for data transmission and communication (the communication side). The European Information Technology Observatory (2007) structures the ICT market into four segments with an estimated total market value of about € 670 billion in 2007 (Exhibit A.V-1).

*Exhibit A.V-1: The EU ICT market according to EITO (2007)*

| Market segment | Products / services included (examples) | Market value for EU (2007) (EITO estimate) |
|---|---|---|
| ICT equipment | Computer hardware, end-user communications equipment (such as mobile phones), office equipment (such as copiers) and data communications and network equipment (such as switching and routing equipment, cellular mobile infrastructure) | €159 billion |
| Software products | System and application software | €76 billion |
| IT services | Consulting, implementation and operations management | €140 billion |
| Carrier services | Fixed voice telephone and data services, mobile telephone services, cable TV | €293 billion |

Source: EITO 2007

In its widest sense, 'e-business' refers to the application of these technologies in business processes, including primary functions (such as production, inbound and outbound logistics or sales), and support functions (such as administration, controlling, procurement and human resources management). Companies in all sectors use ICT, but they do so in different ways. This calls for a **sectoral approach** in studies of ICT usage and impact. The following section introduces a wider framework for the discussion of e-business developments that will be used in the following analysis of the chemical, rubber and plastics industry.

## GAINING MOMENTUM AFTER A PHASE OF DISAPPOINTMENT

When the bust phase of the previous economic cycle – commonly referred to as the 'new economy' – started in 2001, the former internet hype was suddenly replaced by a widespread disappointment with e-business strategies. Companies adopted a more reserved and sceptical attitude towards investing in ICT. Nevertheless, ICT has proved to be the key technology of the past decade (OECD 2004, p. 8), and the **evolutionary development** of e-business has certainly not come to an end. The maturity of ICT-based data exchanges between businesses and their suppliers and customers, fostered by progress in the definition and acceptance of standards, has substantially increased across sectors and regions over the past five years. In parallel, **recent trends** such as 'Web 2.0' and social networking are widely discussed in terms of their business implications and it is widely recognised that 'e'-elements have become an essential component of modern business exchanges. In short, e-business has regained momentum as a topic for enterprise strategy both for large multinationals and SMEs.

Companies use ICT in their business processes mainly for **three purposes**: to reduce costs, to better serve the customer, and to support growth (e.g. by increasing their market reach). In essence, all e-business projects in companies explicitly or implicitly address one or several of these objectives. In almost every case, introducing e-business can be regarded as an ICT-enabled process innovation. Understanding one's business processes and having a clear vision of

> *"Measurement of e-business is of particular interest to policy makers because of the potential productivity impacts of ICT use on business functions. However, the ongoing challenges in this measurement field are significant and include problems associated with measuring a subject which is both complex and changing rapidly."*
>
> OECD (2005): ICT use by businesses. Revised OECD model survey, p. 17

how they could be improved (be it to save costs or to improve service quality) are therefore critical requirements for firms to effectively use ICT.

The increasing **competitive pressure** on companies, many of which operate in a global economy, has been a strong driver for ICT adoption. Firms are constantly searching for opportunities to cut costs and ICT holds great promise in this respect as it increases the **efficiency of a firm's business processes**, both internally and between trading partners in the value chain.

While cutting costs continues to motivate e-business activity, innovative firms have discovered and begun to exploit the potential of ICT for delivering against key business objectives. They have integrated ICT into their production processes and **quality management** and, most recently, in **marketing** and **customer services**. These last sectors are widely considered key to improve competitiveness in the current phase of development of European economies. Competing in mature markets requires not only optimised cost structures, maximal efficiency, and products or services of excellent quality but also the ability to communicate effectively and cooperate with business partners and potential customers.

### A DEFINITION OF E-BUSINESS

As part of this maturing process, electronic business has progressed from a specific to a very broad topic. A central element is certainly the use of ICT to accomplish **business transactions**, i.e. exchanges between a company and its suppliers or customers. These can be other companies ('B2B' – business-to-business), consumers ('B2C' – business-to-consumers), or governments ('B2G' – business-to-government). In the broad sense, transactions include commercial as well as other exchanges such as sending tax return forms to the tax authorities.

If transactions are conducted electronically ('**e-transactions**'), they constitute e-commerce. Transactions can be broken down into **different phases** and related **business processes**, each of which can be relevant for e-commerce (see Exhibit A.V-2). The pre-sale (or pre-purchase) phase includes the presentation of (or request for) information on the offer, and negotiations over the price. The sale / purchase phase covers the ordering, invoicing, payment and delivery processes. Finally, the after sale / purchase phase covers all processes after the product or service has been delivered to the buyer, such as after sales customer services (e.g. repair, updates).

*Exhibit A.V-2: Process components of transactions*

| Pre-sale / pre-purchase phase | Sale / purchase phase | After sale / after-purchase phase |
|---|---|---|
| ▪ Request for offer/proposal | ▪ Placing an order | ▪ Customer service |
| ▪ Offer delivery | ▪ Invoicing | ▪ Guarantee management |
| ▪ Information about offer | ▪ Payment | ▪ Credit administration |
| ▪ Negotiations | ▪ Delivery | ▪ Handling returns |

## Glossary

### *Definitions by standardisation groups (ISO, ebXML)*

*The term 'business transaction' is a key concept underlying the development of e-standards for B2B exchanges. Therefore, definitions have been developed by standards communities to underpin their practical work. Examples include:*

***Business**: "a series of processes, each having a clearly understood purpose, involving more than one party, realized through the exchange of information and directed towards some mutually agreed upon goal, extending over a period of time" [ISO/IEC 14662:2004]*

***Business transaction**: "a predefined set of activities and/or processes of parties which is initiated by a party to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved parties even though some of the recognition may be implicit" [ISO/IEC 14662:2004]*

***e-Business transaction:** "a logical unit of business conducted by two or more parties that generates a computable success or failure state" [ebXML Glossary]*

Practically each step in a transaction can either be pursued electronically (online) or non-electronically (offline), and all combinations of electronic and non-electronic implementation are possible. It is therefore difficult to decide which components actually have to be conducted online in order to call a transaction (as a whole) 'electronic'.

In 2000, the OECD proposed broad and narrow definitions of electronic commerce, both of which remain valid and useful today[150]. While the narrow definition focuses on 'internet transactions' alone, the broad definition defines e-commerce as "the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the goods or service may be conducted on- or offline" (OECD, 2001). The addendum regarding payment and delivery illustrates the difficulty mentioned above to

## Glossary

### *Definition of key terms for this study*

***e-Transactions:** commercial exchanges between a company and its suppliers or customers which are conducted electronically. Participants can be other companies ('B2B' – business-to-business), consumers ('B2C'), or governments ('B2G'). This includes processes during the pre-sale or pre-purchase phase, the sale or purchase phase, and the after-sale / purchase phase.*

***e-Commerce:** the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. (OECD)*

***e-Business:** automated business processes (both intra- and inter-firm) over computer mediated networks. (OECD)*

***e-Interactions:** covers the full range of e-transactions as well as collaborative business processes,. such as collaborative online design processes which are not directly transaction focused.*

150. In 1999, the OECD Working Party on Indicators for the Information Society (WPIIS) established an Expert Group on Defining and Measuring Electronic Commerce, in order to compile definitions of electronic commerce which are policy-relevant and statistically feasible. By 2000, work of the Group had resulted in definitions for electronic commerce transactions.

specify which of the processes along the transaction phases constitute e-commerce (see Exhibit A.V-2). The OECD definition excludes the pre-sale / pre- purchase phase and focuses instead on the ordering process. The SeBW follows the OECD position on this issue,[151] while fully recognising the importance of the internet during the pre-purchase phase for the initiation of business.

Using the OECD definition, e-commerce is a key component of **e-business** but not the only one. A wider focus oriented on business processes has been widely recognised. This vision of e-commerce also covers the digitisation of **internal business processes** (the internal processing of documents related to transactions) as well as **cooperative** or **collaborative processes** between companies that are not necessarily transaction-focused (for example industrial engineers collaborating on a design in an online environment). The OECD WPIIS[152] proposes a definition of e-business as "*automated business processes (both intra-and inter-firm) over computer mediated networks*" (OECD, 2004, p. 6). In addition, the OECD proposed that e-business processes should integrate tasks and extend beyond a stand-alone or individual application. 'Automation' refers here to the substitution of formerly manual processes. This can be achieved by replacing the paper-based processing of documents by electronic exchanges (machine-to-machine) but it requires the agreement between the participants on electronic **standards** and processes for data exchange.

### E-BUSINESS AND A COMPANY'S VALUE CHAINS

In some contexts, the term c-commerce (collaborative commerce) is used. Although this concept was mostly abandoned when the 'new economy' bubble burst in 2001, it had the merit of pointing towards the role of ICT in cooperations between enterprises and the increasing digital integration of supply chains. These developments go beyond simple point-to-point exchanges between two companies.

Despite dating back 20 years to the pre-e-business era, Michael Porter's framework of the company value chain and value system between companies[153] remains useful to understand the relevance of e-business in this context. A **value chain** logically presents the main functional areas ('value activities') of a company and differentiates between primary and support activities. However, these are "*not a collection of independent activities but a system of interdependent activities*", which are "*related by linkages within the value chain*".[154] These linkages can lead to competitive advantage through optimisation and coordination. This is where ICT can have a major impact, in the key role of **optimising linkages** and increasing the efficiency of processes.

The **value system** expands this concept by extending its scale beyond the single company. The firm's value chain is linked to the value chains of (upstream) suppliers and (downstream) buyers; the resulting larger set of processes is referred to as the value system. All e-commerce and therefore electronic transactions occur within this value system.

Key dimensions of Porter's framework (notably inbound and outbound logistics, operations, and the value system) are reflected in the **Supply Chain Management** (SCM) concept. Here, the focus is on optimising the procurement-production-delivery processes, not only between a company and its direct suppliers and customers, but also aiming at a full vertical integration of the entire supply chain (Tier 1, Tier 2, Tier n suppliers). In this concept, each basic supply chain is a chain of sourcing, production, and delivery processes with the respective process interfaces within and between companies.[155] Analysing the digital integration of supply chains in various industries has been an important theme in most sector studies by the SeBW.

151. The respective survey questions ask companies whether they «place / accept online orders».
152. Working Party on Indicators for the Information Society.
153. Porter, Michael E. (1985). Competitive Advantage. New York: Free Press. Page references in quotations refer to the Free Press Export Edition 2004.
154. ibid., p. 48
155. cf. SCOR Supply-Chain Council: Supply-Chain Operations Reference-model. SCOR Version 7.0. Available at ***www.supply-chain.org*** (accessed in March 2006).

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