Sector Report No. 4/2006

ICT and e-Business in the

ICT Manufacturing Industry

ICT adoption and e-business activity in 2006



e-business w@tch

European Commission

About *e-Business W@tch* and this report

The European Commission, Enterprise & Industry Directorate General, launched the *e-Business W@tch* to monitor the growing maturity of electronic business across different sectors of the economy in the enlarged European Union, EEA and Accession countries. Since January 2002, the *e-Business W@tch* has analysed e-business developments and impacts in manufacturing, construction, financial and service sectors. All results are available on the internet and can be accessed or ordered via the Europa server or directly at the *e-Business W@tch* website (http://ec.europa.eu/comm/enterprise/ict/policy/watch/index.htm, www.ebusiness-watch.org).

This document is a sector study by *e-Business W@tch*, focusing on the ICT manufacturing (ICTM) industry. Its objective is to describe how companies in this industry use ICT for conducting business, to assess the impact of this development for firms and for the industry as a whole, and to indicate possible implications for policy. Analysis is based on literature, interviews, case studies and a survey among decision-makers in European enterprises from the ICTM industry about the ICT use of their company.

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Executive Summary

Objectives and scope of the study

This document is a sector study by *e-Business W@tch*, focusing on the **Information and Telecommunication Technology Manufacturing** (ICTM) industry. Its objective is to describe how companies in this industry use ICT for conducting business, to assess the impact of this development for firms and for the industry as a whole, and to indicate possible implications for policy. The analysis is based on existing literature, interviews, case studies and a survey of decision-makers in European enterprises from the ICTM industry about ICT use within their company. The ICTM industry, as defined for the purposes of this study, comprises of two sub-sectors defined according to the NACE Rev. 1 classification. First, the **ICTM I** sub-sector produces office machinery, computers and computers' peripherals. Second, the **ICTM II** sub-sector produces electronic intermediate goods and telecommunication equipment.

e-Business activity

The ICTM industry emerges as the one with the **highest overall use of ICT** and e-business among the ten sectors studied this year by *e-Business W@tch*. There are structural reasons, such as the prevalence of large companies, intensive competition, frequent product changes and production dispersion, which drive the adoption of ICT and business practices. Nevertheless, the level of e-business activity differs with firm size. e-Business arrives in SMEs with a slight **delay**, compared to large enterprises. Additionally, the ICTM I sub-sector is a more advanced user than the sub-sector ICTM II.

Findings regarding ICT diffusion and e-business activity in the ICTM sector are presented in Chapter 3 and the most important ones are the following:

- Significantly more employees, on average, in ICTM companies have **access to the internet** at their workplace compared to other sectors.
- Despite the high ICT endowment, a large share of companies in the sector plan to **increase ICT investments**.
- Not sufficient use of standards causes interoperability concerns.
- Companies in all size-bands exhibit similar patterns with respect to internet adoption as a **selling/procurement** platform.
- **Online auctions play a minor role**: It is said that companies in the ICTM sector were resistant to join trading networks, perceiving them as a means intending to restrain competition and a way to drive down prices.
- **Enterprise resource planning** (ERP) or **supply chain management** (SCM) applications are characterised by large-scale effects and used by large firms.
- Companies engaged in cross-border trading automate document and payment flows more often than firms that trade locally.

- The pressure to electronically integrate the supply chain comes from the bottom of the value chain.
- **Barriers to e-business may also lie outside of the IT-using industries**: Complaints regarding the lack of reliable IT providers, interoperability and high technology cost might be a sign of restrained competition in the IT market.

e-Business trends and implications

An analysis of specific ICT-related issues in chapter 4 focused on selected topics that were found to be particularly relevant to the sector. The selected issues include:

- **Convergence of broadcasting, telephony and computing**: Technological developments have resulted in the convergence of infrastructures and services, which have had some implications for the ICT industry. First, incumbent ICT producers were late in adapting to the convergence trend. Thus, companies might find themselves locked in old technologies. Second, the success of the ICTM sector depends on users' acceptance of new technologies, which in turn depends on **consumers' skills** and **complementary products**. Lastly, **regulation** has an impact on the speed of development and diffusion of new telecommunication services, which indirectly also affects the ICTM industry.
- **Networking enterprise**: According to the e-Business Survey 2006, changing economic conditions force ICTM companies to enhance their competitiveness by joining efforts with other companies within the sector. This has implications for the competitiveness of companies in the ICTM sector. First, as the optimisation of information and goods flow reduces cost of inventory and improves production planning, inter-organisational integration has a positive impact on profits. Second, inter-firm cooperation gives companies **access to competitive resources and information** and enables them to **spread the cost and risk of R&D** projects. This eliminates the problem of efforts duplication and maximises the likelihood of introducing major innovations. Third, as large companies frequently initiate the process of supply chain integration and force their interests and requirements down the value chain, **the economic position of SMEs** might be weakened. Lastly, common standards facilitate supply chain integration. Thus, it is necessary that SMEs' interests are taken into account during the standardisation process.
- **ICT and industry transformation**: The ICTM sector is characterised by a large extent of international specialisation. The use of ICT allowed companies in the ICTM industry to disperse the production different countries according to their comparative advantages. The results of the e-Business Survey 2006 confirmed the substantial impacts of ICT on the ICTM industry. First, because companies implement standardised ICT solutions and business processes, company design in the ICT industry seems to match the architecture of its products, i.e. firms are adopting **modular organisational structures**. This makes cooperation between firms even easier. Second, the ICTM I sub-sector, in particular the PC industry, has mastered the use of ICT tools to **streamline the information exchange** along the value chain and intern the benefits of technological and organisational innovations. Third, the main benefit of ICT deployment stems from the **substitution of inventory flow with information flow**. Finally, a common infrastructure and set of

standards enables companies to benefit from the potential of ICT without investing in private networks. However, **insufficient standardisation** still hampers the electronic integration of the complete supply chain.

- **Who benefits from e-business?** The e-Business Survey 2006 confirmed that ICT is an important driver and enabler of innovation. However, not all e-business technologies offer equally attractive payoffs. Firm and industry factors also influence the final outcomes. First, though large firms use ICT to innovate and increase profitability, SMEs exhibit greater R&D intensity. As both strategies yield equally positive returns, it can be stated that **an aggressive ICT strategy is not the only source of competitive advantage**. Second, out of all ICT applications, computer networks facilitating inter-firm collaboration and e-procurement have the greatest impact on company performance. Third, **start-ups enjoy higher returns on ICT** compared to mature firms. As they are not locked into inflexible organisational structures and have better ICT-skilled workforce, they might be perfectly suited to exploit the full potential of ICT. Also, ICT investments in **service activities exhibit higher ICT productivity gains** compared to manufacturing activities. Last, innovative technologies adopted by companies in an industry are gradually becoming commodities and **ICT-driven growth tapers over time.**

Business impact

Section 5.1 concluded that the '*intensive use - positive performance*' paradigm seems to hold true in the ICTM industry. Thus, companies in this sector are well positioned to benefit from ICT. By combining new tools with adjustments in their product and marketing strategy, they have found ways to **offset the negative effects of some technologies** on company productivity and increased their competitiveness. For instance, unlike other industries, the ICTM sector exhibits positive impact of online sales on firm performance. The main observations on ICT use and impact observed in the ICTM sector include:

- ICT transforms organisational structure and design of business processes.
- Outsourcing and off-shoring affects **employment** and **skills requirements**.
- Companies in the ICTM sector do not expect that the role of ICT and its impact on the way they work will lose any significance. In particular, they anticipate that ICT will affect **accounting, logistics and customer relationships**.
- ICT **intensifies competition** in the industry. The gravity of these changes has been greater in markets in which SMEs operate.
- There is a pattern in the ICTM sector in the way ICT and competition interact: more competition forces companies to use innovative ways of doing business, increase efficiency and productivity. ICT helps them achieve these aims while also increasing the pressure to stay innovative. The final outcome seems to be positive since companies operating in the industry become more efficient, productive and competitive on a global scale.

Policy implications

The discussion in section 5.2 revealed some policy implications relevant to the development of e-business in the ICTM industry:

- **Emphasise the necessity of co-inventions**[1]: Greater market transparency and lower transaction costs resulting from increased ICT use benefit companies that procure online and hurt firms that sell online. Since the introduction of new processes, products and applications, adjustments in the product and marketing strategy can offset negative effects, it is important to emphasise "co-inventions" that accompany ICT implementation. For instance, ICT enables firms to 'leapfrog' the value chain to their final customers, reduce intermediaries and appropriate some part of their value added.
- **Role model of the public sector**: The share of government to business (G2B) transactions conducted with companies from the ICTM sector remains low. The use of ICT, internet and e-business applications in the public sector can spur active use of these technologies in the private sector.
- **Interoperability more important than ever**: Despite the wide diffusion of ICT applications in the sector, there is still potential for further productivity increases through supply chain integration. This potential currently remains underutilised due to interoperability problems. Public bodies might help firms to overcome the market failure resulting form the co-ordination problem.
- **Competition in the IT market**: Markets for advanced IT[2] applications are usually dominated by a few companies. Hence, competition might be restrained. The potential lack of competition in these markets might have serious implications not only for the IT-producing sector, but also for the IT-using sectors and e-business development in general. This issue calls for closer examination and, possibly, competition policy measures securing competition in the IT markets.
- **Customised innovation policies**: Incumbents and start-ups follow various innovation and ICT strategies. Thus, the evolution of technological trajectories in the ICTM sector together with the ICT development patterns pose a challenge for policy makers to customise innovation policy for diverse company groups.
- **Networking for innovation**: Networking organisations get access to new competencies lying within or outside of the industry enabling them to build resources that are difficult to acquire otherwise. The policy challenge is to encourage companies to support industry dialogue and knowledge sharing.
- **Regulation of telecommunication markets**: Telecommunication regulation has significant impact on companies operating in the ICTM industry. Thus, regulatory initiatives should take a comprehensive approach and account for externalities affecting other sectors. For instance, if accepted, the new regulation on roaming fees would reduce prices and increase the demand for mobile services, which in turn could increase the demand for networks capacities.

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1 "Co-invention" means that "*… users of ICT often help make their investments more valuable through their own experimentation and innovation, e.g. the introduction of new processes, products and applications"* (Pilat 2006). See section 3.4.1 for a more detailed discussion.

2 Information Technologies (IT) in this report refers only to software. Information and communication technologies (ICT) refers only to hardware.

1 Introduction

1.1 About *e-Business W@tch*

Policy background

The European Commission launched *e-Business W@tch* in late 2001 to monitor the adoption, development and impact of electronic business practices in different sectors of the economy in the European Union.

The initiative is rooted in the **eEurope Action Plans** of 2002 and 2005. The eEurope 2005 Action Plan defined the goal "*to promote take-up of e-business with the aim of increasing the competitiveness of European enterprises and raising productivity and growth through investment in information and communication technologies, human resources (notably e-skills) and new business models*".[3] *e-Business W@tch* has been an important instrument for the European Commission to assess the developments and progress in this field.

The **i2010** policy[4], a follow-up to eEurope, also stresses the critical role of ICT for productivity and innovation, stating that "*… the adoption and skilful application of ICT is one of the largest contributors to productivity and growth throughout the economy, leading to business innovations in key sectors*" (p. 6). The Communication anticipates "*a new era of e-business solutions*", based on integrated ICT systems and tools, which will lead to an increased business use of ICT. However, it also warns that businesses "*still face a lack of interoperability, reliability and security*", which could hamper the realisation of productivity gains (p. 7).

In 2005, in consideration of globalisation and intense international competition, the European Commission launched a **new industrial policy**[5] to create better framework conditions for manufacturing industries in the coming years. Some of the policy strands described have direct links to ICT and e-business developments. One of the new sector-specific initiatives covered by the policy is the taskforce on information and communication technologies (ICT) competitiveness. The taskforce with stakeholders representatives focuses on identifying and proposing measures to remove obstacles that inhibit ICT take-up among enterprises. Another initiative is to conduct a series of competitiveness studies, to include for ICT, food, and fashion and design industries, in order to analyse trends affecting the competitiveness of these industrial sectors.

These policy considerations constitute the background and raison d'être of *e-Business W@tch* as an observatory of related issues and a core theme for the analysis. Within this broader policy context, two further important facets regarding the mission of the initiative

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[3] "eEurope 2005: An information society for all". Communication from the Commission, COM(2002) 263 final, 28 May 2002, chapter 3.1.2

[4] "i2010 – A European Information Society for growth and employment." Communication from the Commission, COM(2005) 229 final.

[5] "Implementing the Community Lisbon Programme: A Policy Framework to Strengthen EU Manufacturing - towards a more integrated approach for Industrial Policy." Communication from the Commission, COM(2005) 474 final, 5.10.2005

are relevant. First, *e-Business W@tch* studies focus on **sectors** (and not on countries). Second, special emphasis is placed on developments and implications for small and medium-sized enterprises (**SMEs**).

e-Business W@tch is one of several policy instruments used by DG Enterprise and Industry in the field ICT industries and e-business. Other instruments include

- the e-Business Support Network (**eBSN** – a European network of e-business policy makers and business support organisations),
- the **eSkills Forum** (a task force established in 2003 to assess the demand and supply of ICT and e-business skills and to develop policy recommendations),
- the **ICT Task Force**, a group whose work is to draw together and integrate various activities aiming to strengthen Europe's ICT sector, and
- activities in the areas of **ICT standardisation**, as part of the general standardisation activities of the Commission.[6]

Focus and scope

Since its launch, *e-Business W@tch* has published e-Business Sector Studies on more than 20 sectors of the European economy, four comprehensive synthesis reports about the state-of-play in e-business in the European Union, statistical pocketbooks and various other resources, such as newsletters and special issue reports. All publications are available at www.ebusiness-watch.org ('resources').

e-Business W@tch presents a **'wide-angle' perspective** on the adoption and use of ICT in the sectors studied. The topic is not restricted to the measurement of e-commerce transactions (the volume of goods and services traded online), but also comprises an assessment of the degree to which business processes, including intra-firm processes, are electronically linked to each other and have become digitally integrated.

In essence, *e-Business W@tch* studies cover the whole field of what could be described as **collaborative commerce** (see following chapter). However, it becomes practically impossible to cover in detail all areas and facets of e-business in a single sector study. Therefore, each study focuses on a few specific issues, thus allowing the reader to zoom into these topics in more detail.

In addition to the analysis of e-business developments, the studies also provide some **background information** on the respective sectors. Readers, however, should not mistakenly consider this part of each report as the main topic of the analysis. An *e-Business W@tch* sector report is not a piece of economic research on the sector itself, but a study which focuses on the use of ICT and e-business in that particular sector. The introduction to the sector is neither intended, nor could it be a substitute for more detailed industrial analysis.

[6] The 2006 ICT Standardisation Work Programme complements the Commission's "Action Plan for European Standardisation" of 2005 by dealing more in detail with ICT matters.

Methodology

e-Business W@tch combines quantitative and qualitative research elements. The quantitative analysis of ICT and e-business adoption by firms is based to a large extent on representative **surveys** among decision-makers in European enterprises ("e-Business Survey"). Interviews are conducted by telephone, based on a standardised and computer supported questionnaire (CATI[7] method). In total, more than 25,000 enterprises were interviewed in the surveys of 2002, 2003 and 2005. The most recent survey (conducted in April/May 2006) covered more than 14,000 enterprises from 10 sectors in all EU Member States and most EEA and Candidate Countries.[8]

The *e-Business W@tch* Surveys have won recognition by the international research community as a useful instrument for **piloting** new e-business metrics. The experience gained from this piloting is used, for example, by Eurostat for planning and developing their own survey of ICT use by businesses.

e-Business W@tch complements the statistical picture by a more detailed presentation of concrete e-business activity in individual enterprises from the sectors covered, mainly in the form of brief **case studies**. About 75 case studies are conducted in 2006 adding to more than 100 case studies conducted in previous years. Evidence from the survey and case studies is backed up by **desk research** and **interviews** with industry representatives and e-business experts.

The importance of networking and debate

Since its first implementation in late 2001, *e-Business W@tch* has increasingly developed from a market observatory into a **think-tank and intermediary**, stimulating debate among stakeholders at an international level about the economic and policy implications of e-business. The positive feed-back and large uptake for the various publications and statistics provided by the *e-Business W@tch*, for example their exploitation by various research institutions, reflects the demand for sectoral e-business analysis and discussion on related issues.

e-Business W@tch uses several mechanisms for debate and networking with stake-holders. An important platform for this is the **website** (www.ebusiness-watch.org), where all reports and survey data are published. Furthermore, results are presented and discussed with industry at **workshops**, within and via the **Advisory Board**, and, lastly, through the participation of study team members in other events, such as conferences, workshops and working groups organised by third parties.

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[7] Computer Assisted Telephone Interviews, a widely used method in representative household or decision-maker surveys.

[8] The EEA (European Economic Area) includes, in addition to EU Member States, Iceland, Liechtenstein and Norway. Candidate Countries, which are candidates for accession into the EU, are (as of May 2006) Bulgaria, Croatia, Romania and Turkey.

*The **mission** of e-Business W@tch is to monitor, analyse and compare the development and impact of e-business in different sectors of the European economy – not the sectors themselves.*

*Its **objective** is to provide reliable results, based on commonly accepted methodologies, which are not readily available from other sources and will trigger the interest of policy-makers, researchers, and other e-business stakeholders for more in depth analyses or statistical surveys.*

*e-Business W@tch has adopted a "wide-angle" perspective in its **approach**. The necessary trade-offs are transparently depicted in each of its deliver-ables.*

The definition of sectors and the adequate level of aggregation

Economic sectors constitute the main level of analysis for *e-Business W@tch*. The 2006 studies cover sub-sets of **ten different sectors** whose configuration and definition are based on the NACE Rev. 1.1 classification of business activities.[9]

Over the years since its initial implementation in late 2001, *e-Business W@tch* followed a roll-out plan in the coverage of different sectors.[10] In each new period, some new sectors (not covered in previous years) were added.

The rather broad aggregation of various business activities into sectors in earlier implem-entation periods (2002-2004) made it possible to cover a broad spectrum of the economy, but also caused challenges for the analysis of e-business developments. In cases where rather heterogeneous sub-sectors were aggregated, it was sometimes difficult to make general observations or draw conclusions for "the sector" at stake. It also turned out that industry has a clear preference for comparatively narrow sector definitions.

The approach for selecting and defining sectors which was used in 2005 and 2006 reflects these concerns. Many of the sectors studied since 2005 are sub-sectors that had been part of larger aggregations in 2002-2004. A further argument for "**zooming in**" on former sub-sectors is that the broad picture for whole sectors is already available from earlier *e-Business W@tch* studies.

The **selection** of sectors in 2006 has been made on the basis of the following considerations:

- The **roll-out plan** of 2003.
- **Policy relevance** of the sector from the Commission's perspective.
- **Interest** articulated **by the industry** in previous years on studies of this type.
- The current **dynamics of e-business** in the sector and the impact of ICT and electronic business, as derived from earlier *e-Business W@tch* sector studies.

[9] NACE Rev. 1.1 is a 4-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.

[10] See website: "selection of sectors" (www.ebusiness-watch.org/about/sector_selection.htm)

The 10 sectors studied in 2006

The 10 sectors which are monitored and studied in 2006 include six manufacturing sectors, construction and three service sectors. The pulp and paper manufacturing industry is a 'new' sector, i.e. it had not been covered by the *e-Business W@tch* in any earlier period of implementation; the other nine sectors have been covered in previous years, mostly as parts of aggregated sectors (see Exhibit 1-1).

Exhibit 1-1: Sectors studied by e-Business W@tch in 2006

No.	NACE Rev. 1.1	Sector	Reference to earlier (most recent) coverage
1	DA 15 (selected groups)	**Food and beverages**	2005
2	DC 19.3	**Footwear**	2003/04 (as part of the textile and footwear industry)
3	DE 21	**Pulp, paper and paper products**	--
4	DL 30, 32.1+2	**ICT manufacturing**	2004 (as part of electrical machinery and electronics)
5	DL 32.3	**Consumer electronics**	2004 (as part of electrical machinery and electronics)
6	DM 35.11	**Shipbuilding and repair**	2004 (as part of transport equipment manufacturing)
7	F 45.2+3 (selected classes)	**Construction**	2005 (in a broader aggregation, including F 45 in total)
8	H 55.1/3, I 63.3, O 92.33/52	**Tourism**	2005
9	I 64.2	**Telecommunication services**	2004 (as part of ICT services)
10	N 85.11	**Hospital activities**	2004 (as part of health and social services)

1.2 "e-Business" – the conceptual framework

Fresh momentum after the 2001 odyssey

Although the 'new economy' revolution has not taken place as it seemed for a short moment in history it might, the **evolutionary development** of electronic business does not seem to have come to an end. On the contrary, the maturity of e-business has substantially increased across sectors and regions over the past five years. It has been a quiet revolution this time, but as a result, a **new picture of the digital economy** is beginning to emerge. ICT and e-business do matter in the global economy – probably even more than during the hype of the late 1990s.

The overall economic situation and market conditions for business innovation and investment have been difficult for European companies during the last few years. Nevertheless, e-business shows a dynamic development in the European Union. Drivers are new technological developments (wireless access technologies, for example) and the increasing **competitive pressure** on companies in a global economy. Firms are in constant search for opportunities to cut costs. This has probably been the most important

promise of electronic business: cutting costs by increasing the **efficiency of business processes**, internally and between trading partners in the value chain.

From e-Commerce to e-Business

As part of this maturing process, electronic business has progressed from a rather specific to a very broad topic over the past 10 years. Initially, however, particularly in the mid 1990s, the policy and research focus was very much on **e-Commerce**, which can be defined as online commercial transactions.

The term **'transactions'** refers to 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. In the context of this study on e-business, transactions are predominantly commercial business transactions (see boxes for definitions).

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 the various standards communities as an underpinning for their practical work. Examples are:

- ***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]*

If transactions are conducted electronically ('**e-transactions**'), this constitutes e-Commerce. Transactions can be broken down into **different phases** and related **business processes**, each of which can be relevant for e-Commerce. The pre-sale (or pre-purchase) phase includes the presentation of (or request for) information about the offer, and the negotiation about 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 1-2: Process components of transactions

Pre-sale / pre-purchase phase	Sale / purchase phase	After sale / purchase phase
Information about offer	Placing an order	Customer service
Price comparisons	Invoicing	Guarantee management
Negotiations between seller and buyer	Payment	Credit administration
	Delivery	Handling returns

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 this context, during 2000 the OECD proposed broad and narrow definitions of electronic commerce both of which are still valid and useful:[11] While the narrow definition focuses on 'internet transactions' only, the broad definition defines e-Commerce as "*the sale or purchase of goods or services, whether between businesses, house-holds, 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).

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****: Electronic Commerce. The sale or purchase of goods or services, whether between businesses, house-holds, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. (OECD)*
- ***e-Business****: Electronic Business. Automated business processes (both intra- and inter-firm) over computer mediated networks. (OECD)*
- ***e-Interactions****: Electronic Interactions include the full range of e-Transactions, and in addition collaborative business processes (e.g. collaborative design) which are not directly transaction focused.*

[11] 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.

The addendum regarding payment and delivery is an important part of the definition, but can be debated. The difficult question is which processes along the different transaction phases constitute e-Commerce and which do not (see Exhibit 1-2). The OECD definition excludes the pre-sale or purchase phase and focuses on a specific part of the sale / purchase phase, namely the ordering process. *e-Business W@tch* follows the OECD position on this issue.[12]

e-Commerce, defined in this way, is a key component of **e-business**, but not the only one. In recent years, it has been increasingly acknowledged among policy and research communities that the focus on e-commerce transactions may be too narrow to capture the full implications of e-business. A wider, business process oriented focus has been widely recognised. Reflecting this development, the OECD WPIIS[13] proposed a (broader) 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.

This definition reflects an understanding of e-business that encompasses more than e-commerce transactions. The broad concept of e-business also includes the digitisation of **internal business processes**, as well as **cooperative** or **collaborative processes** between companies which are not necessarily transaction-focused. Collaborative e-design processes between business partners are a typical example from industrial engineering. The OECD definition implicitly indicates that the focus and main objective of electronic business is to be found in business process automation and integration, and the impacts thereof.

To bridge the gap between 'e-Commerce' and 'e-Business', it was proposed in earlier years (mainly around 2000) to use the term '**c-Commerce**' (collaborative commerce). Although this concept was rather abandoned when the new economy bubble burst, it has some value as it stresses the role of ICT for cooperation among enterprises. If web service and other emerging technologies (e.g. RFID, mobile applications) hold their promise, the digital integration of B2B trading processes could be taken to a new level, possibly with a considerable impact on industry structure. If so, it could be worth revisiting the former 'c-Commerce' concept.

e-Business and the company's value chain

Given the broad concept of e-Business applied for this study, which concentrates on business processes and a company's interactions with its environment, some further structuring and mapping of processes is necessary. Michael Porter's framework of the company value chain and value system between companies (Porter, 1985) is still valid and useful in this context, although dating back 20 years to the pre-e-business era.

A **value chain** logically presents the main functional areas ('value activities') of a company and differentiates between primary and support activities. However, these are

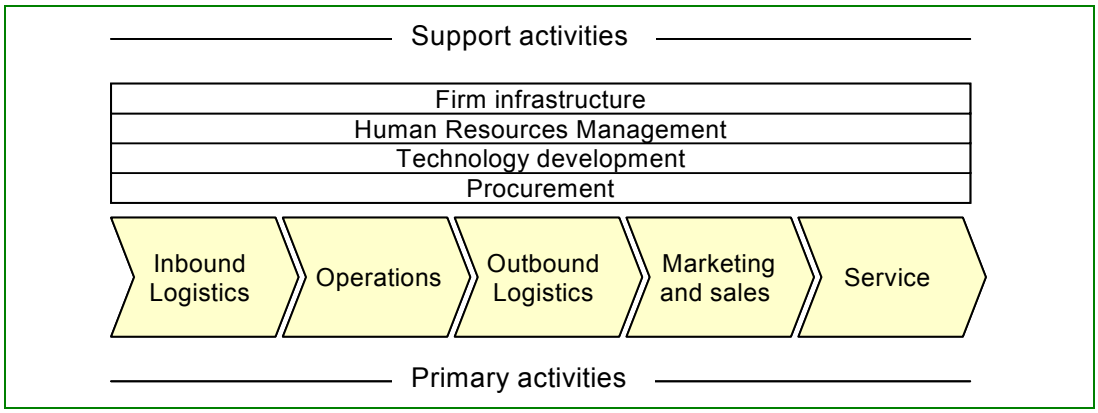
[12] This is reflected in the updated wording of the respective survey questions in 2006, when for "placing / accepting online orders" was asked instead for "purchasing / selling online".

[13] Working Party on Indicators for the Information Society

"*not a collection of independent activities but a system of interdependent activities*", which are "*related by linkages within the value chain*" (p. 48). These linkages can lead to competitive advantage through optimisation and coordination. In fact, it is exactly here that ICT have a major impact, as they are a key instrument to **optimise linkages** and thus increase the efficiency of processes.

The **value system** expands this concept by extending the perspective beyond the single company. The firm's value chain is linked to the value chains of (upstream) suppliers and (downstream) buyers, resulting in a larger set of processes – the value system. e-Commerce, i.e. electronic transactions, occurs within this value system.

Exhibit 1-3: Value chain framework of a company by Michael Porter



Source: Adapted from M.E. Porter (1985) – simplified presentation

Key dimensions of this 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.[14] The analysis of the digital integration of supply chains in various industries has been an important theme in sectors studies previously prepared by *e-Business W@tch*.

e-Business and innovation

A very important aspect for *e-Business W@tch* studies is the link between ICT and innovation. The European Commission places great emphasis on the **critical role of innovation** for European businesses in order to stay competitive in the global economy.[15] On the other hand, a strong competitive pressure provides powerful incentives for companies to continuously engage in innovation and R&D. Thus, innovation, competition and competitiveness are closely intertwined.

[14] cf. SCOR Supply-Chain Council: Supply-Chain Operations Reference-model. SCOR Version 7.0. Available at www.supply-chain.org (accessed in March 2006).

[15] See, for example, "An innovation-friendly, modern Europe". Communication from the Commission, COM(2006) 589, 12 October 2006.

ICT have been identified and widely recognised as a major **enabler of innovation**, in particular for **process innovation**. According to the *e-Business W@tch* survey 2006, 75% of those companies that had introduced new business processes in 2005 reported that this innovation was directly related to or enabled by ICT.

In many cases, the implementation of **e-business processes** in a company will constitute a process innovation in itself. In **manufacturing** sectors, e-business has triggered significant innovation inside the companies, notably in supply chain and delivery processes, such as automatic stock replenishing and improved logistics. In **service** sectors such as tourism, the innovative element is more evident in the way that external transactions are accomplished. For example, if a company starts to sell its services online, this can imply innovation in the service delivery process and in customer communication.

In some sectors, particularly in ICT manufacturing, consumer electronics and telecommunications, ICT are also highly relevant for **product innovation**.

However, as more companies strive to exploit the innovation potential of ICT, it becomes more difficult for the individual company to directly gain competitive advantage from this technology. e-Business is becoming a necessity rather than a means to differentiate from competitors.[16] In addition, the introduction of innovation can cause **substantial costs** in the short and medium term, as it may take time before the investments pay off. This causes challenges in particular for small and medium-sized companies. It is one of the reasons why *e-Business W@tch* focuses on such challenges in its sector studies (see also 'Policy Background' in chapter 1.1).

[16] Cf. Carr, Nicholas (2003). "IT Doesn't Matter". In: Harvard Business Review, May 2003.

2 Context and Background

2.1 Sector definition – scope of the study

The ICTM industry is defined by *e-Business W@tch* for the purpose of its sector studies by the following business activities as specified in NACE Rev. 1.1:

Exhibit 2-1: Business activities covered by the ICTM industry (NACE Rev. 1.1)[17]

NACE Rev. 1.1		Business activities
Divisions	**Groups**	
ICTM I		
DL 30		Manufacture of office machinery and computers
	30.01	Manufacture of office machinery
	30.02	Manufacture of computers and other information processing equipment
ICTM II		
DL 32		Manufacture of radio, television and communication equipment and apparatus
	32.1	Manufacture of electronic valves and tubes and other electronic components
	32.2	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy

ICTM I: Sub-sector 30.01 includes office machinery such as photocopying machines and typewriters. Many products that belong to this section are relatively simple investment goods, partly even mechanical aids used for the organisation of offices. Sector 30.02 contains investment goods and comprises the production of computers, screens, keyboards, scanners, printers, and money machines. It is one of the most important manufacturing sectors in the ICTM industry. As the share of sub-sector 30.01 is negligible, further analysis focuses primarily on the NACE 30.02 aggregate.

ICTM II: Sub-sector 32.1 produces electronic intermediate goods such as valves, tubes, microprocessors and memory chips. Sub-sector 32.2 is classified as investment goods production and contains the production of transmitters for radio and TV, telecommunication infrastructure equipment and end-user equipment, like mobile phones.

The ICTM sector is characterised by a large extent of international specialisation. The use of ICT has allowed for knowledge and information to be codified, standardised and digitalised enabling an in-depth specialisation and fragmentation of the production process. As a result, the production can be dispersed over different countries according to their comparative advantages.

The ICTM industry was already analysed in sector reports on e-business in the Electrical Machinery and Electronics Industries (NACE 30, 31 and 32). However, the electrical (NACE 31) and electronics (NACE 30, 32.1 and 32.1) industries exhibit significant differences in value chains, market dynamics and market structures. The former is a

[17] NACE Rev. 1.1 is a 4-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.

relatively traditional sector dominated by vertically integrated companies that keep large parts of the entire production and value-creation in-house. The latter, in contrast, belongs to the very dynamic and volatile high-tech market with highly specialised companies frequently outsourcing entire production stages to external firms.

Another important distinction between these two industries can be made with respect to their products' markets. Whereas the "consumer electronics" industry almost exclusively serves the B2C market, the ICTM sector (as defined above) delivers its products mostly to the B2B market (with the exception of 30.02 that serves the B2C market as well). In practice, ICTM companies produce network and transmission equipment for broadcasting and supply the consumer electronics sector with processors, memory chips, and other sub-systems installed in end-consumer devices.

Due to these essential differences, it can be expected that the two industries vary with respect to ICT usage, e-business intensity and the impact of e-business on company and industry performance. Thus, it seems worthwhile to take a closer look at the e-business development in the sector that is vital for the development of e-business in general.

It should be noted that the above sector definition differs from the one used by the OECD for the ICTM industry, which also includes NACE DL 31.3 (Manufacture of insulated wire and cables), DL 32.3 (Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods), DL 33.2 (manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process equipment) and DL 33.2 (manufacture of industrial process equipment). The main reason for deviating from the OECD definition is that *e-Business W@tch*, for the study of e-business activity, prefers aggregations of more homogeneous industries in terms of their value chains, main customers and suppliers.

Links to other sectors

Many ICTM firms produce both goods and services. In other words, along providing hardware, ICTM firms deliver also software and implementation and consulting services. IBM, Siemens or HP are some of the most prominent examples of blurring the border between manufacturing and services firms. Furthermore, there are strong dependencies between the ICTM sector and other service, retailing and manufacturing industries. Thus, when analysing ICT and e-business issues in the ICTM industry, particularly for topics related to convergence and supply chain integration (see chapter 3), relations between the ICT industry and other sectors have to be taken into account. Strong links exist with the following industries:

- **ICT trading:** Trading of ICT products is closely related to their manufacture. However, wholesale and retail are not parts of the sector definition applied for the purposes of this report (see Exhibit 2-1) in a narrow sense. Nevertheless, they are increasingly tightly integrated with manufacturing activities and form a major application area of ICT (e.g. web sales activities for consumer electronics by companies like Dell or Apple).
- **Telecommunication services**: The condition of companies from the ICTM II sub-sector seems to depend on the development and take-off of new telecommunication services. New technological trends provide new opportunities in

terms of market and usage expansion. For example, an interesting development with possible impacts on the relationships between telco companies and the ICTM sector is the migration of intelligence from networks to end user sets. Telco devices, for example, are increasingly able to support different network technologies (e.g. mobile telephony networks and Wi-Fi) and to switch between them.[18]

- **Content suppliers:** With regard to the impact of broadband, networked ICT products are increasingly important as distribution channels for digital content. For example, new PCs reach their full potential for the customer only in conjunction with broadband data and content services. Thus, links between ICT manufacturers and content suppliers become closer and relationships are evolving that were rather unlikely in the recent past. For example, PC producers form alliances with telecommunication service providers.[19]

2.2 Industry background

2.2.1 Size of the industry

The following section presents some background information on the sector at stake. A short summary of currently important trends and challenges in the industry provides some insights into industry developments. Below some key data illustrate the size and industry market structure.[20] Data on employment and production value are presented in Annex I.

Exhibit 2-2: Manufacture of radio, television, communication equipment and apparatus in the EU-25 (2003)

NACE Rev. 1.1	Manufacture of…	Number of Enterprises	Production value (in Million €)	Value added at factor cost (in Million €)	Number of persons employed
DL 30	office machinery and computers	9,441	61,028.4	13,026.5	187,910
DL 30.01	office machinery	797	4,237.4	1,530	24,643
DL 30.02	computers and other information processing equipment	6,765	38,276.6	9,891.8	127,586
DL 32	radio, television and communic-ation equipment and apparatus	28,126	162,442	44,612	835,500
DL 32.1	electronic valves and tubes and other electronic components	8,178	49,052	17,173	307,900
DL 32.2	television and radio transmitters and apparatus for line telephony and line telegraphy	14,263	75,361	20,803	330,500

Source: Eurostat New Cronos / Estimates by DIW Berlin 2006

[18] It would be worthwhile to analyse the consequences of this development for market structure and competition in the telco and device manufacturing industry. However, such an effort is out of the scope of this report.

[19] Handelsblatt (2006b). Computerhersteller und TK-Anbieter tun sich zusammen. 5th March 2006.

[20] More recent data were not available at the time of preparing the report.

In 2003, the ICTM I industry contributed a value of over € 60 billion to production in the EU countries (Exhibit 2-2). The sector value added at factor cost was estimated at about € 13 billion. The ICTM II, the telecommunications equipment manufacturing industry, generated € 125 billion in production value and almost € 40 billion in value added.[21] In the same year, over 0.8 million persons were employed in nearly 32 thousand enterprises producing ICT equipment across the EU-25. Providing jobs for 638 thousand people, the ICTM II sub-sector are by far the largest employers in the ICTM sector. Corresponding to the production value and number of employees, companies in this sub-sector have the highest share of value added in the sector.

The ICTM industry exhibits a high level of concentration (Exhibit 2.3). In 2001, in every sub-sector no more than 3% of all enterprises employed more than 250 employees. At the same time, this small fraction of firms accounted for over 70% of value added and over 65% of total industry employment. A large share of companies in the industry had fewer than 10 employees and accounted for 2.4% and 5.4% of value added in the DL 32.1 and DL 30 sub-sector respectively. The relatively high concentration level can be explained by industry-specific features, such as high sunk costs, costly R&D projects, and economies of scale and scope in production.

Exhibit 2-3: Structure in manufacture of office machinery and computers, radio, television and communication equipment and apparatus (2001)

	Total (EU-25)	**1 – 9 empl.**	**10 – 49 empl.**	**50 – 249 empl.**	**250+ empl.**
		Structure in % of total EU-25			
DL 30					
Number of enterprises	8,552	83%	11.2%	3.9%	1.6%
Value added at factor cost	14,482	5.4%	7.4%	13.4%	73.7%
No of persons employed	224,900	7.0%	9.2%	16.3%	67.5%
DL 32.1					
Number of enterprises	8,326	68.4%	20.9%	7.7%	3.0%
Value added at factor cost	17,776	2.4%	7.8%	15.3%	74.5%
No of persons employed	357,900	4.1%	11.2%	19.7%	65.0%
DL 32.2					
Number of enterprises	15,007	86.8%	8.9%	2.9%	1.4%
Value added at factor cost	20,555	4.9%	6.1%	9.7%	79.2%
No of persons employed	398,600	6.6%	7.0%	11.8%	74.6%

Source: Eurostat New Cronos / Estimates by DIW Berlin 2006

2.2.2 Trends and challenges

The following section aims at **assessing the economic position** of the European ICTM sector in the global environment and tries to define the **major technological trends** that drive the market developments in the sector as well as to identify the responses of companies.

[21] Sum of DL 32.1 and DL 32.2.

The economic condition of the European ICTM sector

In order to assess the condition of the European ICTM sector it is worthwhile to compare **productivity levels** and **productivity growth** over the last couple of years in Europe and the United States. When comparing the European ICTM sector with its US counterpart two main patterns emerge (O'Mahoney et al. 2003).[22] Firstly, judging by the shares of the aggregated value added, the ICTM sector plays a considerably **higher** role in the US economy than in the EU. Although there are some exceptions within the EU (Finland and Ireland), other member countries have output shares far lower that in the US. Secondly, the productivity level in the US ICTM sector is **twice as high as** in the EU industry (Denis 2004).

The **productivity gap** between the EU and the US has further deepened over the years. Since 1995, there has been a clear dip in labour productivity growth in the EU manufacturing sector (EC 2004). In spite of high productivity growth rates in the ICTM sector, compared with the overall EU economy, the progress has been significantly slower than in the US ICTM sector. Between 1995 and 2001, the annual labour productivity growth in the EU ICTM sector amounted to 12%. In the same period, labour productivity in the US ICTM sector grew by 24% annually. The lower productivity level in the EU countries is to some extent compensated by lower labour costs when compared to the US (EC 2005).

Accepting the argument that innovation is the most important determinant of the competitive position of the ICTM industry, a closer examination of the **R&D activities** in both the EU and US ICTM industries might answer the question of whether the European ICTM industry might regain its position as a leading global player. Unfortunately, the data does not give an optimistic picture. In 1998, European countries accounted for 36% of **patents** applied for in Europe, 9% in the US and 3% in Japan (EC 2000). The USA and Japan accounted for 36% and 22% respectively of applications to the European Patent Office. However, in terms of R&D expenditures by leading European and American enterprises, broken down by sub-sectors, the situation does not look so critical. Whereas US hardware producers spend more on R&D activities, European electronics and telecommunication equipment manufacturers are ahead of their US counterparts. However, R&D expenditures as a percent of total value added in the EU ICTM sector are in general significantly lower than those in Japan, US and Korea (EC 2005).

Since mid 1980', the European ICTM sector has exhibited an increasing **deficit in foreign trade** for high-technology products (EC 2000). The diminishing role of the European ICTM industry can be partially attributed to the rapid development of the Chinese ICTM sector. In 2003, China became the biggest exporter of ICT goods (USD 180 billion) surpassing Japan and the EU in 2003 and taking over the US in 2004 (OECD 2006). Again, however, there are differences between the two sub-sectors examined in this report. World output share, trade balance and the growth share of trade balance are in favour of the ICTM II sub-sector, indicating that its competitive situation is better, compared to the ICTM I sub-sector (OECD 2004).

[22] Data presented in this section follow the classification from the OECD.

Although the trade deficit is relatively large, terms-of-trade for ICTM goods have increased since 1996 (Dachs, et al. 2006). On the one hand, most of the poor performance of ICT manufacturing trade seems to be rooted in products or parts of products where low-cost producers have a comparative advantage. On the other hand, high-value added products are still produced in Europe. Thus, locations' comparative advantages determine the decision where to manufacture the ICTM industry's products.

Division of labour

The new EU Member States have attracted considerable investments in the ICT manufacturing and service sectors. Offering low labour costs and tax incentives, the Czech Republic, Hungary and Poland have become very attractive investment locations. In many cases the decisions to move production activities to these countries are also driven by their geographical and cultural proximity to European headquarters. These factors are becoming even more important as the region's most obvious advantage, low labour costs, is diminishing because of the competition from other locations and the increasing prosperity.

The attractiveness of the new EU Member States does not come only from the low labour costs in manufacturing. **The outsourcing of white-collar work** is taking off and ICT companies consider the countries in Central Europe as prime investment destinations in areas such as software engineering, market research or even R&D activities (The Economist 2004). For example, companies such as Intel, Siemens, Hewlett-Packard, IBM, Oracle, Motorola and Philips created their R&D centres and financial or human resources units in Poland (Gazeta Wyborcza 2006). In addition to low costs, businesses name abundant and cheap **telecommunications bandwidth** and the **open standards** of the internet as the key drivers of a global division of labour.

Technological trends and market developments

There are a few technological trends driving current market developments that require ICTM companies to adopt new technologies and strategies. The discussion below focuses on three issues:

- The emergence of **next generation networks** is considered as the next 'big thing' in the telecommunication sector and therefore will shape business strategies of companies in the ICTM II sub-sector. On the one hand, the announcements of nearly every European telecommunication company to expand broadband capacities in the near future create large opportunities for companies that produce telecommunication equipment. On the other hand, however, the increasing importance of new telecommunication services such as voice over internet protocol (**VoIP**)[23] might reduce the demand for land-fixed telephony equipment. This creates a potential threat for companies that manufacture products for the traditional telecommunication markets.

[23] See the report on 'ICT and e-Business in the Telecommunications Industry', 2006. www.ebusiness-watch.org/resources/

- The development of next generation networks will accelerate the **convergence** of the content and format of the data.[24] Convergence does not only transform the media and telecommunication industry, it also influences equally strongly the ICTM sector. For example, as PCs change into an interface between the user and the world of information and the importance of mobility increases, PCs producers change their marketing strategy and begin to offer services related to content provision. According to Joseph Reger, Chief Technology Officer at Fujitsu Siemens Computers, alliances between telecommunication companies and PC producers are the answer to the demand for mobile access to the internet (Handelsblatt 2006b).
- Due to the constantly increasing technological perfection of ICT equipment and decreasing prices, **ubiquitous computing** is becoming a reality (ITU 2005). The introduction of microprocessors in entirely new areas from retail and logistics (**RFID**)[25] to automotive industries (**'drive by wire'**) will further increase the demand for ICT equipment in the near future. However, the decreasing prices of ICT equipment and components will further increase the importance of **scale economies**. As a result, large companies will have an advantage over SMEs and a new consolidation wave or market exits can be expected. Furthermore, as ICT products become mature, standardised and can be produced with economies of scale, low-cost location of these products become more and more interesting. This can be illustrated by the shift of PCs production from Europe and the US to Asia. One example is Lenovo, a Chinese PC producer that recently took over IBM's PC unit (BBC 2004). Existing ICT manufacturers answer this trend by increasing **consolidation**, which can be evidenced by the example of Alcatel and Lucent Technologies, two of the major players in the industry that are planning a merger to resist the pressure from rapidly developing competitors (Handelsblatt 2006).

2.3 Review of earlier sector studies

Many issues of e-business in the ICTM industries were analysed in the previous reports on the electrical machinery and electronics sectors (*e-Business W@tch*, October 2002, July 2003, May 2004, August 2004). Some of the main findings from the 2003 survey are summarised below.[26]

[24] See the reports on 'ICT and e-Business in the Consumer Electronics Industry' and 'ICT and e-Business in the Telecommunications Industry', 2006. www.ebusiness-watch.org/resources/

[25] See the 2006 reports on ICT and e-Business in the Food & Beverages, Footwear and Pulp & Paper Industries, all available at www.ebusiness-watch.org/resources/

[26] The survey results are not fully comparable to those of 2006. Figures for 2003 are based on a sample of 5 EU countries ("EU-5"), figures for 2006 on 10 EU countries ("EU-10"). See methodology reports at www.ebusiness-watch.org ('about' > 'methodology').

ICTM sector is an early adopter of e-business

In 2003, basic internet access and standard internet applications such as e-mail and use of the World Wide Web had reached **very high diffusion levels** in the electronics and electrical machinery sectors throughout Europe. Ninety eight percent of sector companies in the EU-5 had internet access and used email, 95% of the employees worked in companies that also used the web and 77% worked in companies that used an intranet.

In the overall electronics sector, **the main drivers of e-business adoption** were the high level of its IT know-how, the competitive pressure, the high degree of standardisation of products and components, the specialisation of firms along a complex value chain, the globalisation of production, and globally dispersed production schemes. In addition, this sub-sector was identified as naturally IT-savvy and predestined to be open to experiment with new technology-driven management solutions. Consequently, in the electronics industry, **e-business enabled and drove** innovative production and logistic schemes, globalisation and specialisation.

In the semiconductor industry, the early success of e-business could be partly explained by the **high level of standardisation** of a large part of electronic components used as an input in the production of electronic systems, combined with the short time available to deliver products to market and with the short lifecycle of electronic components. These factors strongly enhanced the industrialisation and automation of the purchase process.

National differences in adoption

The 2003 survey results indicated that basic internet infrastructures were widely implemented within the electronics and electrical machinery industries across Europe and the lack of ICT infrastructures no longer constituted a major barrier to e-business. However, there were **differences with respect to the availability of broadband** internet connections, remote and wireless access technologies. In general, companies in Nordic countries (Sweden and Finland) lead in these areas of ICT application, while French and Italian firms seemed to fall behind.

There were also significant **differences in e-business adoption** between the countries covered by the e-Business Survey 2003 in this sector. As a general trend, German enterprises and firms in the UK lead in e-business adoption, whereas French firms remained sceptical. While Spanish companies exhibited mostly average or above average usage figures, Italian firms appeared to be entering into a dynamic catching-up process. The French companies' falling behind cannot be fully explained by a lack of infrastructure or IT-skills. Cultural aspects may possibly play a more important role, since the business culture in France displays a marked preference for face-to-face interaction and a tendency towards IT-scepticism. In the Acceding Countries, companies were found to lag slightly behind in most e-business application areas, but there were exceptions, depending on the application.

Online purchasing currently the most widely adopted application

The 2003 survey results showed that purchasing online was the most widely adopted e-business application. **More than 50%** of all enterprises in the Electrical machinery and

Electronics industries made online purchases in 2003, while only 8% of firms made online sales themselves.

The low rate of online sales may be explained by the fact that online marketing activities most often did not include the actual completion of transactions. Nevertheless, the internet did not seem to play a major role for marketing and customer relation purposes in these sectors. Firms may have e-relations with distributors, but in most cases this did not include online sales. Data exchange was limited to online information, promotion tools and the information management of (traditionally accomplished) orders (availability of products, tariffs).

The share of enterprises using **B2B marketplaces** and/or extranet for purchasing or selling online was found to be higher in the electrical and electronics industries sectors than on average across all sectors studied by *e-Business W@tch* in 2003. This shows that e-marketplaces were an accepted channel, knowing that the electronics industry was one of the first sectors to develop B2B sites such as e2Open.

There were no other applications identified to have reached such a high level of acceptance as e-purchasing. For instance, 16% of the companies used the internet for product design, while only 5% used internet-based solutions to their support human resource management.

Differences between small and large firms

Large firms lead in almost any of the more complex e-business applications, such as ERP or SCM. ERP systems, for instance, were used by 13% of the enterprises in the sector representing 45% of employees in the EU-5 area. This means that, in particular, large companies used these technologies.

This confirmed that such applications as **ERP and SCM still tend to be too complex** and too expensive to be attractive for SMEs and micro-enterprises. Technologies that were explicitly used to make internal processes more efficient and cheaper are more applicable to large firms. The advantages of these technologies for small firms are limited in relation to the required fixed investments and the resulting lower economies of scale.

However, SMEs in this sector were not lagging behind as significantly compared to other sectors. In fact, with respect to a variety of e-business applications, SMEs from the electrical machinery and electronics industry showed similar adoption patterns as large firms did. There were no great differences across size-classes in the percentage of companies collaborating online to design new products, exchanging documents with suppliers or customers, or purchasing online.

As a consequence, *e-Business W@tch* attested to both large and small firms in this sector **a comparatively high state of e-business development** despite varying adoption rates across size-classes for some applications.

3 Adoption of ICT and e-Business in 2006

Background information about the e-Business Survey 2006

e-Business W@tch collects data on the use of ICT and e-business in European enterprises by means of representative telephone surveys. The e-Business Survey 2006 was the fourth survey after those of 2002, 2003 and 2005. It had a scope of **14,081 interviews** with decision-makers in enterprises from 29 European countries.[27]

Most tables in this report feature a breakdown of the population of enterprises based on the aggregate of 10 EU countries – **the "EU-10"**.[28] In these countries the survey covered all 10 sectors (at least to some extent) and therefore comparability of the sample across sectors is given. The EU-10 represent more than 80% of the total GDP and inhabitants of the EU-25 and are thus to a large extent representative for the whole EU.

The survey was carried out as an **enterprise survey**, i.e. focusing on the enterprise as a business organisation (legal unit) with one or more establishments. Similarly to 2005, the 2006 survey also included only **companies that use computers**. The configuration of the survey set-up (e.g. sampling) reflects the mandate of *e-Business W@tch* to **focus on sectors** and **SMEs**. As a result, comparisons should mainly be made between sectors and between size-bands of enterprises. Breakdowns by country are also possible, but should be treated cautiously, for several reasons (see Annex II).

In the **ICTM industry** 1687 interviews were conducted; out of these, 1277 with companies from the EU-10. To address sub-sector specific differences, some of the data are broken down into the two main **sub-sectors** of the ICTM industry defined for the purposes of this study, i.e. ICTM I and ICTM II (see Section 2.1).

More detailed information about the survey methodology, including information about sampling and the business directories used, the number of interviews conducted in each country and sector, data on non-response rates, as well as selected results by country are available in **Annex II and III** and on the *e-Business W@tch* website.

[27] The survey was conducted in March-April 2006 using computer-assisted telephone interview (CATI) technology. Field-work was co-ordinated by the German branch of Ipsos GmbH (www.ipsos.de) and conducted in co-operation with their local branches and partner organisations. The countries covered include EU Member States, Acceding and Candidate Countries, and countries of the European Economic Area (EEA).

[28] The EU-10 cover the Czech Republic, Germany, Spain, France, Italy, Hungary, the Netherlands, Poland, Finland and the UK.

3.1 Use of and Access to ICT Networks

Internet access

The quality of the internet connection is essential to the development of e-business. A central indicator for the quality of telecommunication infrastructure is bandwidth. The available bandwidth determines which e-business applications can be efficiently used. Higher bandwidth enables an exchange of more information per unit of time. With a broadband connection, a firm can fully exploit sophisticated ICT systems.

Exhibit 3-1: Internet access and remote access to company network

	Companies with internet access		Companies with broadband internet access		Average share of employees with internet access*		Companies enabling remote access to their network	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**100**	**99**	**84**	**79**	**n.a.**	**74**	**69**	**35**
ICTM I	100	99	84	83		83	76	39
ICTM II	100	99	84	76		67	67	31
Micro (1-9 empl.)		99		78		78		30
Small (10-49 empl.)		99		86		59		47
Medium (50-249 empl.)		100		85		54		70
Large (250+ empl.) *		100		83		59		88
All 10 sectors (EU-10)	**95**	**93**	**76**	**69**	**n.a.**	**43**	**35**	**16**
Micro (1-9 empl.)		89		62		51		12
Small (10-49 empl.)		98		75		29		22
Medium (50-249 empl.)		99		83		33		43
Large (250+ empl.)		99		84		44		60
Food & beverages	95	88	72	64	n.a.	25	35	14
Footwear	96	89	75	62	n.a.	28	17	10
Pulp & paper	99	94	80	68	n.a.	40	56	21
ICT manufacturing	100	99	84	79	n.a.	74	69	35
Consumer electronics	98	97	87	74	n.a.	80	51	32
Shipbuilding & repair	100	100	87	86	n.a.	30	41	27
Construction	95	90	72	64	n.a.	47	25	13
Tourism	93	90	72	68	n.a.	53	38	13
Telecommunication	100	99	88	85	n.a.	90	74	46
Hospitals activities	100	98	85	78	n.a.	41	39	34
Base (100%)	firms using computers		firms using computers		firms with internet access		firms using computers	
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	A1		A3		A2		A5	

* Read: "The average share of employees with internet access in a company from the ICTM industry is 74%."

Source: *e-Business W@tch* (Survey 2006)

Basic **internet connectivity** of companies from the ICTM sector appears to be above the average for the 10 sectors covered by the e-Business Survey 2006 (EU-10). Virtually every company that has a computer is connected to the internet. By share of employment, companies representing the sector's entire workforce are connected. The deployment of **broadband access** in this industry is also above the average of the 10 sectors studied. In fact, ICTM companies representing about 84% of the sector's employment reported using an internet connection technology that can be classified as broadband (either DSL, cable, direct fibre connection or wireless broadband) - see Exhibit 3-1.

A close look at the figures reveals that there are no significant gaps in the ICT uptake between companies of different size with respect to internet access and broadband usage. However, fewer **individual workers** working in larger companies have access to the internet at their workplace than in SMEs. For example, on average 78% of employees working in micro enterprises have internet access, compared to 59% in large companies. This phenomenon might be explained by the fact that more employees in large enterprises are involved in manufacturing activities where the internet is not used as a working tool. In contrast, in SMEs people work primarily in other business areas, such as new product development, where the use of internet is much more needed. This has also been illustrated in the case study about *Option*, a wireless technology developer and manufacturer in Belgium (see section 4.4).

Comparisons with specific sectors show that **remote network access** in the ICTM industry is among the highest across the 10 sectors covered by the e-Business Survey 2006 (EU-10). Even in this sector, however, there are considerable gaps between companies of various sizes. In fact, only 30% of micro and 47% of small firms said that they enable remote access to their ICT systems, shares that are about half the respective one for large firms. Today, remote access can by no means be considered a sophisticated functionality. Thus, this might be a result of organisational structures and workforce compositions varying together with firm size.

On the whole, there are no considerable differences between sub-sectors in terms of their internet usage. Companies from the ICTM I category exhibit a higher share of employees having internet access at their workplace than other sectors studied by *e-Business W@tch* in 2006. Again, this might be attributable to intrinsic characteristics of the sub-sectors discussed in section 2.2 and a larger share of people employed in manufacturing.

Use of internal computer networks

The use of ICT to connect computers internally to a company network (Local Area Networks – LAN, and Wireless LAN) increases with company size in the ICT industry. According to the survey results, **LAN** is widely deployed among companies in the ICTM sector and, in fact, over two thirds of small firms has a LAN (see Exhibit 3-2). **Wireless-LAN technology** is already used by more than 66% of large firms from the sector, but only by 33% of micro and small companies. Large enterprises hold a lead in using VPN (virtual private network) technology to enable secure remote access to the company network. Again, it should be pointed out that the decision to deploy an internal computer network primarily depends on the number of people working in the organisation.

Not surprisingly, the ICTM sector emerges as a very advanced user of internal computer networks. Both firm- and employment-weighted figures for the ICTM sector are significantly higher than the averages for all sectors studied this year.

Exhibit 3-2: Networks and protocols used

	LAN		W-LAN		Use Voice-over-IP		Use VPN for remote access	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**91**	**71**	**47**	**34**	**28**	**20**	**73**	**47**
Micro (1-9 empl.)		67		33		18		40
Small (10-49 empl.)		83		33		24		55
Medium (50-249 empl.)		94		48		28		75
Large (250+ empl.)		99		66		39		86
All 10 sectors (EU-10)	**65**	**46**	**32**	**16**	**16**	**13**	**57**	**26**
Micro (1-9 empl.)		35		12		14		20
Small (10-49 empl.)		59		21		11		32
Medium (50-249 empl.)		84		37		13		57
Large (250+ empl.)		96		47		22		79
Base (100%)	firms using computers		firms using computers		firms using computers		Firms enabling remote access	
N (for sector, EU-10)	1277		1277		1277		619	
Questionnaire reference	A4a		A4b		A4c		A6d	

Source: *e-Business W@tch* (Survey 2006)

Voice-over-IP

The use of telephony services over internet networks, by means of digitised voice transfer technology, is an outcome of the technological convergence (see section 4.1 for a detailed discussion). This way of voice transmission has gained momentum over the past few years, driven by the increasing penetration of broadband and internet communication standards. Established, as well as new telecommunication service companies and internet service providers offer new services based on this technology, which enables user companies to save costs. These services are commonly referred to as "Voice-over-IP" (VoIP) services since they have in common that **they use the Internet Protocol (IP) to transfer voice calls**.

There are many ways for VoIP to be implemented. For example, calls can be initiated and terminated via a computer or a VoIP-enabled phone. Private users typically encounter VoIP services as an internet-based peer-to-peer network service (for example Skype or Google Talk). But from the perspective of corporate users, there are more usage scenarios. Corporate users can generally follow **two paths** if they want to benefit from VoIP. They can use either **hybrid solutions** or pure **IP-based networks**. It can be expected that usage will further increase over the next few years, and eventually, as a common scenario depicts, all fixed network voice telephony might be converted to the

internet protocol. "Voice-over-IP" will then no longer be an issue, being the standard technology for telephony. [29]

Voice-over-IP gaining ground in the ICTM sector. In 2006, one fifth of companies from this sector (accounting for 28% of employment) said that they use VoIP services (see Exhibit 3-2). As in the case of other network applications, diffusion increases by size band: 18% of all micro-companies and nearly 40% of large firms use VoIP. These figures are significantly larger than the total of the 10 sectors studied, thus confirming the technological lead of companies from the ICTM sector.

3.2 ICT Skills, Outsourcing and ICT Budgets

3.2.1 Demand for ICT skills and skills development

An appropriate skills base belongs to the critical complementary factors enhancing the productivity growth from ICT investments (see section 4.4). Thus, the supply and usage of ICT skills has been closely monitored by *e-Business W@tch* since its inception. Based on previous findings, one of the previous policy recommendations was to increase the supply of ICT specialists in order to boost the diffusion and usage of ICT.

Today, only a small share of companies in the ICTM sector and a marginal fraction across all sectors studied reported difficulties in filling vacancies for ICT-related positions (see Exhibit 3-3). In fact, only 3% of all companies in the ICTM sector, which account for 8% of total sector employment, reported difficulties in recruiting qualified ICT specialists. However, although low in absolute terms, this figure is one of the highest among the studied sectors.

The demand for ICT specialists exhibits some clear patterns. First, the likelihood of experiencing difficulties when looking for an ICT specialist increases with firm size. Second, it is primarily tech-savvy industries that complain about the ICT skills shortage. The percentage of firms reporting recruiting difficulties in the ICTM I sub-sector is three times higher than in the ICTM II sub-sector. Thus, companies and industries exhibiting high intensity of ICT-use report recruiting impediments. This sustains the validity of the statement stressing the importance of skills for the effective upsurge of e-business.

As can be seen from the *e-Business W@tch* 2006 survey results, similar to other ICT-savvy industries, the ICTM sector exhibits a high demand for ICT skills and ICT practitioners. In total, about **30%** of all firms in the sector said that they **employ ICT practitioners**, i.e. people with special skills and tasks related to the implementation and maintenance of ICT in the company. A large share of firms investing in ICT-skills enhancement further highlights the importance of ICT-skills for firms in the ICTM sector. On average, the share of companies in the ICTM sector offering their employees ICT training and using e-learning applications is twice as high as the respective all-sectors averages.

[29] See *e-Business W@tch* Sector Study on the Telecommunications Industry, 2006. Available at www.ebusiness-watch.org ('resources').

The above average share of firms investing in employees' ICT skills is common for every size class. Over 20% of micro- and small firms in the ICTM industry, and 38% from the medium-sized and large firms said that they regularly send employees to **ICT training programmes**. The share of active companies in that respect is significantly higher than in other industries. A similar situation can also be observed with respect to the use of **e-learning**.

Considerable differences between SMEs and large firms with regard to ICT-skills reflect the overall pattern of ICT-intensity increasing with firm size and the complexity of value chain in such industries as the ICTM, consumer electronics and telecommunication sectors. This can be interpreted as a sign of the comparatively high importance of ICT in the ICTM industry in the daily work routine of most employees and the critical role of ICT and ICT skills to support the firm strategy.

Exhibit 3-3: Demand for ICT skills and skills development

	Companies employing ICT practitioners		Regular ICT training of employees		Companies with hard-to-fill vacancies for ICT jobs in 2005		Companies using e-learning	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**52**	**31**	**39**	**24**	**8**	**3**	**28**	**20**
ICTM I	59	40	53	33	14	6	40	27
ICTM II	49	24	34	17	6	2	24	15
Micro (1-9 empl.)		29		22		3		19
Small (10-49 empl.)		34		26		4		25
Medium (50-249 empl.)		53		38		9		25
Large (250+ empl.)		58		62		11		50
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Micro (1-9 empl.)		12		9		2		12
Small (10-49 empl.)		15		16		0		11
Medium (50-249 empl.)		29		28		2		19
Large (250+ empl.)		59		41		6		35
Food & beverages	26	11	26	14	2	0	16	9
Footwear	20	13	14	6	1	0	7	5
Pulp & paper	35	16	29	12	3	1	21	13
ICT manufacturing	52	31	39	24	8	3	28	20
Consumer electronics	35	17	21	16	4	2	23	18
Shipbuilding & repair	36	33	29	20	4	0	14	15
Construction	22	14	18	12	2	1	12	8
Tourism	27	12	21	11	3	2	29	15
Telecommunication	63	33	52	21	12	5	41	28
Hospitals activities	57	39	39	34	5	3	26	22
Base (100%)	firms using computers							
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	B1		B4		B2		B5	

Source: *e-Business W@tch* (Survey 2006)

3.2.2 Outsourcing of ICT services and ICT investments

Outsourcing

Firms were asked whether they had **outsourced** any of their ICT services that had previously been conducted in-house to external service providers **in 2005**. In the ICTM industry, this is the case for about 15% of companies, with a propensity to outsource ICT activities increasing with firm size (see Exhibit 3-4). The percentage of firms in the ICTM sector outsourcing their ICT services is comparable with the all sectors average. Thus, independent of the industry, it seems that companies still rely heavily on their own expertise when dealing with ICT issues.

When asked whether outsourcing had increased, decreased or remained the same in 2005 compared to 2004, about a third of companies from the ICTM sector stated that it had increased. Only very few companies said that they had decreased outsourcing, compared to the year before. Here, again, the ICTM sector seems to be slightly more involved in outsourcing than, on average, companies from the other sectors that are studied by *e-Business W@tch* in 2006.

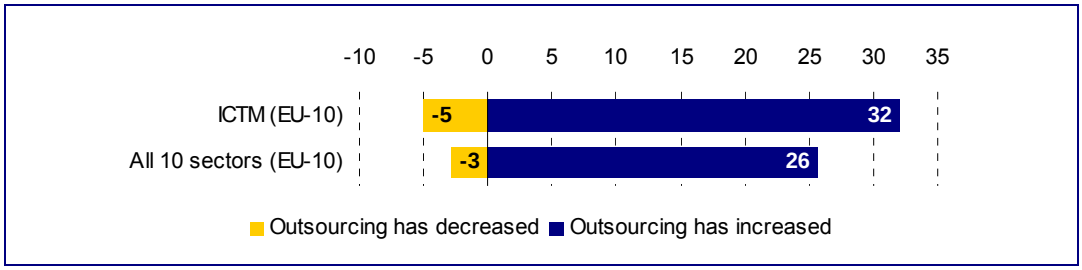
Exhibit 3-4: Outsourcing and spending on ICT

	Have outsourced ICT services in 2005		**Share of ICT budget as % of total costs**		**Have made ICT investments in 2005**		**Difficulty to draw funds for investments**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**22**	**15**	**9**	**12**	**85**	**66**	**6**	**5**
ICTM I	33	17	18	18	88	73	8	8
ICTM II	17	13	6	7	83	60	6	2
Micro (1-9 empl.)		14		12		62		4*
Small (10-49 empl.)		19		11		77		11*
Medium (50-249 empl.)		22		10		87		6*
Large (250+ empl.)		29		6*		81		**
All 10 sectors (EU-10)	**19**	**14**	**6**	**5**	**65**	**50**	**19**	**15**
Micro (1-9 empl.)		8		5		39		25
Small (10-49 empl.)		21		5		60		3
Medium (50-249 empl.)		21		6		78		6
Large (250+ empl.)		31		6		86		29
Base (100%)	firms using computers		all firms (excl. "don't know")		firms using computers		Firms with external funding sources for their ICT investments	
N (for sector, EU-10)	1277		779		1277		78	
Questionnaire reference	B6		C1		C3		C5	

* Data only indicative due to low number of observations (N 25-50).
** Values not displayed because number of observations (N) is <20.

Source: *e-Business W@tch* (Survey 2006)

Exhibit 3-5: Outsourcing trend: percentage of companies that have increased / decreased their outsourcing activities in 2005



Base (100%): Companies that have outsourced ICT services. N (for sector, EU-10) = 208.
Weighting: in % of firms. Questionnaire reference: B7

Source: *e-Business W@tch* (Survey 2006)

ICT expenditure and investments

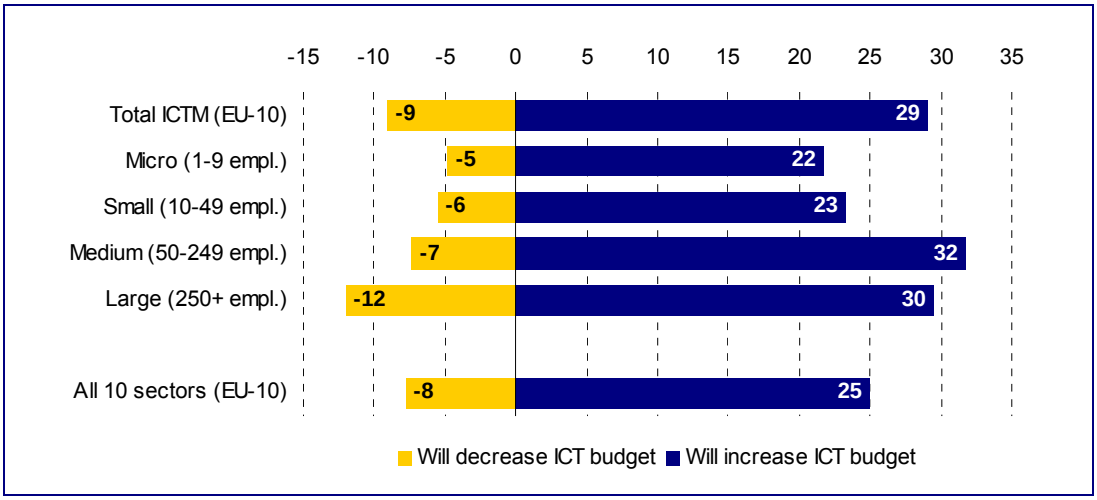
The **average ICT budget** of a company from the ICTM industry, including hardware, software, services and personnel, corresponds to about 12% of total company costs (see Exhibit 3-4). This is well above the all sector average. However, the figure varies with firm size. For SMEs, the average share of ICT expenditure in the total budget was reported to be twice as high as for large enterprises. Thus, it can be argued that large enterprises benefit twofold from their size: first, scale effects enable them to derive greater benefits from network technologies and second, large cost of ICT applications are only a small fraction of their total expenses.

There are significant differences in ICT spending within the ICTM sector. According to the survey findings, companies from the ICTM I sub-sector spend, on average, three times more on ICT than firms from the ICTM II sub-sector. Again, these figures indicate higher ICT intensity of the first sub-sector.

About 30% of all firms from the ICTM industry reported plans to further **increase their ICT budgets** in 2006/07, compared to the current budget. Less than 10% said that they would cut their budgets (see Exhibit 3-6). A majority of about two thirds said that they will maintain the current level of spending.

Similar to all sectors studied by *e-Business W@tch* in 2006, there appears to be a trend towards increasing ICT budgets in the ICTM sector. This might indicate that, despite of high levels of ICT usage, the potential for these technologies to improve operational efficiency has not yet been exhausted and ICT still offers a remedy to increasing competition and cost pressure. This seems to be particularly true for medium-sized and large firms, which are more likely to increase their ICT spending than their smaller counterparts in this sector.

Exhibit 3-6: ICT budget trend: percentage of companies that plan to increase / decrease their ICT budgets in 2006/07



Base (100%): Companies using computers (excl. "don't know"). N (for sector, EU-10) = 1202.
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: C2

Source: *e-Business W@tch* (Survey 2006)

In 2006, *e-Business W@tch* asked companies about the **major source** from which they finance their ICT investments[30] (see Exhibit 3-7), and if they experienced any difficulties in receiving funds from any external financing source (see Exhibit 3-4). In all of the 10 sectors surveyed, **self-financing** (out of the generated cash-flow) is the dominant source of financing ICT investments. In the ICTM industry, nearly 80% of firms said that this is their major source. It can be assumed that **bank loans** are typically used for larger ICT investments, but they are the major financing source for only 6% of firms. The share of venture capital in financing ICT projects is insignificant compared to the other sources - no more than two out of one hundred firms in this sector said that this is their major source for ICT investments. Interestingly, public funds and other sources of financing were reported at least as important as bank loans. Judging by the answers to the question if companies experienced any difficulties to draw funds for ICT investments, companies in the ICTM sector (in particular from ICTM I) have fewer obstacles to obtain money for ICT investments when using external funds, in comparison to the all sectors average (see Exhibit 3-4 above).

[30] Ideally, a question about the breakdown of investments into the different financing sources would be asked; however, only few interviewees would be in a position to spontaneously answer this question on the telephone; furthermore, such a question would be extremely time-consuming. Thus, the only feasible solution was to ask for the *major* source.

Exhibit 3-7: Major source for investments in ICT

	Cash-flow financing		Bank loans		Venture capital		Public funds and other	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**75**	**79**	**7**	**6**	**1**	**2**	**4**	**7**
Micro (1-9 empl.)		80		6		2		8
Small (10-49 empl.)		75		7		2		5
Medium (50-249 empl.)		74		8		2		4
Large (250+ empl.)		77		4		1		3
All 10 sectors (EU-10)	**74**	**82**	**5**	**7**	**1**	**1**	**9**	**7**
Micro (1-9 empl.)		82		8		1		2
Small (10-49 empl.)		81		6		1		2
Medium (50-249 empl.)		70		8		1		2
Large (250+ empl.)		67		2		1		8
Base (100%)	firms that have made investments in ICT							
N (for sector, EU-10)	957		957		957		957	
Questionnaire reference	C4		C4		C4		C4	

Source: *e-Business W@tch* (Survey 2006)

3.3 Standards, Interoperability and ICT Security Issues

A "standard," used as a technical term, is "*a technical specification approved by a recognised standardisation body for repeated or continuous application, with which compliance is not compulsory*".[31] There are national, European and international technical standards. The agreement on shared technical standards is an instrument to achieve compatibility between different systems. Without interoperability of ICT systems, which requires standards and compatibility between standards, advanced forms of e-business (such as the digital integration of systems in B2B exchanges) is hardly possible.

3.3.1 Types of e-standards used

The sector study on the Electronic Machinery and Electronics Industry of 2004 reported that "*… among the various standards, a relative majority of manufacturers of electronic products use Electronic Data Interchange (EDI), a standards-based mechanism for trading partners to electronically communicate with each other despite disparate systems, software and architectures installed…*"[32]

[31] Directive 98/34/EC of the European Parliament and the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations, Official Journal of the European Communities L 204, 21/07/1998 pp. 0037 - 0048. http://europa.eu.int/eur-lex/pri/en/oj/dat/1998/l_204/l_20419980721en00370048.pdf

[32] See *e-Business W@tch* Sector Study on the Electrical Machinery and Electronics Industries, 2004. Available at www.ebusiness-watch.org ('resources').

At the beginning of its diffusion, EDI was considered expensive and technically difficult to implement. Much of the expense was attributed directly to transaction fees charged by value added networks (VANs). Today, EDI is growing in popularity because transaction fees can be avoided by leveraging the internet as the communications transport mechanism. One the other hand, new XML-based standards allow an optimised integration of components within a system, not only for marketplace purchase and supply but also for other applications and processes. The data from the *e-Business W@tch* 2006 survey seems to confirm this migration trend (see Exhibit 3-8).

Only 3% of all companies in the ICTM sector reported the use of EDI, while 10% and 14% of the ICTM companies said that they used XML and proprietary standards. There are, however, some noteworthy differences between companies of various size and sub-sectors. For example, whereas large enterprises clearly lead in the use of EDI-based standards, the discrepancy in the use of XML-based and proprietary standards between SMEs and large firms is not so clearly pronounced. Furthermore, companies from the ICTM I sub-sector clearly lead in the adoption of more recent XML-based standards, compared to their counterparts from the ICTM II sub-sector. This, again, is a sign of the dynamics and the technological lead found in the ICTM I sub-sector.

Exhibit 3-8: Use of e-standards

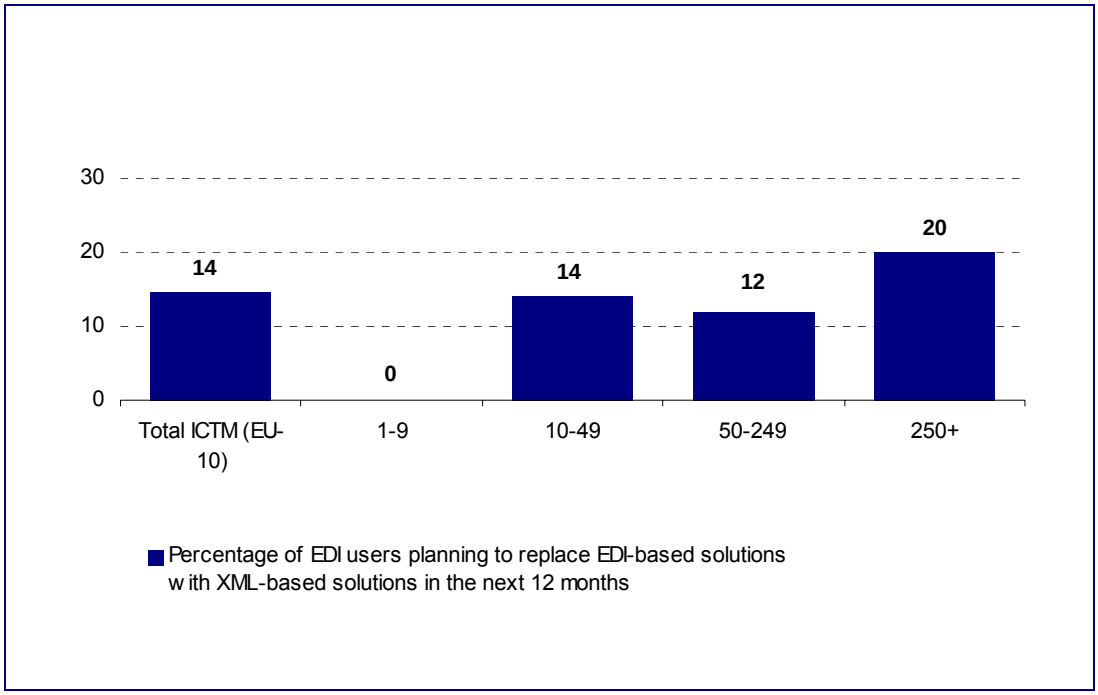
	EDI-based standards		**XML-based standards**		**Proprietary standards**		**Other standards**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**21**	**3**	**16**	**10**	**26**	**14**	**6**	**3**
ICTM I	19	2	27	18	26	20	8	4
ICTM II	21	4	12	5	25	10	5	3
Micro (1-9 empl.)		1		10		13		3
Small (10-49 empl.)		6		11		21		4
Medium (50-249 empl.)		13		16		25		5
Large (250+ empl.)		47		27		33		11
All 10 sectors (EU-10)	**9**	**3**	**11**	**5**	**19**	**12**	**4**	**2**
Micro (1-9 empl.)		2		6		10		
Small (10-49 empl.)		4		5		13		
Medium (50-249 empl.)		10		10		24		
Large (250+ empl.)		29		27		31		
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	G1a		G1b		G1c		G1d	

Source: *e-Business W@tch* (Survey 2006)

Proprietary standards are still abundant in the ICTM sector. Fourteen percent of all firms, accounting for a quarter of the total sector employment, said that they use proprietary standards with their business partners. Furthermore, the evidence from the *e-Business W@tch* 2006 data indicates that companies that use EDI-based standards have no intention to move to XML-based standards (see Exhibit 3-9). Neither large nor small firms appear to be particularly eager to switch from EDI-based standards to internet-based standards.

Considering the clear benefits of open standards, an issue also illustrated in the case study about *Nokia* (see section 4.2), the widely spread proprietary standards could be hampering the efficient use of e-business in this industry. The fact that proprietary standards are still commonly used, particularly by large companies in the ICTM sector, requires the introduction of costly middleware and customised programming. This, in turn, increases the costs of the supply chain integration.

Exhibit 3-9: Plans to migrate to XML-based standards



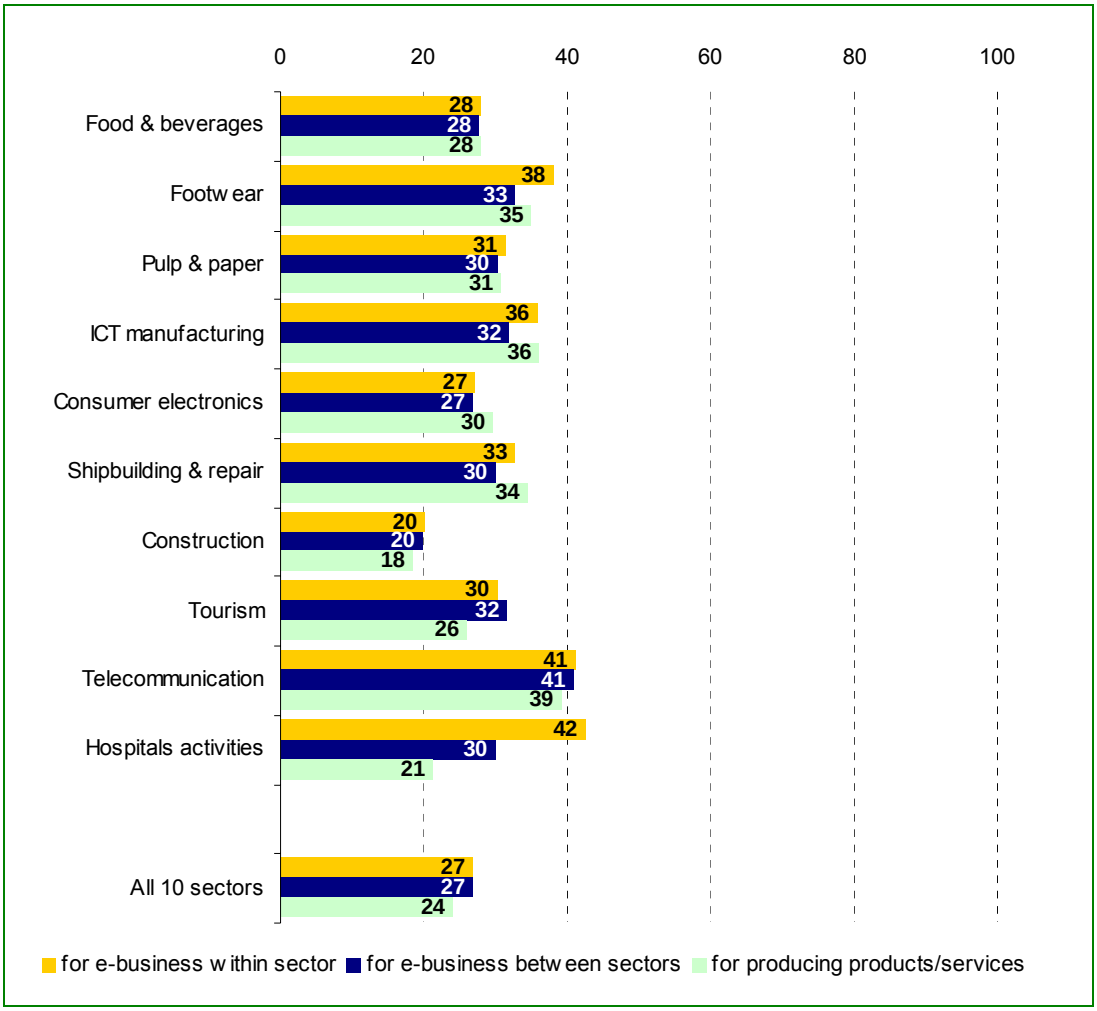
Base (100%): Companies using computers (excl. "don't know"). N (for sector, EU-10) = 93.
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: G4

Source: *e-Business W@tch* (Survey 2006)

3.3.2 Interoperability challenges

Interoperability refers to the "*ability of two or more systems to exchange data, and to mutually use the information that has been exchanged.*"[33] *e-Business W@tch* asked companies whether they regard interoperability as critical for conducting e-business with companies from their own sector, from other sectors, and for producing their products or services. Results indicate that interoperability is significantly more important for firms from the ICTM sector than -on average- across all the sectors that are studied by *e-Business W@tch* in 2006 (see Exhibit 3-9). This does not come as a surprise, considering the high level of value chain integration in the industry (see section 4.3). The case study about *Tesla* illustrates the negative impact of the lack of interoperability for utilising various applications (section 4.4).

Exhibit 3-10: Perceived importance of interoperability: percentage of companies saying that interoperability is critical ...



Base (100%): Firms using computers. N (for sector, EU-10) = 1277.
Weighting: in % of firms. Questionnaire reference: G5a-c

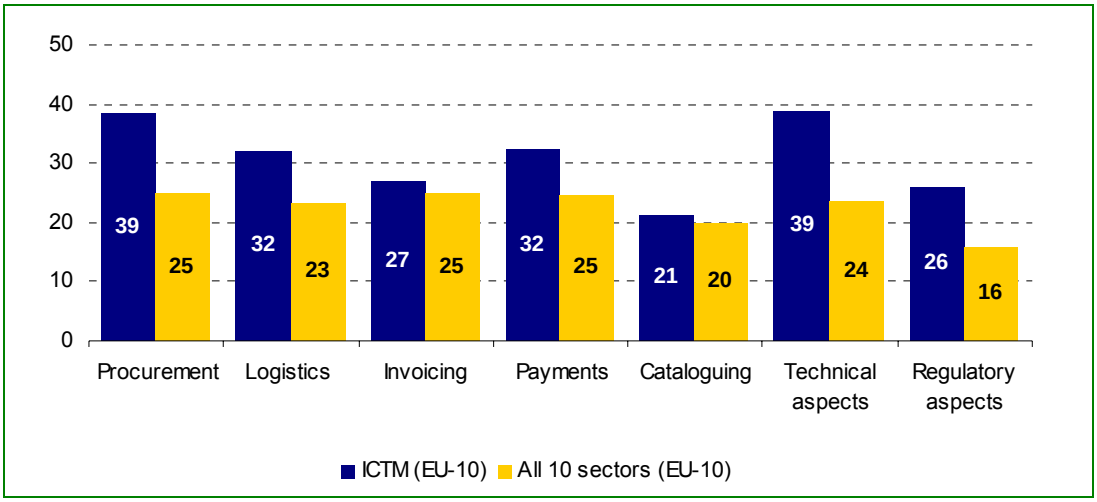
Source: *e-Business W@tch* (Survey 2006)

[33] Definition by IEEE and ISO, cf. *e-Business W@tch* Special Study on e-Business Interoperability and Standards, September 2005, p. 14. Available at www.ebusiness-watch.org ('resources').

In the ICTM industry, 36% of all companies see **interoperability as a critical** issue for interactions with firms from the same industry. The same number of companies reported that smooth data exchange between suppliers and customers is important for producing products and/or services. This issue has been clearly illustrated in the case study about *Option*, a medium-sized company in Belgium that deploys ICT to facilitate collaboration with other organisations at different stages of the product life-cycle (section 4.4).

e-Business W@tch also asked companies whether they experience any **difficulties** stemming from a **lack of interoperability**. Only those firms were asked which said that interoperability was critical for e-business and/or producing their products. Seven potential problem areas were suggested by the survey. For every area, ICTM companies reported high rates of problems regarding the lack of interoperability (see Exhibit 3-11). The business functions in which most ICT companies seem to face interoperability challenges are procurement and technical aspects. In contrast, cataloguing is the least harmed by the lack of compatibility between systems and standards. In other words, the lack of industry-wide standards hampers the process of supply chain integration in crucial fields, i.e. cooperation with suppliers (procurement, logistics and payments) and product development and manufacturing (technical aspects). On the other hand, activities such as cataloguing, have been relatively well standardised.

Exhibit 3-11: Problems due to a lack of interoperability: firms experiencing difficulties in …



Base (100%): Firms that say that interoperability is critical for their e-business. N (for sector, EU-10) = 624.
Weighting: in % of firms. Questionnaire reference: G6

Source: *e-Business W@tch* (Survey 2006)

Call for action to improve interoperability

The findings from the e-Business Survey 2006 indicate that the rather significant level of experienced interoperability challenges could be linked to the low deployment of e-business standards. If so, this calls for activities to amend the situation in order to encourage and facilitate e-business uptake among the companies in the ICTM industry. Projects aimed at enhancing interoperability for the exchange of computerised data should therefore be supported. Furthermore, efforts could be made to establish standards for product classification and to spread XML standards, since this could open up new possibilities for SMEs (see policy challenges, section 5.2).

3.3.3 Use of Open Source Software

The open source model

Open source software (OSS) 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. In the past years, the public awareness of OSS has grown steadily, with the operating system Linux (an alternative to proprietary operating systems such as Windows) being the best-known project. Besides Linux, other OSS such as the database mySQL or the internet browser Firefox (a spin-off of the Mozilla browser) have achieved significant market shares.

Policy is interested in monitoring OSS developments and the uptake among companies for several reasons. There is some debate and different views on whether the use of OSS based operating systems could possibly reduce ICT costs for SMEs, at least in the long run. Another aspect is whether OSS systems may help to "unlock" companies from specific ICT service providers in the future.

Deployment of Open Source Software

Against this general interest for the issue in policy and industry, companies were asked by *e-Business W@tch* this year whether they used OSS, either in operating systems, databases or browsers. Results for the ICTM industry show that the **use of OSS** clearly **increases with firm's size**, with considerable gaps between the small firms (with up to 49 employees) and the medium-sized ones, and again between the medium and large ones. However, the adoption of OSS in the ICTM sector is significantly higher than the all-sectors average.

In particular, **operating systems** (including Linux) based on OSS appear to be widely used by companies from the ICTM industry. Among the large firms, 66% reported having OSS operating systems in place.

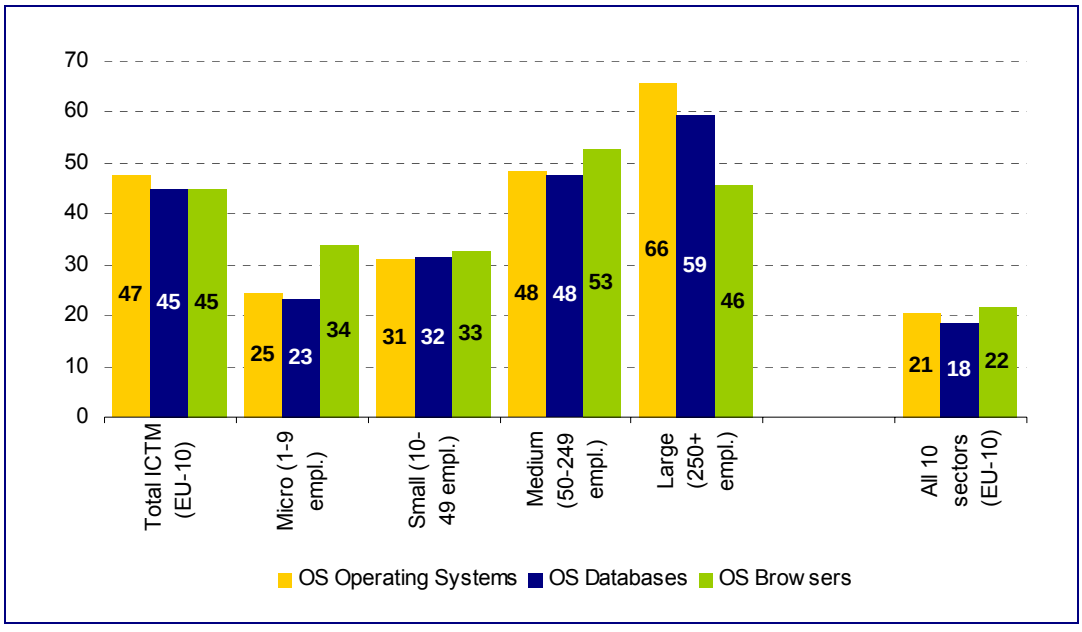
The differences in OSS adoption rates between industries can be partially explained by the overall ICT-intensity across the presented sectors. For example, the high adoption levels in Telecommunication, ICT Manufacturing and Consumer Electronics industries

reflect the high rates of ICT usage in these industries. At the other extreme are industries with less complex value chains and production processes, such as Tourism, Food and Beverages or Pulp and Paper, which usually trail behind in ICT usage indices. Here, again, these industries do not score high in OSS adoption.

The high adoption rates of OSS in ICTM and other ICT-savvy industries might indicate that OSS offers superior performance and features compared to proprietary solutions. This has been confirmed by available studies on the reasons for OSS adoption indicating that, contrary to commonly held beliefs, cost savings are not the key driver of OSS usage. According to Berlecon (2002), superior stability and access control are ranked as the most important criteria for OSS adoption decisions. Thus, the high complexity of operations, as well as huge data and information volumes call for solutions that in many cases are not provided by proprietary software vendors. MySQL and Apache are prime examples of OSS superiority over proprietary applications.

Furthermore, **internal ICT expertise**, measured in terms of ICT expenditures, the demand for IT specialists and employee IT training, is an important prerequisite for OSS adoption (Nepelski et al. 2006). It has been shown, however, that primarily ICT-savvy sectors exhibit high demand for IT specialists (see Exhibit 3-3) and investments in ICT (see Exhibit 3-6). Thus, only firms in these sectors are able to afford superior but at the same time maintenance-intensive OSS solutions. In contrast, small firms operating in the tourism or construction sectors are facing significant budget constraints and refrain from investing in ICT applications or employing IT specialists. Thus, the lack of investments in complementary assets hinders the diffusion of OSS in these industries.

Exhibit 3-12: Companies using Open Source Software



Base (100%): Companies using computers. N (for sector, EU-10) = 1277.
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: G8

Source: *e-Business W@tch* (Survey 2006)

3.3.4 ICT security measures

e-Business W@tch covered security controls and other measures applied by European enterprises to counter security threats in its survey of 2005. Results, which were presented in a special report,[34] indicated that basic components such as firewalls and secure servers – for those enterprises requiring these – already exhibited high levels of penetration. As a follow-up to this study on ICT security, questions on selected security measures that were of particular interest to policy were also included in the e-Business Survey 2006 as well.

Secure Server Technology and Firewall

"**Secure server technology**" means that data exchange between computers is based on certain technical standards or protocols, for example "Secure Sockets Layer" (SSL). This is a commonly used protocol for managing the security of message transmission on the internet. SSL has recently been succeeded by Transport Layer Security (TLS), which is based on SSL.[35]

In the ICTM industry, 33% of all firms reported using of Secure Server Technology (see Exhibit 3-13). While figures for SMEs are already significantly higher than the average across the 10 sectors studied this year by *e-Business W@tch*, deployment among large ICTM firms (68% on average) is much higher than in other sectors studied in 2006.

Exhibit 3-13: ICT security measures used by enterprises

	Secure Server Technology		Firewall		Digital Signature or Public Key Infrastructure		Open Source Operating System	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**57**	**33**	**32**	**19**	**95**	**79**	**47**	**27**
Micro (1-9 empl.)		29		17		76		25
Small (10-49 empl.)		45		28		90		31
Medium (50-249 empl.)		59		33		95		48
Large (250+ empl.)		68		45		98		66
All 10 sectors (EU-10)	**36**	**20**	**78**	**62**	**21**	**15**	**21**	**9**
Micro (1-9 empl.)		16		56		13		7
Small (10-49 empl.)		23		73		17		10
Medium (50-249 empl.)		36		84		25		23
Large (250+ empl.)		64		94		39		47
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	G9a		G9c		G9b		G8a	

Source: *e-Business W@tch* (Survey 2006)

[34] See *e-Business W@tch* Special Study on ICT Security, e-Invoicing and e-Payment Activities in European Enterprises, September 2005. Available at www.ebusiness-watch.org ('resources').

[35] Cf. Whatis.com (http://searchsecurity.techtarget.com)

Secure server technology is normally closely linked with e-commerce activity. In fact, deployment figures for the ICTM sector correspond in all size-bands very closely to the percentage of firms that said that they place orders online, but is much higher than the share of companies that sell their products over the inter- and other networks. This might indicate that the use of secure connections for data exchange is primarily driven by high internal security requirements.

Surprisingly, **firewalls** seem to be substantially less used by companies in the ICTM industry than in other sectors studied. Companies accounting for only a third of this sector's employment reported using of a firewall to protect their ICT systems from malicious mail and other forms of intrusion, compared to nearly 80% average for all sectors. One can speculate that, considering the advanced level of ICT development in the ICTM sector, companies in this industry use more complex tools.

Digital signature

An **e-signature** is electronic information attached to or associated with a contract or another message used as the legal equivalent to a written signature. Electronic signature is often used to mean either a signature imputed to a text via electronic means, or cryptographic means to add non-repudiation and message integrity features to a document. **Digital signature** usually refers specifically to a cryptographic signature, either on a document, or on a lower-level data structure. The rationale for measuring the adoption of digital signatures is that it is an important step for the integration of business processes between different enterprises, specifically for the legal recognition of documents sent electronically, as is the case of **invoices**.[36]

In 2005, *e-Business W@tch* asked companies whether they had had "*rules that specify the use of digital signature or Public Key Infrastructure,*" as part of a question on the use of ICT security measures. In total, about 11% of firms (accounting for 20% of employment) reported that they had such rules. On average, the numbers in 2006 appear to be slightly higher. In the ICTM industry, nearly 80% of firms reported the use of digital signature / public key infrastructure (see Exhibit 3-13). Although, the use increases slightly with company size, SMEs do not lag behind large firms in terms of the use of digital signature.

Acknowledging the high rate of digital signature proliferation, it comes as a puzzle that e-invoicing is used by less than one third of all companies in the ICTM sector (see Exhibit 3-13). It is generally assumed that the deployment of digital signature / public key infrastructure is a prerequisite for the evolution of interoperable solutions for many e-business processes, particularly those with strong contractual content such as the transfer and agreement of large liabilities. As it emerges from the data, however, infrastructure and technology alone do not guarantee a successful uptake of inter-firm data exchange on a large scale. Thus, as it is argued in section 4.4, additional adjustments have to be made before new ways of doing business replace old processes.

[36] Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures, Official Journal of the European Communities, L 13, 19.1.2000, pp. 12-20. http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_013/l_01320000119en00120020.pdf

3.4 Internal and External e-Integration of Processes

The use of ICT and e-business to support and optimise intra-firm processes has become increasingly important, particularly in manufacturing. By **digitisation of formerly paper-based processes**, information and documents related to incoming or outgoing orders can be **seamlessly processed** along the company's value chain; orders can be linked with production and inventory management, and the underlying software systems support controlling and management by enabling full transparency of all business processes.

Furthermore, **collaborative** processes within and between companies are supported, such as information sharing among employees (for example by use of an intranet), planning and demand forecast, organising and archiving documents, and human resources management. In general, ICT applications for these purposes are predominantly used by large companies and eventually by medium-sized firms. Examples of ICT supporting all kinds of business activities and supply chain integration are illustrated in case studies presented in the report (see, for example, the case studies on *Motorola* and *Linking business processes in supply networks*, in sections 4.2 and 4.3, respectively).

3.4.1 Use of software systems for internal process integration

The ICTM industry exhibits a higher than average rate of **intranet** use (see Exhibit 3-14). Frequently, internal ICT networks enable companies to store and exchange information within a company in a secure way and create infrastructure for programmes automating business processes. The use of intranets varies with firm size and sub-sector. First, similar to other network applications, the use of intranets is subject to strong scale effects. In other words, the value of the network increases with the number of individuals using it. Thus, large enterprises clearly lead in the adoption of intranets. Second, companies from the ICTM I sub-sector are ahead their counterparts from the ICTM II sub-sector in terms of intranet adoption.

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 in operating those processes. In addition, ERP systems can play an important role for supporting the connectivity between enterprises. For manufacturing companies, ERP systems are an important "hub" for much of their e-business activities with other companies.

Exhibit 3-14: Use of ICT systems for internal process integration

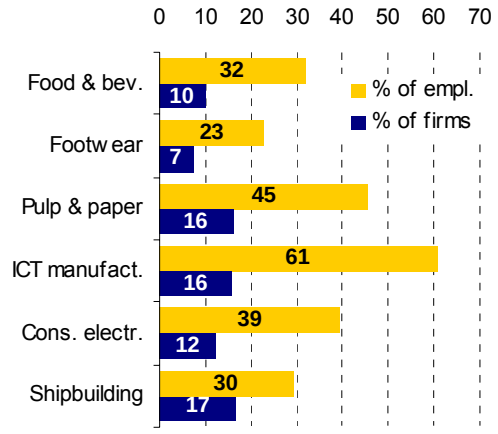
	Intranet		Accounting software		ERP system		Document Management system	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**68**	**38**	**79**	**63**	**61**	**16**	**24**	**16**
ICTM I	75	46	73	67	55	14	22	17
ICTM II	66	31	81	60	53	17	24	15
Micro (1-9 empl.)		33		61		10		15
Small (10-49 empl.)		50		77		30		17
Medium (50-249 empl.)		70		86		61		23
Large (250+ empl.)		89		87		74		29
All 10 sectors (EU-10)	**42**	**23**	**70**	**57**	**19**	**11**	**19**	**13**
Micro (1-9 empl.)		19		50		7		11
Small (10-49 empl.)		28		70		16		13
Medium (50-249 empl.)		43		85		25		19
Large (250+ empl.)		76		88		45		42
Base (100%)	firms using computers		firms that do not use ERP systems		firms using computers		firms using computers	
N (for sector, EU-10)	1277		850		1277		1277	
Questionnaire reference	D1a		D1e		D1d		D1c	

Source: *e-Business W@tch* (Survey 2006)

The deployment of ERP systems in the ICTM industry is slightly higher than in other manufacturing industries. However, the use of ERP is particularly low among the smallest firms. In contrast, medium-sized and large enterprises make intensive use of ERP systems.

The imbalance between small and large company size classes might have a negative impact on the progress of supply chain integration at the lower levels of the supply chain. This situation, however, is slowly changing and this sector's SMEs are catching up with the use of manufacturing process management tools (see Exhibit 3-14 and the case studies in section 4.4.2)

Exhibit 3-15: Companies with an ERP system



Base (100%): Companies using computers.
N (for sector, EU-10) = 1277.
Questionnaire reference: D1d

Source: *e-Business W@tch* (Survey 2006)

In the survey of 2006, *e-Business W@tch* asked those companies that do not use an ERP system whether they used a special **accounting software** (other than just spreadsheet calculation programmes, such as MS Excel). Accounting software typically substitutes to some extent the functionality of ERP software, although on a much simpler level and with a lower potential for automating order related document flows. According to the *e-Business W@tch* findings, SMEs compensate for the lack of expensive ERP systems by making an intensive use of accounting applications. Even for the micro-enterprises the rate of accounting software adoption is higher than the all sectors average (see Exhibit 3-14). Consequently, a marginal share of the smallest companies from the ICTM sector appears to have neither an ERP nor an accounting system at place. It is difficult to envisage how these companies manage their financial and accounting processes.

Special software systems for **document management** are used by a small fraction of firms in the ICTM industry, as in most of studied this year by *e-Business W@tch*. These software systems are typically used to archive and manage documents of any type in digital format. The small rate of document management systems use comes as surprise, considering the industry's dependence on knowledge and accurate information.

3.4.2 Use of ICT for cooperative and collaborative business processes

As depicted in section 4.3, the supply chain in the ICTM industry is extremely complex and involves a number of discrete activities that are increasingly organised in integrated production networks. The execution of many activities carried out within cooperation networks depends strongly on the use of ICT tools. However, although significantly above the all sector average, the current deployment of such tools for online cooperation and collaboration[37] in the value system is rather limited (see Exhibit 3-16). Only one quarter of all firms in the industry at stake say they use online tools to share documents in collaborative workspace. Similarly, despite the critical importance of new product development and production times, few firms have tools supporting collaborative design ("**e-design**") or demand forecasting.

As in the case of other complicated ICT tools that facilitate cooperation and collaboration between separate organisations, there are considerable differences in the adoption of these tools between small and large firms in the ICTM sector. Again, this can be explained by high price and implementation cost of such applications.

Collaborative **forecasting of demand** is another example. Sophisticated tools for calculating demand, determining the amount and time of production and thus the demand for various inputs (supply goods), storage capacity and other services exist. Figures for the adoption of related systems in the ICTM industry are similar to those for collaborative design. Also, the observation that the use in other manufacturing industries is higher among larger firms holds true. The same point can also be made about systems for **managing capacity** and inventory online.

[37] "Cooperation" means splitting a common, centrally managed task into sub-tasks which are performed by different partners of the cooperation. "Collaboration" means that several partners work together on the same task at the same time.

Exhibit 3-16: Online cooperation and collaboration within the value system

	Share documents in collaborative work space		Manage capacity / inventory online		Collaborative design processes		Collaborative forecasting of demand	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**45**	**26**	**37**	**16**	**27**	**15**	**26**	**16**
ICTM I	56	34	32	17	33	18	30	20
ICTM II	41	19	39	15	24	13	25	13
Micro (1-9 empl.)		23		13		14		15
Small (10-49 empl.)		35		24		18		21
Medium (50-249 empl.)		42		35		23		25
Large (250+ empl.)		64		51		37		38
All 10 sectors (EU-10)	**27**	**14**	**22**	**10**	**15**	**7**	**20**	**11**
Micro (1-9 empl.)		10		8		5		10
Small (10-49 empl.)		19		14		8		13
Medium (50-249 empl.)		31		21		13		19
Large (250+ empl.)		47		41		25		41
Base (100%)	firms with internet access		firms with internet access		firms with internet access		firms with internet access	
N (for sector, EU-10)	1268		1268		1268		1268	
Questionnaire reference	D5a		D5e		D5d		D5c	

Source: *e-Business W@tch* (Survey 2006)

3.4.3 Deployment of e-invoicing

Introduction

In the e-Business Survey 2006, special attention was paid to the issue of electronic invoicing (e-invoicing). e-Invoicing is a computer-mediated transaction between a seller / biller (invoicing entity) and a buyer / payer (receiving entity), which **replaces traditional paper-based invoicing processes**. In e-invoicing, the invoice is electronically generated and sent by the biller and electronically received, processed and archived by the payer. In practice, e-invoicing typically goes hand in hand with making payments electronically.[38]

It is widely recognised that the use of e-invoicing promises rather easy-to-achieve cost savings for both parties involved (invoicing entity and receiving entity), because processing invoices in a standardised, electronic format can be accomplished much faster compared to the often cumbersome handling of printed invoices. The cost saving potential obviously depends on the number of invoices that have to be processed; companies and sectors differ widely in this respect.

[38] For more background information on e-invoicing activities of enterprises, see *e-Business W@tch* Special Report "ICT Security, e-Invoicing and e-Payment Activities in European Enterprises" (September 2005). Available at www.ebusiness-watch.org ('resources').

Current state of adoption

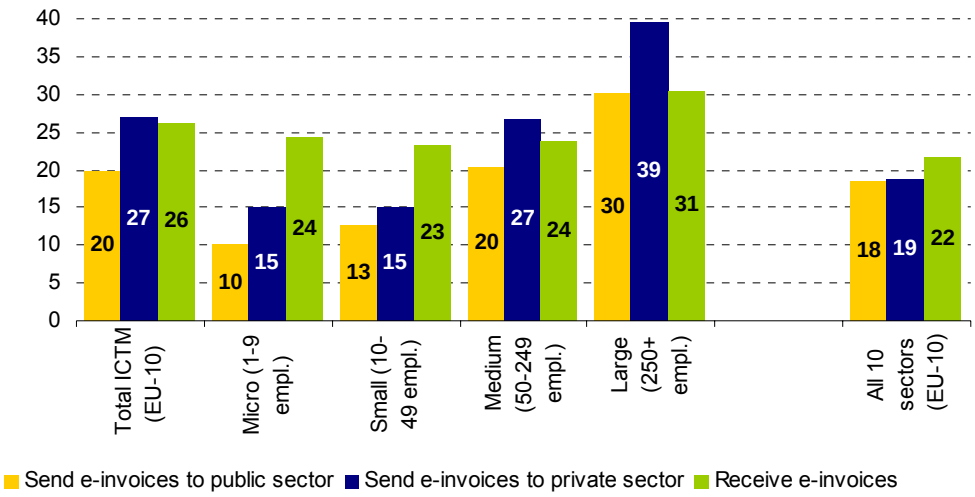
e-Invoicing can either be accomplished in a **web-based** environment, or processes can be integrated with the **ERP** system of a company. ERP-based systems (which are used in business to business e-invoicing) promise high cost-saving potential for companies. However, again, as primarily large enterprises use ERP systems, only they seem to realise the benefits from the process automation and the reduction in paper flow. In fact, evidence from the survey confirms this assumption.

Results show that although e-invoicing is used by a larger share of firms in the ICTM sector than in other sectors and that large enterprises clearly lead in the adoption of electronic billing forms (see Exhibit 3-17). In the ICTM industry, firms representing at least 20% of employment said that they send e-invoices in 2006 (to customers in the public sector and/or in the private sectors), and more than a quarter said that they receive e-invoices from suppliers. On average among the 10 sectors studied this year by *e-Business W@tch*, it is about 20% of firms (by employment) that send and receive e-invoices.

The percentage of invoices sent electronically to public institutions is much lower than of those sent to businesses. For example, whereas companies accounting for 27% of total sector employment sent invoices to the private sector, companies accounting for 20% of total employment did so to the public sector. The lower percentage could result from fewer government to business (G2B) transactions, compared to business to business (B2B) transactions. Nevertheless, the public sector can spur the development and usage of ICT in the private sector by making intensive use of the new technologies itself. This includes active use in providing services to its "customers", i.e. citizens (‘government to citizen’ G2C) and businesses, but also the internal use for improving and optimising their own routines (‘government to government’ G2G). Government institutions with their experience in handling public calls can also serve as a role model by increasingly using public tendering and digitalizing the tax and customs systems. Thus, by active use of ICT, the internet, and e-business applications, the public sector can create positive network externalities and accelerate the development of e-business in the private sector.[39]

[39] See, for example, *e-Business W@tch* Report “E-Business in Transport Equipment Manufacturing: Key issues, case studies, conclusions” (Aug. 2004). Available at www.ebusiness-watch.org ('resources').

Exhibit 3-17: Adoption of e-invoicing: percentage of firms ...



Base (100%): Companies with internet access. N (for sector, EU-10) = 1268.
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: D5

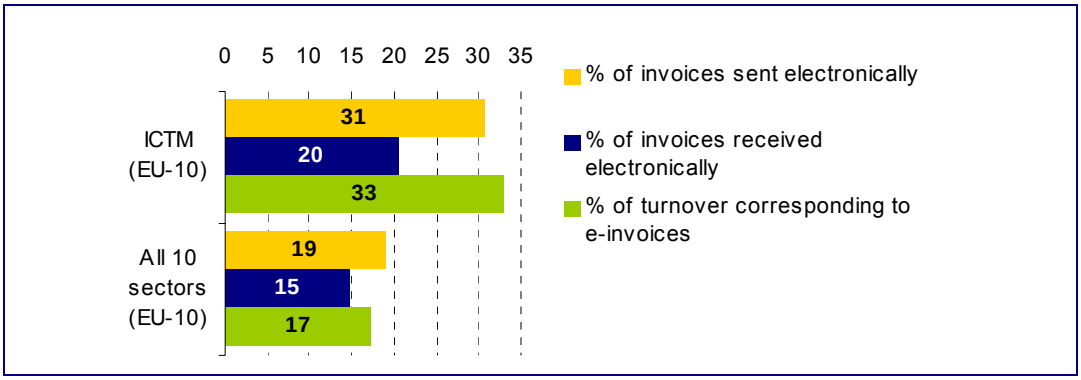
Source: *e-Business W@tch* (Survey 2006)

The percentage of companies that have an e-invoicing system in place does not reveal the whole picture. The share of invoices sent electronically is very informative. When only looking at those companies from the ICTM sector that actually use e-invoicing, the **average share of e-invoices** (measured as % of a company's total invoices sent or received) is nearly twice as higher as the average figure for the total of the 10 sectors studied this year by *e-Business W@tch*. On average, users reported that about one in three invoices sent is an e-invoice, and about one in five invoices received is an e-invoice (see Exhibit 3-18).

This discrepancy between the share of received and sent e-invoices is explainable because many of the smaller companies are just starting with issuing and sending e-invoices. This process is being continuously improved as it can be frequently done in a web-based environment, often supported by their bank or other financial institutions, or by adding a module to the accounting software, similarly as for online banking. However, adapting the software systems for receiving invoices electronically can be more complicated.

The significantly higher values in the ICTM sector than the 10 sectors' average reveals significant differences between individual sectors in this respect. Companies in Footwear, Construction or Food and Beverages have reported considerably lower shares of invoices sent or received electronically.

Exhibit 3-18: Average share of e-invoices as % of total invoices sent by companies



Base (100%): Companies sending/receiving e-invoices (without "don't know"). N (for sector, EU-10) = 250/271. "Weighting: in % of firms." Questionnaire reference: D6, D7, D8

Source: *e-Business W@tch* (Survey 2006)

3.5 e-Procurement and Supply Chain Management

Efficient management of procurement is a fundamental activity along a sector's value chain, which is quite complex and fragmented as in the ICTM industry. Due to a relatively large number of transactions, even slight improvements in this domain can produce significant overall **cost savings**. Online procurement can be carried out regardless of a real integration of systems with suppliers, for instance by making orders from a supplier's website. This is often the first step towards a more comprehensive and integrated use of ICT in business processes.

3.5.1 B2B online trading: companies placing orders online

Online orders and the average share of e-procurement

Over two thirds of all the surveyed ICTM firms said that they place orders to suppliers online (see Exhibit 3-18).[40] This figure is significantly higher than the all sectors average. However, in previous surveys, a significant percentage of firms that purchased online said that these purchases account for less than 5% of their total procurement. Obviously, many companies only occasionally ordered online products or services from suppliers (e.g. for office supplies) rather than practising e-procurement in a regular and systematic way. Thus, the relatively high adoption rates of online purchasing/ordering always had to

[40] Note that the underlying question in the e-Business Survey 2006 was changed compared to previous years. In 2006, companies where asked whether they "use the internet or other computer-mediated networks *to place orders* for goods or services online". In previous surveys, the question was whether they "use the internet or other computer-mediated networks *to purchase* goods or services online". Thus, a direct comparison of figures, e.g. with those for the electrical machinery and electronics industry in 2004, is not recommended.

be qualified in terms of the **share of e-procurement** as percent of the total procurement volume.[41]

Similar to other ICT-related industries, in the ICTM industry, more than 50% of companies placing orders online said that these orders account for over a quarter of their total procurement. In other sectors, the relative share of e-procurement is significantly lower on average. The intensity of electronic procurement use is illustrated by case studies in sections 4.2 and 4.3.

Exhibit 3-19: Companies ordering supply goods online

	Place orders online		**Place 1-25% of their orders online**		**Place more than 25% of orders online**		**Use specific ICT solutions for e-sourcing**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**72**	**69**	**67**	**49**	**33**	**51**	**20**	**10**
ICTM I	72	78	49	28	51	72	22	12
ICTM II	72	62	73	69	27	31	20	9
Micro (1-9 empl.)		68		45		55		9
Small (10-49 empl.)		74		66		34		16
Medium (50-249 empl.)		72		65		35		20
Large (250+ empl.) *		68		68*		32*		23
All 10 sectors (EU-10)	**57**	**48**	**74**	**75**	**26**	**25**	**16**	**9**
Micro (1-9 empl.)		44		73		27		7
Small (10-49 empl.)		54		80		20		10
Medium (50-249 empl.)		60		76		24		16
Large (250+ empl.)		68		75		25		29
Food & beverages	54	39	86	91	14	9	14	5
Footwear	35	29	83	87	17	13	9	5
Pulp & paper	59	49	81	75	19	25	14	8
ICT manufacturing	72	69	67	49	33	51	20	10
Consumer electronics	70	71	60	47	40	53	16	9
Shipbuilding & repair	62	53	78	69	22	31	18	12
Construction	53	51	74	72	26	28	12	6
Tourism	60	39	77	72	23	28	20	12
Telecommunication	78	77	54	49	46	51	26	12
Hospitals activities	67	67	71	73	29	27	19	12
Base (100%)	firms using computers		firms placing orders online		firms placing orders online		firms using computers	
N (for sector, EU-10)	1277		911		911		1277	
Questionnaire reference	E1		E3		E3		E7	
* Data only indicative due to low number of observations (N ~ 25-50).								

Source: *e-Business W@tch* (Survey 2006)

[41] Companies were asked to estimate how large a share of their total purchases (2003, 2005) / orders (2006) is conducted online.

Interestingly, the two sub-sectors examined in this report exhibit considerable differences in the use of e-procurement. The share of companies from the ICTM I sub-sector placing more than 25% of orders online is twice as high as this from the ICTM II sub-sector. This result is somehow surprising, as online procurement belongs to one of the least advanced e-business applications, which is reflected in the nearly equal use of e-procurement in all firm size classes. It could be attributed to differences in the types of inputs procured by companies operating in the two sub-sectors. For example, sub-sector ICTM I is dominated by lean, specialised firms, which produce standardised products on a large scale. Thus, the high level of dis-integration and the need for uniform inputs increase the propensity for online procurement. On the other hand, the ICTM II sub-sector is a relatively traditional sector dominated by vertically integrated companies that keep large parts of the entire production and value-creation in-house.

Another reason driving the deployment of electronic procurement is the need for **coordination of the goods flow** in supply networks. According to the survey results, presented in case studies of this report, dispersing operations around the world and creating a network of partners and subsidiaries is not a domain of multinational concerns any more (see Exhibit 3-22). Today, even relatively small companies outsource or offshore their operations to distant locations, depending on their comparative advantages. In this context, automating the process of procurement and the flow of goods along the value chain becomes a necessity, which warrants a transparent organisation of activities and goods allocation.

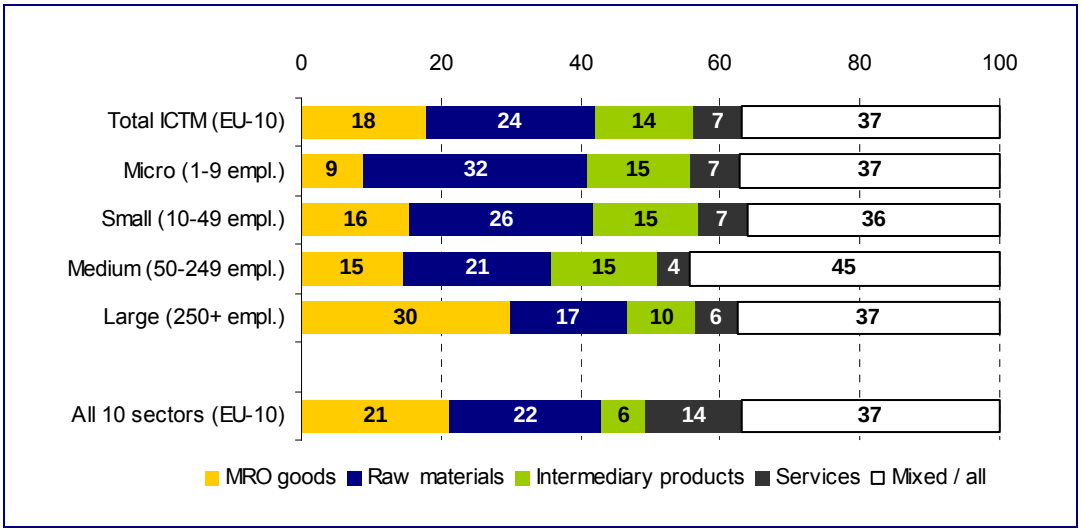
Main type of supply goods ordered online

Online sourcing and procurement can relate to different types of inputs. These include MRO goods,[42] raw materials, intermediary products and services. As indicated in the introduction to this section, the survey confirms that **MRO goods** and **raw materials** have the highest importance for ICTM companies in their e-procurement strategy. One fourth of firms that place orders online said that these orders are *mainly* for raw materials (see Exhibit 3-20). The share of raw materials in electronic procurement decreases with firm size. Whereas nearly a third of all micro- and one fourth of small enterprises said that they procure raw material online, only 17% of large firms did so. Large firms, in contrast, have the highest share of MRO that are bought online.

The composition of goods procured online by ICTM companies is close to the average in the 10 sectors studied this year by *e-Business W@tch*. A majority of firms (37%) said that the type of inputs procured online is "mixed", while 22% said that raw materials are the main category. Raw materials are, of course, mostly relevant for manufacturing companies and industries such as construction. In service sectors, MRO goods and services are more important types of supplies.

[42] MRO goods are maintenance, repair, and operating supplies. This category typically includes office supplies and diverse other items which are not materials or components directly used for the products or services which a company produces.

Exhibit 3-20: Main type of supply goods ordered online



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 914. Data for larger size-bands only indicative, due to the small number of observations.
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: E4

Source: *e-Business W@tch* (Survey 2006)

A noteworthy finding is that the adoption of electronic procurement practices remains dependent on product complexity. Intermediary products or services consequently require considerable effort to define technological specifications and legal terms of the contract in the pre-purchase phase. Thus, they do not lend themselves to online procurement. In contrast, raw materials and MRO goods, which are frequently standardised and available from a number of suppliers, constitute the highest share of inputs procured electronically. The dependency on standardised products, such as raw materials, as a driver of the acquisition process digitalisation is illustrated by the case study about *Linking Business Processes in Supply Networks* (section 4.3).

Use of ICT for e-procurement processes

As in 2005, *e-Business W@tch* asked companies whether they "*support the selection of suppliers or procurement processes by specific ICT solutions*." The rationale for this question is to further test whether electronic procurement is in fact a systematic and **digitally integrated** process in a firm, or rather an occasional business activity without much significance for the overall business.

Despite the high rate of companies placing orders online, only a marginal fraction has a specific ICT solution supporting the procurement process. Furthermore, such solutions are primarily used by large enterprises. In the ICTM industry, only about **10% of firms** (representing 20% of this sector's employment) reported the use of software solutions or internet-based services for e-procurement (see Exhibit 3-18). This shows that there is a considerable gap between the percentage of companies placing at least some orders online (~70%) and those that use special software for doing so (10%). It can be assumed that companies without such software place orders mainly through websites or extranets

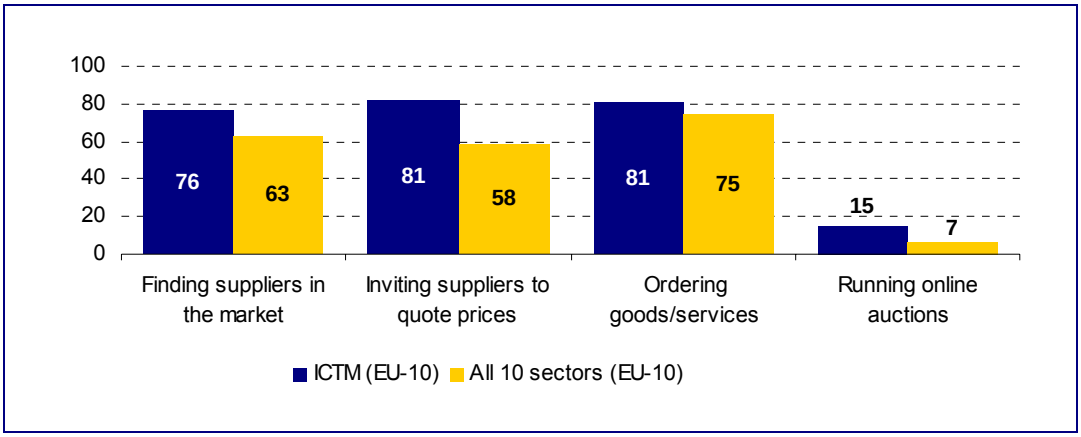
of suppliers, which does not require any special e-procurement system. The digital back-office integration of procurement related processes (all the way from ordering to the receipt of goods / services) is probably not in advanced state in these cases.

Those companies that have procurement systems in place tend to use them for several functions, mainly for inviting suppliers to quote prices and ordering goods/services (81%) and finding suppliers in the market (76%). These findings are slightly above the average figures for all the sectors studied this year by *e-Business W@tch* (see Exhibit 3-21).

15% of surveyed firms in the ICTM sector said that they use ICT solutions to run online auctions. The respective share is even lower (7%) on average across all sectors studied this year by *e-Business W@tch*. Thus, contrary to initial expectations, online auctions do not seem to play an important role in companies' procurement strategies. At present, in fact, electronic auctions are said to be one of the main reasons why the development of online trading took longer than expected. Suppliers were resistant to join trading networks; SMEs, in particular, appear to perceive these networks as a means to restrain competition and a way to drive down prices at the expense of suppliers and not as a means of increasing efficiency of procurement processes and decreasing costs for both trading partners.

This has raised some concerns regarding the availability of legal instruments counteracting unfair commercial practices in B2B markets.[43] Furthermore, in order to foster the development of business practises that facilitate consensus, cooperation and business integration, the European Commission supports the dialogue with industry stakeholders to identify trust-related barriers in B2B e-markets.[44] However, considering the low level of e-auctions acceptance, further examination is needed.

Exhibit 3-21: Sourcing and procurement processes supported by specific ICT solutions



Base (100%): Companies using specific ICT solutions for e-procurement. N (for sector, EU-10) = 198
Weighting: in % of firms. Questionnaire reference: E8

Source: *e-Business W@tch* (Survey 2006)

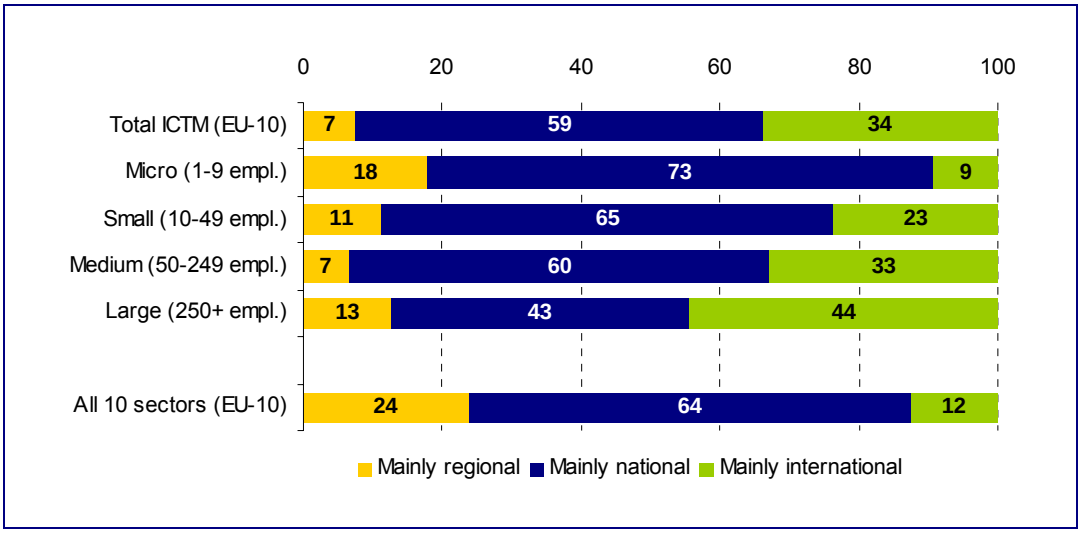
[43] See, for example, the study commissioned by DG Enterprise and Industry which is available at http://ec.europa.eu/enterprise/ict/policy/doc/b2b_2006_ls.pdf.

[44] For more details see http://ec.europa.eu/enterprise/ict/policy/b2b/index.htm.

Main location of suppliers in e-procurement

Most ICTM companies report that they order online mainly from suppliers in their own country. About 66% of those companies that order online indicated either **regional or national suppliers** as their main geographic market for procurement activities (see Exhibt 3-22). Interestingly, the remaining thirty four percent of firms in this sector said that their procurement activities are truly international, i.e. they buy goods or services online mainly from international suppliers. Thus, the share of firms with an international procurement scheme is nearly three times higher than on average in the 10 sectors studied (12%), while in other industries the national and/or regional focus in procurement activities is more important. The globalisation of the ICT supply chain is illustrated in the case studies presented in the current report (see, for example, sections 4.2 and 4.3).

Exhibit 3-22: Main location of suppliers in e-procurement



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 908. Data for larger size-bands are only indicative, due to small number of observations.

Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: E5

Source: *e-Business W@tch* (Survey 2006)

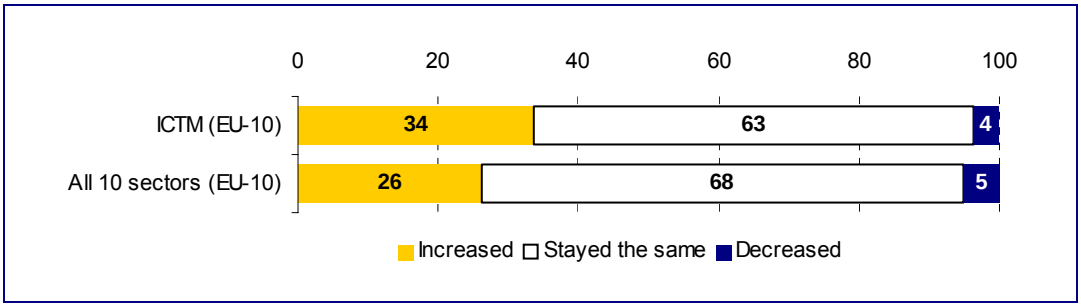
Impact of e-sourcing on supplier selection

As in previous years, *e-Business W@tch* asked companies that use e-procurement whether this has had an impact on the selection of suppliers, i.e. whether the number of suppliers has rather increased or decreased due to their e-procurement strategy, or whether this activity was without impact on the number of suppliers. A majority of companies from the ICTM industry reported that e-procurement is **without an effect on the number of suppliers** (about 63%). Only about 4% of firms said that they have consolidated their supplier base by means of e-procurement. This finding is somewhat in conflict with the fact that many large firms that have established (or are establishing) sophisticated e-procurement schemes have the explicit target to **streamline their supplier base**. Having such e-procurement schemes companies could bundle

procurement activities from different establishments or even branches in order to exploit economies of scale. However, previous sector studies by *e-Business W@tch* have already shown that it is hardly possible to support this assumption by data from the e-Business Survey. The main reason is that supplier consolidation is a strategy that is mainly used by the largest firms; thus, results do not really show up in this SME-focused survey. However, the effects clearly have an economic impact. More than a third of ICT firms placing orders online said that the number of their suppliers has increased. A plausible explanation could be that e-sourcing has helped these companies to find new suppliers in the market.

It has been found that a decrease in the number of suppliers occurs in companies that have experienced a positive impact of electronic procurement on procurement costs (Nepelski 2006). This means that a reduction of procurement costs caused by a new technology and adapted processes offer companies an incentive to increase the number of their suppliers and enable them to benefit from more competition in the upstream markets.

Exhibit 3-23: Impact of e-sourcing and e-procurement on the number of suppliers



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 882
Weighting: in % of firms. Questionnaire reference: E9

Source: *e-Business W@tch* (Survey 2006)

3.5.2 e-Integrated supply chains: SCM, financial e-processes and ICT links with suppliers

SCM – Supply chain management

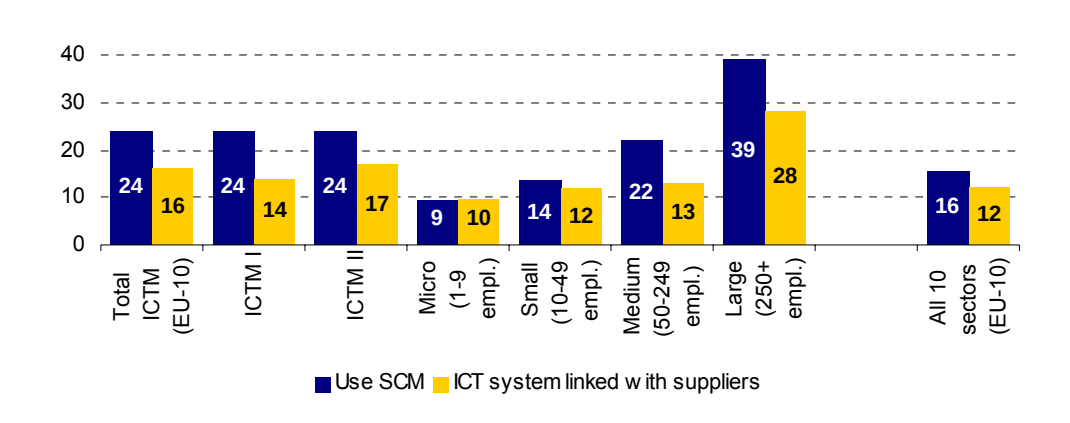
Supply chain management (SCM) systems play an important role in facilitating the flow of goods along the entire value chain of an industry. In particular, SCM systems help ICTM companies to match supply and demand through integrated and collaborative interaction tools, as well as to optimise inventory levels. SCM provides an overview 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. SCM coordinates and integrates these flows both within and among companies.[45] One of the key objectives of any

[45] Cf. www.mariosalexandrou.com/definition/scm.asp: "Definition of Supply Chain Management"

effective SCM system is to eliminate **the bullwhip effect**[46], i.e. reduce inventory (with the assumption that products are available when needed).

In the ICTM industry, enterprises representing 24% of employment said that they have an SCM system (see Exhibit 3-24). As in the case of other ICT applications with network characteristics, the use of SCM systems increases with firm size. While only about 10% of small firms said that they have adopted SCM, over 20% of medium-sized ones and nearly 40% of large firms in this sector did so. The current deployment of SCM in the ICTM industry is clearly above the all-sectors average.

Exhibit 3-24: Supply chain integration: use of SCM and ICT links with suppliers



Base (100%): Companies using computers. N (for sector, EU-10) = 1277
Weighting: Totals (for the sector, sub-sectors and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: D1f, F13a

Source: *e-Business W@tch* (Survey 2006)

In order to find out more about the level of supply chain integration in the ICTM industry, *e-Business W@tch* also asked companies whether their ICT system was linked to that of suppliers. Interestingly, the share of firms in the ICTM sector which reported having ICT links with suppliers is lower than the share of firms with an SCM system by over 30% (see Exhibit 3-24). Intuitively, this finding seems to contradict the idea of SCM where some form of linking ICT with suppliers can be regarded as prerequisite. A possible explanation, however, is that many companies have software for managing their inventory and supplies internally, without really integrating suppliers directly through the system. Thus, they use a form of SCM that is not interactive between different companies; they just automate the internal flows of materials and information, and use other means to communicate their demand to suppliers.

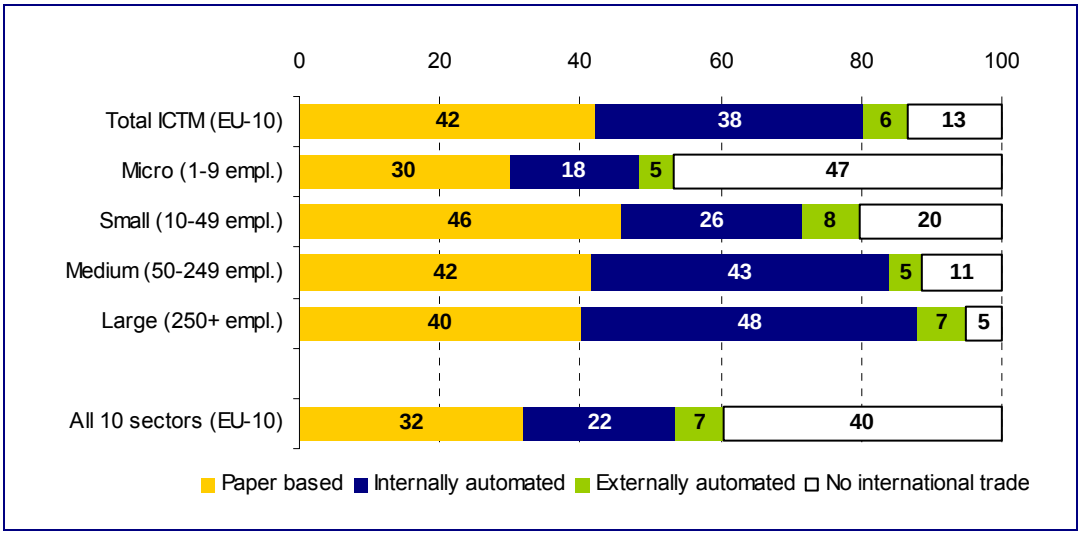
[46] The Bullwhip Effect is observed in forecast-driven distribution channels. Because customer demand is not perfectly stable, businesses forecast demand in order to properly position inventory. Forecasts are based on statistics, and they are rarely perfectly accurate. Because forecast errors are a given, companies often carry an inventory buffers. Moving up the supply chain from end-consumer to raw materials supplier, each supply chain participant has greater observed variation in demand and thus greater need for safety stock. The effect is that variations are amplified the farther you get from the end-consumer. Source: www.wikipedia.org

Integration of financial processes in international trade

A new question in the 2006 e-Business Survey was whether the financial processes in trading with international suppliers were mainly paper based, internally automated or externally automated. It is acknowledged that this question remains a bit vague, as the difference between "internally integrated" and "externally integrated" is rather tentative, and because a telephone interview situation does not allow to go into a lengthy discussion of these issues. Even so, it gives an idea of the back-office integration of financial processes in international business.

Results for the ICTM industry show that paper-based processes are being slowly eliminated from day-to-day business practice. This is particularly true for large enterprises, 55% of which said that their financial processes in international trade have been either internally or externally automated (see Exhibit 3-25). But also SMEs seem to abandon paper-based flow of financial documents, with more than a third among them reporting similar automation. Except for micro-enterprises, where international trade is anyhow less frequently reported, there seems to be a clear relationship between trading across borders and the automation of financial processes in the ICTM industry. In other words, companies engaged in international e-trading are more likely to have automated their financial processes. This might be interpreted in two ways. On the one hand, ICT might enable firms to expand their operation. On the other hand, ICTM firms might seek to reduce the longer time needed for cross-boarder transactions by automating and optimizing the flow of documents and payments. At this point, it is, however, difficult to determine the direction of causality.

Exhibit 3-25: Integration of financial processes in international e-trade



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 865
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)" . Data for larger size-bands are only indicative, due to small number of observations. Figures for size-bands are in % of enterprises from the size-band.
Questionnaire reference: E6

Source: *e-Business W@tch* (Survey 2006)

3.6 e-Marketing and Sales

ICT, and in particular the internet, can be used in various ways to support marketing activities, including the communication with customers, offering products for sale, and developing new marketing strategies. Manufacturers of ICT equipment typically do not directly sell to end consumers, but to component manufacturers, OEM or intermediaries (wholesalers and retailers chains). An exception is the PC market, where final producers use the internet to establish direct links with end customers. A prominent example of this strategy in the ICTM I is DELL (see section 4.3.1). As demonstrated in section 4.4.2, companies in the ICTM sector successfully use e-selling channels to overcome the middlemen and, by providing value-added services, have managed to overcome the negative effects of e-selling on prices.

3.6.1 Companies receiving orders from customers online

Online orders from customers

According to the e-Business Survey 2006 results, about **a quarter** of all firms active in the ICTM industry in the EU-10 **enable customers to order products online**. There is practically no difference between companies from different size-bands in this respect (see Exhibit 3-26). At first sight, this appears to be quite a high figure. However, due to a change of the survey question from 2004 to 2006[47], the results are not directly comparable to the ones from the previous surveys on online-selling, e.g. in 2004, when only 8% of firms from the electrical machinery and electronics industry reported online sales.

Furthermore, as in the case of online procurement, it is worthwhile to put these findings into perspective and take a closer look at the shares of customer orders received online (as percent of the total order volume).[48] In the ICTM industry, a vast majority (64%) of those companies that enable customers to order online said that these orders account for **up to 25% of their total orders** received. In contrast, 36% said they receive more than a quarter of their orders online. In other sectors, the percentage of companies where online orders account for more than 25% is, however, considerably lower (25%). Again, this indicates the advancement of companies from the ICTM industry in the use of ICT to optimise operations in their value chain. Interestingly, companies from all size-bands exhibit similar patterns with respect to online selling.

[47] Note that the underlying question in the e-Business Survey 2006 was changed compared to previous years. In 2006, companies where asked whether they "allow customers *to order goods* or book services online from the website or through other computer-mediated networks". In previous surveys, the question was whether they "use the internet or other computer-mediated networks *to sell* goods or services online". Thus, a direct comparison of figures, e.g. with those for the electrical machinery and electronics industry in 2004, is not recommended.

[48] Companies were asked to estimate how large a share of their total sales to customers (2003, 2005) / orders from customers (2006) is conducted online.

As in 2005, *e-Business W@tch* asked again in 2006 whether companies "*support marketing and sales processes by specific ICT solutions*." The rationale for this question is to further test to what extent their e-commerce activities are **digitally integrated** processes, or whether they use rather "simple" forms of e-commerce, such as receiving orders by e-mail without any system integration of the related information and document flow.

In the ICTM industry, **12% of firms** (representing about 24% of this sector's employment) reported the use of software solutions or internet-based services for their marketing and sales activities (see Exhibit 3-26). This shows that there is a considerable gap between the percentage of companies receiving at least some orders online (~27%) and those that use special software for doing so (~12%). As in the case of other advanced applications, there are considerable differences within the ICTM industry and between company size-bands. The adoption of systems designed to automate the process of selling is positively correlated with firm size. No major differences are observed between the two sub-sectors, with a possible exception in terms of employment-weighted data for accepting orders online.

Exhibit 3-26: Companies receiving orders from customers online

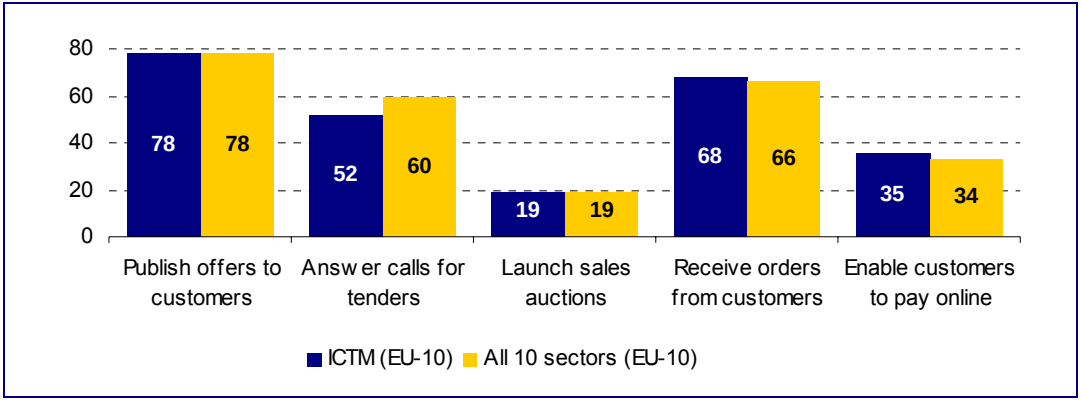
	Accept orders from cust-omers online		Receive 1-25% of orders online		Receive more than 25% of orders online		Use specific ICT solutions for e-selling	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**26**	**27**	**55**	**64**	**45**	**36**	**24**	**12**
ICTM I	36	29	58	64	42	36	25	16
ICTM II	22	25	53	65	47	35	23	9
Micro (1-9 empl.)		27		65		35		10
Small (10-49 empl.)		25		66		34		17
Medium (50-249 empl.)		25		56		44		27
Large (250+ empl.)		27		**		**		20
All 10 sectors (EU-10)	**35**	**25**	**73**	**75**	**27**	**25**	**18**	**9**
Micro (1-9 empl.)		23		79		21		6
Small (10-49 empl.)		26		76		24		12
Medium (50-249 empl.)		29		75		25		16
Large (250+ empl.)		26		74		26		27
Base (100%)	firms using computers		firms accepting orders online		firms accepting orders online		firms using computers	
N (for sector, EU-10)	1277		329		329		1277	
Questionnaire reference	F4		F6		F6		F10	
** Values not displayed because number of observations (N) is <20.								

Source: *e-Business W@tch* (Survey 2006)

The patterns of using e-selling applications in the ICTM industry are similar to those observed across all sectors. Those companies that have specific sales systems in place tend to use them mainly for **publishing offers** to customers (78%) and for **enabling customers to place orders** (68%), answering calls for tenders (52%) and online payment (35%). The large discrepancy between the presence of the order placing

function and the possibility to pay online for the ordered goods shows how important it is to make a difference between the various phases in e-commerce transactions. Enabling customers to place an online order is in many cases still separated from the payment of this order. Payment is then accomplished in traditional ways, e.g. by bank transfer upon receipt of an invoice for the respective order.

Exhibit 3-27: Marketing and sales processes supported by specific ICT solutions



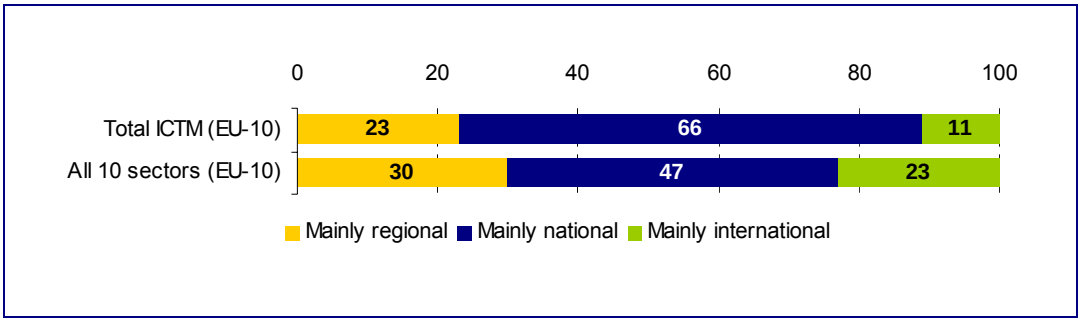
Base (100%): Companies using specific ICT solutions for marketing / sales. N (for sector, EU-10) = 228
Weighting: in % of firms. Questionnaire reference: F11

Source: *e-Business W@tch* (Survey 2006)

Location and type of customers placing online orders

Most ICTM companies reported that they receive online orders mainly from customers in their own country or their own region. Almost two thirds of those companies that accept online orders from customers reported **national customers** as their main geographic e-commerce market. About a quarter said that, in on-line selling, their main customers' base is regional (see Exhibit 3-28). Only one out of ten firms said that orders are truly international, i.e. that it receives orders mainly from an international customer base. In fact, according to these results, this share in ICTM is significantly lower than on average in the 10 sectors studied (23%).

Exhibit 3-28: Main location of customers that order online



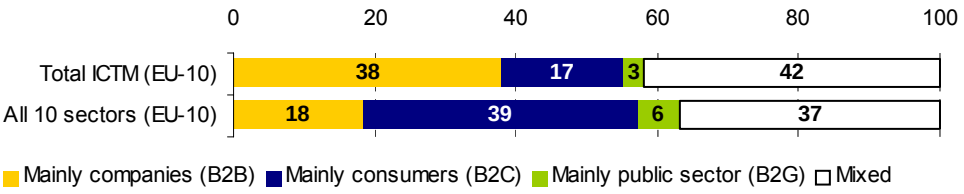
Base (100%): Companies accepting orders online (without "don't know"). N (for sector, EU-10) = 346
Weighting: in % of firms. Questionnaire reference: F7

Source: *e-Business W@tch* (Survey 2006)

The high concentration of e-transactions in national or regional markets is quite puzzling and remains in strong contrast to e-procurement, where the number of firms conducting international transactions was much higher (see Exhibit 3-22). One can speculate that inputs procured electronically from abroad include interim products. These are being processed and then sold to companies further down the value chain or final customers, which operate within the same regional or national cluster. This together with the finding that companies mostly procure electronically raw materials and intermediary products, would mean that most of the value added comes from within the country in which a firm operates. This, in turn confirms the discussion in section 2.2 regarding the allocation of tasks according to a location's comparative advantage. However, in order to draw sound conclusions on this complex issue, a detailed analysis of the share of total e-procurement / e-selling with respect to location of suppliers / buyers would also be needed.

Most of the e-commerce activity in the ICTM industry is either B2B focused or mixed. In fact, about 40% of firms receiving orders electronically said that these are mainly from other companies. An equal share indicated that these orders are 'mixed'. Seventeen percent said that orders are mainly from consumers, a fact which might indicate that these manufacturers have a different business model in terms of sales channels, i.e. they sell either final or interim products directly to end customers or companies at further stages of the value chain rather than going through wholesale and retail intermediaries. This is in line with the discussion in section 4.2, where it is argued that companies from the ICTM sector use ICT tools to avoid the fierce price competition by avoiding intermediaries and establishing direct links to their customers (see also the case study about *RCD*, section 4.4).

Exhibit 3-29: Main type of customers that order online (B2B / B2C / B2G)



Base (100%): Companies accepting orders online (without "don't know"). N (for sector, EU-10) = 346
Weighting: in % of firms. Questionnaire reference: F8

Source: *e-Business W@tch* (Survey 2006)

3.6.2 e-Integration of marketing processes: CRM and ICT links with customers

One of the ICT applications that can help companies to improve the distribution of their products is **Customer Relationship Management** (CRM) for business intelligence purpose, i.e. an application for gathering, providing access to and analysing consumers' data. CRM systems help the company to systematically increase the knowledge about customers and their profitability, and to build and adapt marketing strategies on the basis of this knowledge.

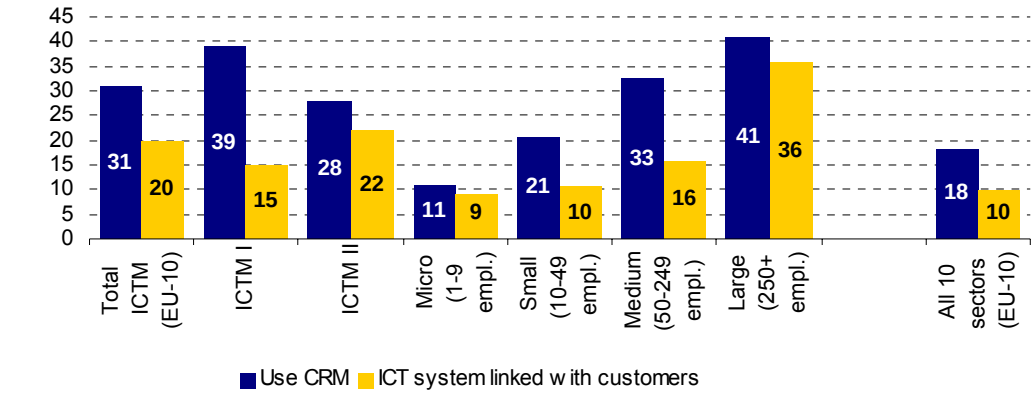
CRM is a term that refers to a broad range of methodologies and software applications that help an enterprise manage customer relationships in an organised way. Normally, this will be based on some kind of database with systematic information about customers and the business record the company has with them. Ideally, this information will support management, salespeople, people providing service, and possibly the customers themselves in their tasks; for example by matching customer needs with product plans and offerings, and by reminding customers of service requirements. Three levels of application of CRM are commonly distinguished:[49]

- **Operational CRM**: supporting front-office work by storing basic data on customers (e.g. addresses, track record of contacts); front-office will enter new data as part of their work;
- **Analytical CRM**: analysis of data gathered through operational CRM in order to segment customers;
- **Collaborative CRM**: facilitates interactions with customers through all channels (personal, letter, web, e-mail) and supports co-ordination of employee teams.

Compared to the other sectors studied this year by *e-Business W@tch*, CRM is more widely diffused in the ICTM industry. In 2006, enterprises accounting for over 30% of this sector's employment reported the use of CRM, a percentage that is almost double the respective all-sectors average (see Exhibit 3-30). Nevertheless, as in other sectors studied this year, even in ICTM there is a gap between the small firms on the one hand, and the medium-sized and large ones on the other. Applications facilitating customer management and marketing activities are mainly used by companies with at least 50 employees. The main reason for the low diffusion levels of CRM systems among small firms is that CRM software suites are quite expensive and require a lot of organisational preparatory work to be effectively introduced in a company.

[49] Cf. www.mariosalexandrou.com/definition/crm.asp: "CRM Definition"

Exhibit 3-30: Use of CRM and integration of ICT systems with customers



Base (100%): Companies using computers. N (for sector, EU-10) = 1277
Weighting: Totals (for the sector, sub-sectors and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: F2, F13b

Source: *e-Business W@tch* (Survey 2006)

Furthermore, a gap in CRM use between is visible between the sub-sectors at stake. According to the survey results, these applications are significantly more diffused in the ICTM I sub-sector than in ICTM II. This might reflect the generally higher adoption of ICT tools and, also, a different structure of the value chain in the former. In this sense, companies from ICTM I sub-sector might deal more frequently with individual users than companies from the ICTM II sub-sector, which usually deliver products to other businesses. For example, companies from the ICTM II sub-sector primarily supply large telecom operators. Thus, their need for a customer behaviour analysis tool might be limited, compared to companies serving B2C markets characterised by a large number of individual users with small purchase volumes.

In 2006, *e-Business W@tch* also asked companies whether their ICT system is linked to that of its customers. Similar to the situation on the procurement side, where figures were different from those for SCM adoption, ICT links with customers do not match CRM deployment in this industry. The pattern for ICTM, however, is quite similar both in comparison to the all-sectors average and between this sector's different size classes. As for CRM, it is practically only large firms where ICT integration with customers takes place at a significant level. Interestingly, the pattern seems to change when looking at the two sub-sectors subsumed under ICTM for the purposes of this study. There, the higher share shown for ICTM II practically confirms the above mentioned argument about the different markets to which the two sub-sectors are addressing their products. It is also possible, that these links are part of an integrated e-commerce scheme between companies, e.g. via dedicated EDI connections.

3.7 ICT and Innovation

The **capability for innovation** is very important for European companies, in ICTM and in general.[50] Innovation increases competitiveness, which in turn leads to better products, increased quality and higher social welfare. Thus, taking into account the fact that the production of low value-added products is being outsourced to low cost locations, innovation allows the European ICTM sector to face global competition and to keep its position in higher market segments that rely on differentiation and quality (see section 2.2).

In this context, both product and process innovations (e.g. automation, flexible re-organisation) are key instruments to remain competitive. Successful **product innovations** can be realised by a large-scale deployment of leading-edge research results, a highly efficient research process organisation, and a highly qualified work-force. **Process innovations** are centred on the production and management processes, such as automated and computer-based manufacturing systems, or processes aimed at manufacturing products that can combine costs of mass production with differentiation of customised optimisation of the value chain.

The competitive scenario pushes companies towards the use of technologies such as ICT to improve products and processes, to enhance quality and to broaden applicability of materials. In this context, *e-Business W@tch* asked 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. Companies that indicated that they have introduced innovations were then asked follow-up questions on the role of ICT for their innovation activity.

Nearly half of enterprises in the ICTM industry said that they had launched new (or improved) products in 2005. About two thirds of these product innovations had been directly related to or enabled by ICT (see Exhibit 3-31). Thus, the incidence of **product innovation** is higher than on average in the 10 sectors this year by *e-Business W@tch* and the role of ICT is relatively more pronounced in the process of new product development.

[50] See also the special report about “the role of new companies in e-business innovation and diffusion”, available at www.ebusiness-watch.org ('resources').

Exhibit 3-31: ICT and Innovation activity

	Companies with new product innovation in 2005		Share of ICT-enabled product innovations		Companies with process innovation in 2005		Share of ICT-enabled process innovations	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**54**	**45**	**54**	**60**	**51**	**29**	**70**	**75**
ICTM I	60	52	68	69	56	34	79	88
ICTM II	52	39	48	51	49	26	66	62
Micro (1-9 empl.)		43		61		26		80
Small (10-49 empl.)		50		55		40		53
Medium (50-249 empl.)		58		54		52		74
Large (250+ empl.)		53		52		54		67*
All 10 sectors (EU-10)	**32**	**24**	**50**	**45**	**32**	**20**	**75**	**63**
Micro (1-9 empl.)		22		41		16		69
Small (10-49 empl.)		25		42		25		57
Medium (50-249 empl.)		33		45		38		71
Large (250+ empl.)		48		49		53		81
Base (100%)	firms using computers		firms with product innovation		firms using computers		firms with process innovation	
N (for sector, EU-10)	1277		630		1277		468	
Questionnaire reference	I1		I2		I3		I4	
* Data only indicative due to low number of observations (N ~ 25-50).								

Source: *e-Business W@tch* (Survey 2006)

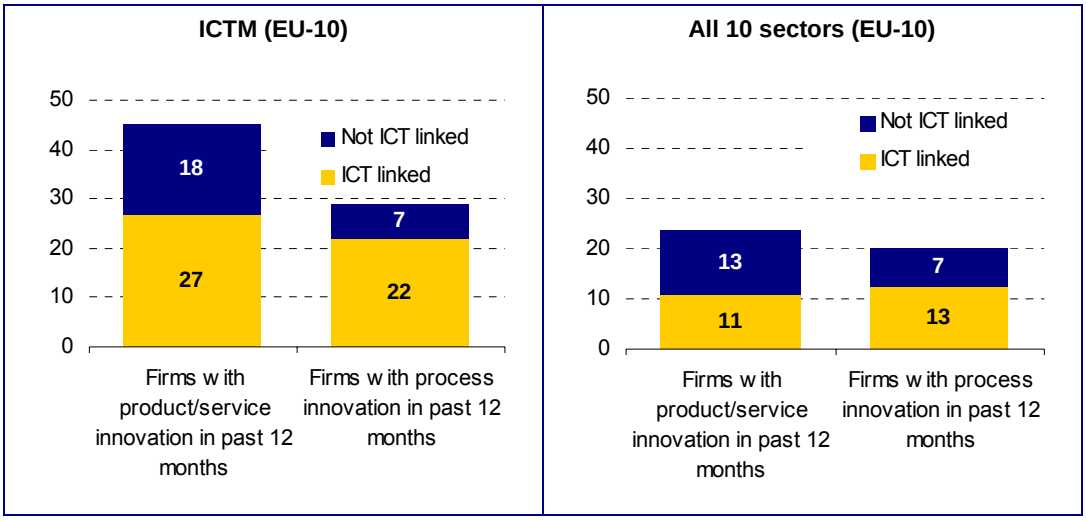
An interesting finding is that, in the ICTM sector, SMEs are equally innovative as large firms. Although this is true for both traditional and ICT-enabled innovations, SMEs more frequently reported introducing ICT-enabled innovations than large firms – and micro ICTM firms did so even more than this sector's SMEs (see Exhibit 3-31). The creative use of ICT by SMEs in the ICTM sector might thus compensate for the, on average, lower levels of advanced systems diffusion among this specific size class (see Exhibit 3-16 and Exhibit 3-24). On the other hand, however, this might indicate that SMEs are catching up in terms of ICT use and are at the point at which large firms were a few years ago. This argument corresponds to the discussion in section 4.4 that ICT-benefits taper over time, do not guarantee everlasting advantages and innovative technologies become commodities over time. Thus, technological advantage can be sustained only if a company remains innovative and open to new technologies. The importance of ICT in the process of new product development in a small high-tech firm is illustrated in the case study about *Signalion* (see section 4.4).

Companies from both sub-sectors exhibit different innovation patterns. Regardless of the innovativeness measure, companies from the ICTM I sub-sector appear to be leading in this respect within the ICTM industry. Higher innovation figures might be a sign of a more dynamic economic environment in the ICTM I sub-sector. The importance of ICT in enabling new innovations might reflect superior IT competency of companies operating in

this sub-sector, which could be a result of more intensive use of ICT. Thus, it can be assumed that the greatest benefits of the use of new technologies accrue to companies that adopt them first and learn how to use them to their advantage ahead of others.

Although a smaller share of companies in this sector reported process innovations within the last 12 months in comparison to product innovations, the role of ICT in these cases appears to have been indispensable (see Exhibit 3-32). In total, about 30% of ICTM companies (representing about half of this sector's employment) reported to have introduced new processes in 2005. 75% of those companies confirmed that these innovations were critically linked to ICT. Although in most sectors ICT-induced innovation prevails with respect to other process innovations, this figure confirms the intensity of ICT usage and its importance for optimising business operations in the ICTM sector.

Exhibit 3-32: The role of ICT for product and process innovation



Base (100%): Companies using computers. N (for sector, EU-10) = 1277
Weighting: in % of firms. Questionnaire reference: I1 – I4

Source: *e-Business W@tch* (Survey 2006)

3.8 Drivers and Inhibitors for the Uptake of e-Business

3.8.1 Drivers of e-business adoption

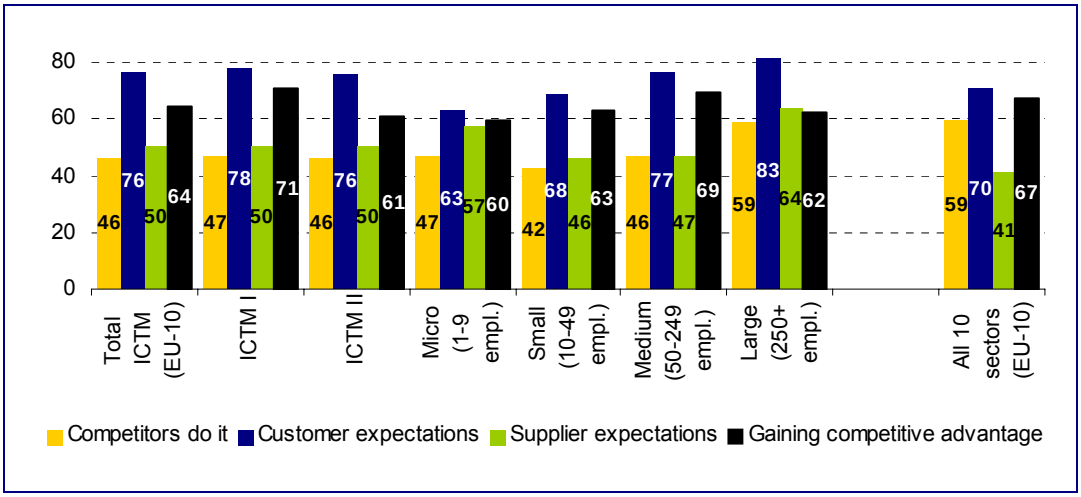
Those companies that confirmed that e-business constitutes "*a significant part*" or "*some part*" of the way they operate (see Exhibit 5-1), were asked to indicate important reasons for starting their e-business activity. Four main reasons were suggested, in order to see whether it was more a reaction to pressure from outside (from customers or suppliers), or whether companies saw an opportunity to gain competitive advantage.

In ICTM, as in most other sectors surveyed this year by *e-Business W@tch*, the majority of companies said that they perceive at least some significance of e-business for their operations (see Exhibit 5-1). As shown by replies recorded for the follow-up question, ICTM companies perceive all suggested reasons as relevant, with **customers' expectations** and the opportunity to gain **competitive advantage** being seen as the

most important ones (see Exhibit 3-33). "Imitating competitors" and "suppliers expectations" were reported less frequently both in ICTM and across all sectors surveyed, indicating that the negotiating power of suppliers is usually limited. However, compared to the all-sectors respective averages, ICTM firms seem to assign more importance to their suppliers' expectations than to their competitors' behaviour.

In summary, the adoption of e-business solutions by firms in this sector seems to be primarily consumer-driven. This conclusion is also in line with evidence gathered from case studies conducted for this report. For example, *Tesla*, a Czech manufacturer of telecommunication equipment, cited an efficient information exchange with customers as the key reason to update its information management system (see case study in section 4.4).

Exhibit 3-33: Drivers of e-business adoption: companies saying that ... was an important reason for starting e-business



Base (100%): Companies saying that e-business is a part of their operations. N (for sector, EU-10) = 908. Weighting: Totals (for the sector, sub-sectors and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: H2

Source: *e-Business W@tch* (Survey 2006)

The overall results for the ICTM sector are quite similar to the answers obtained from companies from other sectors. However, a closer look at the responses reveals that companies in the ICTM II sub-sector are motivated more by external factors to engage into e-business, be it consumers or suppliers, rather than by the attempt to get a competitive advantage. Furthermore, it appears that pressure from customers increases with firm size, reflecting the downstream (from customers to suppliers) flow of supply chain integration. This is also indicated by a case study conducted for this report, illustrating how a downstream company assists its suppliers in automating the process of order fulfilment (see section 4.2).

3.8.2 Barriers to e-business adoption

Companies that stated that e-business does not constitute a significant part in their day-to-day business were then asked what major obstacles they face with respect to e-business. Similarly to other sectors studied this year by *e-Business W@tch*, companies from the ICTM sector named the **costly technology**, security concerns and non-compatibility of systems as the most important reasons for non-adopting e-business (see Exhibit 3-33). Technological complexity seems to be of a lesser concern in the sector at stake, compared to the average for all sectors studied. Two reasons appear to be the most plausible ones to explain this observation: First, companies in the ICTM sector are both users and producers of the ICT. This creates spill-over effects that result in deeper knowledge and understanding of ICT and give them an advantage over firms from other sectors studied this year. Second, exposed to intensive competition, ICTM firms might be forced to look for innovative ways of doing business more intensively than firms in other sectors studied this year.

Also, less frequently than companies from other sectors, firms in the ICTM industry see small firm size as a chief argument not to engage in e-business activities. On the one hand, companies accounting for a quarter of the sector's total employment reported that they are too small to adopt e-business applications, compared to 55% for the respective all sectors average. One third of all surveyed firms were also concerned about the **security** of data transferred through the internet. In addition, companies accounting for 19% of the sector employment reported that legal issues and difficulties to find appropriate IT, i.e. software, providers constitute barriers to e-business adoption.

There are, however, differences **within** the ICTM sector. As it would have been expected, micro-firms in particular and small ICTM companies indicated this issue to levels comparable to the all-sectors average, while for medium and large firms this does not seem to be a concern. Such significant differences between ICTM companies from different size classes can also be observed in respect to 'systems' compatibility' and, interestingly, in terms of problems with technological complexity and the reliability of IT providers which were mentioned much more frequently by large than by micro and SMEs. On average, the share of SMEs seeing the lack of reliable IT providers, high technology cost and technological complexity as barriers to e-business is two to four times smaller than this for large firms.

The significant share of ICTM companies complaining about cost and complexity of the technology, the lack of IT providers and inter-system compatibility calls for a closer examination. Since these complaints come primarily from the sector's large enterprises (see Exhibit 3-34), these concerns could have a negative implication for the speed of supply chain integration. Since these problems arise at the value chain stage at which the actual supply chain integration begins, this could have serious implications for the diffusion of e-business at the higher stages of the value chain. In other words, this affects indirectly the adoption of e-business by SMEs.

The combination of the obstacles named by large enterprises might be a sign of **insufficient competition in the IT market**. This might be the case in the segment of advanced IT applications, i.e. applications designed to support complex and extensive operations typical for large enterprises. These markets are usually dominated by a few

large companies and competition might be restrained. As a consequence, large enterprises might face problems common to uncompetitive markets, i.e.:

- inferior quality (lack of reliable IT providers),
- artificially created lock-in to technologies provided by particular software developer, high switching cost (technological complexity and a lack of inter-system compatibility), and
- excessive pricing (technology too expensive).

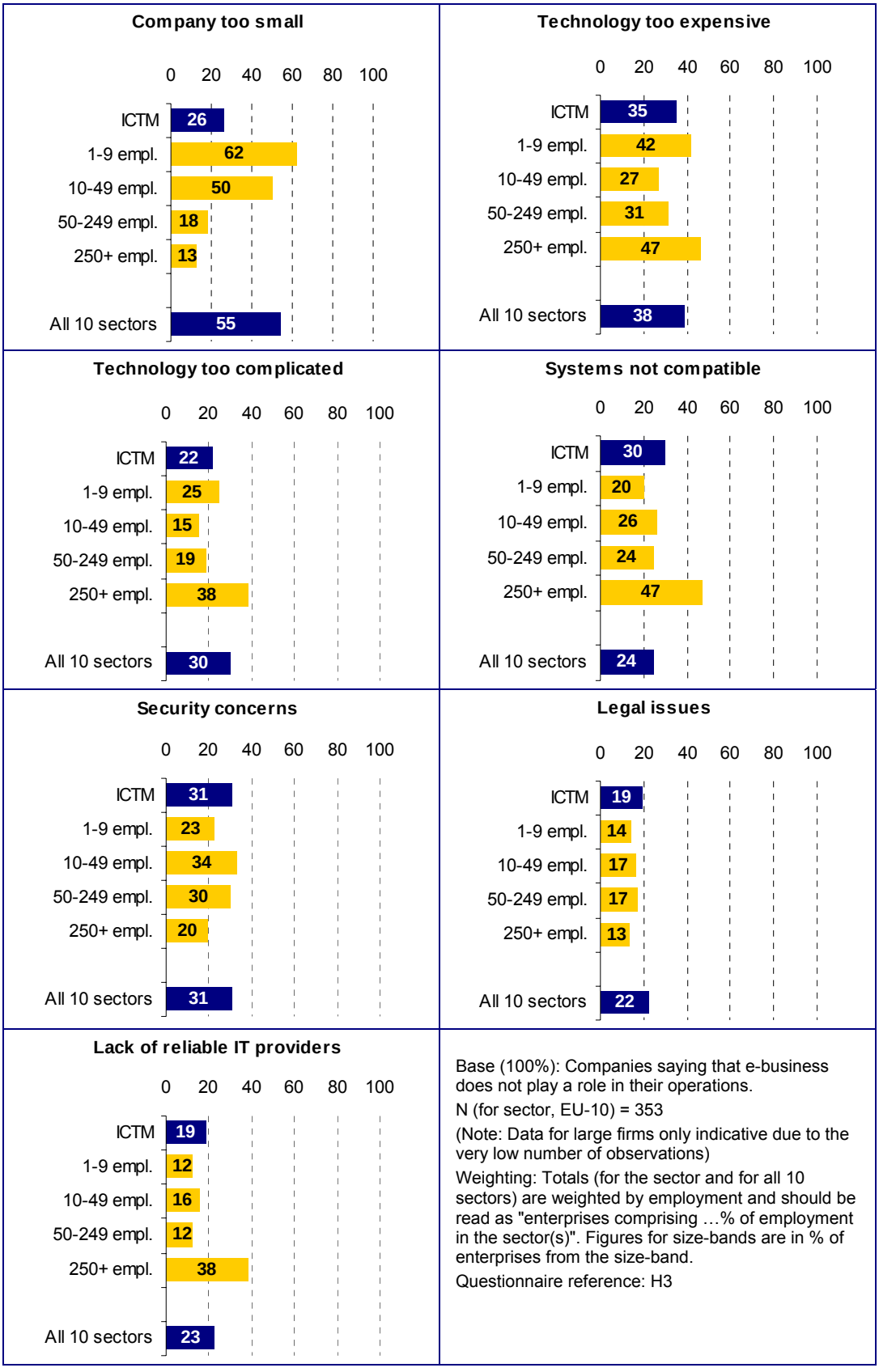
Thus, there might be two separate markets for e-business applications. One market for SMEs, which would be characterised by a sound degree of competition, and another for large enterprises, which is dominated by few software providers. Consequently, on the one hand, smaller enterprises might enjoy the benefits of highly competitive market of IT applications for SMEs, be it a greater choice of IT providers, higher quality or relatively lower prices. On the other hand, large firms are confronted with the outcomes of uncompetitive market: lack of choice, inferior quality and overpricing.

However, it is not clear whether this conclusion concerns ICTM firms only or also companies from all sectors. An analysis of the indicators' values across size-bands did not yield any conclusive results. This might be attributed to the considerably large gap in ICT adoption between ICTM sector and other sectors studied by *e-Business W@tch* this year. Furthermore, high concentration in the IT market reminds of the concern expressed by a representative of the automotive industry, who said that the situation with e-business platforms promoted by major software vendors in the international market looks very much alike to the one which exists for operating systems in the PC world.[51] In any case, in order to draw clear conclusions on this important matter, further research is needed.

The above discussion shows that, if the competition level in IT market is low, it might have serious implications for engaging in e-business. These conclusions, however, rest on strong assumptions and should, therefore, be interpreted with caution. Nevertheless, the subject requires close attention from competition policy makers, as it might have negative implications not only for the IT-producing market, but also for the IT-using sectors.

[51] See *e-Business W@tch* Sector Study on the Automotive Industry (July 2005), available at www.ebusiness-watch.org ('resources').

Exhibit 3-34: Barriers to e-business adoption as perceived by companies



Source: *e-Business W@tch* (Survey 2006)

3.9 Summary

Main findings

Among the ten sectors studied by *e-Business W@tch* in 2006, the ICTM industry emerges as one with very **high overall use of ICT** and e-business (see "e-Business Index 2006," following page). There are structural reasons, such as the prevalence of large companies, intensive competition, frequent product changes and production dispersion, which drive the adoption of ICT and business practices in this specific industry. Nevertheless, even in such an ICT-intensive sector, the level of e-business activity **varies with firm size**. Furthermore, a closer look at the adoption levels within this industry revealed **differences in ICT use between the studied sub-sectors**.

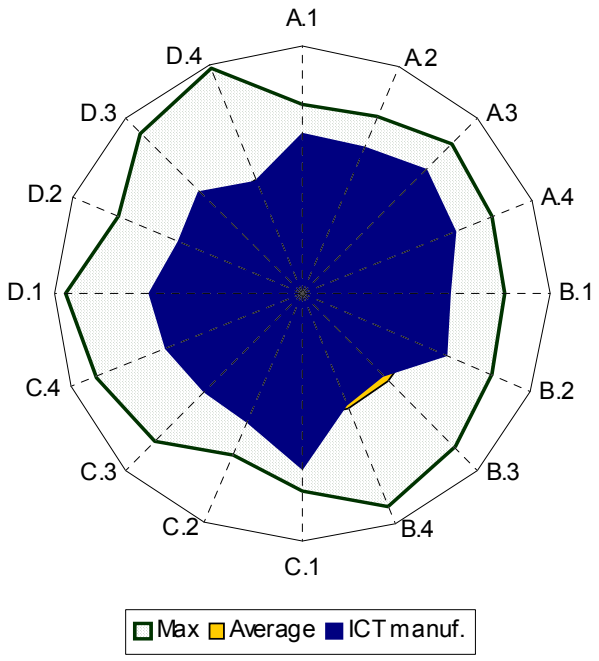
In general, companies from the ICTM I sub-sector seem to be more advanced ICT users than those from ICTM II. In addition, firms from the former appear to adopt ICT and e-business practices for strategic reasons more frequently than firms from the latter. This difference might be a result of diverse economic conditions prevailing in both sub-sectors (see chapter 2). For example, the higher level of competition might be an important reason why companies from the ICTM I sub-sector are more advanced users of ICT (see section 5.1.3). Similarly, lean organisation forms and the dependency on arm-length's transactions require more intensive use of applications facilitating inter-firm collaboration and information exchange.

The main survey findings are summarised below:

- **Internet access at the workplace**: Significantly more employees in ICTM companies have access to the internet at their workplace than in other companies.
- **ICT investments**: Despite a high ICT endowment, a large share of companies in the sector is planning to increase ICT investments.
- **Need for interoperability**: An insufficient use of standards supporting inter-firm collaboration causes serious interoperability concerns.
- **e-Selling and e-procurement not affected by firm size**: companies in all size-bands exhibit similar patterns with respect to the adoption of the internet as a selling/procurement platform and the share of orders placed/received online.
- **Online auctions play a minor role**: It is said that companies in the ICTM sector were resistant to join trading networks, perceiving them as a means intending to restrain competition and a way to drive down prices.
- **Network technologies and scale effects**: Applications such as ERP or SCM are characterised by large scale effects and are primarily used by large firms.
- **Globalisation drives process automation and vice versa**: Companies engaged in cross-border trading automate document and payment flows more often than firms operating within their national borders.
- **Bottom-up supply chain integration**: the pressure to integrate the supply chain comes from the bottom of the value chain, i.e. OEMs or customers.
- **Barriers to e-business might lie in a lack of competition in the IT markets**: Complaints about the lack of reliable IT providers, interoperability and expensive technology might be a sign of restrained competition in the IT market.

e-Business Index and Scoreboard 2006 [52]

e-Business Scoreboard 2006



Component indicators
(based on data in % of firms)

A. ICT Networks
A.1 Internet connectivity (index)
A.2 LAN
A.3 W-LAN
A.4 Remote access to company network

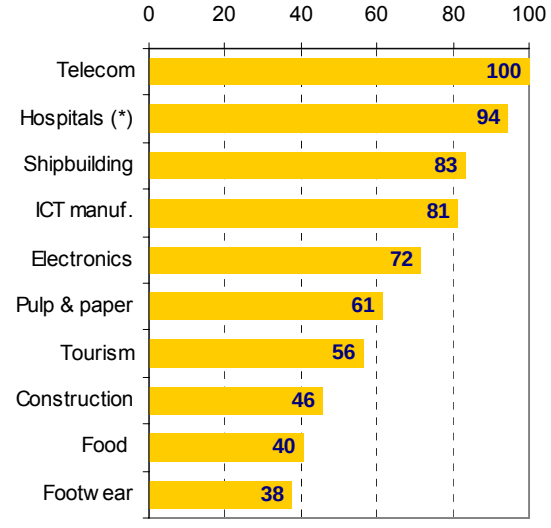
B. e-Integrated Business Processes
B.1 Intranet
B.2 ERP systems
B.3 Online tracking of production time
B.4 e-Invoicing

C. e-Sourcing and Procurement
C.1 Firms placing orders online
C.2 Use of ICT systems for sourcing
C.3 ICT system linked with suppliers
C.4 Online inventory management

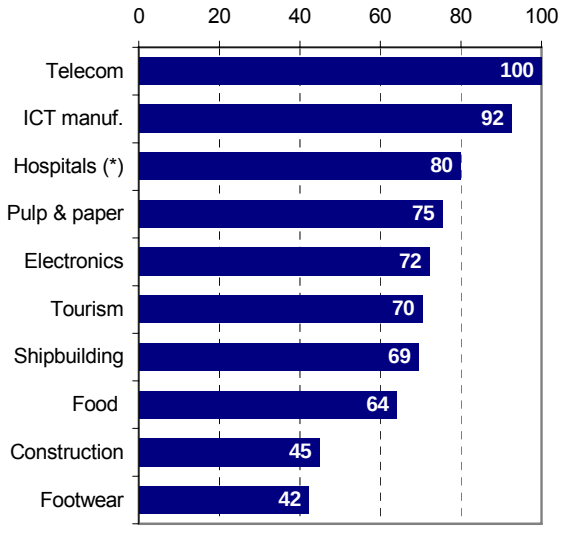
D. e-Marketing and Sales
D.1 CRM use
D.2 Firms accepting orders online
D.3 Use of ICT systems for marketing/sales
D.4 ICT system linked with customers

e-Business Index 2006
(based on 16 component indicators of the Scoreboard)

based on data in % of firms
(emphasises activity in smaller companies)



based on employment-weighted data
(places a higher weight on activity in larger firms)



(*) The index for the hospital sector is not fully comparable to the other industries, as there are only few micro and small organisations in this sector. Thus, the apparently more intensive use of ICT is largely an artefact of the specific structure of this sector. When comparing only the large enterprises and organisations, hospitals would not be within the top rank.

Source: *e-Business W@tch* (Survey 2006)

[52] See Annex II for information about the structure and computation of the scoreboard.

4 Current e-Business Trends and Implications

ICT and e-business are not only used by ICTM companies to support business processes, they also play a role as integral parts of the products and services supplied. Indeed, as noted in chapter 2, many companies in the ICTM sector provide hardware, software, implementation and consulting services. At the same time, ICTM companies are intensive ICT users themselves. In fact, companies from the ICTM industry emerge as technological leaders compared to other sectors studied this year by *e-Business W@tch* (see the presentation of the survey results in chapter 3).

Taking into account this sector's double role as user and supplier of the specific technologies, this chapter deals with two key ICT and e-business related trends in the ICTM industry. The first is the likely impact of convergence on this sector's output. The second is whether and how the use of ICT changes the structure of the ICTM industry. The discussion concludes with an assessment of e-business benefits for companies in the ICTM sector. This chapter does not claim to provide a comprehensive analysis of these trends, as that would exceed the limits of this report. In fact, it would be difficult to realise, as ICT and e-business are relevant for nearly all core business areas of the ICT manufacturing industry. Therefore, the issues discussed, as well as the case studies presented, should rather be understood as representative examples of current practice and the related opportunities and challenges.

In this context, the following specific issues were selected as particularly topical in coordination and agreement with DG Enterprise and Industry, as well as with relevant industry federations and experts:

- **Convergence** belongs to the most important trends in the ICT manufacturing sector. For example, VoIP is believed to change the terms of competition in the telecommunication market. This in turn, will lead to changes in the industry supplying the telecommunication industry, i.e. the ICTM II sub-sector. Similar, spurring the demand for broadband connections and generating an entire range of new products and services, convergence opens up new perspectives for companies in the sector.
- **The extended enterprise concept**. Intensive competition forces companies in the industry to re-locate their production facilities and outsource their operation to low-cost locations. At the same time, short product life cycles require retaining research, engineering and development tasks close to destination markets. Considering the market characteristics and production organisation, effective communication along the entire value chain is vital to companies' operations. Thus, the report focuses on analysing the relevant survey results and on the identifying of strategically relevant e-business solutions supporting inter-organisational collaboration.
- **Industry transformation**. Advanced e-business tools enabling virtual collaboration on product development or supply chain management between separate companies offer companies opportunities to redesign their processes and relations with business partners. Furthermore, innovative processes create efficiencies at both firm and industry level. One of the focus points is an analysis of the impact of

new technologies and e-business practices on the relations between companies as well as on the entire value chain.

- **Who benefits from e-business?** One of the most important findings of the preceding *e-Business W@tch* studies was that ICT is an important driver and enabler of innovation. Continuing this line of research, the study at hand will assess the implications of ICT and e-business for productivity, employment and market share development in the ICT manufacturing industry. In addition, this report aims at determining which firm or industry factors enable companies to benefit from e-business solutions.

The case studies and business examples presented in this chapter are shown in the following exhibit.

Exhibit 4-1: Case studies and business examples presented in this report

Section	Company / project	Country	Topic(s)
4.1	Business example: *Samsung*	South Korea	Market developments and strategy
4.1	Business example: *Intel*	USA	Market developments and strategy
4.1	Business example: *Voice over Internet Protocol*	-	Concerns regarding the take-off of VoIP
4.2	Business example: *Lucent Technologies*	USA / Asia	Supply chain integration
4.2	Business example: *SMEs and standardisation*	-	SMEs in the ICT standardisation process
4.2	Case study: *Motorola*	USA	• Process automation • Value chain integration
4.2	Case study: *Nokia*	Finland	• Process integration • Use of standards
4.3	Business example: *Dell*	USA	Value Chain Integration
4.3	Business example: *Elcoteq*	Finland/ Estonia	• Industry transformation • Near-shoring • Value chain network
4.3	Case study: *Linking Business Processes in Supply Networks*	Finland	• Automation of procurement processes • Global supplier integration
4.3	Case study: *Signalion*	Germany	• Collaborative work • Inter-firm data exchange
4.4	Case study: *Tesla*	Czech Republic	• Enterprise resource planning • Information management
4.4	Case study: *RCD*	Czech Republic	• Accounting and ERP systems • e-marketplaces
4.4	Case study: *Option*	Belgium	• Product design • Engineering Workflow Management • Personal Performance Measurement • e-Shop

Source: *e-Business W@tch* (2006)

4.1 Convergence of broadcasting, telephony and computing

4.1.1 Introduction: Convergence as a cross-sectoral issue

Workshop on "Convergence in High-Tech Industries": outcome

Convergence has been identified as an overriding trend that impacts all three ICT-related sectors studied by *e-Business W@tch* in 2006[53]. Due to the importance of this issue, the *e-Business W@tch* conducted a workshop, which focussed on "Convergence in High-Tech Industries". The workshop was held on 15 June 2006, in Brussels, with almost 30 representatives from industry and policy.[54]This section will summarise and elaborate convergence issues identified and discussed at this workshop.

Two major issues were identified following intensive discussion in the course of the workshop. First, convergence of markets, products and services is a cross-sectoral issue, bringing telecommunication services, CE manufacturing and ICT manufacturing together. Various drivers and effects of convergence can be identified that are described in this overview. Second, there are numerous different effects of convergence in ICT-related sectors. Presentations at the workshop, for example, concerned the impact of convergence on business models and innovation in high-tech sectors, the way convergence influences standardisation and interoperability issues, as well as statistical measurement of ICT manufacturing. The last paragraph of this section gives an overview over the aspects of convergence that are analysed in the three *e-Business W@tch* reports on ICT-related sectors.

Drivers and types of convergence

Although there is no single definition of **convergence**, this term is frequently used to describe **technology trends that lead to blurring lines between different industries and their offerings**. In the course of the discussion on convergence in ICT-related sectors, the following technology trends have been named as important **drivers**:

- Digitisation of content, enabling the distribution of content over IP-based channels.
- IP transformation of telecommunication services, enabling the delivery of voice services over IP-based channels.
- Increased availability and importance of broadband internet connections in Europe, enabling the digital delivery of high value content services.
- Increasing availability and capability of mobile technologies, bringing services based on mobile and fixed-line networks together.

In combination, these technology developments allow for the delivery of data, voice and various content services via the same, broadly available fixed and/or mobile networks. As a result, products and services that were formerly clearly differentiated and offered by

[53] ICT Manufacturing, Telecommunication Services and Consumer Electronics – see reports on www.ebusiness-watch.org/resources.

[54] http://www.ebusiness-watch.org/events/ICT.htm

different industries or players are now provided as “converged products and services”. While, for example, CD players were formerly produced by CE manufacturers and CDs by the phonographic industry, now MP3 players with integrated music software as well as the online store to purchase music are offered by one and the same provider (e.g. Apple). Another example is the convergence of fixed and mobile telephony: formerly clearly separated offerings over different networks by fixed line and wireless operators are now increasingly offered as one service.

Most market observers agree that convergence means a deeper integration of products and services from (formerly) different industries. However, there is no consensus on the necessary degree of integration when discussing “converged services or products”. In fact, one can distinguish between **different levels of product and services integration:**

- **Cross selling and bundling**, i.e. the combination of products and/or services on a marketing and sales level by combining related offerings (e.g. mobile phones and wireless telephony services or internet access, telephony and TV access services). While cross selling is primarily a marketing concept, bundling goes a step further by focussing more on the exploitation of complementary effects, e.g. by generating one invoice for the combined service offering.
- **Integrated (seamless) services,** i.e. the technical combination of products and services, e.g. devices with integrated functionalities such as network access that allow direct access to video or audio content services. For the provision of integrated (seamless) services, collaboration of different players (or units) on the production level is required.
- **(Truly) Converged services,** i.e. integrated services (e.g. voice, internet and content) offered over one common infrastructure or over infrastructures working closely together (e.g. mobile and fixed networks). This is often also discussed as the final stage of convergence

While there are already several examples for services bundles and integrated service offerings, the provision of truly converged services is currently in the beginning.

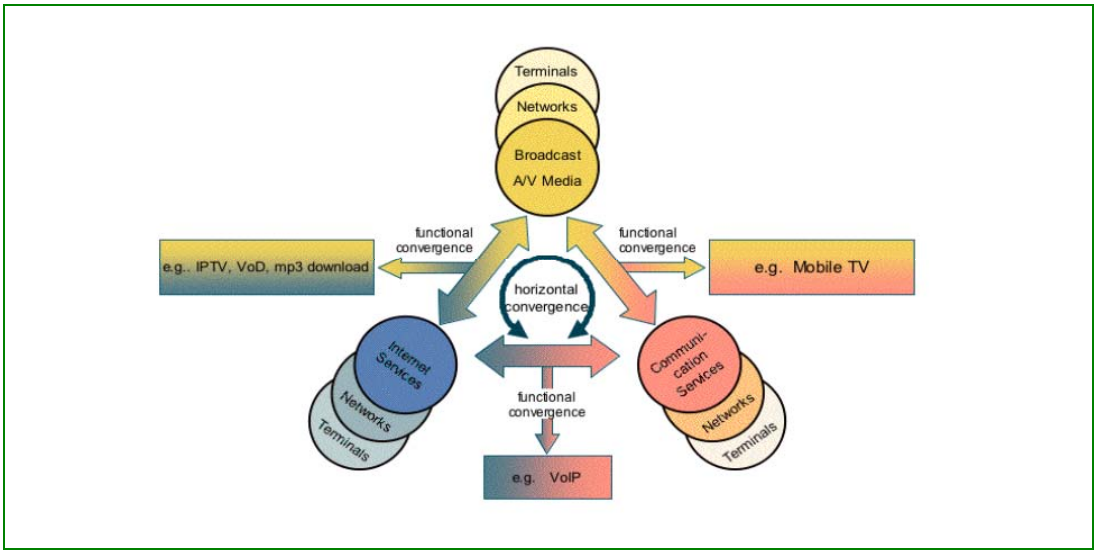
Another perspective on “convergence” and its stakeholders can be gained by distinguishing the **effects of convergence-driving technology developments** (see Exhibit 4-2):

- **Functional convergence** (also called “product and services convergence”): Formerly separated products and services are now offered as combined services or bundles (as described above). Functional convergence results, for example, in the so-called “multiple-play” strategies (e.g. triple or quadruple-play) by telco companies or internet service providers that combine e.g. Internet access, fixed and wireless telephony services and TV.
- **Vertical convergence** (also called “value chain convergence”): The necessity to seamless interplay of combined services tackles both technical and business issues. For example, CE devices need to support various digital content formats or communication standards. In addition, the software needed to use different content and communication services needs to be pre-installed on devices. Consequently, activities along the value chain of a certain product segment need to be integrated.

Issues attributed to vertical convergence include integration of supply chain processes and collaboration of manufacturing partners as well as the development of standards and solutions assuring the interoperability of products and services.

- **Horizontal convergence** (also called "market convergence"): As a consequence of convergence, lines between traditional ICT service and product segments are blurring. Issues related to horizontal convergence include:
  - Increased importance for traditional ICT sectors and necessity to collaborate with formerly clearly separated industries, in particular the content industry.
  - Blurring lines between traditional market segments of ICT related sectors leading to enforced competition, e.g. in the telco market the enforced competition between cable companies, fixed line operators, and mobile operators.
  - Entrance of new players or players from formerly different industries, into traditional ICT market segments like the VoIP software provider Skype into the telephony market or, the other way round, the ICT company Apple into the media industry.

Exhibit 4-2: Types of convergence in ICT related sectors



Source: Georg Luetteke (Phillips/EICTA)[55]

[55] Georg Lütteke, "*Convergence and Interoperability*", presentation at the *e-Business W@tch* workshop on "Convergence in High-Tech Industries," Brussels, 15 June 2006 (see http://www.ebusiness-watch.org/events/proceedings).

Convergence in *e-Business W@tch* sector reports

Some of the convergence issues listed above are covered in this year's *e-Business W@tch* reports on e-business activities in three ICT related sectors:

- The report on **ICT in the ICT manufacturing** industry identifies forthcoming challenges and opportunities related to convergence for telecommunications and network equipment manufacturing sectors. Furthermore, the report discusses the consequences of technological convergence for the economic environment and how companies operating in this sector adapt to changing market conditions.
- The report on **ICT in the CE manufacturing industry** particularly focuses on the increased impact of broadband for the sector's output, as well as on related opportunities and challenges for CE manufacturers. In addition, the report discusses standardisation activities in the field of Digital Rights Management (DRM) technologies. The increased importance of DRM technologies to protect content is also driven by convergence trends in this sector.
- The report on **ICT in the telecommunications industry** discusses the background and impact of convergence-driving technology developments, such as new broadband access technologies, VoIP, and IPTV. Moreover, it sheds some light on triple-play strategies by telco companies as an outcome of convergence in this sector.

Exhibit 4-3: Convergence issues analysed in ICT-related sector reports

Report Section	Issues	Contents
ICT manufacturing (SR 04)		
Section 4.1.1	Convergence and market development	• Challenges and opportunities related to convergence for ICT manufacturers • Companies' reactions to changing economic conditions • Expansion into new business fields
Section 4.1.1	Future outlook	• Interdependency between market developments and regulatory framework • Changing business models in the ICTM I • The importance of complementary products for the uptake of new services and technologies
CE manufacturing (SR 05)		
Section 4.1	Impact of broadband	• Impacts on sector output: converged CE products and services • Opportunities and challenges for CE manufacturers • Case study illustrating business opportunities for manufacturers of networked CE devices (*KiSS Networked Entertainment*, Denmark)
Section 4.2	Digital Rights Management (DRM)	• Challenges related to the implementation of DRM technologies in CE devices • Interoperability of DRM technologies; case study on an interoperability framework (*Open Mobile Alliance*)

Telecommunication Services (SR 09)		
Section 4.1.2	New broadband access technologies	• Background and impacts for users and providers • Two case studies (*WiMAX Telecom*, *T-Mobile Slovakia*) on the rollout of new broadband technologies in Eastern Europe
Section 4.1.3	Voice over Internet Protocol (VoIP)	• Background and impacts for users and providers • Case study (*Upnet*, Lithuania) and business example (*Skype*, Luxembourg) illustrating opportunities and challenges for specialised VoIP providers
Sections 4.1.4, 4.1.5 and 4.1.6	Further aspects of convergence	• Spotlights on convergence-driving technologies with possible future importance, such as IPTV and mobile TV • Outcome of convergence on the telco market • Case study on opportunities and challenges related to triple play of telco companies (*Grupalia Internet*, Spain)

Source: *e-Business W@tch* (2006)

4.1.2 Convergence and market development

Today, convergence is one of the most important trends in the ICTM sector. It transforms the media and telecommunication industries and, hence, it is believed to change the terms of competition in the telecommunication market. This in turn, could lead to changes in the ICTM II sector, i.e. the industry supplying the telecommunication services industries. A popular example of convergence and the resulting changes in the market is the transition of telephone services to **Voice over Internet Protocol (VoIP)**. As it emerges from the survey data, VoIP is gaining ground (see Exhibit 3-2) and, eventually, might even replace traditional telephony. This, in turn, will change the structure of the demand for telecommunication equipment supplied by the ICTM II sub-sector, i.e. the demand for traditional fixed-line telephony equipment will decrease. At the same time, however, by generating an entire range of new services and products and spurring the demand for broadband connections, convergence will increase the demand for products produced by the ICTM sector. Thus, convergence has some **substitution effects** that affect companies in the ICTM sector. The following paragraphs aim at identifying the forthcoming challenges and opportunities relevant for companies in the ICTM sector.

Since the internet technology and communication standards achieved technological maturity, it can serve as infrastructure to bundle all data-related services reliably and efficiently (Economist 2006). Consequently, operators can replace different networks for services such as voice, data and video with a single network on which everything is carried as IP (internet protocol) packets.

Similar, wireless communication seems to be replacing the traditional fixed-line telephony. There are already clear signs of these substitution effects in some countries, e.g. the proportion of “mobile-only” households is approaching 10% in America, around 15% in Western Europe and over 35% in Finland (Economist 2006a). Thus, the demand for traditional land-line telephony equipment might decrease. At the same time, however,

spurring the demand for wireless network equipment and broadband connections and generating an entire range of new products and services, convergence opens up new perspectives for companies in this sector.

The rapid diffusion of mobile and internet-based technologies has created a challenge for companies in the ICTM II sub-sector. Earlier, companies in this sub-sector derived their competitive advantage from the ability to transfer the advances in integrated circuits and computing power into capabilities of designing and manufacturing equipment specifically cut to the telecommunications carriers' needs (Nguyen et al 2006). Today, however, the decisive ability is to develop and produce equipment such as routers and fibre-optics for the very dynamic market changing together with the emergence of new telecommunication services.

Traditional telecommunications equipment manufacturers are said to **have lost market shares to newcomers** or to companies that, due to their proximity to the internet technologies, were able to respond to the new trends more rapidly (e.g. Cisco and Newbridge). Consequently, telecom equipment manufacturers such as Alcatel, Ericsson, NT, Lucent or Siemens had to turn to the mobile technologies in order to maintain their profits. Here, however, they faced **fierce competition from aggressive hi-tech companies** such as Nokia, Motorola or Samsung, which benefited from considerable investments and aggressive strategies focused on emerging trends. The business example below illustrates how *Samsung* moved into a new business area that was previously dominated by other telecommunication product manufacturers.

Business example:

Samsung takes aim at Cisco

Samsung has started shipping a router designed for corporate users, part of a planned assault on a market long dominated by Cisco.

"By the year 2010, we are trying to get around 10% of the market share for the enterprise market," said Hwan Woo Chung, vice president of Samsung's Mobile WiMax Group, during the CommunicAsia exhibition in Singapore. His division also announced plans for a WiMax[56] phone at the show.

According to Chung "The addition of corporate networking products rounds out Samsung's product line, which already includes cellular handsets and carrier networking products". But the move puts the company in uncharted territory, addressing the needs of corporate customers, which differ from those in the consumer and operator markets where the company has traditionally played.

Samsung's first corporate networking product, the Ubigate iBG3026, is billed as an "enterprise switch router" and combines the functions of a switch, router, VoIP (voice over Internet Protocol) gateway, and firewall, Chung said. The rack-mountable iBG3026 is designed for mid-sized networks that support between 100 and 300 users. It is available now in South Korea and China, and will be available worldwide by the end of this year.

Samsung plans to sell additional networking products in the second half of the year, said Chung. The iBG2006 and iBG2016 will be aimed at smaller offices, supporting up to 50 users and from 50 to 100 users, respectively. During the second quarter of 2007, Samsung will introduce the iBG3046, which is designed for large corporate networks, with more than 300 users.

Down the road, Samsung's corporate networking products will add support for wireless technologies, Chung said.

Source: www.techworld.com/ (22 June 2006)

The following business example illustrates further the necessity to adapt a company's business strategy to changing market conditions. It shows that having a dominant position in one market does not necessarily make a company successful in other areas.

[56] WiMAX is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to wired broadband like cable and DSL. Source: www.wimaxforum.org (last accessed Oktober, 23rd 2006).

Business example:

Intel exits the mobile processor market

This year, Intel sold its communications and application processor business to Marvell Technology Group for US$600 million (Euro 472 million). The move is part of Intel's effort to shore up its core business in the face of increasing competitive pressure from AMD and a slowing market.

In April 2006, Intel announced that it expected a 3% drop in revenue for 2006, and said it would undertake a reorganisation that could include layoffs within 90 days.

The company's chief executive officer, Paul Otellini, announced plans to cut spending by $1 billion (Euro 786 million) and capital expenditures by $300 million (Euro 235 million) this year, and to begin a 90-day structural reorganisation of "nonperforming business units."

Getting rid of the communications business appears to fit nicely into that plan. "Communications is a long and mostly sad story at Intel," said Gordon Haff, an analyst with Illuminata. "It's a product line where they just pumped untold dollars into a black hole for years now."

Indeed, analysts say Intel entered that market segment too late to be profitable. "It's an area that made sense at one point for Intel to make an investment there and to attempt to establish a presence in the wireless space, but frankly that market was pretty mature by the time Intel got involved in it. It's a market that tends to focus on high volume, very thin profit margins, with really bloodthirsty competition. So it's a tough place to make a dollar," said Charles King, an analyst with market research firm Pund-IT.

Source: www.techworld.com/ (28th June 2006)

The current position of ICT equipment manufacturers illustrates how changing market conditions might overthrow incumbents, notwithstanding their strong position. Having built expertise and capacities to supply the traditional market, they found themselves **locked-in** and unable to move towards emerging trends and technologies. Consequently, margins across the industry are being hit by intense price competition as some players move aggressively to gain market share and build a position in new markets. This story leads to a conclusion that a dominant market position together with know-how and cutting edge technologies might restrict a company's responsiveness to changing conditions and stifle its ability to introduce or adopt major innovations.

One way of addressing these changes is to move away from traditional business areas and to look for new growth segments. A clear example of this strategy is the increased focus on R&D and the role of industrial laboratories. This case is clearly illustrated by the recent move of Lucent Technologies that, due to the increase in competition, had to align its strategy with the R&D efforts (WSJ, 22 August 2006). Turning away from basic research, the company aims at leveraging its critical R&D capabilities so that research can seamlessly flow from the laboratories into commercial applications. The vision is to create new revenue streams to replace those eroded by competition, especially in the business of selling traditional telecommunication equipment.

To address the challenges of convergence, telecom equipment companies are also seeking to link with rivals to address increased competition and convergence of traditional markets with new ones (WSJ July, 27th 2006). For example, Siemens AG agreed to form a joint venture with Nokia Corp. for their respective telecom-infrastructure units, while Sweden-based Telefon AB L.M. Ericsson, the world's largest wireless-infrastructure vendor, bought earlier this year the smaller UK company Marconi, which specialises in fixed-line operations.

The question of investment decisions regarding new product development might be analysed and compared to financial decisions. This means that companies enter into new projects only if the present value of future earnings from these projects is higher than the return rate from other investment options. A company's decision has implications for its future position in the market and the market structure itself. This approach assumes that companies make rational decisions whether to exercise an investment option or not and perfect predictability of future developments.

In summary, intensive ICT usage alone does not guarantee market success in this sector, as ICT enables a firm to introduce only incremental improvements. What seems to be of equally great importance is an appropriate product strategy and organisational flexibility allowing spotting and following new market trends.

4.1.3 Future outlook

The future condition of companies operating in the ICTM industry will be strongly influenced by convergence. For example, companies from the ICTM II sub-sector depend on the development of **mobile telephony** and **broadband networks** (data on the broadband usage across the studied sectors can be found in Exhibit 3-1). Both trends provide new opportunities in terms of market and usage expansion.

However, it takes time till new technologies become mature and gain users' acceptance. Thus, there is some **risk** associated with the further progress of new technologies driven by convergence. As illustrated by the following business example, new internet technologies such as VoIP still need time to become widely used.[57] The discussion reveals that there are still some concerns regarding the technology features of VoIP, which remain unresolved.

[57] For an extensive discussion of the VoIP trend see the report on 'ICT and e-Business in the Telecommunications Industry', 2006. www.ebusiness-watch.org/resources/

Business example:

Concerns about the take-off of VoIP

The use of VoIP is gaining ground. This trend, which originally started with individuals, is now entering into business use. However, some IT professionals are expressing concerns about the use of VoIP in business environments, in particular as regards the general reliability and robustness of the technology. VoIP, unlike many other applications running on the IP infrastructure, can be especially sensitive to packet loss, "jitter"[58] and, most particularly, any 'excessive' delay in transmission of data.

In the distant past, many organisations put considerable effort into managing the flow of traffic over their voice- and IT-networks. As bandwidth increased and as computer networks became more robust and reliable, the active effort taken to monitor and manage network services tailed off. VoIP, as well as future network-sensitive and, potentially, "bandwidth hungry" applications are almost certain to make active network management again an essential component of IT management.

Tools to help ease the management workload will be required and/or the administration of VoIP will be delegated to a service provider. VoIP has great potential business benefits, particularly in terms of enabling greater business flexibility, but it cannot run itself.

Source: www.finfacts.ie/Private/cib/itdirector.htm (6th April 2006)

In addition to the uncertain business environment, the development of both mobile and broadband networks might be influenced by the **regulatory framework** (ITU 2005). An example constitutes the question of whether VoIP should be considered as part of internet services and if so, whether it resides in the domain of Internet Service Providers or of voice transmission, i.e. the market domain of telephone operators (Gillis et al. 2006).

Generally speaking, the relationship between regulatory activities and the demand for network equipment, i.e. products of the ICTM II sub-sector, is not satisfactorily understood. The process of regulation is widely recognised to benefit consumers and business users in the price dimension, but the effects of the same actions on investments are by far less clear (Bohlin, et al. 2004). This is due to the complex articulation of the regulation process encompassing an array of challenges, such as assuring the efficient use of existing networks, creating an investment friendly environment and countering new monopolisation of markets. These actions are likely to affect investment decisions of firms operating in the telecommunication services sector and, in turn, will have an impact on firms in the ICTM sector. In more general terms, regulatory efforts have mainly been led by the need to restore or to promote static efficiency, whereas network investments are likely to affect dynamic market efficiency as well. Consequently, the ongoing debate on whether and, if "yes", how new telecommunication services should be regulated might postpone investments in new technologies in the telecom sector. This, in turn, could affect the position of companies in other industries, notably in the ICTM II sub-sector.

[58] An abrupt and unwanted variation of one or more signal characteristics.

Regarding future outlook, similar problems to those of companies from the ICTM II sub-sector have companies operating in the other sub-sector that is covered by this report, i.e. the **producers of PCs and office machinery** (ICTM I). For many years there have been two models of how to make computers and other digital devices (WSJ May, 11th 2006). One is the "component model", which is championed by Microsoft, and the other is the "end-to-end model", which is championed by Apple Computer.

In the component model, many different companies produce hardware and software that run on a standard platform, creating a world of cheap, commodity devices. In the end-to-end model, one company designs both the hardware and software, which works well together, but the product costs more and the choice is limited. So far, the competition for the dominance of the personal computer market was won by the Microsoft's approach. Aided by efficient assemblers like Dell, and by corporate departments that were employed to integrate the components, the Microsoft's component-based Windows platform defeated Apple's end-to-end Macintosh platform.

However, with the increasing focus on converging media services and mobility, the end-to-end model is the early winner, linking hardware, software and web services in a tight way. Although it is too early to determine which model will dominate computer market in the future, the decreasing attractiveness of the component model would force PC makers to re-think their strategy and come up with products meeting the demand for integrated access to converged services and applications.

The pace of convergence and the rate of new technologies' acceptance do not depend solely on the technological development. **Content provision** and **consumers' skills** are of equal importance. To this point, the slow diffusion of new mobile phone technologies or digital TV can be attributed to an inadequate and limited content offer that, from a consumer's point of view, does not justify an expensive switch from the traditional technologies.

4.1.4 Summary of main points and conclusions

The development of new technologies and services affects companies in the ICTM sector as producers of ICT. Despite obvious advantages, the opportunities stemming from the expansion of internet technologies and related services have not been fully utilised by companies in the ICTM sector. Locked into traditional technologies, firms dominating the market in the pre-internet era lost significant market share to newcomers. Despite the fact that the future scenario for the ICTM looks fairly positive, the success of manufacturers of the technology depends on a number of factors. Thus, opportunities go hand in hand with high uncertainty and risk.

- **Business convergence follows technological convergence**: Technological convergence blurred the lines between various business areas and changed the market environment in the ICTM sector. Telecom- and network-equipment manufacturing companies were forced to expand into new business areas. However, many firms were late to adapt to changing conditions and lost market shares to newcomers.
- **Growth requires business integration**: Companies expanding operations in converged markets are forced to focus on integrating business processes between various units and businesses.
- **Technology should follow strategy**: Decisions to implement particular technologies should be paired with market strategy. Companies heavily investing in cutting edge technologies in order to achieve a dominant position might find themselves locked-in and unable to follow new market trends if a technological shift occurs.
- **Complementarities between technology and content**: Companies' success relies on the acceptance and diffusion of new technologies, which in turn, depends on consumers' skills and the provision of complementary products by content providers.
- **Regulatory framework**: The regulatory framework might influence the decisions regarding the development of new communication technologies.

4.2 The extended enterprise concept

Intensive competition in the ICT sector forces companies to re-locate their production facilities and outsource their operation to low-cost locations or enhance their competitiveness by joining efforts with other companies in the ICTM sector and establishing production networks. At the same time, short product life cycles require retaining research as well as engineering and development tasks close to destination markets. Considering the market characteristics and production organisation, effective communication along the entire value chain is vital to companies' operations. This section focuses on the identification of strategically relevant e-business solutions supporting inter-organisational collaboration and the relevance of enterprise networking.

4.2.1 Networking enterprises

Increasing competition in the global marketplace continues to put pressure on companies in the ICTM sector. According to the results of the e-Business Survey, in order to increase efficiency and cut costs, companies have been streamlining internal processes and improving the information flow and utilisation of corporate knowledge with the help of ICT (see Exhibit 3-33). Furthermore, as the optimisation of the supply chain is a strategic

success factor, companies increasingly rely on their suppliers and customers to reduce costs, improve quality, develop new business processes and provide feedback information on market developments. Consequently, the ICTM sector is one of the most advanced users of technologies facilitating inter-firm process integration, such as collaborative design tools (see Exhibit 3-16) or SCM (see Exhibit 3-24).

According to Lee (2000), tight integration between partners involves four elements:

- **Information integration**, which is the sharing of information and knowledge between members of the supply chain. Shared information includes demand information, inventory status, capacity plans, production schedules, promotion plans, demand forecast and shipment schedules. **The most obvious benefit of information integration is the reduction of the bullwhip effect**, i.e. inventory and back-order levels fluctuations across the supply chain.
- **Coordination**, which is the re-deployment of decision rights, work, and recourses to the best-positioned supply chain member. For example, a company might opt to move some of its activities to its supplier or customer, given its better knowledge of the product or the overall market. Improved coordination of business activities between organisations in the industry value chain was a cause of ICT-driven industry transformation, an issue discussed in section 4.3.
- **Integration**, which can be achieved only if companies define and maintain their channels of communication. Here, again, ICT applications proved to deliver communication infrastructure facilitating production networks.
- **Organisational linkage**, which institutionalises joint cooperation and enables partners to align the incentives of multiple players. Examples include joint business units or teams managing the same tasks.

The following business example illustrates the benefits of supply chain integration at Lucent Technologies, one of the biggest producers of telecommunication equipment in the world. ICT enabled the firm to adapt the demand-driven production practices and to gain a competitive advantage over its rivals.

Business example:

Supply chain integration at Lucent Technologies

At the end of the 1990's, Lucent Technologies revamped its supply chain strategy in Asia. This involved re-aligning the missions of its manufacturing sites in Asia and North America, linking with local suppliers, and redesigning products and processes to support supply chain management.

Cost reduction was one highly desirable result but not the only one. Supply chain integration also created profits, increased market share, strengthened the competitive position and enhanced the value of the company.

Shortly thereafter, the Taiwan government deregulated the telecommunications industry and opened up the telecom equipment market to global competitors. Lucent won 100 percent of the market share of switching systems in Taiwan — an achievement attributed to the company's new supply chain strategy.

Source: Lee (2000).

SMEs in the integrated value chain

In order to fully benefit from supply chain optimisation, value chain integration has to reach the lowest levels of suppliers. As a consequence, SMEs located at the base of the value chain need to adopt e-business solutions and practices enabling them to participate in electronic collaboration with their customers and suppliers.

So far, by setting technological requirements and conditions for doing business electronically, large companies have played a leading role in the process of industry integration and e-business diffusion in the ICT industry has followed the bottom-up pattern. Results of the e-Business Survey confirms that SMEs in the ICTM sector lag behind large firms in terms of deployment of inter-organisational applications (see section 3.4). Consequently, SMEs are often ignored in the process of standards development and in the creation of new organisational concepts (see the box below). As their active participation is decisive for the further development of inter-organisational e-business, it is advisable that SMEs actively and creatively cooperate with component manufacturers and PC vendors, communicating to them their constraints and needs.

SMEs in Standardisation for a Competitive Market

Standardisation for the future generation of information and communications technology (ICT) will be critical. Without the interoperability that it brings, along with its other benefits such as lowering costs and facilitating international trade, we will be lost in a quagmire of machines that cannot perform their tasks without communicating but that cannot communicate due to a lack of standardisation.

While much focus is given to the standardisation activities of large ICT vendors, little attention is give to the standardisation activities and needs of SMEs. With SMEs representing the majority of companies in Europe, and likely around the world, this is unfortunate and possibly a market-limiting mistake. Unless SMEs also understand how to effectively participate in and apply standardisation, the Future Generation of ICT will be destined for failure.

Source: Karine Iffour, NORMAPME (www.normapme.com/)

Case studies

The case studies below illustrate how companies leverage their operations through the integration of business process between organisations in the area of customer order fulfilment. As shown in the first case study, *Motorola* eliminated the burden of manual work and increased the speed of product delivery while, in parallel, also improving the quality of its processes. The second case study describes how *Nokia*, a leading manufacturer of telecommunication equipment, pursues an assertive strategy of mergers and acquisitions. This strategy enabled Nokia to set foot in new markets and achieve an advantage over its rivals. In the same case study it is also described how the company managed to overcome the organisational challenges of business integration by using industry standards. The paragraph following these case studies compares the approaches of the two companies to process integration, leading to some interesting conclusions.

CASE STUDY 1: PROCESS INTEGRATION AT MOTOROLA, USA

Abstract

Broad adoption of Business to Business Integration (B2Bi) in the ICT manufacturing industry demands the standardisation of exchanges between suppliers and customers. Leveraging the standards for hi-tech manufacturing, Motorola chose a new way of conducting business with its supply-chain partners, employing XML-based B2B Standards, Enterprise Application Integration (EAI) and Business Activity Monitoring (BAM) technologies. Driving the changes are supply-chain complexity, global competition and the need for Motorola to conduct business in non-conventional ways.

The implementation of the RosettaNet B2Bi standard marks a new way for Motorola to conduct supply-chain business with its trading partners. At its core is a new manufacture-to-ship strategy, whereby orders are placed with the most advantageous manufacturer, and the products are shipped directly to the customer. Within Motorola, orders are generated from Oracle ERP, translated and then sent as XML standard documents to its trading partners, using a common middleware business technology. With the employed B2Bi standards, adding partners is greatly simplified for Motorola, with no systemic changes required.

Case study fact sheet

Full name of the company:	*Motorola*
Location (HQ / main branches):	*Schaumburg, USA; 320 facilities in 70 countries*
Main business activity:	*Production of telecommunication equipment*
Year of foundation:	*1928*
Number of employees:	*~69,000*
Turnover in the last financial year:	*$ 35 billion (about € 28 billion[59])*
Primary customers:	*Enterprise and consumers*
Most significant geographic market:	*International*
Main e-business applications studied:	*Enterprise Application Integration (EAI); Business Activity Monitoring (BAM)*
Key words:	*Supply chain integration; Process automation*

Background and objectives

Motorola is a world-class leader in a wide range of communications and electronics markets. The company provides integrated communications solutions and embedded electronic solutions and is presently expanding its software operations in an effort to add internet access capabilities to its phones and other electronic devices.

Motorola was seeking to **streamline its supply chain** and further leverage its manufacturing trading partners to include customer order fulfilment. The goal of the first RosettaNet implementation in the process of customer order fulfilment automation was to establish **standards-based public business processes** and **integrate trading partner systems** to support direct customer order fulfilment from the contract manufacturer

[59] Interbank exchange rate of 15 October 2006

instead of Motorola. A challenge was to transform one internal Motorola ERP system into two separate, but seamless, systems: ERP used by Motorola and a brand new instance of SAP running in the contract manufacturing plant.

e-Business activities

Program structure

To analyse, design, plan and implement the new business processes, as well as having the right people available to work on the new B2Bi changes, was a key to success. Support came from the executive management at Motorola. The organisation structure was adopted for the project and defined in a cross-functional modelling session. The current ICT structure allowed for the separation of operations from project responsibility. The business subject matter experts were involved in the project, while continuing their functional roles.

Workflow automation

Before the migration of the contract manufacturer as a separate entity, the following interfaces were in practice: Create Order, Change Order, Order Status, Order Cancel and Ship Notification. The previous process was based on internal Motorola company systems, which were dependent on database connections and user intervention for data transfer between applications. Order Change and Order Cancel processes were manual.

The chosen method of communication and standards was Partner Interface Processes (**PIPs**), which **define standard business processes between trading partners.** Once the process was analysed, the following PIPs were identified to replace the old systems' interfaces:

- Automated conversion of Customer Purchase Orders / Motorola Sales Order and Changes to the trading partner Purchase Orders (PIPs 3A4 and 3A8);
- Automated Reversal of Customer Orders / Motorola Sales Order with the trading partner purchase orders (PIP 3A9);
- Automated Updates on Customer Order / Motorola Sales Order Status from the contract manufacturer (PIP 3A6);
- Automated Shipment/Manifest data to Motorola initiated by the Trading Partner's Shipment/Manifest process (PIP 3B2).

In addition to changing the business processes, the B2B public standard enabled the definition of performance and frequency targets.

In this new model, the only interfaces between the contract manufacturer and Motorola are standard B2Bi PIPs, which provide reusability, security and flexible communication for both Motorola and its trading partners. Order creation is more accurate and real-time, through the implementation of the interface defining the automated conversion of customer purchase orders. The manual processes of 'order cancel' and 'order change' are now fully automated in the new system. Automated order updates allow contract manufacturers to pass more accurate and real-time information about the status of an

order to Motorola. In addition, shipping and logistics operations are fully automated due to the implementation of standard interfaces.

According to Mr Lagrèze, from Motorola's Enterprise e-Business Solutions Division, "one of the biggest challenges in this project was the transformation of one big system into two different systems, while allowing the business to run flawlessly during the transition phase." Indeed, during the transition / transformation phase, business ran without any interruption from the integration activities.

Impact

Mr Lagrèze says that "s*tandards-based B2Bi changed the way Motorola interacts with its trading partners*." The Motorola ERP system and the contract manufacturer SAP system are now able to communicate with each other extensively, using an industry standard. Regardless of the back-end systems any company uses, a common standard enables the communication between them to be seamless. In a world of complexity and diversity, simplification and streamlining make doing business easier.

After the implementation of the system, flawless business continuity has been achieved by having the capability of 24/7/365 days online ordering process. An order created by the business users is instantaneously transmitted to the trading partner without being affected by holiday events, cultural occasions and human error.

Thanks to the adoption of standard B2Bi interfaces, the Motorola system is now capable of adding more contract manufacturers as it was designed with high re-usability in mind. Currently, Motorola is working on adding more partners to the same system, while other partners are in the process of interfacing their systems to Motorola's system. In addition to the re-usability of the B2Bi integrations to the back-end systems, Motorola has the capability to add more PIPs, new third-party logistics and other supply chain participants. This enables Motorola to take the next step in its supply chain transformation.

The ultimate value to Motorola in using industry standard B2Bi is the improvements in the speed of order processing and the commitment process for Motorola customers. As less paper-work and manual processes are now required, orders can be tracked and fulfilled more effectively. Information is more real-time, thus enabling Motorola to focus on more strategic issues and new business opportunities, rather than spending time in manual processes and manual order tracking.

Lessons learned

For this project, as well as for future ones, identifying lessons learned helps in the continuous-improvement characteristic of the Motorola Six Sigma Quality Initiative. It was very important to implement continuous improvement throughout the program life-cycle. To facilitate this, "Lessons Learned" were formulated at the close of each phase of the project before moving on to the next phase. The focus was on positive examples of collaboration and performance that could be institutionalised, as well as process deviations in performance and behaviours that could be improved.

- **Senior Leadership** – All levels of management at Motorola and the contract manufacturer were involved in this program. Included were the executive steering group, business champions and senior stakeholders. The senior leadership focused on scope and quality, not just schedule. Business continuity and a smooth transition to the new way of doing business were key success variables.
- **Core Leadership** – The Core Project Leadership Team included the program manager, a dedicated project manager, an IT manager, e-Business managers, a business manager, a test manager and the project management office (PMO). This team developed the strategy for the B2Bi implementation, program structure, communication plan, budget and project schedule. The planning, monitoring and removal of barriers ensured budget and schedule attainment.
- **Quality: Project Methodology** – A formal methodology was followed, with pre-defined deliverables, reviews and signoffs before moving from phase to phase. The project manager was responsible for all reviews and deliverables, and the PMO acted as the gatekeeper to ensure compliance. Understanding the requirements of the methodology and the time needed for the reviews were included in a checklist at the beginning of the project. This helped the new teams unfamiliar with the process, but accountable for it, to follow it. In addition, the project plans included detailed reviews for the individual components. This procedure helped in the schedule development and methodology conformance.
- **Testing Practices** – An independent test team was available to run tests on the implementation of the PIPs between Motorola and the contract manufacturer. Testing was well planned and no compromises were made on its duration. Functional teams were involved in the end-to-end (E2E) testing between the two companies. An open-phone bridge was used to provide real-time status, allowing faster identification of problems emerging during the E2E testing. This is especially important in B2Bi implementations, where code problems may appear at the back-end systems, the front-end systems or in the transmission between systems and companies. In this context, real-time verbal communication helped with parallel transmission and status verification and reduced the sequential checking engendered by e-mail.

References

Research for this case study was conducted by Aneta Herrenschmidt-Moller (Aneta@HMoller.com), on behalf of e-Business W@tch. Sources and references:

- Interviews and project description delivered by Mr. Hermann Lagrèze, Manager EMEA Region, Enterprise e-Business Solutions, Motorola (April 2006).
- www.motorola.com (March 2006)
- High performance working research project, www.ilo.org/ (March 2006)

CASE STUDY 2: BUSINESS INTEGRATION AT NOKIA, FINLAND

Abstract

This case study describes how Nokia, a leading manufacturer of telecommunication equipment, expands into new markets by following a strategy of mergers and acquisitions. One of the main challenges of expansion is how to integrate acquired companies into Nokia's business units and supply chain. In order to overcome this organisational challenge Nokia makes extended use of automated process integration not only to integrate suppliers and customers, but also to integrate companies that were recently acquired.

Case study fact sheet

Full name of the company:	*Nokia Corporation*
Location (HQ / main branches):	*HQ: Helsinki, Finland* *Production Units / Networks Technology : Brazil, China, Germany, Great Britain, Hungary, India, Mexico, South Korea*
Sector (main business activity):	*Manufacture of telecommunications equipment and apparatus (NACE Rev. 1.1 DL 32.2)*
Year of foundation:	*1865*
Number of employees:	*n.a.*
Turnover in last financial year:	*34.191 Billion Euro*
Primary customers:	*Operators, distributors, retailers and corporations*
Most significant market area:	*Mobile phones*
Main e-business applications studied:	*Integration of inter-organisational processes;* *Use of standards*
Key words:	*Inter-firm integration; Standards for document exchange*

Background and objectives

Nokia is a world leader in mobile communications. It provides equipment, solutions and services for network operators and corporations. Nokia has a world market share of 35%. Its main competitor is Motorola (USA) with a market share of 17.7%. Number three in the market is the South-Korean producer Samsung, followed by LG Electronics and the Japanese-Swedish cooperation Sony-Ericsson. The importance of smaller producers continues to decline. Producers not belonging to the largest five have even experienced a reduction in turnover.

Nokia's growth strategy – the answer to convergence

The communications industry, being Nokia's most significant market area, continues to undergo significant changes as more users in growth markets gain access to mobile communications, enterprises becomes increasingly mobile, the importance of end-to-end solutions increases and technology continues to evolve. Another trend is an increased emphasis on the role of customisation in mobile devices. These changes have demanded agility and flexibility from industry players to adapt to new market conditions rapidly. Thus,

Nokia aims at capitalizing on efficiency and its skill in execution as well as demand-supply chain management to respond to these requirements.

The company **enters new product and service niches**, as technologies from diverse industries start to converge.[60] Keeping pace with convergence requires offering more comprehensive products and entering into new business areas. Pursuing these goals, Nokia intensively expands by endogenous growth and acquisitions (See Annex IV). However, acquiring new companies creates a challenge of **seamless integration** of separate organisational entities, ICT infrastructures and business processes. Nokia's approach to business integration is to use standardised interfaces and business processes facilitating the cooperation between Nokia and its suppliers and subsidiaries.

e-Business activities

Nokia is a devoted user of e-business applications. In nearly every business area, the company has an operating ICT application, e.g. ERP, SRM, SCM, which has been in place for a relatively long time. For example, the ERP system has been used for over 10 years.

However, the increasing complexity of supply chain management and the pressure to increase the efficiency of operations at every stage of the production process, also requires the company to extend the capabilities of ICT applications to external operations. This is particularly visible whenever a new company is acquired and has to be integrated into Nokia's value chain. Since a successful integration of business processes is a condition for a successful merger, Nokia adapted three alternative solutions, which can be used side by side to facilitate process integration with entities belonging to its network:

- **Web access tools**, which are deployed to facilitate operations and integrate applications between Nokia and its customers and suppliers.
- **Interfaces** and **standardised processes**, which are based on RosettaNet standards, Nokia's chosen de-facto standard for automating system-to-system integration.
- **Electronic Data Interchange** (EDI), which is the most common standard in manufacturing industries for business-to-business transactions.

Nokia actively drives the development and adoption of standardised business processes and interfaces based on its demand-supply network's business priorities. These priorities are derived from needs that arise for either Nokia or any of the suppliers while using standards for communication and process integration.

By applying standardised business processes and system interfaces, Nokia is able to change proprietary solutions into a common system supporting communication across multiple platforms, applications and networks. This guarantees seamless communication and information exchange between companies or business units cooperating with each other.

[60] A list of Nokia's acquisitions can be found in Annex IV.

Nokia currently has standardised connections in its production network covering almost all critical business areas and 75 of its most important suppliers. The focus thus lies on integrating the suppliers that play a crucial role in the value chain.

Impact

Miika Andersson, Nokia's RosettaNet Champion, stated that "*building a common connection has minimal requirements for implementation. Yet, making own back-end processes and system standards compliant is very critical to be able to realise benefits from process integration, and sometimes requires flexibility internally to make compromises in own back-end processes. However, once done this is not needed anymore for further implementations with other trading partners.*"

Today, using standardised business processes and interfaces is a "business-as-usual" procedure within Nokia, although not the same processes are used with all suppliers. Furthermore, still new processes are constantly adopted. Although Nokia did not share any particular number, Mr. Andersson stated that "*communication and processes, handled via the RosettaNet standards, is a 'quite big part' of the business volume.*"

Nokia states that implementing standardised interfaces and processes forced both Nokia and its trading partners to 'clean' their own back-end business processes and systems. This is, according to Miika Andersson, the biggest and most important impact.

Nokia maintains that the deployment of standard-based automated processes between systems operating between various organisations and business units is key enabler for:

- speed, visibility and collaboration in the extended value chain,
- transparency and efficiency in each business transactions,
- and efficiency and speed in implementing new business processes with trading partners.

Unfortunately, Nokia did not give any numbers to make the advantages and impacts on their business processes and demand-supply network more tangible. This is also due to the fact that Nokia's focus is on integrating processes to make them work well rather than going into detail by modifying and analysing business processes. Thus, the company has not conducted a deeper analysis on the impacts, especially concerning any organisational issues.

Lessons learned

According to the company's speaker, two main issues emerge as particularly important in the process of business integration.

- The adoption of standard processes and interfaces was **a natural choice** of many suppliers and business units. The company did not need to encourage any supplier to adapt them. Instead it was the suppliers that encouraged Nokia to apply them in the first place. Suppliers who need to deal with many other costumers saw the significant advantages of using one communication framework before Nokia encountered them for itself.

- **Process integration is a journey** rather than just switching on a system, which requires patience and ongoing attention. In order to improve the communication and information exchange between the members of Nokia's value network, the company is still in the process of adding new applications, processes and suppliers.
- The critical factor for the success of business process integration is to understand the need to **ensure back-end processes and system readiness**. Nokia says that underestimating the importance of these back-end processes and the system readiness is often a cause in **delaying the implementation** of a process with certain partners.

References

Research for this case study was conducted by Nicole Petrick, DIW Berlin, on behalf of e-Business W@tch. Sources and references used:

- *Questionnaire submitted to Miika Andersson, Nokia RosettaNet Champion.*
- *Telephone interview with Miika Andersson, (May 3rd, 2006.)*
- *Nokia's Annual Report: Nokia in 2005. English version.*
- „Handymarkt: Nokia stark, Siemens schwach" (February 1st , 2006).
- *Websites:*
  - Nokia Corporation, www.nokia.com/
  - RosettaNet Organization, www.rosettanet.org/

SUPPLY CHAIN INTEGRATION AT NOKIA AND MOTOROLA – A COMPARISON

The two market-leading telecommunication firms *Nokia* and *Motorola* devote significant resources towards a complete integration along the value chain by using industry standards defined by the RosettaNet organisation. Both companies realise the value that the automation and integration of the back- and front-end processes brings, and view the use of the discussed e-business applications as a natural and essential part of this integration. At a wider scale, this attitude is also reflected in the 2006 e-Business Survey results, which show that large ICTM enterprises are the most advanced users of standards and inter-organisational technologies (see sections 3.3 and 3.4).

Nokia names the need to better integrate companies acquired in the pursuit of their growth strategy as the primary incentive. *Motorola*, on the other hand, is focused on a manufacture-to-ship strategy resulting in the need for complete supplier integration. Correspondingly, *Motorola's* focus is on the operations with suppliers while *Nokia* has a broader target and embraces not only suppliers but also customers and new business units under one umbrella.

Regardless of the final objective, the means to get there was quite similar for both companies. Both Motorola and Nokia used **standardised interfaces** between the firm and their respective partners in order to create an automated and more efficient communication and collaboration channel. Furthermore, during the implementation process, a top priority for both companies was to ensure continuous collaboration while integration was taking place. A smooth transition with close to no business disruptions was of particular importance considering the on-going nature of the process integration. Given this, the companies emphasised the importance they put on their interaction with suppliers and the important contribution the latter made towards the adoption of standard processes and interfaces.

As to the benefits from the integration efforts, both companies state that they see the use of ICT as one of the major means to improve their competitive position. This argument is even more justified by the fact that the companies are leading and competing in the highly versatile and innovation intensive market of mobile communications. The continuing pressure that high market concentration exerts on *Nokia* and *Motorola* forces them to look for tools and opportunities to guarantee a faster and higher quality approach of dealing with suppliers, for bringing their products to the market and for winning customers.

4.2.2 Collaboration and innovation

Besides immediate benefits of supply chain integration in terms of cost reduction, collaboration between supply chain partners can tremendously enhance the innovativeness level of businesses engaged in formal networking. Companies actively cooperating with other organisations within the framework of their innovation strategies perform better in terms of the proportion of turnover generated from new or improved

products (Feams et al. 2003). The reasons why inter-organisational collaboration increases the outcomes of innovation activities include:

- **Access to complementary assets**: As companies operating in the ICT sector increasingly depend on the information provided by suppliers and customers, the access to complementary assets and information make innovation projects commercially successful.
- **Knowledge spillover**: Institutionalised cooperation enables companies to transfer codified and tacit knowledge. As a result, organisations become familiar with new competencies that are emerging within or outside the industry at a stable pace. Such acquisition of know-how enables a company to create and develop resources that are otherwise difficult to mobilise, imitate and substitute.
- **R&D synergies and risk sharing**: Benefiting from additional assets and sources of knowledge, networking companies spread the costs of R&D projects and reduce the risks associated with more uncertain initiatives. Consequently, the duplication of efforts is minimised while the likelihood of coming up with a major innovation is maximised.

In spite of the fact that in general over half of all alliances fail, empirical evidence confirms that strategic alliances enable companies to access social, technical, and competitive resources that otherwise would require years of operating experience (Feams et al. 2003). Linked companies are likely to extend the scope of cooperation to joint R&D initiatives. As research activities in the ICTM sector require substantial financial outlays and advanced R&D architecture, this argument seems particularly important for SMEs, which frequently face significant budget constraints. However, despite these difficulties, the results of the e-Business Survey 2006 indicate that SMEs are equally innovative as large firms. Moreover, SMEs more frequently reported introducing ICT-enabled innovations than large firms – and micro ICTM firms did so even more than this sector's SMEs (see Exhibit 3-31). SMEs in the ICTM sector lag behind their larger counterparts only in terms of process innovation.

As mentioned above, companies' innovation capabilities could be improved by facilitating inter-firm cooperation and this networking can be increased by using ICT tools supporting collaborative work. e-Business Survey results, however, reveal that SMEs in the ICTM sector are only slowly adopting tools for cooperative and collaborative business processes (see section 3.4.2). The issue of networking and using collaborative tools for innovation is very well illustrated by the case study about *Signalion*, a high tech start-up (section 4.3). Maintaining close links with research institutes and knowledge exchange with other firms and institutions enabled this firm to get access to knowledge unavailable within the company. This, in turn, partially compensated the lack of appropriate engineering skills on the market. Furthermore, networking helped the founders in starting up the company and facilitated an easier access to customers.

In addition to the availability of general skills, there is a question of the availability of IT-skills. Appropriate skills are an important complementary asset necessary in the ICT-enabled innovation process (see section 3.7, Exhibit 3-32). As indicated by the survey results, only a small share of firms in the ICTM sector reported having problems with filling vacancies for ICT jobs (see Exhibit 3-3). However, over one tenth of large

companies in the ICTM sector reported problems with finding appropriate IT specialists. As large companies are the primary employers of such specialists, the issue of the IT skills availability has not lost any importance.

4.2.3 Summary of main points and conclusions

The deployment of inter-organisational applications in the ICTM industry is slightly higher than in other manufacturing industries (see section 3.4). However, the use of such applications as ERP or SCM is particularly low among the smallest firms (see Exhibit 3-15 and Exhibit 3-24). Similarly, this sector's SMEs lag in the adoption of tools supporting collaborative product development or inventory management, compared to large firms (see Exhibit 3-15). The imbalance between small and large company size classes regarding the use of applications supporting processes between companies might have a negative impact on the progress of supply chain integration at the lower levels of the supply chain. This is particularly worrisome, as the deployment of inter-firm computer networks has a significant impact on firm and its industry competitiveness. The following points summarise the key implications of networked enterprises and outline some issues requiring closer attention.

- **Supply chain integration maximises profits**: Optimising the flow of goods and information along the value chain reduces inventory costs and improves production planning.
- **Networking stimulates innovativeness**: Inter-organisational cooperation gives companies access to competitive resources and information. By being able to spread the cost and risk of R&D projects, firms eliminate the problem of efforts' duplication and maximise the likelihood of introducing major innovations.
- **Who accrues benefits?** Frequently, large companies initiate the process of supply chain integration forcing their interests and requirements on business down the value chain. In addition, controlling the major resources and information, they might exercise their power on small firms.
- **SMEs participation in standard setting**: The full potential of supply chain integration can be realised if all its members become integrated in the network. Thus, it is necessary that SMEs play an active role in the standardisation process that is essential to achieve this integration.

4.3 ICT and industry transformation

e-Business Survey results confirm that ICT has important consequences for company performance. Firms from the ICTM sector reported that ICT has had positive impact on process efficiency, work organisations and even firm boundaries, i.e. outsourcing decisions (see section 5.1). Network technologies supporting collaborative work and linking inter-firm processes are said to have particularly positive impact on organisations (see section 4.4). Advanced e-business tools, which enable virtual collaboration between separate companies on product development or supply chain management, offer companies opportunities to re-design their processes and relations with business partners. Furthermore, innovative processes create efficiencies at both firm and industry level. The focus of the following section is the impact of new technologies and e-business practices on the relations between companies as well as on the entire value chains of the ICTM industry.

4.3.1 Industry evolution

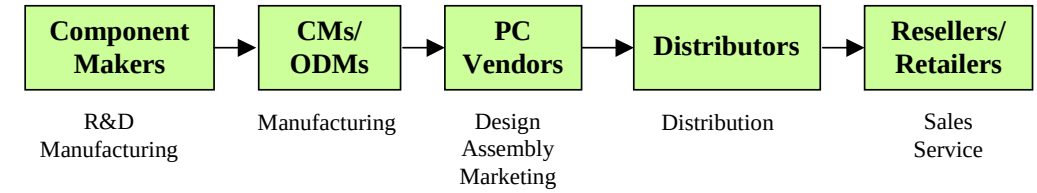
Products of the ICTM industry have typically a **modular architecture**. Their components, peripherals and software can be developed independently and integrated into the final system using standardised interfaces (Dedrick et al. 2005).

The modular product architecture enabled the creation of an industry whose structure is characterised by a high degree of specialisation and separation of functions. As discussed in section 2.2, this applies to the allocation of tasks with respect to a location's comparative advantage. A number of firms became involved in production networks organised by final products manufacturers. Suppliers competed in one or two market segments involving either manufacturing of components or complete systems or providing sales, distribution and technical support services. For example, central to the development of PC industry was the dominance of the **"Wintel"** product architecture based on the standards set originally by IBM and later controlled by Microsoft and Intel. This de facto standardisation allowed companies in the industry to achieve substantial economies of scale as they produced for the global market.

Exhibit 4-4 presents the shape of the PC industry structure that existed until the mid 1990's. Components and sub-assemblies were shipped by suppliers and contract manufacturers (CM[61]) according to production schedules. PC manufacturers planned their production volume to meet **demand forecasts** and assembled PCs using standardised methods. Complete products were forwarded to distributors, who held inventory for sale to retailers who, in turn, held inventories for sale to the final customer. Such a production design required high levels of inventory at every stage of the value chain and many transfers of components, sub-systems and final products.

[61] A contract manufacturer (CM) is a firm that manufactures components or products for another, hiring firm (Wikipedia).

Exhibit 4-4: PC industry value chain (untill mid 1990's)



Source: Dedrick, J. et al. 2005.

The composition of the PC industry structure was challenged by three developments in the market and technological environment. First, **an increased rate of innovation** in major components (microprocessors, hard disk drives, memory chips) led to faster depreciation of components and finished inventories. This forced companies to reduce their inventory turnover. Second, the success of the **direct-sales** and **build-to-order** strategies pioneered by Dell and Gateway motivated other PC manufactures to re-think their strategies and to focus on core activities (see the business example below). Third, rapidly **declining prices** of electronic products reduced profit margins and increased pressure to cut costs.

Business example:

Dell – Virtual Value Chain

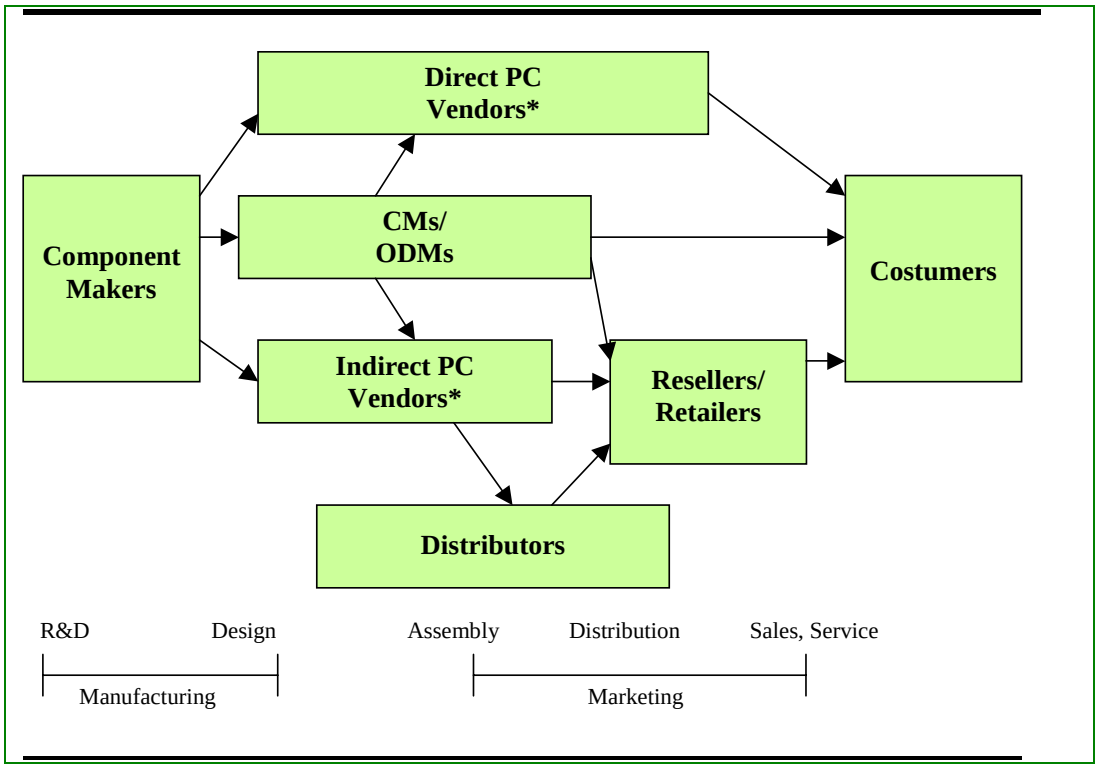
Since Dell's founding in 1984, the company forged its direct sales and build-to-order business model, based on selling personal computers directly to consumers through the Internet and by telephone. Such a strategy proved to be successful in minimizing inventory, bringing new products to market quickly and defeating other PC makers with its more competitive pricing.

The model rests on a simple concept: by circumventing two links in the supply chain, Dell allowed individual business customers to order PCs directly rather than making them go through a central purchasing office. It also enabled them to lease computers, and to make electronic payments via the Internet. Besides, build-to-order production let Dell store virtually no aging inventory, moving Dell up towards the introduction of new technologies and adjustment of production to demand faster than its rivals. Importantly, Dell does not have to purchase components and assemble PCs until it has received payment from the customer, thus, avoiding a negative trade receivables balance. Instead, Dell uses the freed cash flows for making investments in its support infrastructure and product quality.

The direct business model positioned Dell as the world's leading computer-systems company and in 2005 it had the biggest global market share and growth in shipments (18 and 23 percent respectively).

Source: www.dell.com

Exhibit 4-5: PC industry value chain (2004)



* Some PC vendors sell through both direct and indirect channels.

Source: Dedrick, J. et al. 2005.

Due to the intensified competition – partially driven by the adoption of ICT (see Exhibit 5-6), many companies exited the market or merged and the entire value chain was transformed. Exhibit 4-5 illustrates the modern value chain of the PC industry. Although in most cases companies perform the same functions as before, the nature and scope of their activities have either expanded or become more focused. On the one hand, PC makers reduced the scope of activities by **outsourcing** manufacturing, final assembly and some parts of product development. On the other hand, CMs, original design manufacturers (ODMs) and distributors extended the scope of their activities.

The business example below illustrates how *Elcoteq*, a Finish electronics manufacturer, reacted to the intensified competition pressure by expanding its production capacities in low-cost locations and creating a network of plants connected to each other.

Business example:

Nearshoring in central Europe at Elcoteq

Elcoteq SE is a leading electronics manufacturing company with original design manufacturing capabilities in the communications technology field. The company operates in 15 countries on 4 continents and employs approximately 20,000 people. The products offered include terminal products and communications network equipment.

Between 1992 and 1997 the company grew rapidly thanks to the sharp growth in the outsourcing of production to manufacturing partners. Rapid growth and limited production facilities in Lohja (Finland), led Elcoteq to expand to Tallinn (Estonia). Elcoteq fostered a fast international expansion that resulted in a network of plants covering, by 1999, more than ten countries in Europe, America and Asia. Due to intensified competition, the company then further developed this network by acquisitions and joint-ventures to be modern and cost-competitive, while implying consistent manufacturing methods.

In 2003, due to a strategic revision process, Elcoteq expanded its service portfolio. As a result, the company acquired, established or became a share-holder in new product introduction centres. Moreover, Elcoteq expanded its manufacturing capacity by acquiring two companies with plants in Germany and Finland.

In 2004, Elcoteq further concentrated and expanded its operations. The company sold its industrial electronics business to a Swiss company, thus transferring its Swiss and two Finnish production plants, including the Lohja plant, to the new owner. Elcoteq further strengthened its service portfolio and expanded its network of manufacturing plants by building new production space in Estonia and intending to build a new plant in Russia.

Source: www.elcoteq.com

Apart from the re-location of production activities, the industry transformation has had an important implication for **the source of innovation** – both in terms of the place in the value chain and geographical origins. As the innovation process is frequently coupled with product development and manufacturing, parallel to outsourcing manufacturing activities, OEMs reduce their R&D competencies and become depend on contract manufacturers and suppliers for the provision of new products. For example, Dell, a company that mastered the concept of the lean organisation, spends only about 1.6%of revenues on R&D, compared to 4-7% by other major PC manufacturers, who still support their own technology platforms (Dedrick, J. et al. 2001).

Survey results confirm that ICT has an impact on companies' sourcing strategies and the shape of relations in the value chain. For example, a large share of companies from the ICTM sector said that they procure electronically from suppliers located abroad (see Exhibit 3-22). Furthermore, electronic procurement seems to expand companies' sourcing options by enabling them to purchase from more suppliers (see Exhibit 3-22). What is, however, particularly interesting, is that ICT seems to play an important role in

defining firms boundaries, i.e. it influences companies' decisions about keeping certain activities internal and outsourcing others (see Exhibit 5-4). In other words, ICT influences the transaction costs and, consequently, the 'make or buy' decisions and changes the way firms define their boundaries.

Case studies conducted for this report add to the insights derived from the quantitative analysis in chapter 3 and the above discussion. For example, the case study about *Linking Business Processes in Supply Networks* (section 4.3) confirms that China is becoming increasingly important as a product development base. This raises the question of how much manufacturing can be outsourced to low-cost locations without damaging the capabilities of European producers to deliver innovative products. In order to keep their strength, companies reducing the share of in-house production and new product development will have to develop new competencies. One possibility is to create more efficient links with the end customers, which might enable them to spot new market opportunities and transfer new innovations into marketable products. The case study about *RCD* illustrates how ICT can be used to this end (section 4.4).

Another outcome of specialisation and increased focus on core competencies observed among large enterprises is the emergence of market niches for services which can be provided even by small companies. Innovation and product development have become prominent areas in which firms from the ICTM sector are gaining competitive advantage. As it emerged from the discussion in section 3.7, ICT has become an important enabler of both process and product innovations in this industry – and this applies to both the sector's SMEs and large firms. The case study about *Signalion* illustrates how a technology start-up serves large enterprises by providing products and services that are entirely ICT-enabled (section 4.3).

4.3.2 The role of ICT in the value chain

The critical condition for disintegration, outsourcing knowledge-intensive activities and introducing the demand-pull manufacturing process is quick and efficient information exchange along the value chain. Thus, all members of the value chain invested heavily in a variety of internal ICT systems and external networks and applications that link them together (Dedrick et al. 2005). However, as indicated in section 3.4, this is particularly true for large enterprises in the ICTM sector. This section explains how ICT is used to coordinate activities and information exchange along the ICT industry value chain. The case study about *Linking Business Processes in Supply Networks* (section 4.3), a Finish supplier to the telecommunications equipment manufacturers, illustrates how an electronics manufacturing company uses ICT in the manufacturing process and sourcing process in its global network of plants and suppliers.

Internal ICT systems

According to the survey results, a large share of companies in the ICTM sector in general and ICTM I in particular have introduced management information systems, such as ERP and CRM (see Exhibit 3-15 and Exhibit 3-30), as well as a number of customised applications and middleware to link all these systems together. The result was a

reorganisation of the factory floor into production cells and the adoption of just-in-time inventory management techniques.

The main **benefits** brought about by these applications include increased operational efficiency, productivity and improved customer service (see Exhibit 5-2). Furthermore, according to companies' responses, logistics is one of the main business areas, which is being strongly affected by ICT (see Exhibit 5-5). Thus, the main gain was **the substitution of inventory** and other resources flowing within and between organisations with **information flow** (Dedrick et al. 2005).

Other value chain partners, such as CMs and distributors, took similar steps and consequently increased the scope of services that they could offer to PC makers. Most of the applications installed by them are **generic** and **not relationship-specific**, which enables them to reap the benefits of scale economies and prevents them from being dependent on one customer.

Despite the abundance of various ICT systems, the complexity and interdependence of product development or manufacturing processes requires that they are managed within a single firm's hierarchy, either a PC maker or a chief supplier. The lack of robust and widely adopted **standards** and applications integrating processes across firms' boundaries hinders further disintegration of some activities (Dedrick et al. 2005). In fact, according to the e-Business Survey 2006, the business function where most companies experience interoperability challenges are procurement, technical aspects and logistics. In other words, the lack of industry-wide standards hampers the process of supply chain integration in crucial fields, i.e. cooperation with suppliers (procurement, logistics and payments) and product development and manufacturing (technical aspects) (see Exhibit 3-11).

Inter-organisational ICT systems

According to the e-Business Survey, the ICTM I sub-sector, including PC manufacturers, is an advanced adopter of the internet and e-commerce (see chapter 3). Creating **a selling platform** for customers and **a communication channel** with suppliers, the internet was perfectly suited to support the demand-driven manufacturing concept. The web enabled PC makers to manage the variety of product configurations together with constantly fluctuating demand. Today, the internet is used primarily for such functions as product configuration, sales transactions, information exchange and customer service. A big share of B2B transactions between companies in the ICT sector is carried out electronically (see Exhibit 3-18). However, although ICT has rapidly diffused since the 1990's, the industry value chain still remains linked by a mix of information systems consisting of advanced e-commerce applications and EDI, email, traditional phone calls and faxes.

It is believed that the implementation of EDI/XML and specifically ebXML would speed up the process of supply chain integration, in particular at upper stages that are populated by SMEs. [62] The increasing importance of XML-based standards is confirmed by the current

[62] The eXtensible Markup Language (XML) is has been designed for ease of implementation and for interoperability with both SGML and HTML. The XML specification defines a standard way to identify structures by adding markup to documents containing structured information. For more

survey data (see Exhibit 3-8). However, EDI-based standards are still commonly used particularly by large companies in the ICTM sector. Furthermore, the *e-Business W@tch* 2006 data indicate that few companies using EDI-based standards said that they intend to move to XML-based standards (see Exhibit 3-9). According to these data, neither large nor small ICTM firms seem to be particularly eager to switch from EDI-based standards to internet-based standards. The **lack of common standards** combined with the **limited ICT capabilities of SMEs** impose the introduction of costly middleware and customised programming. Thus, the potential of supply chain integration is still being limited by **the lack of common standards** and the widely spread use of costly EDI-based applications.

Case studies

The 2006 survey results (see Exhibit 5-2) and the above discussion show that ICT has a positive impact on firm performance in the ICTM sector. However, it has been also shown that the lack of common standards and skills constrains limit the potential of supply chain integration. The following case studies also illustrate these issues. The first case study is about *Linking Business Processes in Supply Networks* at a Finish ICT supplier, which reduced its vulnerability to changing raw material prices by automating supply processes. To achieve this objective, the company joined a supplier network that is facilitated by an independent IT provider. Apart from the cost savings and improved process efficiency, the company and its suppliers enjoy the great flexibility and low operating costs offered by an open application. The second case study describes *Signalion*, a high-tech start-up.[63] Due to an increasing outsourcing trend in telecom equipment manufacturing, the company has taken over activities that were previously conducted by telecommunication companies and producers of telecommunication equipment, i.e. product testing and simulation. *Signalion's* business model is an example of the blurred lines between the actual ICT use and the use of ICT to develop new product or offer services.

information see the Special Report on Standards and Interoperability, available at www.ebusiness-watch.org.

[63] The Special Report on "the role of new companies for e-business uptake" is available at www.ebusiness-watch.org/resources/

CASE STUDY 3: LINKING BUSINESS PROCESSES IN SUPPLY NETWORKS, XYZ, FINLAND[64]

Abstract

XYZ OYJ is an international company manufacturing power systems used, for instance, in mobile network base stations. In recent years, the company experienced rapid growth, which created an organisational challenge to maintain high product quality and flexibility without increasing operational costs.

As materials needed in manufacturing are XYZ's biggest single expense item, the company began planning the digitalisation of its acquisition process in June of 2002. A year later, it began integrating its business processes with its suppliers and completed the projects by the end of 2004. Smooth coordination between XYZ and the suppliers' manufacturing and logistics processes since then guaranteed benefits and increased cost efficiency for both parties.

Case study fact sheet

Full name of the company:	*XYZ OYJ*
Location (HQ / main branches):	*Finland*
Main business activity:	*Power conversion solutions, electronics design, manufacturing services*
Year of foundation:	*n. a.*
Number of employees:	*n. a.*
Turnover in the last financial year:	*n. a.*
Primary customers:	*Telecommunications, Industrial electronics, Healthcare*
Most significant geographic market:	*Europe, America, Asia*
Main e-business applications studied:	*Global supplier integration; Digitalisation of the acquisition process*
Key words:	*Expansion; procurement, automation*

Background and objectives

XYZ OYJ is an international company supplying the telecommunications, industrial electronics and healthcare industries. It provides electronics design and manufacturing services for customers with a need for low and mid-size volumes, quality custom power supply products and systems for converting electricity and ensuring disturbance-free power for electronic equipment. It designs and manufactures, based on its own technology, advanced and customised power conversion solutions that are used, for instance, in mobile network base stations.

XYZ's main customers are within the telecommunications, industrial electronics and healthcare sectors and it supplies the world leaders in their fields, such as Ericsson and Nokia. The firm has operations in Europe, the United States of America and China.

[64] The real name of the company has been witheld.

Product development takes place in Finland, the USA and China – the last one becoming increasingly important as a product-development base.

In recent years, the company experienced rapid growth with geographical expansion in low cost countries (e.g. China & Estonia) and production outsourcing. That, together with international competition and price erosion, created an organisational challenge to maintain high product quality and flexibility without increasing operational costs. To stand up to the challenge the company had introduced **structural changes** and **adjustments through its operations**, pursued lower material costs and continued strong R&D investment during the downturn.

After structural improvements, to address all the problems even more effectively, XYZ decided to introduce e-business solutions independently of the geographical location. Now all the factories share **similar production facilities** and have up-to-date production lines based on automatic surface-mounting and wave-soldering technologies as well as automatic testing lines. In addition, the company manufactures highly standardised products, allowing for flexible manufacturing at any of the firm's plants, which are near the customer. Consequently, production capacity can be further expanded quickly and at a reasonable cost and capacity peaks can be effectively redirected to other facilities.

As materials needed in manufacturing are XYZ's biggest single expense item, the company realised that further expansion of operations required significant **changes in the organisation of the sourcing process**. The need for an improvement of operational efficiency became further evident in light of increasing raw material prices. As part of its future strategy, the company began planning the **digitalisation of its acquisition process** in 2002. The idea of electronic purchase processes arose in the company due to the fact that the production's and material flow's sensitivity to rapid market fluctuations needed improvement. Almost two thirds of the company's turnover goes to material purchases. *"It has fatal consequences if a company cannot flexibly keep up with quick market fluctuations. For example, the amount of capital tied in stocks is considerably larger,"* says XYZ's Vice President (VP), *"we realised that all available improvements in material acquisition and management must be made."*

e-Business activities

The goals of the electronic purchase process project at XYZ were, among other things: automated routine operations, decreased number of human errors, faster data transfer, thinner material flows and, as the result of above mentioned, lower total costs of supplies, increased flexibility and better timing of orders and sales. To this end, XYZ joined an inter-company electronic platform. According to company's VP, *"The choice was based specifically on the company's desire to make production and material flows adapt more flexibly to rapid market fluctuations."*

The project covered 65 suppliers, which account for almost 95 percent of XYZ's purchases. The fact that the solution did not require any investment at all from the suppliers made it easy for them to join the network. Consequently, the biggest suppliers are already piloting EDI connections enabling the data transfer directly between systems. With the remaining suppliers XYZ exchanges data over supplier's intranet, XYZ's own solution.

Error-free document exchange

Formerly, forecasts, orders and order confirmations were faxed to suppliers. If, for example, forecasts are considered, this meant that about 2500 pages had to be faxed every Monday. If a sudden change in the market occurred, an extra forecast had to be faxed in the middle of a week. In contrast, the electronic massage format makes it easy to update order forecasts as well. Today, the suppliers using EDI connections get forecasts and orders directly into their own systems and a few suppliers load forecasts from supplier's intranet to Excel and further with the help of a macro to their own systems.

Earlier, when the documents were faxed, XYZ was not able to control whether suppliers had received forecasts and orders or not. Now the company can even check online whether the messages have been read. If a supplier has not confirmed an order in two days, the system sends a reminding notice automatically. After three days a new notice is sent and if a supplier is still not reacting the system informs XYZ's delivery supervisors about the matter. *"The system is now making a remarkable share of the uninteresting work earlier made by man and therefore very prone to errors,"* says company's VP. Due to the fact that suppliers' order confirmations arrive directly to the XYZ's ERP system instead of being faxed, nobody has to enter them manually into the database. In contrast, formerly three persons were occupied with entering these data into the system. Now the same people can concentrate on controlling if deliveries are actually arriving on time.

Logistics management

The improvements are of great importance to the whole business of XYZ, as one of the conditions of existence in the business is cost-effective logistics. Efficient data transfer guarantees the most optimal logistic processes.

"Now we can react to market fluctuations much quicker than our competitors and due to that we have been able to capture more market shares," says company's VP. The exact part of electronic data transfer in the improved situation is, according to him, difficult to estimate but he believes that it has played a vital role. It has sped up the total delivery process and improved the control. Thanks to that, the number of production interruptions caused by material shortage has decreased. Furthermore, due to electronic networking, XYZ can thin down material flows further and reduce the size of the stocks, which decreases the amount of capital tied in stocks.

System's extensibility

As XYZ's foreign operations continued to expand, the company also extended the use of electronic processes to the Chinese plant in 2004. It includes, as the Finnish system, weekly forecasts and orders to suppliers as well as order confirmations that saved automatically to order stock. Thirty of the 40 Chinese suppliers are already part of the platform. "*When production was launched in the Estonian factory, platform's services were taken into use on the same scale as in Finland and China. Thereby we could not only reap the operational benefits, but could also provide similar operational models for the entire XYZ Group, and the organisation was able to link up with the entire supplier network quickly and easily from different parts of the world,*" says the company's VP.

Impact

"*Thanks to the electronic forecasting, order and order confirmation system, the manageability of the entire operating process has improved significantly, and we have been able to* ***reduce average inventory value*** *thereby increasing turnover*", stresses the company's VP. These are significant savings for XYZ since over half of the company's 2003 turnover consisted of material purchases. The reduction in inventory value has freed funds for more profitable operations. Disruptions in production due to lack of components are nearly non-existent.

It is worthwhile to emphasise the benefits of a common system that joins the company's plants across the world making the production lines more efficient and up-to-date without centralisation. It is easier to make production transfers between XYZ China and XYZ Finland from a material handling point of view and digitalised purchase process made it possible for XYZ China to give forecasts to suppliers making it easier to follow material prices in different markets.

Lessons learned

An important conclusion concerns the significance of **interoperability** for the implemented solution. Adding additional suppliers does not involve substantial marginal cost and can be borne even by small partners. This considerably leveraged the usability of the system by extending its reach to companies that are not able to afford expensive proprietary systems.

Because of linking international network of different businesses across the world, another important experience was mentioned by the company representative: learning about **cultural differences** and becoming sensitive about them, learning to find out if the listener understands what one wants to say.

It was realised that much time was needed to be devoted to teaching the users outside Finland, at the buyers' site and at the suppliers' site and to explain what electronic purchasing process means and what it demands from users. It was very important while introducing the systems to **handle matters from a user's point of view, not from a technical point of view**.

References

Research for this case study was conducted by Aneta Herrenschmidt-Moller (Aneta@HMoller.com), on behalf of e-Business W@tch. Sources and references:

- *Interview with Vice President at XYZ (May 12th, 2006).*
- *Project description delivered by IT service provider (May 2006).*
- *Annual report 2005. XYZ.*
- *XYZ's web site.*

CASE STUDY 4: RAPID PROTOTYPING / SIGNALION, GERMANY

Abstract

Signalion is a high-tech start-up that was created in the course of a research project conducted at the Technical University in Dresden. Founded in 2003, the spin-off developed a rapid prototyping platform, which enables telecommunication equipment manufacturers to test their systems before they are actually built. Thus, it reduces time-to-market and development costs by helping to avoid numerous redesign cycles. During the product development phase, Signalion deploys sophisticated collaborative design applications to design and build hardware and software. This case is an example of the blurred lines between actual ICT use and the development of ICT-based new products or services.

Case study fact sheet

Full name of the company:	*Signalion GmbH*
Location (HQ / main branches):	*Dresden, Germany*
Sector (main business activity):	*Development and manufacture of rapid prototyping systems*
Year of foundation:	*2003*
Number of employees:	*16*
Turnover in last financial year:	*n.a.*
Primary customers:	*Telecommunication equipment manufacturers*
Most significant market area:	*International*
Main e-business applications studied:	*Computer aided product design*
Key words:	*Collaborative work; inter-firm data exchange*

Background and objectives

In 2003, Signalion was founded as a spin-off of the Vodafone Chair at the Dresden Technical University (see how the Vodafone Chair combines research with business in the box below). Financed by founders' capital, in 2005, Signalion launched its first product. The business idea rests on a concept (patent pending) for the development of new wireless communication systems.

Signalion makes intensive use of computer-aided design (CAD) tools, which support collaborative work within the company's team. The final product is a prototyping platform, which is sold to telecommunication companies for testing new network designs or used by Signalion to offer services. The overlapping boundaries between the ICT use for product development and ICT being the centre of the actual product or service provided are quite common in the ICTM industry. This case study illustrates how ICT facilitated an emergence of new service and product markets, which were not present in the past.

Linking research with business

The objective of the Vodafone Chair Mobile Communications Systems at the Dresden Technical University is to carry out leading-edge research, which furthers the advancement of wireless communications technology.

Basic research and close cooperation with industry are key to the success of the projects. Chair projects shall also enable researchers to start-up their own company, based on the work performed at the university. In addition to Signalion, Vodafone Chair research led to the creation of a few others high-tech companies that continue to successfully operate in the Saxony region.

Source: www.vodafone-chair.de (August 2006)

e-Business activities

Signalion has developed a hard-software platform enabling telecommunication equipment manufacturers to test mobile telecommunication systems before they are actually built. The product resembles the concept of flight simulators, i.e. before testing a physical prototype, a fully software configurable communication system is created to work on and to learn from.

The role of ICT within Signalion

In order to comprehend the complexity of modern wireless networks and to design and develop communication systems and tools for their testing, Signalion uses intensively ICT tools to support product development. In particular, according to Mr. Tim Hentschel, Signalion's CEO, the company uses a number of CAD systems. Based on their functionalities, different systems are used to design various components of the prototyping platform. The systems in place include:

- The hardware designed with *PADS of Mentor Graphics*: These applications cover the entire design flow, from design definition through signal integrity analysis, functional simulation, layout and outputs to manufacturing.
- The radio frequency hardware designed with *Microwave Office of AWR* (Applied Wave Research): This application is built on a high-frequency design platform characterised by an open design environment and advanced unified data model, which gives the user a high level of openness and interoperability.
- All physical layer (PHY) algorithms designed and simulated with *Matlab of The Mathworks*: MATLAB is a technical computing language and interactive environment for algorithm development, data visualisation, data analysis and numeric computation. The application is used for signal and image processing, communications, control design, test and measurement. An important advantage of the tool is that its features enable Signalion to document and share the designs.

- The VHDL (**V**ery High Speed Integrated Circuit **H**ardware **D**escription **L**anguage) code for the FPGAs (Field Programmable Gate Array)[65] is designed and simulated with *Modelsim of Mentor Graphics*.
- For the final FPGA design Signalion uses a tool suite of *XILINX*.

A critical issue in designing new products is the efficient data exchange between involved parties. Thus, an indispensable feature of the design systems is to support **collaborative work**. According to Mr. Hentschel, "*The systems allow Signalion to exchange data not only within the team but also with customers and partners.*" The exchange of design data depends, however, on the type of service offered. Currently, Signalion offers two types of services: "*The first type is a consulting service where we design algorithms - mainly with Matlab - for the customers. In this case, source code is exchanged. We also do hardware custom designs. Here the complete design (schematic, layout, Gerber data[66]) is exchanged. The second type of services is a customisation of our systems where we design customised VHDL code that is used to configure the FPGAs in our prototyping systems. No data is exchanged in this case."*

Providing tools for wireless prototyping

Signalion's product is based on a "*Hardware in a Loop*" concept. It starts with the simulation of wireless systems and results in a working prototype at the end. It addresses the problems within the algorithm design stage and provides the designer with a toolkit to build up a prototype step by step on a flexible and scalable hardware platform.

In next steps, more and more parts of the PHY-algorithms of the wireless system are moved onto the hardware prototyping platform. Ultimately, it results in a full working prototype and includes all PHY-algorithms on the hardware platform. This enables a full proof-of-concept of the wireless communications system design at a very early stage of the design process.

Working with the prototype, the designer is confronted with all the problems occurring in reality, such as channel estimation errors, radio frequency impairments, real world radio channel characteristics, and others in the design phase. Therefore, many of the potential design errors can be discovered in the early stages of the design flow.

The system architecture is a scalable solution that allows the application of multiple antennas at the transmitter as well as at the receiver. All hardware components of Signalion's rapid prototyping platform offer at least two independent wireless communication channels to set up multi antenna systems.

The efficiency of the "*Hardware in a Loop*" approach depends heavily on the interface between the software simulation environment and the rapid prototyping hardware platform. This interface must be able to handle high data transfer rates between the simulation software and the hardware. Moreover, it should be as easy to use and to configure as other functions within the simulation environment.

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[65] A field programmable gate array (FPGA) is a semiconductor device containing programmable logic components and programmable interconnects. Source: www.wikipedia.org.

[66] Computer instructions for fabricating printed circuit boards and CAD data. Source: www.wikipedia.org.

Impact

Running an unlimited number of tests and being able to freely modify the design, Signalion is able to simulate various system layouts without incurring the high cost of redesigning conventional wireless chip design flows. The prototyping platform allows for an early verification of potential problems even before the chip design begins. This approach has significant implications for the design process of new communication systems. In particular, as the use of rapid prototyping eliminates the need for building tailored prototypes and helps to avoid numerous redesign cycles, it improves the process of developing new systems in three ways:

- New products can be **more quickly delivered to the market**, which cannot be overestimated considering the current dynamics of the telecommunication equipment market.
- Thorough testing and control in the development phase **reduces the risk of developing faulty systems** and guarantees that the final system complies with all technical specifications and fulfils functional requirements. This, in turn, lowers the cost of rolling-out and maintaining new systems,
- The ease and low cost of new product testing considerably **increases the quality of the final systems**.

Lessons learned

Being a high-tech firm, Signalion has high expectations regarding its workforce skills. The company is an intensive user of programming tools and ICT applications supporting product development, as well as a producer of ICT equipment and provider of sophisticated ICT-enabled services for the telecommunication sector. Thus, Signalion's employees have to master all sides of the product, its development and application.

One of the main obstacles to the company development is the **skills and competence shortage**. According to Mr. Hentschel, "*There are too few highly qualified engineers (…) Regarding the availability of appropriate engineering skills, I must say that it is not so important that the people know how to use a particular tool. The most important thing is that they are motivated, open-minded and well educated in our field of work (i.e. communications and hardware design). They should have some practical experience from projects or internships. Working with a particular tool can be learnt relatively quickly*." The skills shortage problem is additionally intensified by the fact that Signalion faces tough competition from large companies when trying to recruit university graduates.

By maintaining **close links** to the Dresden Technical University, Signalion has access to knowledge unavailable within the company. This, in turn, partially compensates the lack of appropriate skills on the market. Furthermore, networking helped the founders in starting up the company and facilitated an easier access to customers, who were closely cooperating with the University Chair.

References

Research for this case study was conducted by Aneta Herrenschmidt-Moller (aneta@hmoller.com), on behalf of e-Business W@tch. Sources and references used:

- *Telephone interview and e-mail correspondence with Mr. Tim Hentschel, Signalion's CEO, in July 2006.*
- *A Flexible Prototyping Platform for Wireless Communication Systems, Matthias Stege, Signalion GmbH.*
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- *Websites:*
  - Signalion, www.signalion.com
  - Vodafone Chair Mobile Communications Systems, TU Dresden, www.vodafone-chair.de

4.3.3 Summary of main points and conclusions

According to survey results (see section 5.1) and the discussion in the preceding sections, the diffusion of advanced ICT tools has had a significant impact on the organisational structure of firms and the value chain in the ICTM industry. For example, nearly half of the surveyed companies in the ICTM sector reported that ICT influences the organisational structure of their company, while one third reported similar influences on their outsourcing decisions (see Exhibit 5-4). Furthermore, as argued above, ICT has enabled equipment makers to adopt demand-driven production and a standardised organisational structure, which result in significant inventory and overhead cuts. However, although the sector is an ICT forerunner (see section 3.9), one could argue that there is still underutilised potential, for example in areas such as inter-firm collaboration and integration (see Exhibit 3-16), where the use of ICT can further increase the efficiency of operations along the value chain.

The following points summarise the key implications of ICT for the industry value chain and outline some future developments.

- **ICT facilitates lean organisation**: As ICT enabled companies to exchange information more efficiently, outsourcing and focusing on core competencies became a standard practice in the industry.
- **Standardised processes follow standardised ICT**: Firm structure in ICTM I seems to follow the modular architecture of the industry products. ICT systems deployed along the value chain and based on common standards facilitate the emergence of standardised business processes and organisational structures. This gives companies access to a larger supplier pool and enables them to expand their reach.
- **Demand-driven production**: Companies in the ICTM I utilise ICT tools to manufacture products for which there is a demand on the market. This leads to a more efficient allocation of resources and higher customer satisfaction.
- **Information replaces inventory**: The main benefit of ICT is the substitution of resources and physical activities by information, i.e. the information exchanged between value chain partners reduces the need for inventories kept at various stages of the manufacturing process.
- **Standards required**: A common infrastructure and set of standards enable all companies to benefit from the potential of ICT without investing in private networks. Unfortunately, a lack of standards hampers the process of supply chain integration.

4.4 Who benefits from e-business?

The following section summarises the most recent findings from the 2006 e-Business Survey, as well as from empirical research on ICT and firm performance. Due to the novel character of the topic, most of the results are generalised and not available for particular industries. However, according the survey results, companies in the ICTM sector frequently report positive impact of ICT on their performance (quantitative information about the impact of ICT and e-business on company performance in the ICTM sector can be found in section 5.1). Similarly, the results of a thorough empirical analysis of the subject is presented in the Special Report on *Impacts of ICT on corporate performance, productivity and employment dynamics* indicate that, although not straightforward, there is a positive relationship between the deployment of ICT and positive company performance.[67]

A key finding from previous *e-Business W@tch* studies[68] was that ICT is an important driver and enabler of innovation (see section 3.7 in this report). Continuing this line of research, the following section assesses the implications of ICT and e-business for productivity, employment and market share development in the ICTM manufacturing industry. In addition, this section aims to answer the question of what firm or industry factors enable companies to benefit from e-business solutions.

4.4.1 ICT and innovation

An analysis of financial performance measures and innovation activities revealed that the more innovative firms are more likely to grow, which should increase their chances of survival in the market (Koellinger 2005).[69] Plants that manage to incorporate advanced ICT systems, process control technologies or even advanced packaging technologies tend to grow in terms of their relative productivity (Baldwin et al. 2003). In turn, productivity growth driven by adopting these technologies leads to growth in market share. Eventually, **ICT increases the chances of market success**.

Empirical examinations indicate that the most successful and innovative ICT projects are accompanied by **co-inventions** and/or co-investments. Co-invention means that "*users of ICT often help make their investments more valuable through their own experimentation and innovation, e.g. the introduction of new processes, products and applications. Without this process of "co-invention", which often has a slower pace than technological innovation, the economic impact of ICT would be more limited. Firms that have introduced process innovations in the past are often particularly successful in using ICT. This is particularly important in services, as ICT helps firms in re-inventing business processes and developing new applications*" (Pilat 2006).[70]

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[67] The document can be found at www.ebusiness-watch.org ('resources').

[68] For example, see *e-Business W@tch* Sector Study on the Automotive Industry (July 2005), available at www.ebusiness-watch.org ('resources').

[69] A more elaborative analysis of the relationship between ICT, innovation and firm performance in the ICT industry will be a part of the Final Report on the ICT and e-business in the ICT industry.

[70] Alternatively, co-inventions are called 'innovational complementarities', see Bresnahan et al. 1995.

The digital divide between small and large companies has been a great concern for policy makers. The fact that SMEs lag behind large firms in terms of the ICT adoption raised an issue of whether this could impair the competitiveness of SMEs and slow down overall productivity growth in Europe. However, as indicated in previous reports, taking market- and firm-specific factors into account, companies make rational investment decisions and select applications that match their particular needs.[71] In other words, not only ICT and ICT-enabled innovations determine a firm's success. An investigation of the association between ICT, R&D, innovation and profitability revealed that the **R&D intensity was greater for smaller firms** while **ICT innovation was stronger in larger companies** (Vemuri et al. 2003). Furthermore, the two separate strategies of deploying high R&D intensity or investing heavily in ICT innovation yield **similar profitability outcomes**. Intensive pursuit of one of these strategies was sufficient for profitability.

These theoretical conclusions are confirmed by the empirical findings of the e-Business Survey 2006. Although on average less innovative, SMEs reported using ICT more often to conduct both product and process innovations (see Exhibit 3-31). Thus, the creative use of ICT might compensate for the, on average, lower levels of ICT diffusion and lower innovation capabilities among SMEs. The positive impact of ICT on SMEs' performance has been also confirmed in the ICTM industry (see Exhibit 5-2). Furthermore, case studies conducted for this report illustrated that, in many cases, while innovation is crucial in a company's strategy, the use of ICT is treated as a supportive element (see, for example, the case study about *Option*, section 4.4).

There are two critical complementary factors enhancing the productivity growth from ICT investments: **organisational change** and **skills base**. They are important for the success of organisational innovation. The most important factors complementing the adoption of ICT and contributing to larger gains from ICT investments include, among others, a firm's experience in innovation, its use of advanced business practices and the intensity of organisational restructuring (Gretton et al. 2004). Furthermore, the adoption of **ICT triggers organisational changes** such as the introduction of total quality management, lean administration, flatter hierarchies and the delegation of authority, giving companies an opportunity to modernise their operations (Falk 2001). The empirical findings of the e-Business Survey 2006 also confirm that ICT has an impact on organisational structure, job or tasks description and employee training (section 5.1).

Besides playing a decisive role in the success of ICT implementation, the relationship between a firm's workforce and the intensity of ICT use has two more aspects. First, across manufacturing industries, **ICT substitution** for lower cost labour appears well advanced, and more remaining employees tend to be better skilled and active information users (Clayton 2005). Second, as **higher wages** are positively correlated with ICT investments, it seems that companies in the manufacturing sectors are aware of the strong complementary effects between ICT and the workforce skills and tend to award their staff accordingly. The importance of appropriate skills for ICT-intensive activities has been illustrated in the case study about *Signalion* (section 4.3).

[71] For example, see *e-Business W@tch* Sector Study on the Automotive Industry (July 2005), available at www.ebusiness-watch.org ('resources').

4.4.2 Which technologies offer greater benefits?

Data from the e-Business Survey on the diffusion of ICT applications indicate that there are substantial discrepancies between the adoption rates of various technologies in the ICTM sector. For example, while companies accounting for almost 70% of the sector's employment said that they place orders online, the respective share for accepting orders online is 27% (see Exhibit 3-18 and Exhibit 3-26). Before drawing a premature conclusion suggesting market failure, it might be worthwhile to analyse the benefits from different technologies. As indicated by a recent empirical study, some ICT technologies might have a stronger effect on firm performance than others (EC 2004a). Furthermore, other characteristics such as country of origin or the industry in which a firm operates, might determine whether a firm can count on positive returns on its ICT investments. In particular:

- **Start-ups enjoy higher productivity gains from ICT investments**:[72] productivity effects of hardware and software are **30%** greater in younger manufacturing firms compared to older firms (Clayton 2005). This result confirms the relevance of organisational design or its change. Start-ups do not carry the balance of organisational structures that evolved over the past and are not locked-in into the traditional ways of doing business. Thus, by adopting new technologies they are able to immediately adjust their processes to new requirements and to maximise the benefits offered by new tools. An example of how a start-up company makes use of advanced ICT applications in product design was presented in the case study about *Signalion* (section 4.3).

  In contrast, in order to reap the benefits of the installed ICT applications, older firms need to go through a lengthy, complex and costly way of business process re-engineering. Again, this is in line with the discussion in section 4.1 where it was argued that incumbent companies are not fast enough to react appropriately to emerging technologies and are overthrown by aggressive newcomers. Furthermore, start-ups are assumed to have a younger and better ICT-skilled work force. Thus, their co-investments in ICT skills might be expected to be considerably lower, compared to older firms. The relevance of organisational change and the improvement of ICT-skills as complementary efforts to ICT investments are discussed in section 4.4.1. The pros and cons of adapting the organisational design to the requirements of ICT systems are illustrated in the case study about *RCD* (section 4.4).

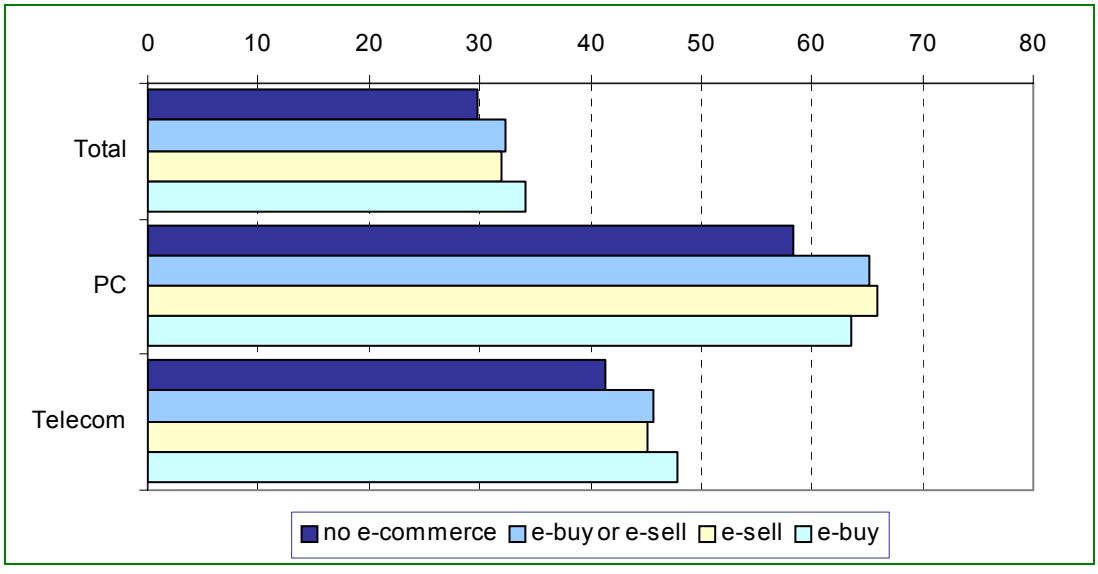
- **Service sectors exhibit higher ICT productivity gains** compared to manufacturing industries (Clayton 2005). As a number of companies in the ICT industry place increasingly more emphasis on services accompanying ICT equipment rather than on manufacturing, the immediate implication is straightforward: the deployment of the ICT tools in service areas should yield greater benefits than in manufacturing activities.

[72] See Special Report on The role of new companies for e-business uptake is available at www.ebusiness-watch.org/resources/

- **Computer networks** and applications supporting **inter-firm cooperation** might be of particular importance, as they allow a firm to outsource certain activities: to exchange information between suppliers and customers and to integrate processes along the value chain. The positive effects of these technologies are associated with network or spill-over effects. Networks were estimated to **increase labour productivity** by roughly 5% (Atrostic et al. 2002 and 2005). This confirms the conclusions of the discussion in section 4.2 suggesting that inter-connected enterprises benefit from improved information flow and greater innovation capabilities. Some benefits of integrating operations with customers and suppliers along the vale chain are illustrated in the case study about *Option* (section 4.4).

- **Online procurement vs. online sales**: the comparison of the impact of online procurement and online sales yields surprising results (see Exhibit 4-6). Whereas the most significant and largest productivity gains, associated with e-commerce use, stem from online procurement, **electronic selling lowers productivity**, as measured in terms of value added (EC 2004a). The explanation of these results is related to the most commonly cited impact of e-commerce on markets, i.e. that the internet increases market transparency, lowers search and supplier switching costs and improves the management of the supply chain. Thus, while companies procuring electronically seem to enjoy these benefits, firms selling their products online suffer from the negative effect of the internet on prices. Interestingly, **the ICTM I** sub-sector stands out of this general trend. As this sector has been most revolutionised by the information economy, it might be presumed that firms in this sector have moved further to change business processes and methods of working to match the new technology. Therefore, they may be able to achieve gains from e-selling. In addition, as discussed in section 4.3, many firms in the ICTM I deployed ICT to "leapfrog" the value chain to their final customers, reducing intermediaries and appropriating some part of their value added. This has been illustrated in the case studies about *RCD* and *Option* (section 4.4), with both companies using electronic channels to get a direct link to their customers.

Exhibit 4-6: Value added per employee, 2000 (£´000s)



Source: e-commerce and firm performance, EC 2004a.

- **ICT-driven growth tapers over time**: Productivity growth effects in industry sectors diminish over time, indicating that the ultimate productivity effect from adoption of one form or generation of ICT is a step up in levels, rather than a permanent increase in the rate of growth (Gretton et al. 2004). Naturally, further technical developments can trigger further productivity-enhancing processes. Thus, **either technological forerunners or firms constantly evolving can sustain the advantage stemming from ICT**. This issue is illustrated in the case study about *Tesla* (section 4.4), whose management realised the potential danger of being locked in obsolete ICT systems. They, therefore, decided to replace their stand-alone applications, which severely limited the company's organisational flexibility, with an integrated ERP system.

Case studies

The results of the e-Business Survey (see section 3.7) and the findings of empirical research indicate that ICT retains its innovative potential. Evidence gathered from interviews with companies' representatives also confirms this finding. The following three case studies illustrate how companies use ICT to change their business practices or to introduce new products. The first one demonstrates how *Tesla*, a large ICT manufacturer from the Czech Republic, progressed in its use of ICT to support internal processes and production management. The second case study describes how *RCD Radiokomunikace* was able to improve process quality management thanks to the implementation of a new management information system. In addition, the case study describes *RCD's* experiences in using e-marketplaces and the resulting impact on its business strategy. Finally, the case study about *Option*, a Belgian developer and manufacturer of wireless telecommunication technology, is an example of how to counteract new technological developments by maintaining the right innovation strategy and using ICT to support it.

CASE STUDY 5: TRANSFORMING INFORMATION MANAGEMENT AT TESLA, THE CZECH REPUBLIC

Abstract

Tesla is a Czech manufacturer of radio and communication technology products. Since 1995, the company has been developing its IT infrastructure with the aim to improve process efficiency and to support the information management. This was due to the company's expansion to the new markets and a stringent need to gain a better control of its complex business processes. Tesla introduced a number of several information management solutions, which serve now as a linchpin for its core operations. However, an inconsistent and disintegrated approach towards the systems implementation did not allow a desired workflow support and made the company review its requirements to information management. As a response to this, Tesla is now implementing a unified Enterprise Resource Planning (ERP) system.

Case study fact sheet

Full name of the company:	*Tesla, plc*
Location (HQ / main branches):	*Prague, the Czech Republic*
Sector (main business activity):	*Manufacture of television and radio transmitters and apparatuses for line telephony and line telegraphy (NACE DL. 32.2)*
Year of foundation:	*1921*
Turnover in last financial year:	*400 million Euro*
Number of employees:	*297*
Primary customers:	*Telecommunication companies from Europe, Asia, Africa and South America*
Most significant market area:	*Development and manufacture of radio communication technology*
Main e-business applications studied:	*Information Management Systems;* *Automation and integration of internal processes*
Key words:	*ERP, the evolution of ICT requirements*

Background and objectives

Established in 1921, Tesla[73] held a state-sponsored monopolistic position in electronics production until the collapse of the socialist economy in former Czechoslovakia in 1989. Confronted with increasing competition, Tesla responded with a comprehensive reorganisation of its conglomerate structure. This led to significant downsizing and Tesla's transformation into a public limited company followed by its privatisation in 1993. While maintaining its wide electro-technical portfolio range, Tesla has narrowed its operations to the design and production of radio and television transmitters and antenna systems. Today, the Czech market makes up a considerable 65% of its sales while 25% and 10% of its sales are generated on the European and the world markets respectively.

[73] An acronym from the Czech "***Te**chnika **SLA**boproudá*" meaning "Light-current Technology"

The undergone transformation provided an opportunity to review business processes within the company and revise its strategic goals. Considering the large size of the company and the complexity of its technological processes, a considerable effort had to be exerted to manage and coordinate Tesla's operations. To this, Tesla identified a need for **process automation** and a well-functioning **information management**. Furthermore, as capital equipment constitutes the main part of Tesla's product portfolio, it was of great importance to shorten the lead-time in production and, thus lower the manufacturing costs. In order to achieve these goals, Tesla deployed an **ERP** solution.

At the beginning of the development of company's ICT infrastructure, Tesla started with basic applications covering a few business functions and proceeded with the introduction of more advanced systems. Providing support for internal organisation they play a crucial role in sustaining Tesla's operations. These **stand-alone** and subsequently integrated ICT systems were targeted at Tesla's most urgent business needs. This approach, however, resulted in a high complexity of the ICT infrastructure and a lack of interoperability between the solutions. Having learned from previous experience, Tesla defined a plan for better information management and is now planning to implement a sophisticated ERP system in order to address the changed business requirements. The evolution of Tesla's ICT framework supporting the business processes in the company is a central topic for further discussion.

e-Business activities

Initially, EFAS Software provided by Pragodata, an IT provider from the Czech Republic, formed a basis for information management in Tesla. EFAS comprised a number of the following functionalities:

- A finance and accounting module supporting the record and process of financial and accounting transactions,
- A warehouse module managing and tracking inventory,
- A billing module generating invoices to the customers,
- An asset management module managing fixed assets.

Beginning in 1995, Tesla started advancing its existing applications and introduced the new ones with an extended scope of functions. The installation as well as operating maintenance of almost all of Tesla's ICT systems was outsourced. Thereby, EFAS was replaced with its upgraded version, SCBA solution, provided and maintained by Pragodata's successor SoftCell. The new system supported the same business processes as EFAS. As an ICT system serving for the production needs, including the preparation of production, production management and control, Tesla uses an in-house developed application called ASR. Originally, it was used in one of the company's manufacturing departments and was later exploited throughout the enterprise. Design and technological development of Tesla's products is enabled by the SYSKLASS system named after its supplier. Payroll functions were performed by the EconFis system from the Czech company IDS Scheer.

Most of the above mentioned systems run on **UNIX**, an Open Source operating system. The advantage of using Unix was seen in its terminal server architecture, which allows

multitasking and data-processing simultaneously by multiple users. Parallelly, some minor applications work on the Microsoft Windows platform and a few run on Oracle database.

As it appears, Tesla overlooked the opportunity to **standardise** its ICT infrastructure by using compatible systems, and thus to take advantage of a unified business environment and a more cost-effective approach to its enterprise resource planning. Acquiring separate solutions Tesla did not have a long-term plan for the information management in the company. Instead, the company took a different, step-by-step approach and concentrated on taking immediate actions to address its organisational complexity. Tesla's main objective was to find and launch specific ICT systems that would support particular business processes. The systems were introduced in stages and the implementation of each lasted about twelve months. A major drawback of these ICT systems was that they were not designed to be compatible with each other and the integration between them was not such that it required subsequent effort from Tesla to develop the interfaces to connect them.

As a result, the communication between the ICT systems involves collecting and processing of the transactions and updating the master files at scheduled intervals. Some interaction between the systems is permitted by the use of the database, called PROGRESS, which pools and updates all the data from SCBA, EconFis and ASR systems. This provides a simplified and easy-to-use view of the data for the users, though limited by the scope of the systems included in the database.

The ICT systems described form a core of the business management in Tesla and were effective in addressing the then company's key needs. However, as the company is redesigning its business processes, the systems deployed are no longer able to solve emerging information management issues and create obstacles to its further development. In particular, most of the processes within the company had to be adapted to the current ICT systems. Such process customisation is especially painful considering the need for processes' development and evolved best practice controls, which the old systems do not include. Furthermore, designed as independent solutions, they require significant costs, both in terms of time and money, to maintain their integration.

As a result, Tesla found itself **locked in** the information management tools that are *"managing the company"* and thus call for new technological initiatives. Thus, the next advancement will be the introduction of a single ERP software package that will cover almost all of the company's activities and will eliminate the **interoperability problems**. Tesla has just started a new project and it is now in the planning phase. The tender process to select an appropriate solution will be held at the end of 2006 while the actual implementation of the chosen ERP is scheduled in the second half of 2007. As it turns out, the independency of the current information management systems, a feature creating a number of problems for the company and pushing towards a uniform system, will play a crucial role in maintaining seamless operations during the transition to the new ERP software. Thus, the company will be able to continue its everyday activities within independent modules until the equivalent parts of the new systems are introduced.

Impact

The adoption of the ICT systems had a positive impact on company's information management and production planning processes. In particular, the modernisation of the operations and process innovation brought by the information management solutions facilitated a successful restructuring of the company. Having created a framework for the core business activities, the ICT systems, as Mr. Ondrej Lakomy, IT manager at Tesla, says, "*enable the existence of the company*".

The foremost positive impact delivered by the information management systems was that they sped up the underlying processes, a strategic issue for Tesla. Apart from this, they reduced the burden of paper work and improved the control of information across the company.

Though the importance of the existing ICT systems at Tesla is undeniable, the inconsistent approach to their implementation had a number of negative outcomes and impacts for Tesla:

- The existing information management systems failed to establish a flexible business environment in the company and to embrace all the necessary controls. This increases the complexity of interfacing between the systems. As a result, maintaining the systems requires from users specific knowledge and skills.
- The current systems are considered outdated as well, which poses additional constraint on the maintenance capabilities.
- The annual costs to maintain the current ICT systems amount to 69,000 euros, which from Tesla's point of view does not match their actual capabilities. Besides, in running the systems, Tesla is heavily dependent on the suppliers of each solution, not all of which are reliable enough. This creates a risk for the sustainability of internal business operations.

Lessons learned

The lack of interoperability made Tesla aware of the need for an **integrated and cohesive approach** towards information management. Mr. Lakomy comments: "*We have to look farther into the future, beyond the current tasks and problems, and attempt to anticipate business requirements and development perspectives as well as to fully realise the value that stems from a well-organised internal business management.*"

Tesla also recognised that successful ICT system implementation is underpinned by strong project management and an active **engagement of the main stakeholders** outside the IT area. Project teams, occupied with the implementation of the current ICT systems, were mostly technical- and not process-oriented. Furthermore, they did not took into account the objectives that the solution was to achieve in the overall company's context. Tesla acknowledges that they substantially undervalued the importance of the **human factor** in the implementation and use of their information management systems. "*The project implementation team should be more focused on the dissemination of the systems' "philosophy" and accomplishment of the business-related tasks rather than going too far into technical and organisational issues*", Mr. Lakomy emphasises.

What is more, Tesla saw a need to shift focus from back-office applications to front-end services. It considers **the lack of interaction with customers and suppliers** as one of the main drawbacks of the current solutions and contemplates addressing this problem with the forthcoming ICT project.

Keeping these lessons in mind, Tesla is now applying a radically different approach to the implementation of its new information management system. The main emphasis will be on the functionality and operating capacity of the system. Therefore, Tesla is opting for a comprehensive ERP solution able to effectively integrate disparate business processes, to enhance internal analysis and control in order to reach a higher development level.

References

Research for this case study was conducted by Oksana Pryshchepa, DIW Berlin, on behalf of e-Business W@tch. Sources and references used:

- Telephone interview with Mr. Ondrej Lakomy, IT manager at Tesla, July 25, 2006
- Questionnaire submitted to Mr. Ondrej Lakomy.
- Website of Tesla, plc.: www.tesla.cz (August 25, 2006)

CASE STUDY 6: QUALITY NOT PRICE AT RCD RADIOKOMUNIKACE, CZECH REPUBLIC

Abstract

RCD Radiokomunikace is a Czech producer of customised radio-systems. Despite its small size, the company has been intensively expanding its ICT infrastructure and e-business activities. First, in 2001, RCD implemented a new enterprise resource planning system. This represented the final step towards achieving ISO quality management certification, which was one of the main customers' requirements. Second, for the last two years, RCD has successfully experimented with e-markets. Until now RCD used e-markets primarily as an information source, currently about five percent of total revenue is generated through transactions initiated on e-market. The company plans to build up their own e-market to avoid some of the drawbacks that they have experienced, including competition based only on price.

Case study fact sheet

Full name of the company:	*RCD Radiokomunikace spol. s r.o.*
Location (HQ / main branches):	*Pardubice, Czech Republic*
Sector (main business activity):	*Research, development, production and installation of commercial of antennas, filters, radios as well as accumulators and other radio accessories*
Year of foundation:	*1993*
Turnover in last financial year (2005):	*4.6 million Euro*
Number of employees:	*84*
Primary customers:	*Government and GSM operators*
Most significant geographic area:	*Czech Republic, Germany, EU*
Main e-business applications studied:	*Quality certification and an enterprise resource planning system;* *e-marketplaces and auctions for government and private sector contracts*
Key words:	*Quality management, growth*

Background and objectives

RCD Radiokomunikace (RCD) was established in 1993. It has since grown to 84 employees and has had an average annual turnover of 4.6 million Euro over the last few years. The company specialises in development and production of specific components, assembly, final testing and certification for professional radio systems. RCD's major customers include the Czech Interior Ministry, the Defence Ministry, Radiomobil and Český Mobil as well as Ericsson, Eurotel, and HFWK Kölleda. Over the last year, RCD increased its exports by 300%.

In the highly competitive market of professional radio communications, RCD has invested above the average (for small and medium enterprises) into **research and development** and is also an **intensive ICT user**. For example, it has implemented an up-to-date ERP system that helped the company achieve its ISO **quality certification**. Furthermore,

since 2004, RCD has been participating in **e-marketplaces**. The following section describes in detail the company's experience with e-business.

e-Business activities

ERP and quality management

In order to achieve ISO quality management certification, RCD needed to modernise their business and production management as well as finance, accounting, economic analysis and human resources systems. For RCD, the **benefits of achieving certification** include an improved understanding and consistency of all quality practices within the organisation, better documentation, higher customer and supplier confidence and stronger relationships. In order to achieve high quality of process management, RCD decided to deploy an enterprise resource planning solution (ERP). The company chose K2 Atmitec to install and maintain an ERP system. The system was fully implemented by March of 2001. Comprising of a number of modules, it supports all internal workflows, functions and data flows. Examples of business processes facilitated by the ERP solution include sales, purchasing, inventory management, production planning, marketing, accounting and controlling.

Implementation and running costs

The implementation costs amounted to approximately five thousand Euro for the licence, about fourteen thousand for the implementation itself and around three thousand for further hardware and software. The running costs total three thousand Euro per year.

e-Markets and price competition

In 2004, RCD actively began participating in several e-marketplaces. The prime motivation behind this strategic move was to **adapt to new market challenges and requirements**. Some of the markets that RCD regularly uses include Centrade, Allytrade and B2B Centrum. All of them are based in the Czech Republic. Other sites that are heavily used are SEPO and Central Address, the e-market of the Czech Department of Defence and the government in general. On the EU level, RCD regularly scans the Ted (tenders electronic daily) database, which is managed by the EU Publications Office.

Without the use of e-markets, RCD would not be able to obtain government contracts that constitute a significant percentage of their work. Mr. Karel remarked, "*The government authorities are trying to help fight corruption by issuing all of their new contracts, including a detailed listing of requirements, on e-markets*." Mr. Karel went on to sum up his experiences with e-markets till date as that *"we do not see any other way than e-business for some of our products, and there is significant market pressure to expand the range of products we purchase and offer using the internet."*

Regarding costs, since RCD currently uses e-marketplaces purely as a source of information and does not directly sell via e-market activity, **no significant costs** result. All computer workstations at RCD are connected to the internet and the existing software and hardware (up-to-date computers, Windows OS, broadband connection) are sufficient for handling all e-market activity.

Apart from using e-markets as an information source, RCD sells some products over e-auctions as well. However, this is only carried out on a limited basis and only in the case of **standardised products**. A specific drawback that RCD observes is that in e-auctions, **price is the only major factor** driving transactions.

Impact

Both the implementation of the new ERP system and the resulting certification as well as the recently introduced e-market activity have had significant impacts at RCD.

For RCD, improving the quality of internal processes facilitated by the ERP application enabled it to meet the ISO requirements. As many customers required RCD to obtain an ISO quality certificate, this move has opened up new opportunities. However, it also had an impact less visible to the outside. All processes starting form inquiry and purchase order to implementation and invoicing are now transparent, reliable and secure. The new system has considerably increased the efficiency of some departments and reduced the error rate. All company activities that have an impact on the quality of design, development, production, installation and maintenance are now consistently recorded, monitored and evaluated in compliance with the standard. Mr. Karen states, *"The feedback gained through such an evaluation is used as a way to bring about further quality enhancements."* Furthermore, all the employees are engaged in the quality system in one way or another.

From a subjective point of view, the impact of having a modern enterprise control system in place on RCD's operations is quite substantial. Mr. Karel observes, *"Without its support and functionality, we would not be able to provide the current level of service, both in value and in quality."* However, a quantitative analysis of the impact the new system has had on RCD has not been performed.

Lessons learned

For RCD, the new ERP software needed not only to meet all of their needs, but the product also had to be user friendly. This required a **sizeable amount of customisation** and meant that the supplier had to remove all aspects and all modules that were not needed. The IT provider's willingness to adapt the software to RCD's needs heavily influenced RCD's decision in choosing K2 Professional. In hindsight, according to RCD, this was a very wise choice and permitted the **modernisation** of many of RCD's systems **without** requiring very expensive and time-consuming **re-organisation** of all the business processes. After the system was installed and fully implemented, only a few bugs had to be fixed. Today, according to Mr. Karel, the system "*meets all current requirements and we are satisfied that it is user friendly, reliable and secure*". All problems and upgrades are solved at the technical level, without any involvement by the company's management.

RCD has also realised that e-marketplaces and e-auctions are the future sales channel for certain products. Furthermore, decisive market pressure is moving in this direction. *"It is a big trend today to use e-business,*" says Mr. Karel. However, regarding online markets and auctions, RCD had both **positive and negative experiences**. One of the

biggest observed differences between e-markets and traditional ways of doing business is the lack of face-to-face interaction. Furthermore, when asked about the most important lessons learned, Mr. Karel mentioned that *"only certain standardised products can be sold in e-auctions because there is only one real criterion – price. Thus, the most important point to consider when using e-auctions is to choose the right price-offer strategy."* However, RCD designs and produces highly customised products, which do not lend themselves to be sold at e-auctions. Thus, in order to maintain the control over the sales process, RCD is currently **contemplating** designing and operating its **own e-market**. By deploying a custom-tailored online venue, in which RCD would efficiently and effectively present its products and services, the company expects to reduce sales cost. Even more importantly, RCD would be able to move away from competing "only on price" and, at the same time, reduce its dependency on intermediaries.

References

Research for this case study was conducted by Aljoscha Kaplan (akaplan@diw.de), on behalf of e-Business W@tch. Sources and references:

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- *Websites (all August 2006):*
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  - International Organisation for Standardisation, http://www.iso.org/iso
  - K2 Atmitec, http://www.k2atmitec.com
  - ATLAS Consulting, http://www.atlascon.cz

CASE STUDY 7: ICT, INNOVATION AND GROWTH MANAGEMENT AT OPTION, BELGIUM

Abstract

Option is a Belgian developer and manufacturer of wireless technology products. Due to the intensive development of the mobile communication market, Option has recently experienced rapid growth. Consequently, the company has faced a challenge to keep up an innovative and entrepreneurial spirit, while expanding its product range, geographical reach and manufacturing capacities. The case study describes how the company takes advantage of modern ICT applications to manage the rapid expansion, to design the appropriate organisational structure and to find the right balance between operations that should be kept internal and those that could be outsourced.

Case study fact sheet

Full name of the company:	*Option*
Location (HQ / main branches):	*Leuven, Belgium*
Main business activity:	*Wireless communication and data solutions*
Year of foundation:	*1986*
Number of employees:	*341*
Turnover in the last financial year:	*€ 0.2 Million*
Primary customers:	*Business and consumers*
Most significant geographic market:	*International*
Main e-business applications studied:	*Product design; Engineering Workflow Management System; Personal Performance Measurement System; e-Shop*
Key words:	*Growth management; R&D and ICT strategy*

Background and objectives

Founded 20 years ago, Option is a medium-sized company specialised in designing, developing and manufacturing products for wireless solutions. Due to the intensive development of the mobile communication market, Option has recently experienced rapid growth. However, with a diversifying product portfolio and increasing production volumes, the company faces the challenge of preserving the entrepreneurial spirit and innovativeness common to a small high-tech company while increasing the scope of operations and production volume. To reach this goal, Option takes the following measures:

- R&D and new product development are given the main priority.
- Significant efforts are made to ensure that the right systems and structures are in place and allow Option to stay at the cutting-edge and to sustain growth,
- Suppliers and customers are in close cooperation, which facilitates an ongoing technical dialogue and ensures that only products for which there is a demand are being developed,

- By networking with other companies, Option takes advantage of their expertise or production capacities, which allows it to focus on its core activities.
- Being a provider of ICT equipment, the company is also an intensive user of ICT systems. Applications that are currently being used support the entire product life cycle beginning with product design, testing, production, quality control and sales.

e-Business activities

R&D

One of the R&D areas is the development and seamless integration between GPRS, UMTS and Wireless LAN networks. The ability to design and develop new products in depends on a number of factors. These include: the ability of the company to attract and retain skilled technical employees, the availability of critical components from third parties, the ability of the company to successfully complete the development of products in a timely manner and the ability of the company to manufacture products at an acceptable price and quality. A failure by the company or its suppliers in any of these areas, or a failure of these products to obtain commercial acceptance, could mean the company is unable to recover its research and development expenses. This, in turn, might result in a decrease in its market share and revenues. According to Jan Callewaert, President and CEO of Option, "*Preserving our technology leadership and investing in new product development remain key priorities for Option. As a result we continue to create new market opportunities for the company with the introduction of new products.*"

Designing and testing

As mentioned above, new product design is Option's core competency. In order to take advantage of collaborative product design, the company became a client of an **on-line resource platform** dedicated to accelerating the development of wireless networking products. The portal provides a comprehensive resource for system designers by delivering a powerful array of solutions and information in a single location.

Semiconductors constitute the central focus of wireless networking equipment design. Given the dynamic nature of the technologies and standards associated with wireless networking equipment, the ability to program continues to be an important feature of the designs. Thus, to address the complexity of the designs, the development of new products is centred on a field programmable gate array (FPGA).[74] According to Bernard Schaballie, VP of Engineering at Option, "*FPGAs present a compelling solution for the wireless market where wireless technologies and standards are constantly changing. With the increasing number of gates available today at such competitive price points, FPGAs will help wireless manufacturers to design products in much shorter design cycles.*"

[74] FPGA is a semiconductor device containing programmable logic components and programmable interconnects. The programmable logic components can be programmed to duplicate the functionality of basic logic gates such as AND, OR, XOR, NOT or more complex combinational functions such as decoders or simple math functions. www.wikipedia.org

The use of web design tools proved to be successful. The portal has been optimised specifically for wireless applications. Consequently, it gives the company access to a knowledge pool targeted for applications ranging from a 3G wireless base-station to a wireless handset. In addition, Option might view and analyse solutions ranging from specific reference designs to design concepts created in the course of collaboration with other companies active in the areas of cellular networks, fixed broadband wireless and wireless LANs. The site is also offering useful information, including wireless technology tutorials, market overviews, system block diagrams, extensive glossaries and a directory of wireless experts.

In the process of testing new products Option intensively uses ICT applications. For example, the company's internal system product quality team also develops and maintains its own automatic test systems that are capable of monitoring everything from the physical layers to the application parts. At the same time, the company relies on external expertise. For example, Option has used Ericsson testing centres to field test high-end components. David Callaert, Technical Coordinator of System Engineering at Option, says that "*this type of testing required teamwork and cooperation between both companies. Ericsson's professionalism was instrumental in the success*."

Manufacturing

Despite the fact that Option still maintains in-house manufacturing, the company is **outsourcing** a large part of manufacturing operations to third parties. For manufacturing Option's products, the company relies on Jabil Circuit, a contract manufacturer specializing in the production of electronics. The outsourcing agreement allows Option to improve its current working capital situation and reduce overall costs by leveraging Jabil's supply chain solutions and material procurement advantage. This partnership provides Option the opportunity to redeploy various resources and in doing so further strengthens its **core R&D competence**. Bart Goedseels, VP of Operations at Option said that "*Outsourcing reduces Option's financial exposure significantly at the time where the company is coming out with a new generation of multiple products in volume*."

Although Jabil Circuit's Milan facility remains Option's primary contract manufacturing partner, the company has not given up internal manufacturing completely. Option's production engineering and logistics facility in Cork, Ireland, now has 18 operational product assembly lines. With its ability to run orders for several customers in parallel, the facility is central to serving Option's portfolio of more than 70 customers. Furthermore, in order to reduce the dependency on one production source, the management decided to appoint a second manufacturing partner. Celestica in the Czech Republic commenced manufacturing operations in January of 2006.

Spreading manufacturing activities between various locations and partners and the need for **undisrupted information flows** to meet market demand for the company's products requires an appropriate system capable of interconnecting the organisations involved. In order to facilitate smooth information exchange, a new SAP **Engineering Workflow Management System** is currently being implemented. The new system will link the company sites in Belgium, Ireland, Germany and Sweden as well as contract manufacturing partners. This will ensure efficient execution of multiple development projects, from initial design to manufacturing and distribution.

Management

Option's growth and maintenance of operations at various locations, pose a challenge regarding human resource management. Consequently, with the acquisition of wireless router business from Possio (Sweden), and the integration of a fourth location into the Option Group, a new **Personal Performance Measurement System** has been implemented to form the basis for the 2006 Personnel & Group Performance Plan. This new HR system ensures consistent benchmarking for all staff members across all countries where Option has its subsidiaries.

Sales and distribution

Option pursues a dual sales strategy. On the one hand, the company distributes its products under its own name using its sales channels and own **eShop**.[75] On the other hand, under bilateral agreements, Option supplies customised versions of its products to major telecommunication companies around the world, including T-Mobile, Vodafone, Mobistar, Mobitel, Orange, Cellcom and Cingular Wireless.

Impact

The use of ICT has had considerable impact on Option's performance in most areas of the product life cycle management. In particular:

- Networked applications, supporting collaborative product design and development, reduce the product development time. Furthermore, by enabling inter-organisational cooperation, these tools give Option access to expertise outside the company.
- Internal and external testing systems help increase the quality of final products and reduce the development time.
- The manufacturing management system enables an optimal production design and reduces the amount of inventory levels needed at various stages of the production process.
- The inter-organisational ICT system, which facilitates the production process, enables Option to spread the production volumes between separate entities, without incurring any coordination problems or disruption in manufacturing due to inaccuracy of information. This, in turn, allows the company to focus on new product development, while profiting from external organisations' expertise and cost efficiencies in manufacturing.
- The use of a human resources management system creates a robust corporate management framework, which ensures consistent benchmarking for all members of staff across all countries where Option has its subsidiaries.
- The company's electronic sales platform gives Option a direct access to the end consumers and allows it to leap-frog the 'middle man'. This, in turn, increases brand awareness in the user market.

[75] eshop.option.com

Lessons learned

Option is an example of a company operating in a highly dynamic market that has experienced rapid growth over the last couple of years. Consequently, the company has faced a challenge in keeping up an innovative and entrepreneurial spirit, while expanding its product range, geographical reach and manufacturing capacities. Modern ICT technologies help Option to manage the rapid expansion, adopt an appropriate organisational structure and to find the right balance between operations that should be kept internal and those that could be outsourced. In particular:

- ICT strengthens its core competencies in new product design and development,
- ICT enables Option to create an infrastructure facilitating information exchange between organisations in the value chain and to outsource activities. This, in turn, allows it to benefit from scale economies available to the external contractors.
- e-Shop allows Option to get direct access to its consumer base and, thus, build brand awareness and attain higher margins.

References

Research for this case study was conducted by Aneta Herrenschmidt-Moller (Aneta@HMoller.com), on behalf of e-Business W@tch. Sources and references:

- *Correspondence and telephone Interview with Jan Vercruysse, Vice President Technology and Bart Goedseels, Vice President Operations (July/August 2006).*
- *Annual report 2005.*
- *Websites:*
  - *www.option.com*
  - *www.ericcson.com*

4.4.3 Summary of main points and conclusions

Most firms from the ICTM industry reported that ICT had a positive impact on business process efficiency, their internal work processes and productivity (see Exhibit 5-2). A large share of companies stated that ICT positively influences their relationship with customers. However, one of the most important findings is that ICT is an important driver and enabler of innovation (see section 3.7). Nearly half of enterprises in the ICTM industry said that they had launched new or improved products in the 12 months before the survey. About two thirds of these product innovations had been directly related to or enabled by ICT (see Exhibit 3-31). However, as it has been argued in this section, the internet does not remain the only source for a competitive advantage and certainly not all ICT applications have a positive impact on firm performance.

The following points summarise the main conclusions regarding the benefits of ICT.

- **ICT enables innovation and market success**: ICT enables companies to introduce new products or innovative ways of doing business. This, in turn, leads to productivity growth and an increase in market share.
- **One size does not fit all**: Though large firms use ICT to innovate and increase profitability, SMEs exhibit greater R&D intensity also yielding positive financial returns.
- **Network technologies are particularly attractive**: Advanced computer networks, which facilitate inter-firm collaboration, generate higher benefits in terms of value enhancement than applications focused on internal use.
- **Online procurement guarantees the largest benefits**: The best performing firms are those using e-commerce for purchasing only. Electronic markets increase transparency and reduced prices may make companies that are selling online worse off.
- **Start-ups enjoy higher returns on ICT**: As young companies are not locked into inflexible organisational structures and have a younger and better ICT skilled workforce, they are perfectly suited to exploit the full potential of ICT.
- **Service sectors exhibit higher ICT productivity gains**: ICT manufacturing companies might expect greater benefits from ICT investments in service areas than in manufacturing activities.
- **ICT-driven growth tapers over time**: As once innovative technologies become commodities over time, technological advantage can be sustained only if a company remains innovative and open to new technologies.

5 Conclusions

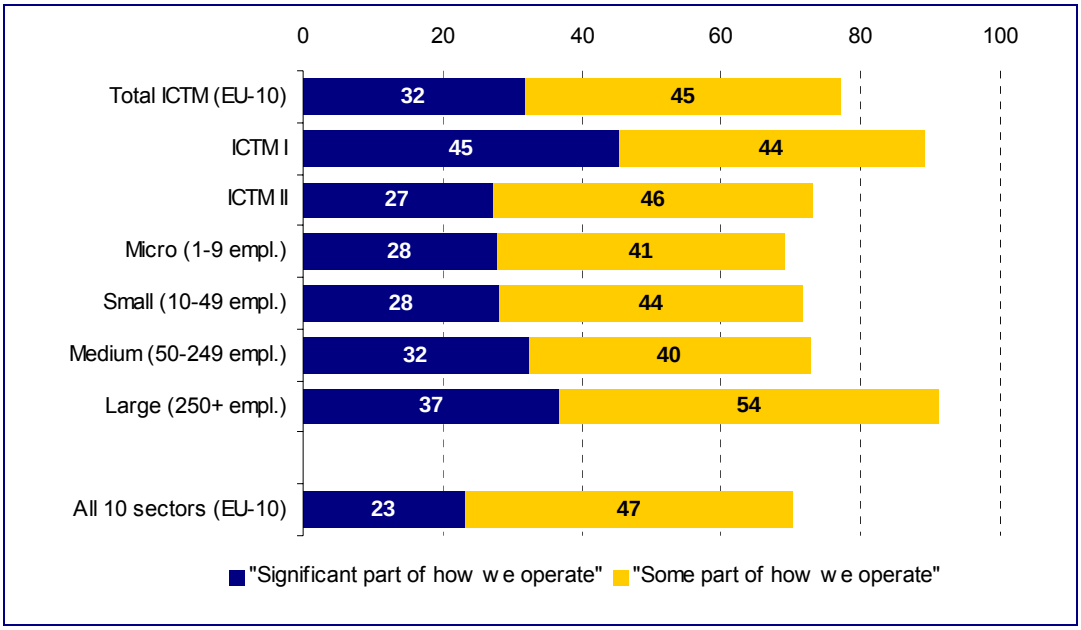
Based on the results of the e-Business Survey presented in chapter 3 and the preceding analysis some conclusions regarding the e-business usage in the ICTM sector can be identified. First, the importance of e-business for companies' operations and the impact of ICT on their performance will be discussed. Then, taking into account a broader picture, an assessment of ICT use for this industry's structure will be made. Lastly, policy implications will be suggested.

5.1 Business impact

5.1.1 Implications for enterprises

Exhibit 5-1 presents companies' own assessment of e-business importance for their operations. Not surprisingly, companies from the ICTM sector see e-business as a very relevant part of their businesses. This is in line with the intensive use of ICT by firms in this sector. The importance of electronically facilitated operations increases with firm size as well. However, there are significant discrepancies between the two sub-sectors. A considerably larger share of companies from the ICTM I sub-sector perceive e-business as a significant part of their operations, compared to the ICTM II sub-sector.

Exhibit 5-1: Perceived overall importance of e-business for company operations



Base (100%): Companies using computers (excl. "don't know"). N (for sector, EU-10) = 1261
Weighting: Totals (for the sector, sub-sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: H1

Source: *e-Business W@tch* (Survey 2006)

Most firms from the ICTM industry (57%) reported that ICT had a positive impact on business process efficiency, their internal work processes and productivity (see Exhibit 5-2). Nearly 60% of companies from the ICTM sector stated that ICT positively influences their relationship with customers.

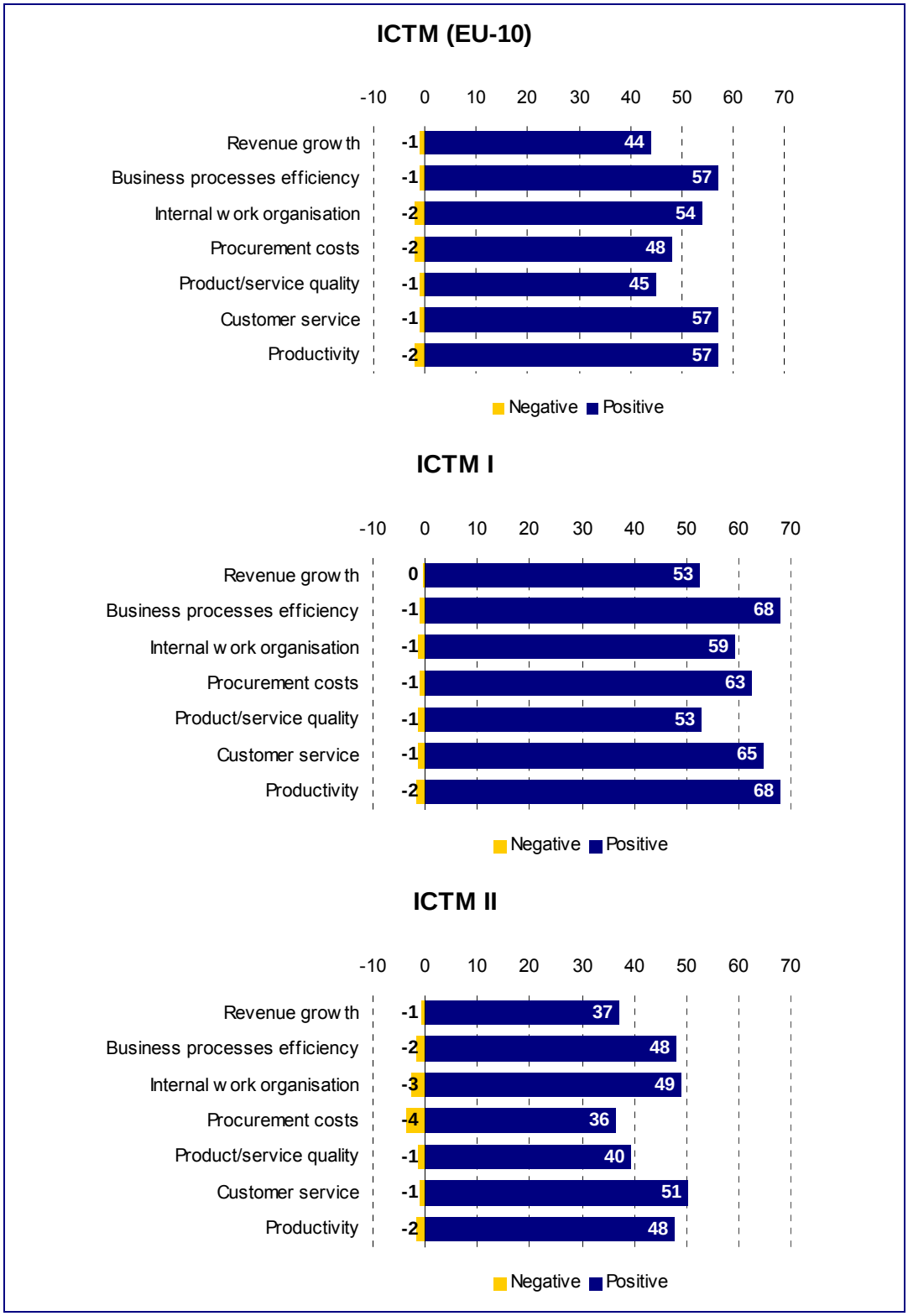
In contrast, less than one half of companies experienced a positive influence of ICT on procurement costs, revenue growth and quality of products. This suggests that ICT may have primarily an indirect positive impact on company performance, i.e. through process reorganisation and that direct impacts, be it revenue growth or lower procurement cost, are less common.

Exhibit 5-2 shows how companies perceive the influence of ICT on various business areas. Again, the most advanced users, i.e. firms from the ICTM I sub-sector, report the highest satisfaction from ICT use. Regardless of the area of operations, companies from this sub-sector see more benefits in ICT use than their counterparts from ICTM II. It seems that the importance of e-business is strongly related to the need for ICT and its actual use.

Impact on specific business areas

The "*intensive use - positive performance*" argument seems to be confirmed by the answers of companies from different sub-sectors and size-bands (see Exhibit 5-3). Along the entire analysis in chapter 3, it has been found that companies from the ICTM I sub-sector are ahead of those from the ICTM II sub-sector, just as large enterprises are ahead of SMEs. Thus, the actual use of ICT and the involvement into e-business seems to be strongly influenced by structural differences between both sub-sectors, i.e. the level of competition in the market in which a firm operates, type of customers, suppliers, products and size.

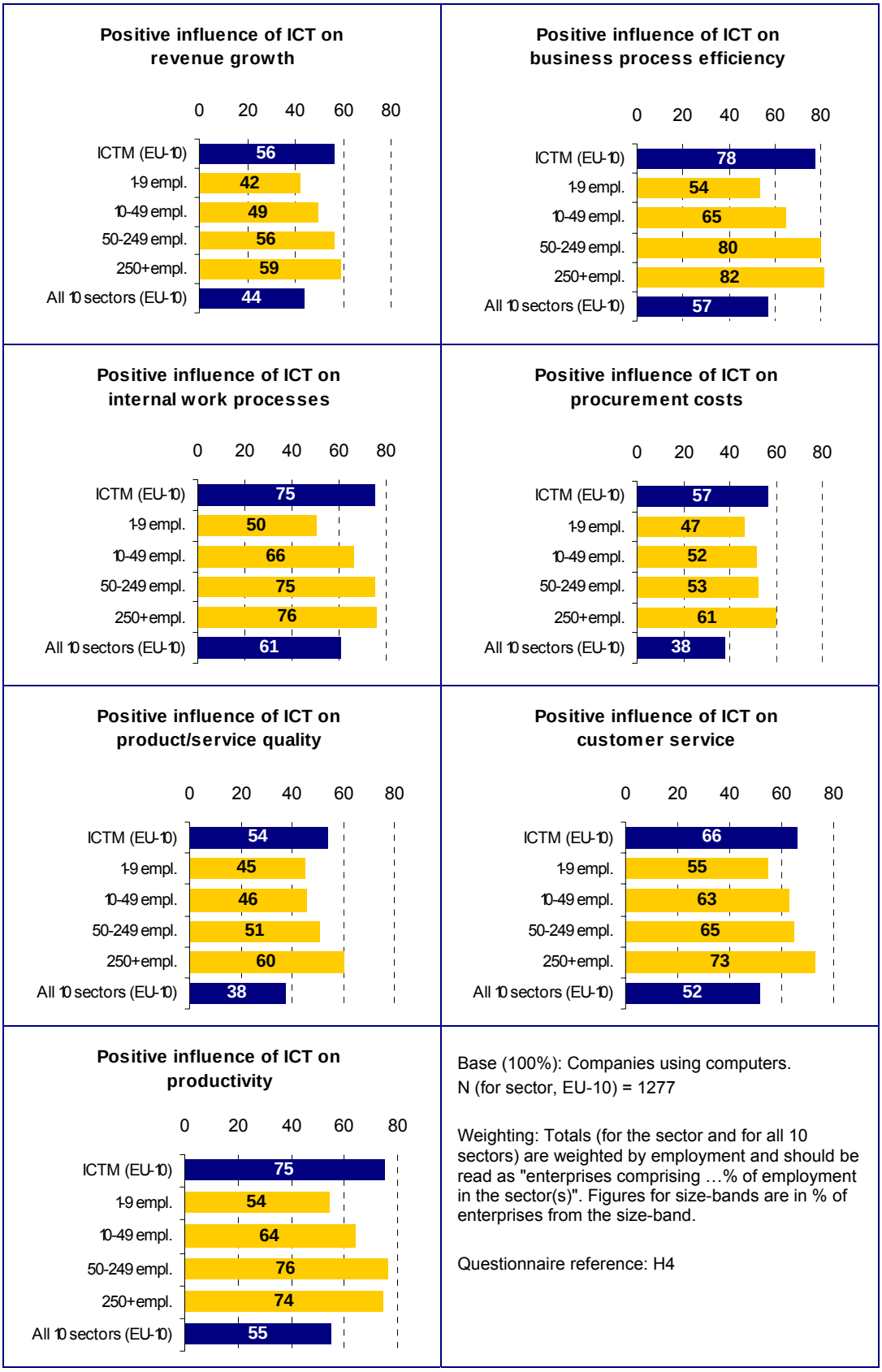
Exhibit 5-2: Perceived ICT influence on the company's business



Base (100%): Companies using computers. N (for sector, EU-10) = 1277
Weighting: in % of firms. Questionnaire reference: H4

Source: *e-Business W@tch* (Survey 2006)

Exhibit 5-3: Perceived ICT influence on the business of the company by size-bands



Source: *e-Business W@tch* (Survey 2006)

Impact on organisation

Results of the e-Business Survey 2006 and the discussion in section 4.3 suggest that ICT transforms organisational structure, the design of business processes and changes the demand for skilled workforce. Over 40% of all firms in the ICTM sector reported that ICT applications have influenced organisational structure, job description and employee training (see Exhibit 5-4).

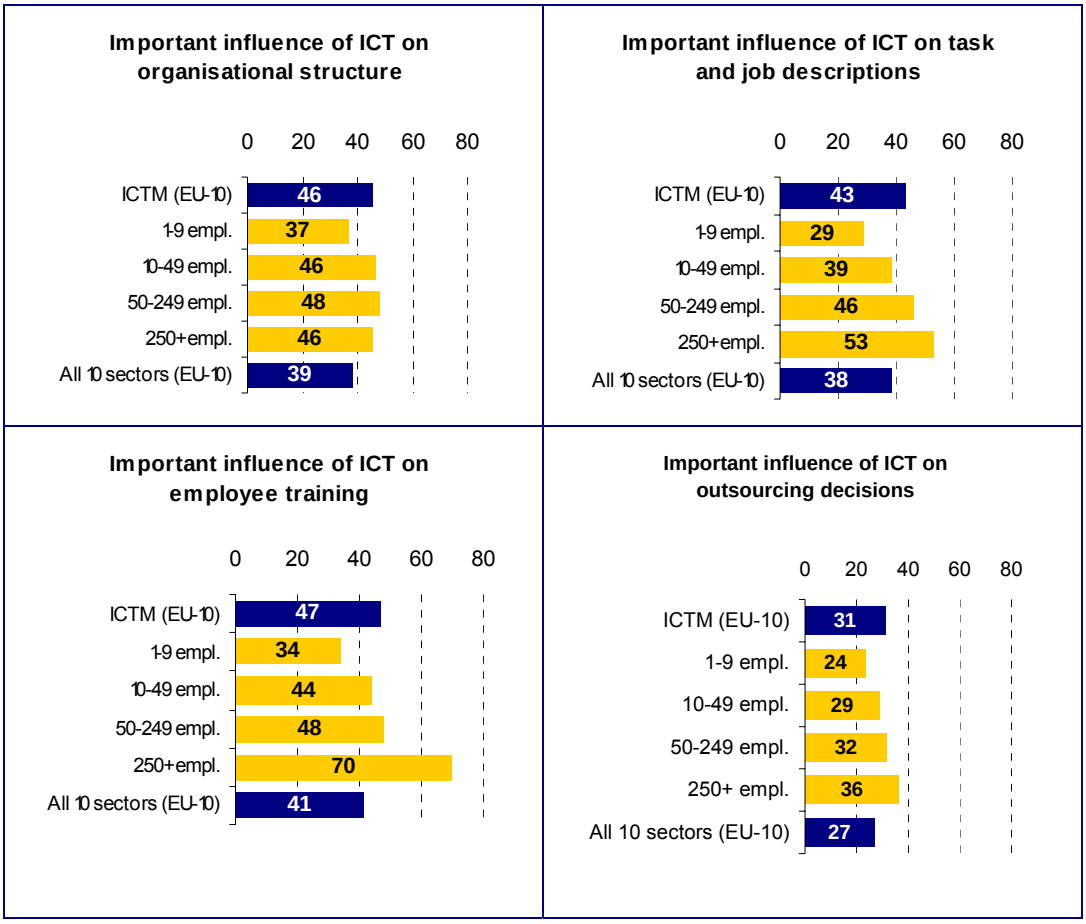
According to the survey findings and the discussion in section 4.3, ICT has an important impact on the value chain and companies' **"make-or-buy"** decisions. In the ICTM sector, companies accounting for a third of the total employment stated that ICT influences their outsourcing decisions (see Exhibit 5-4). The diffusion of inter- and intra-organisational applications enables companies in this sector not only to streamline business processes, but also to re-design their organisations leading to an increase in outsourcing, concentration on core competencies or, in some cases, to expanding the range of products and services offered.

Dell corporation is one of the most pronounced examples of how technology might influence the choice of strategy and, eventually, organisational structure (see business example in section 4.3). Focusing on supply chain management and trimming manufacturing activities, Dell evolved from a PC vendor to a pure e-commerce company with its core competency in efficiently managing the information flow between component producers, assemblers and customers. Thus, ICT allows companies in this sector to create **virtual networks** that increase the efficiency of supply chain management (see also the survey findings in section 3.4, as well as the case studies on *Motorola*, section 4.2 and on *Linking Business Processes in Supply Networks*, section 4.3).

As reported by companies in the ICTM sector, ICT influences their outsourcing decisions (see Exhibit 5-4). Thus, although the current data do not allow specifying the extent to which ICT makes outsourcing possible or which activities are outsourced thanks to ICT, it can be said that ICT lowers transaction costs and enables companies to use arm's length transactions to organise economic activity. As outsourcing and off-shoring manufacturing activities to low-cost locations will further proceed and the importance of R&D and services will increase, this might have a twofold effect on **employment** in the European ICTM sector. On the one hand, the demand for low-skilled employees in the manufacturing area will decrease while, on the other hand, companies will increase their demand for a skilled workforce in the areas of R&D, service and customer support. Thus, as also indicated by companies themselves (see Exhibit 5-4), ICT and outsourcing will have a considerable impact on **skills requirements**. A practical illustration of this issue was depicted in the case study about *Signalion*, a high-tech start-up (section 4.3)

There seems to be a link between business process automation and the level of international e-trading, i.e. in particular large companies carrying on international transactions online are likely to have **automated their financial processes** (see Exhibit 3-25). This might be interpreted in two ways. On the one hand, ICT might enable firms to expand their operation. On the other hand, ICTM firms might seek to reduce the longer time needed for cross-boarder transactions by automating and optimizing the flow of documents and payments. At this point, it is, however, difficult to determine the direction of causality.

Exhibit 5-4: Perceived influence of ICT on organisational structure:



Base (100%): Companies using computers. N (for sector, EU-10) = 1277

Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: H7

Source: *e-Business W@tch* (Survey 2006)

ICT impacts on competitiveness and productivity[76]

Considering that network technologies generate the highest payoffs of all ICT investments (Atrostic et al. 2002 and 2005), companies in the ICT sector are well **positioned to benefit from ICT**. The ICTM sector exhibits very high levels of network technologies adoption, compared to other sectors covered by the e-Business Survey in 2006 (section 3.4). For example, enterprises representing 24% of employment in the ICTM industry said they have an SCM system (see Exhibit 3-24). The current deployment of SCM in the ICTM industry is thus clearly above average when compared to the total of 10 sectors studied this year by *e-Business W@tch*. The most obvious benefits of these technologies stem from substitution of inventory and physical activities with information flow. Moreover, network technologies give companies easier access to external knowledge and resources, thus strengthening their innovation capabilities and improving

[76] See e-Business W@tch Special Study on the "Impact of ICT on corporate performance, productivity and employment dynamics" (2006), available at www.ebusiness-watch.org ('resources').

their competitive position. This is particularly true in the case of applications supporting collaborative work. Again, ICTM companies emerge as very advanced in the process of facilitating cooperation between firms with ICT tools (see Exhibit 3-16).

Despite the fact that, generally, only electronic procurement is associated with a positive impact on company performance, companies in the ICTM sector seem to have found ways to **offset the negative effects of online selling on prices**. Due to the internet, companies can leapfrog distributors and intermediaries and sell directly to consumers. Thus, ICT may have primarily an **indirect positive impact on company performance**, i.e. through process reorganisation. Direct impacts such as revenue growth or lower procurement cost, are less common (see Exhibit 5-3).

In order to further boost their competitive advantage, firms increase customer loyalty by offering add-ons or value enhancing services. Thus, **the adoption of new tools together with organisational changes and adjustments in product and marketing strategy** might contribute to an increase in productivity and competitiveness. *Dell* and *Lucent Technologies* (see sections 4.2 and 4.3, respectively) provide examples of how technology aligned with changes in strategy and organisational structure can increase company performance and give companies competitive advantage over their rivals.

As discussed in section 2.2, firms choose to produce labour intensive components of the production process in low-cost locations and produce skill- and R&D-intensive components in Europe or the US. However, the outsourcing of manufacturing might also have some future implications for the **competitiveness of the European ICTM sector**. Since component manufacturers, located mainly outside of Europe, are taking over the responsibility for new product development and innovation, their importance in the value chain and bargaining power increases. Consequently, European OEMs concentrating on supply chain management and customer support **reduce their R&D activities and become dependent** on CM and assemblers for new product delivery. Again, *Dell* is a clear example for the outsourcing of manufacturing processes followed by a reduction of R&D expenditures. Although Dell's strategy proved successful, today the company is loosing its market share to competitors (Handelsblatt 2006c). This raises an issue of how much manufacturing can be outsourced without damaging a company's ability to deliver innovative products and deteriorating its market position. Furthermore, companies trimming down their manufacturing operations and innovation capabilities will have to find new competencies, in order to play a role in the value chain.

Future impact

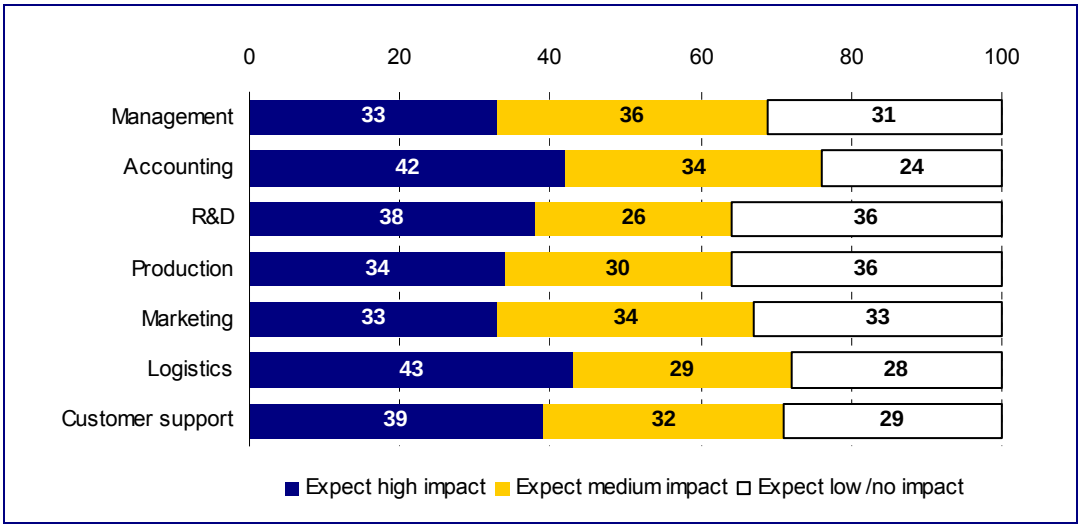
According to the e-Business Survey 2006, companies in the ICTM sector do not expect that the role of ICT and their impact on the way these companies operate will lose any momentum (see Exhibit 5-5). In particular, firms from this sector expect that ICT will have a high or medium impact on business areas such as accounting, logistics and customer support.

The advantage of ICT in **accounting** is shown by the survey findings (see Exhibit 3-25) and illustrated in the case study on *RCD* (section 4.4). In fact, this company said that a new accounting application has enabled it to meet the ISO requirements regarding process management practices. This, in turn, has lead to more transparent, reliable and secure processes and eliminated potential negative human influence, i.e. errors and fraud.

The globalisation of the value chain increases companies' dependence on efficient **logistics** services. Here, ICT and improved supply operations will facilitate the transformation towards lean organisation and lower logistics costs. In contrast to the past, when logistics systems were focused on stored inventory, modern ICT applications manage information flow independently from the flow of goods by connecting critical points along the supply chain and by focusing on the management of in-transit inventory. This issue is also shown by the survey findings. Companies in the ICTM sector frequently reported a positive impact of ICT on business process efficiency (see Exhibit 5-3). Similar evidence was gathered in the case study about *Linking Business Processes in Supply Networks* (section 4.3).

Similarly, the positive impact of ICT on **customer relationships** is indicated by survey findings (see Exhibit 5-2) and described in the case study about *Tesla* (section 4.4). This company stated that their old applications did not appropriately support their workflow, and that this had negative consequences for the relations with customers. Therefore, the firm decided to implement a new application, which enables it to anticipate future demand developments and accommodate them into their own production schedule.

Exhibit 5-5: Anticipated future impact of ICT



Base (100%): Companies using computers. N (for sector, EU-10) = 1277
Weighting: by employment , i.e. figures should be read as "enterprises comprising …% of employment in the sector". Questionnaire reference: H8

Source: *e-Business W@tch* (Survey 2006)

Concluding assessment

Exhibit 5-6 summarises the main impacts of ICT and e-business for individual enterprises. The assessment of ICT impact integrates the analysis of results from the e-Business Survey 2006 and the qualitative discussion in chapter 4 of this report. The scores should not be understood as 'exact' results of a quantitative computation, based on some model; they are tentative and merely indicative, reflecting the impression the study team gained from interviews, case studies and the literature review. They are presented and should be regarded mainly as an instrument to stimulate debate.

It is also clear that no such general conclusion can apply to each individual company. There will be specific cases of SMEs and large firms with a totally different ICT experience for whom the pattern below does not apply. Nevertheless, by analysing the impact of ICT on organisational structure, it becomes obvious that the existence and the degree of this impact are related to the size of a company. This can be explained by the high intensity of ICT use in this sector's large firms. In other words, before observing any ICT influence on organisational structure, a company needs to be an advanced user of these applications. Consequently, it can be expected that **ICT will continue to affect companies in the ICTM sector of different sizes in different ways**.

Exhibit 5-6: Impact of ICT and e-business on competition in the ICTM industry

	Business areas where ICT and e-business can have an impact	Observed impacts in large firms *low < > high*	Observed impacts in SMEs *low < > high*
1	Organisational structure		
2	Work-flows / operational organisation		
3	Sourcing and procurement		
4	Production / service provision		
5	Logistics		
6	Marketing / sales		
7	Customer support		
8	Research & development		
9	Product & service innovation		
10	Process innovation		
11	Skills requirements		
12	Outsourcing		
13	Employment		
Maximum: 3 points (or)			

Source: *e-Business W@tch* (2006)

5.1.2 Implications for industry structure

This section assesses the implications of ICT and e-business adoption on the structure of the respective industry. As in 2005, we use the 'five-forces-model' developed by Michael E. Porter (1980), to discuss and assess e-business implications on the industry's structure.

Background information:

Michael E. Porter's Five-Forces Model

The 'Five Competitive Forces' model was developed by Michael E. Porter in his book „Competitive Strategy: Techniques for Analysing Industries and Competitors" in 1980. Since that time it has become an important tool for analysing industrial structure, competition and strategic options of players. Porter's model is based on the insight that a corporate strategy should meet the opportunities and threats in the organisations external environment.

Porter has identified five competitive forces that shape every industry and every market. These forces determine the intensity of competition and, hence, the profitability and attractiveness of an industry. The objective of corporate strategy should be to modify these competitive forces in a way that improves the position of the organisation. Porter's model helps to identify the main driving forces in an industry. Based on the information derived from the Five Forces Analysis, companies can decide how to influence or to exploit particular characteristics of their industry.

The instrument has been applied by e-Business W@tch since 2004/05 to assess the influence of ICT and e-business on competition in a sector.

Michael E. Porter is the Bishop William Lawrence University Professor at Harvard Business School.

As it has already become clear in the course of the analysis, ICT has important implications for competition in the ICTM industry. Following the Porter's Five Forces Model, this section offers an assessment of the major implications of e-business for economic dynamics in this sector. The discussion is additionally supported with the results of the e-Business Survey 2006. Exhibit 5-7 lists the five competitive forces in order of their importance.

Exhibit 5-7: Impact of ICT and e-business on competition in the ICTM industry

Competitive forces		General importance in the sector (currently) *low < > high*	Impacts of ICT and e-business *low < > high*
1	Threat of new entrants	■■■	■■
2	Substitution of products / services	■■■	■■■
3	Bargaining power of suppliers	■	■
4	Bargaining power of customers	■■■	■■■
5	Rivalry in the market	■■■	■■■
Maximum: 3 points (■■■ or ■■■)			

Source: *e-Business W@tch* (2006), developed from Michael E. Porter

Threat of new entrants

The ICTM sector is far from being a mature industry. Competition is still fierce and new entries still take place. Emerging Chinese and Taiwanese manufacturers compete aggressively with American and European incumbents and successfully reduce the latter's market shares or even force them to exit the market. It can be expected that the position of traditional PC vendors will be further eroded by the introduction of low-cost PCs announced by companies that have not been operating in the PC market so far (WSJ 2006a). Furthermore, a strategy change of niche players might lead to more intensive competition in the mass market for PCs. For example, a recent move of Apple to install Intel processors in their computers and making them Windows-compatible can be treated as an entry to the PC market which is traditionally dominated by companies such as Dell, IBM or Fujitsu-Siemens (Handelsblatt 2006a).

Similarly, companies operating in the ICTM II sub-sector are confronted with new competitors as a result of converging technologies and markets. Thus, although **ICT and e-business does not directly lead to new market entries**, technological change has a strong impact on competition in the ICTM industry.

Substitution of products / services

Modular product architecture, standard interfaces and comparable performance characteristics reduce the differentiation level of electronic products and enable customers to choose between several suppliers. As the availability of alternative products limits potential returns by placing a price ceiling, companies are forced to either offer add-ons in the form of value added services, complementary features to the core product or to put a greater emphasis on costs. The added pressure on costs may also increase requirements for capital by forcing companies to acquire the most modern facilities and equipment or to concentrate on achieving greater economies of scale. Furthermore, as the internet enables customers to compare price and product characteristics at no cost, **ICT further increases the competitive pressure**.

As mentioned in section 4.1, by shifting demand from traditionally separated services to converged products affects the demand for equipment, i.e. both hardware and software, needed for providing these services, on the one hand, and increase the demand for equipment capable of handling new services, on the other hand. For example, the rapid development of mobile broadband technology will decrease the demand for the fixed-line cables and switches. Similar, the diffusion of IP infrastructure will reduce the demand for equipment used in voice, data and video networks.

Bargaining power of suppliers

As indicated by the survey results, electronic procurement enables firms in the ICTM industry to increase the number of suppliers, which in turn probably reduces suppliers' bargaining power (see Exhibit 3-23). The relatively limited bargaining position of suppliers in the ICTM sector is also illustrated by the fact that their expectations are not the main driver of e-business diffusion in the sector (see Exhibit 3-33). As a result, ICTM companies said that they rarely link electronically these processes with those of their

suppliers. They seem to use other less advanced forms of communication with them (see Exhibit 3-24).

As discussed in section 4.3, ICT transforms the ICTM industry. Firms at the lower value chain levels take over the responsibility for a number of activities and increase their value added shares in final products. An immediate conclusion would be that, at the same time, these companies also increase their bargaining power. However, this effect is counter-balanced by the modular architecture of final products making inputs dispensable. The generic character of inter-organisational systems and non-relationship specific ICT connections further reduces the dependency on certain suppliers.

Bargaining power of customers

According to the survey results, buyers' position in the markets for ICT products is considerably sound. Customers' expectations, for example, constitute one of the main drivers of e-business diffusion in the ICTM sector (see Exhibit 3-33). Commoditisation and substitutability of electronic products, together with non-existent switching costs that would lock buyers to one product, give consumers a great amount of power. Private or business consumers have a large choice of nearly identical products offered by various PC vendors and can shop for the most attractive offer. Components' modularity enables small PC vendors or skilled users to freely select parts and assemble them for customised solutions. By **making markets more transparent end empowering customers**, the internet allows buyers to shop for favourable price and purchase selectively.

Large companies, with particularly powerful positions, dominate the telecommunications equipment market. Again, here, buyers might exercise great pressure on producers and, as fixed costs characterise the industry, raise the stakes to keep capacity filled. Furthermore, as carriers (i.e. the main buyers of telecom equipment) have grown larger and have gained more leverage over the equipment makers, they put pressure on them to merge as well. The recent merger between Lucent Technologies and Alcatel or the joint-venture between Nokia and Siemens indicate that the merger trend that swept network operators in recent years is spilling over into the equipment industry (WSJ 2006).

Rivalry in the market

Results of the e-Business Survey 2006 confirm that ICT intensifies competition in the industry (see Exhibit 5-8). In fact, companies in the ICTM sector reported, more often than companies from other sectors studied, that ICT increases rivalry in the market.

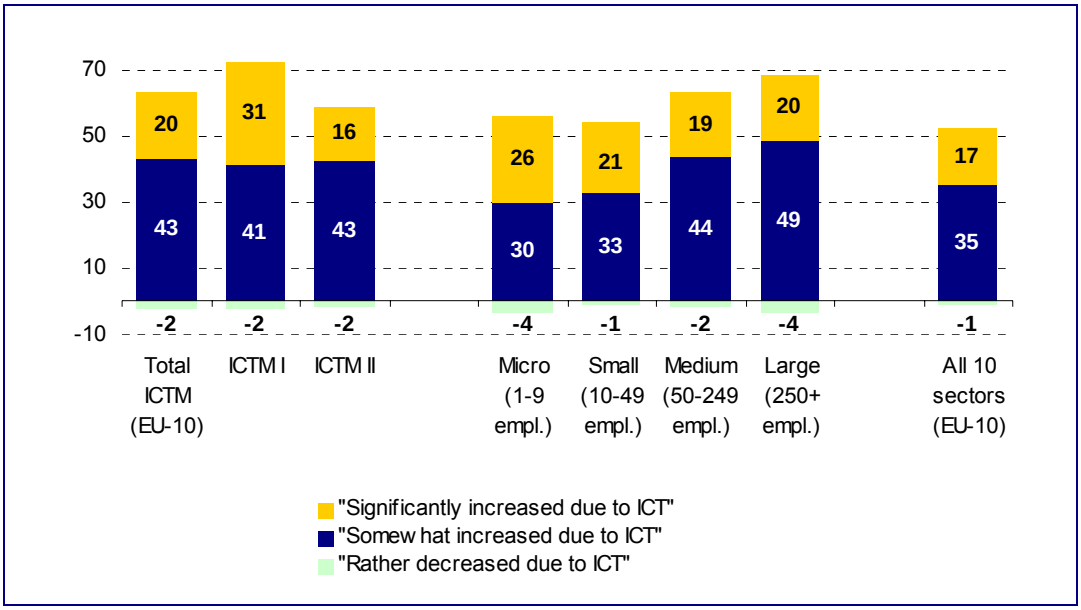
Altogether, firms accounting for 63% of the sector total employment believed that ICT has significantly or somewhat increased competition in their industry, compared to 52% for all sectors studied by *e-Business W@tch* in 2006. Again, however, there are some notable differences in perceptions between companies from different size-bands and sub-sectors. Although large companies more frequently express the view that ICT has increased competition, the gravity of these changes has been greater in the markets in which SMEs operate. This reflects the general concern expressed by SMEs (see Exhibit 5-8 and the case study about *RCD* in section 4.4) that e-business practices in general and electronic markets in particular increase price competition and decrease their profits. Thus, they have to look for ways to avoid cut-throat competition by differentiating their products,

improving quality or offering value added services. Another strategy to overcome the erosion of margins is to use ICT to leapfrog intermediaries.

There is also a slight difference to what extent ICT affects the competition in both sub-sectors at stake. It seems that companies from the ICTM I sub-sector are more affected by the competition-effects of ICT, than their counterparts from ICTM II.

Overall, the ICTM sector is a highly dynamic industry with rapidly changing technological trends and frequent product introductions. Price competition is fairly common since the product life-cycle gets shorter and products become obsolete more quickly. Competitive moves of one firm are immediately followed by competitors who initiate retaliation or actions to counter the move. The competitive advantage is derived from innovation, which decreases the certainty of future revenues. An extreme example of technological rivalry is **the chip industry** (see the business example on *Intel* in section 4.1). Dictated by technological requirements, every generation of computer chips involves building up a new factory. As a result, the industry experiences periodical large capacity augmentations disrupting the supply / demand balance and leading to overcapacity and price-cutting.

Exhibit 5-8: Perceived impact of ICT on competition in the industry



Base (100%): Companies using computers. N (for sector, EU-10) = 702
Weighting: Totals (for the sector, sub-sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: H6

Source: *e-Business W@tch* (Survey 2006)

Similar to the ICTM I sub-sector, companies in ICTM II sub-sector are exposed to growing competition. New competitors are gaining market shares by cutting prices and, at the same time, customers are being lured away by telephone systems that operate via internet technology provided by external companies, such as Cisco Systems (WSJ 2006).

5.1.3 Competition and ICT

The survey findings and the issues analysed in this report allow a preliminary conclusion regarding the relationship between the ICT adoption, use and impact and competition in the market at stake to be made. In section 2.2 it was assumed that both sectors vary slightly with respect to competition intensity. Whereas ICTM I is a very dynamic and volatile high-tech market populated with highly specialised companies frequently outsourcing entire production stages to external firms, the ICTM II sub-sector resembles more traditional industrial structures present in such sub-sectors as electrical machinery. In other words, ICTM II is dominated by vertically integrated companies that keep large parts of the entire production and value-creation in-house and serve a small number of usually large customers such as telecommunication companies.

In the course of the analysis, it was confirmed that there are some clear differences between companies from various sub-sectors with respect to why they use e-business, how they use it and what effect it has on them. In particular, the following has been found:

- **Strategic reasons for ICT**: Companies from the ICTM I sub-sector reported using ICT for strategic reasons more often than their counterparts from ICTM II (see Exhibit 3-33).
- **Intensity of ICT use**: Companies from the ICTM I sub-sector said that they spend more on ICT and use electronic channels for conducting transactions on a larger scale compared to firms from the ICTM II sub-sector (see, for example, Exhibit 3-4, Exhibit 3-18).
- **ICT and innovation**: Regardless of the innovation type (ICT- or non-ICT-enabled), companies from the ICTM I sub-sector appear to be more innovative than firms from the ICTM II sub-sector (see Exhibit 3-31).
- **ICT impact**: Companies from the ICTM I sub-sector seem to enjoy greater benefits from ICT use, compared to firms in the ICTM II sub-sector (see Exhibit 5-2).
- **Impact of ICT on competition**: ICT is said to have a greater impact on competition in the ICTM I sub-sector than in the ICTM II sub-sector (see Exhibit 5-8).

In summary, there seems to be a **clear pattern in the way ICT and competition interact**: *more competition forces companies to look for innovative ways of doing business, increase efficiency and increase productivity*. ICT helps enterprises to achieve these aims but, at the same time, increases the pressure to stay innovative. Overall, the outcome seems to be **positive**, as companies operating in the industry become more efficient, productive and, therefore, able to compete on a global scale.

5.2 Policy implications

The preceding discussion revealed some important issues related to e-business in the ICTM sector, as well as several areas where e-business developments may have implications for policy. Relevant considerations made in this context can be grouped around two main overall objectives[77]:

- **Direct implications**: Policies aiming at accelerating the adoption of ICT and e-business activity among companies, particularly among SMEs. This is based on the assumption that ICT is a key driver of productivity and competitiveness.
- **Indirect implications**: Policy interventions that affect the sector as a producer of ICT.

Exhibit 5-9 presents a preliminary assessment of possible policy implications for the ICTM industry.

Exhibit 5-9: Policy implications arising from e-business activity in the ICTM industry

	Policy issues	Possible initiators	Policy leverage *low < > high*
Direct implications			
1	Emphasise the necessity of co-inventions	Industry federations Business support networks	■
2	Role model of the public sector	European Commission National Governments	■■■
3	Interoperability more important than ever	Standardisation bodies Industry federations	■
4	Competition in the IT market	European Commission National Governments National competition offices	■■■
Indirect implications			
5	Customised innovation policies	European Commission National Governments	■■■
6	Networking for innovation	Industry federations Business support networks	■■
7	Regulation of telecommunication markets	European Commission National Governments Regulation bodies	■
Maximum: 3 points (■■■ or ■■■)			

Source: e-Business W@tch (2006)

Despite the fact that the following policy implications are built on the analysis of the ICTM sector, some of them are of rather generic nature and might apply to other sectors as well. For example, the importance of the relationship between ICT, co-inventions and firm performance holds for all sectors. Similarly, the problems of restrained competition in the IT market might have negative consequences for other sectors as well.

[77] European Commission (2005). "More Research and Innovation - Investing for Growth and Employment: A Common Approach". Communication from the Commission, COM(2005) 488 final.

5.2.1 Direct implications

Emphasise the necessity of co-inventions

Results of empirical research on ICT use and benefits provides an answer to the question of why some technologies are used more intensively than others despite similar technological complexity and an overall positive efficiency impact (section 4.4). For example, online selling and online procurement have a positive impact on market transparency. However, the diffusion of online procurement in the ICTM sector remains still far ahead of that of online selling (see Exhibit 3-19 and Exhibit 3-26). The reason for the low acceptance level of online selling in the ICTM sector, compared to online procurement, can be found in its negative effects on prices (see section 4.4). In other words, while market transparency and lower transaction cost delivered by ICT benefit companies procuring online, they seem to hurt firms selling online at the same time (see section 4.4).

For a large share of ICTM companies, new technologies have allowed them to re-engineer their internal processes and organisation structures (see Exhibit 5-2). In several cases, ICT were also reported as enabling ICTM firms to develop completely new products and services or improve processes (see Exhibit 3-31). In other words, successful ICT implementations are accompanied by **co-inventions** (see section 4.4.1). In this sense, ICT enables firms to leapfrog the value chain to their final customers, reduce intermediaries and appropriate some part of their value added.

Thus, adjustments in product and marketing strategies or organisational changes can offset negative effects of online selling and contribute to an increase in productivity and competitiveness at both firm and macro level. Therefore, the policy challenge is to emphasise the fact that ICT implementation generates the **greatest benefits only if combined with organisational changes** and strategy modifications.

Role model of the public sector

The survey evidence suggests that the diffusion of electronic practices in G2B are lower that in B2B transactions (see Exhibit 3-17). Although this might be a result of a lower number of G2B than B2B transactions in general, the active use of ICT, the internet, and e-business practices in the public sector can spur an active use of these technologies in the private sector, for example via the creation of positive network externalities.

The public sector in the European Union and its Member States can help to support the development and usage of ICT in the private sector by making intensive use of new technologies. This includes active use of providing services to its "customers" (citizens and businesses), but also for internal use of improving and optimising their own routines.

Interoperability more important than ever

In the ICTM industry, 36% of all companies see interoperability as a critical issue for interactions with firms from the same industry (see Exhibit 3-10). The business functions in which most ICT companies seem to face interoperability challenges are procurement and technical aspects (see Exhibit 3-11). In particular, large companies claimed that

systems incompatibility constitutes an important barrier to e-business diffusion (see Exhibit 3-34). Thus, despite the wide diffusion of ICT applications in this sector, there is still potential for further productivity increases through supply chain integration that remains underutilised due to interoperability problems.

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 (see Exhibit 3-34).

Supporting standardisation initiatives and programmes encouraging SMEs to participate in the standardisation process can mitigate this problem. The importance of standards as a means of reducing transaction cost and increasing competitiveness has been recognised by policy makers.[78] An example of an initiative that brings the SMEs' interests into the standardisation process is through NORMAPME, the "European Office of Crafts, Trades and Small and Medium- Sized Enterprises for Standardisation".[79] Given that there are still problems related to the lack of interoperability, this type of actions should be continued. Particular emphasis should be placed on promoting participation of all relevant stakeholders in the standardisation process and on disseminating the results among all interested parties, notably SMEs.

Competition in the IT market

According to the survey findings, a significant number of large ICTM companies complain about high cost and complexity of the technology, a lack of reliable IT providers and inter-system compatibility (see Exhibit 3-34 and section 3.8.2). This might be a sign of **restrained competition in the IT market** in the segment of advanced IT applications designed for large companies. The potential lack of competition in these markets might have serious implications not only for the IT-producing sector, but also for IT-using sectors. This, in turn, might have an effect on the development of e-business in general.

It is not clear whether this conclusion concerns ICTM firms only or also companies from all sectors. An analysis of the indicators' values across size-bands did not yield any conclusive results. In any case, there is a need for **closer examination of these issues** and, possibly, competition policy measures to secure competition in the IT-markets.

[78] http://ec.europa.eu/enterprise/standards_policy/index_en.htm

[79] www.normapme.com

5.2.2 Indirect implications

Customised innovation policies

The ICTM sector is an industry where changes in technology, market structure, global scope and vertical integration have been pervasive and rapid. Responsiveness to consumers' needs, aggressively pursuing new technological trends, introducing novel products and manufacturing capabilities have been the driving forces of success and also of failure.

There are two types of technology change that have different effects on the industry dynamics (Christensen 1997). Technologies of the first type sustained the evolution of one technological trajectory. As it emerged from the discussion in section 4.1, mainly industry's dominant firms follow this trajectory. Innovations of the second type, introduced by entrant firms, disrupt or redefine these trajectories and lead to considerable changes in market structure. An example of a disruptive innovation is the VoIP telephony pioneered by *Skype*, a telecommunication start-up, not incumbent.[80]

These observations correspond to the finding that incumbents and start-ups in the ICTM sector follow various innovation strategies (see Exhibit 3-31 and section 4.4).[81] On average, SMEs produce a nearly equal share of product innovations as large firms, while large firm lead in terms of process innovations (see Exhibit 3-31). Thus, on the one hand, established companies concentrate on innovations enabling them to move up on the current technological trajectory, i.e. process innovations. Small firms, on the other hand, achieve greater returns from efforts to move to a next trajectory, i.e. product innovations. Another noteworthy finding is that SMEs more frequently deploy ICT in the innovation process, compared to large firms. This is true for both product and process innovations. This indicates also that SMEs and large enterprises have diverse innovation strategies.

The evolution of technological trajectories in the ICTM sector poses a challenge for policy makers to **customise innovation policy measures for diverse company groups within the ICTM sector**. For example, on the one side, policy measures addressing start-ups should concentrate on improving the framework conditions for innovation in general. This might include the availability of appropriate skills or addressing inefficiencies in financial markets. On the other side, policy measures designed for established manufacturers should focus on creating conditions allowing firms to utilise the potential of ICT to optimise process efficiency. For example, as ICT enables firms to take advantage of different locations with respect to their comparative advantage, policy makers should further continue to eliminate barriers to cross-border trade.

The impact of ICT for innovation and the acceleration of productivity growth are recognised in the context of the 'renewed' Lisbon Strategy.[82] Consequently, the issue of increasing the competitiveness of the ICTM sector and facilitating the efficient ICT uptake

[80] A detailed discussion of the development of VoIP telephony can be found in the report on Telecommunication Services – see http://www.ebusiness-watch.org/resources/by_sector.htm.

[81] See Special Report on "The role of new companies for e-business uptake", available at http://www.ebusiness-watch.org/resources/special.htm.

[82] See http://europa.eu.int/information_society/eeurope/i2010/index_en.htm

by promoting innovation has been addressed by the European Commission and should be continued further.[83]

Networking for innovation

Companies in the ICTM sector have managed to increase productivity through a continuous development of e-business practices (see Exhibit 5-2) and section 4.3). Significant benefits are achieved by introducing innovative ways of organising inter-firm interactions, modified business processes and integrating companies along the value chain. In addition to cost saving benefits, active cooperation facilitated by ICT improves the outcomes of innovation activities.

Applications linking inter-firm processes such as product design and inventory management have considerable impact on company performance. Furthermore, networking organisations get access to new competencies lying within or outside of the industry enabling them to build resources that are difficult to acquire otherwise. As applications supporting collaborative work facilitate the flow of information between companies and increase the transparency of inter-organisational cooperation, joint R&D activities are more likely to produce superior outcomes, compared to stand-alone efforts.

However, even in such an ICT-savvy industry as the ICTM sector, the adoption of technologies supporting collaborative work remains low (see Exhibit 3-16). In light of this, the policy challenge is to **encourage companies to support inter- and intra-industry dialogue** and implement e-business solutions that facilitate the exchange of both inputs and knowledge. This can be achieved by initiatives, for example similar to 'ICT for Enterprise Networking', which supports the uptake of integrated value chains.[84]

Regulation of telecommunication markets

Actions of regulatory bodies together with the scope and pace of regulation could have an impact on companies operating in the ICTM industry. The process of new telecom services regulation affects companies' decision regarding which products to develop. In turn, this might influence investments in new technologies and telecommunication networks and affect the technological progress (Baake et al. 2006, EITO 2003).

An example of the potential impact of regulation concerning the telecommunication sector on the ICTM industry is the proposal for eliminating roaming fees on public mobile networks within Europe.[85] If accepted, the new regulation would reduce the prices and increase the demand for mobile services, which, in turn would increase the demand for networks capacities. This will then have a direct effect on companies in the ICTM sector.

Thus, the policy challenge is to **take a comprehensive approach towards telecommunication regulation** and to account for externalities affecting other related sectors, such as the ICTM industry.

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[83] For details of the EC industry policy see: http://ec.europa.eu/enterprise/ict/index_en.htm

[84] For details see http://cordis.europa.eu.int/ist/ict-ent-net/index.html

[85] Proposal for Regulation of the European Parliament and of the Council on roaming on public mobile networks within the Community and amending Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services, http://ec.europa.eu/information_society/activities/roaming/docs/regulation/regulation_en.pdf

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Annex I: Size and Structure of the ICT Manufacturing Industry

This section gives an overview of the size and structure of the ICT manufacturing industry, using key economic indicators from the New Cronos database of Eurostat. New Cronos is structured in nine parts ("themes"). Most of the data are derived from theme 4, "Industry, trade, and services," and here from the collection sbs (structural business statistics). All statistics presented were prepared by the DIW Berlin, which obtained the most recent data available from Eurostat in March 2006. Gaps in the official statistics resulting from missing data for individual countries or the respective year in the time-series of a country were computed by the DIW Berlin. The most recent official statistics available for industry-wide macro-economic indicators are those for 2003 or older.

Employment, productivity and labour cost (EU-25)

Exhibit A 1, Exhibit A 2 and Exhibit A 3 provide an overview of employment, productivity, and labour costs statistics for the ICT sub-sectors in the EU-25 countries. In 2003, the European producers and suppliers of ICT equipment employed over 800 thousand people. The German ICT sector alone provided almost every fifth job in the sector. The next largest employers in the industry were France and the UK. According to the data, the ICT industry also plays an important role in the economies of Ireland and Finland. In the former, the DL30 sub-sector accounts for almost 6% of total employment in manufacturing. In some New Member States, telecommunication equipment manufacturing seems to be of greater importance than the EU-25 average, e.g. Hungary and the Czech Republic.

Productivity, measured as value added per employee, varies significantly in the European ICT industry. The UK (DL 30), Ireland (DL 32.1) and Finland (DL 32.2) reported the highest productivity levels in respective sub-sectors. The lowest productivity in the sector was observed in among the New Member States, i.e. countries in which the production of ICT equipment is almost nonexistent. However, low productivity levels in the New Member States are compensated by low labour costs (including social benefits received by employees). Whereas labour costs in Baltic countries belong to the lowest in Europe, the German, Austrian and French workforce is the most expensive in the EU-25.

A comparison of productivity levels and labour costs yields interesting results. For example, whereas productivity of Hungarian workers in the DL 30 sub-sector exceeds the value added per employee in Italy or Portugal, they earn only one third of the wage paid to their Italian counterparts or one forth of the EU-25 average. Similar favourable ratios can be observed in other Central European countries. Thus, the attractive combination of high productivity and low labour costs still remains a source of comparative advantage in countries such as the Czech Republic, Hungary, Poland or Slovakia.

Exhibit A 1: Employment, productivity and labour cost in manufacture of office machinery and computers (DL 30) in EU-25 (2003)

	Employment		Productivity		Labour Cost	
	Persons employed	% of manu-facturing	Value Added at factor cost per person employed (1000 EUR)	% of manufacturing	Personnel cost per person employed (1000 EUR)	% of manu-facturing
Belgium	764	0.1%	71.6	99.0%	41.1	92.3%
Czech Republic	8,419	0.6%	8.8	64.1%	7.4	105.4%
Denmark	1,303	0.3%	75.3	129.5%	47.7	118.3%
Germany	43,596	0.6%	84.4	149.5%	59.5	137.5%
Estonia	287	0.2%	11.8	119.0%	8.4	136.9%
Greece	•	•	•	•	•	•
Spain	5,980	0.2%	29.5	68.9%	28.4	108.5%
France	29,185	0.7%	90.2	172.4%	66.1	169.5%
Ireland	13,104	5.7%	90.0	53.6%	38.9	104.8%
Italy	16,176	0.3%	39.0	92.4%	28.4	110.4%
Cyprus	•	•	•	•	•	•
Latvia	153	0.1%	13.1	165.0%	5.9	162.6%
Lithuania	439	0.2%	8.2	122.5%	3.4	85.6%
Luxembourg	•	•	•	•	•	•
Hungary	12,928	1.5%	42.7	258.7%	10.1	126.0%
Malta	•	•	•	•	•	•
Netherlands	•	•	•	•	•	•
Austria	1,377	0.2%	41.6	68.6%	40.0	101.8%
Poland	•	•	•	•	•	•
Portugal	845	0.1%	29.9	144.6%	21.3	165.9%
Slovenia	845	0.3%	25.4	112.8%	18.1	124.7%
Slovakia	1,930	0.5%	4.4	40.0%	6.3	102.4%
Finland	353	0.1%	46.7	67.5%	34.3	87.6%
Sweden	•	•	•	•	•	•
United Kingdom	34,914	1.0%	91.5	158.8%	36.8	105.9%
EU-19	172,598	0.6%	73.6	154.1%	44.3	139.5%
Others	15,312	0.4%	21.0	58.9%	14.5	59.4%
EU-25*	**187,910**	**0.6%**	**69.3**	**149.9%**	**41.8**	**135.7%**

Source: Eurostat New Cronos / * Estimates by DIW Berlin 2006

Exhibit A 2: Employment, productivity and labour cost in manufacture of electronic valves and tubes and other electronic components (DL 32.1) in EU-25 countries (2003)

	Employment		Productivity		Labour Cost	
	Persons employed	% of manu-facturing	Value Added at factor cost per person employed (1000 EUR)	% of manufacturing	Personnel cost per person employed (1000 EUR)	% of manu-facturing
Belgium	5,306	0.8%	86.5	119.6%	52.8	118.7%
Czech Republic	17,939	1.3%	13.0	95.0%	6.8	96.4%
Denmark	1,967	0.4%	56.6	97.3%	37.9	94.1%
Germany	73,052	1.0%	70.0	124.0%	53.0	122.5%
Estonia	1,083	0.8%	8.9	89.1%	5.6	92.2%
Greece	•	•	•	•	•	•
Spain	11,643	0.4%	31.1	72.5%	28.9	110.4%
France	61,835	1.6%	52.7	100.7%	43.6	111.8%
Ireland	6,572	2.9%	196.5	117.0%	40.4	108.7%
Italy	33,260	0.7%	58.5	138.5%	33.9	131.6%
Cyprus	•	•	•	•	•	•
Latvia	339	0.2%	4.4	55.8%	2.7	73.4%
Lithuania	4,376	1.6%	12.2	181.9%	6.6	164.9%
Luxembourg	0	0.0%				
Hungary	16,502	1.9%	15.7	95.3%	10.0	124.7%
Malta	•	•	•	•	•	•
Netherlands	4,052	0.5%	46.8	69.0%	41.8	100.0%
Austria	9,553	1.5%	78.2	129.0%	46.6	118.6%
Poland	•	•	•	•	•	•
Portugal	3,105	0.4%	41.4	199.8%	20.1	156.5%
Slovenia	4,079	1.7%	16.7	74.1%	12.2	83.9%
Slovakia	5,309	1.3%	11.6	106.9%	5.8	94.1%
Finland	4,055	1.0%	40.8	58.9%	33.8	86.4%
Sweden	•	•	•	•	•	•
United Kingdom	29,995	0.8%	55.1	95.7%	36.6	105.4%
EU-21	294,022	1.0%	54.8	113.4%	37.3	116.6%
Others	13,866	0.4%	76.4	280.1%	23.7	119.7%
EU-25*	**307,888**	**0.9%**	**55.8**	**120.6%**	**36.7**	**119.1%**

Source: Eurostat New Cronos / * Estimates by DIW Berlin 2006

Exhibit A 3: Employment, productivity and labour cost in manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (DL 32.2) in EU-25 (2003)

	Employment		Productivity		Labour Cost	
	Persons employed	% of manufacturing	Value Added at factor cost per person employed (1000 EUR)	% of manufacturing	Personnel cost per person employed (1000 EUR)	% of manufacturing
Belgium	5,600	0.9%	109.9	151.9%	85.3	191.4%
Czech Republic	8,833	0.6%	18.5	134.7%	9.9	141.0%
Denmark	2,577	0.6%	66.6	114.4%	46.4	115.2%
Germany	51,481	0.7%	60.6	107.3%	58.5	135.1%
Estonia	•	•	•	•	•	•
Greece	•	•	•	•	•	•
Spain	7,196	0.3%	53.6	124.9%	33.9	129.6%
France	60,757	1.5%	53.5	102.4%	63.1	161.8%
Ireland	2,035	0.9%	64.8	38.6%	39.5	106.2%
Italy	54,319	1.1%	50.1	118.6%	34.4	133.9%
Cyprus	•	•	•	•	•	•
Latvia	631	0.4%	12.5	158.0%	4.4	122.7%
Lithuania	349	0.1%	7.4	111.3%	4.9	122.1%
Luxembourg	•	•	•	•	•	•
Hungary	5,089	0.6%	22.0	133.0%	12.1	150.7%
Malta	•	•	•	•	•	•
Netherlands	839	0.1%	59.7	88.0%	37.9	90.7%
Austria	14,529	2.3%	74.7	123.1%	70.0	178.0%
Poland	•	•	•	•	•	•
Portugal	3,224	0.4%	60.6	292.8%	41.7	324.3%
Slovenia	1,672	0.7%	44.0	195.2%	38.0	261.5%
Slovakia	2,851	0.7%	8.2	75.7%	6.4	104.8%
Finland	30,287	7.2%	197.9	286.0%	51.6	131.9%
Sweden	•	•	•	•	•	•
United Kingdom	30,704	0.9%	57.7	100.2%	59.2	170.4%
EU-18	282,973	1.0%	70.2	144.8%	51.0	158.8%
Others	47,565	1.4%	19.5	72.1%	51.5	264.7%
EU-25*	**330,538**	**1.0%**	**62.9**	**136.0%**	**51.1**	**165.8%**

Source: Eurostat New Cronos / * Estimates by DIW Berlin 2006

Production value (EU-25)

The production value data reveals that Germany, Ireland and France are the largest producers of computers and telecommunications equipment respectively (see Exhibit A 4, Exhibit A 5 and Exhibit A 6). The enlargement of the EU in 2004 added almost 8% to the total EU production value of the ICT industry and contributed to the increase of value added by nearly 5%. Among the 10 new Member States, the Czech Republic and Hungary have the largest share in ICT equipment production. The contribution of the remaining countries to the European production value in this sector is almost negligible.

Exhibit A 4: Production value and value added in manufacture of office machinery and computers (DL 30) in EU-25 (2003)

	Production value		Value Added at factor cost	
	Million EUR	% of EU-25	Million EUR	% of EU-25
Belgium	191.6	0.3%	54.7	0.4%
Czech Republic	2,434.5	4.0%	74	0.6%
Denmark	275.1	0.5%	98.1	0.8%
Germany	13,247.2	21.7%	3,680.2	28.3%
Estonia	28.3	0.0%	3.4	0.0%
Greece	•	•	•	•
Spain	872.2	1.4%	176.7	1.4%
France	10,696.5	17.5%	2,631.7	20.2%
Ireland	15,030.8	24.6%	1,179.1	9.1%
Italy	3,127	5.1%	631.6	4.8%
Cyprus	0	0.0%	0	0.0%
Latvia	10.2	0.0%	2	0.0%
Lithuania	9.4	0.0%	3.6	0.0%
Luxembourg	•	•	•	•
Hungary	1,961.4	3.2%	552.5	4.2%
Malta	•	•	•	•
Netherlands	1,296.8	2.1%	292.9	2.2%
Austria	725.8	1.2%	57.3	0.4%
Poland	•	•	•	•
Portugal	127	0.2%	25.3	0.2%
Slovenia	67.5	0.1%	21.5	0.2%
Slovakia	217.6	0.4%	8.4	0.1%
Finland	70.7	0.1%	16.5	0.1%
Sweden	•	•	•	•
United Kingdom	9,755.4	16.0%	3,196.2	24.5%
EU-20	60,145	98.6%	12,705.7	97.5%
Others	883.4	1.4%	320.8	2.5%
EU-25*	**61,028.4**	**100.0%**	**13,026.5**	**100.0%**

Source: Eurostat New Cronos / * Estimates by DIW Berlin 2006

Exhibit A 5: Production value and value added in manufacture electronic valves and tubes and other electronic components (DL 32.1) in EU-25 (2003)

	Production value		Value Added at factor cost	
	Million EUR	% of EU-25	Million EUR	% of EU-25
Belgium	1,063	2.2%	459	2.7%
Czech Republic	712	1.5%	234	1.4%
Denmark	270	0.5%	111	0.6%
Germany	15,622	31.8%	5,113	29.8%
Estonia	47	0.1%	10	0.1%
Greece	•	•	•	•
Spain	1,204	2.5%	362	2.1%
France	9,855	20.1%	3,258	19.0%
Ireland	2,497	5.1%	1,291	7.5%
Italy	4,960	10.1%	1,947	11.3%
Cyprus	•	•	•	•
Latvia	4	0.0%	2	0.0%
Lithuania	147	0.3%	53	0.3%
Luxembourg	•	•	•	•
Hungary	1,675	3.4%	260	1.5%
Malta	•	•	•	•
Netherlands	588	1.2%	190	1.1%
Austria	1,720	3.5%	747	4.4%
Poland	•	•	•	•
Portugal	973	2.0%	128	0.7%
Slovenia	182	0.4%	68	0.4%
Slovakia	321	0.7%	62	0.4%
Finland	492	1.0%	165	1.0%
Sweden	•	•	•	•
United Kingdom	5,079	10.4%	1,654	9.6%
EU-20	47,410	96.7%	16,114	93.8%
Others	1,643	3.3%	1,059	6.2%
EU-25*	**49,052**	**100.0%**	**17,173**	**100.0%**

Source: Eurostat New Cronos / * Estimates by DIW Berlin 2006

Exhibit A 6: Production value and value added in manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (DL 32.2) in EU-25 (2003)

	Production value		Value Added at factor cost	
	Million EUR	% of EU-25	Million EUR	% of EU-25
Belgium	1,425	1.9%	615	3.0%
Czech Republic	•	•	•	•
Denmark	683	0.9%	172	0.8%
Germany	10,600	14.1%	3,118	15.0%
Estonia	•	•	•	•
Greece	•	•	•	•
Spain	1,098	1.5%	386	1.9%
France	14,016	18.6%	3,253	15.6%
Ireland	699	0.9%	132	0.6%
Italy	8,584	11.4%	2,721	13.1%
Cyprus	•	•	•	•
Latvia	17	0.0%	8	0.0%
Lithuania	15	0.0%	3	0.0%
Luxembourg	•	•	•	•
Hungary	414	0.5%	112	0.5%
Malta	•	•	•	•
Netherlands	135	0.2%	50	0.2%
Austria	2,908	3.9%	1,085	5.2%
Poland	•	•	•	•
Portugal	743	1.0%	195	0.9%
Slovenia	217	0.3%	74	0.4%
Slovakia	82	0.1%	24	0.1%
Finland	13,830	18.4%	5,995	28.8%
Sweden	•	•	•	•
United Kingdom	6,139	8.1%	1,773	8.5%
EU-18	61,605	81.7%	19,714	94.8%
Others	13,756	18.3%	1,089	5.2%
EU-25*	**75,361**	**100.0%**	**20,803**	**100.0%**

Source: Eurostat New Cronos / *Estimates by DIW Berlin 2006

Annex II: The e-Business Survey 2006 – Methodology Report

Background and scope

e-Business W@tch collects data relating to the use of ICT and e-business in European enterprises by means of representative surveys. The e-Business Survey 2006, which was the fourth survey after those of 2002, 2003 and 2005, had a scope of 14,081 telephone interviews with decision-makers in enterprises from 29 countries, including the 25 EU Member States, EEA and Acceding / Candidate Countries.[86] Interviews were carried out in March and April 2006, using computer-aided telephone interview (CATI) technology.

Questionnaire

The questionnaire is similar to those used in the previous surveys from 2002 to 2005 in order to ensure a basic continuity of the research approach. The module on ICT impact was substantially extended compared to 2005, in response to current policy interest, in exchange for some questions from other modules.

Some questions which were also used in previous surveys were slightly modified. The most important change in this context concerns questions on e-commerce: up to 2005, companies were asked whether they "purchase / sell online"; in 2006, companies were asked whether they "place / accept orders online". This is a more precise question, since the terms "purchasing" and "selling" leave it open whether ordered goods also have to be paid online in order to qualify for "online purchasing / selling".

Some specific topics were added or expanded in the questionnaire in order to reflect the latest e-business developments; examples are the new questions on the use of RFID and Voice-over-IP.

The questionnaires of all four surveys (2002, 2003, 2005, 2006) can be downloaded from the *e-Business W@tch* website (www.ebusiness-watch.org/about/methodology.htm).

Population

As in 2005, the survey considered only **companies that used computers**. Thus, the highest level of the population was the set of all computer-using enterprises which were active within the national territory of one of the 29 countries covered, and which had their primary business activity in one of the 10 sectors specified on the basis of NACE Rev. 1.1.

Evidence from previous surveys shows that computer use can be expected to be 99% or more in all sectors among medium-sized and large firms. Differences are more relevant, however, for micro and small enterprises, in particular in the food and beverages industry, the textile and footwear industries, construction and tourism. In these four sectors, 10-30% of micro enterprises and 4-15% of small firms (depending on the country and sector) do not use a computer.[87] This should be considered when comparing figures over the

[86] The EEA (European Economic Area) includes, in addition to EU Member States, Iceland, Liechtenstein and Norway. Acceding Countries with whom an Accession Treaty has been signed are Bulgaria and Romania; Candidate Countries, which are candidates for accession into the EU, are (as of September 2006) Croatia, the former Yugoslav Republic of Macedonia, and Turkey. In most of these countries, interviews and/or case studies were conducted.

[87] Non-computer users include typically small craft firms (textile, construction), bars, restaurants or pensions (in tourism), and small food producing companies.

years, as figures either represent a percentage of "all companies" (as in 2002 and 2003) or a percentage of "companies using computers" (as in 2005 and 2006). Differences are minimal, though, when figures have been weighted by employment.

The 10 sectors which were selected for the 2006 survey are extremely heterogeneous in terms of their size. Construction and tourism are by far the largest with about 1.5 million enterprises in each of the EU-25.[88] At the other end of the range is the consumer electronics industry with about 5,400 enterprises; this is a factor of about 280 between the largest and smallest sector. This imbalance has inevitably a substantial impact on weighting and thus on aggregate results, which are dominated by figures from construction and tourism.

Table 1: Population coverage of the e-Business Survey 2006

No.	NACE Rev. 1.1	Sectors covered	No. of enterprises in EU-25 *	No. of interviews conducted
1	DA 15 (most groups)	Food and beverages	282,000	1,709
2	DC 19.3	Footwear	13,700	980
3	DE 21	Pulp, paper and paper products	18,400	1,158
4	DL 30, 32.1+2	ICT manufacturing	31,800	1,687
5	DL 32.3	Consumer electronics	5,400	665
6	DM 35.11	Shipbuilding and repair	7,200	150
7	F 45.2+3 (selected classes)	Construction	1,546,000	2,655
8	H 55.1/3, I 63.3, O 92.33/52	Tourism	1,500,000	2,663
9	I 64.2	Telecommunication services	12,900	1,580
10	N 85.11	Hospital activities	(e) 13,000	834

* mostly based on Eurostat SBS, latest available figures

(e) = estimated on the basis of figures for the former EU-15 (no figures available for EU-25)

Sampling frame and method

No cut-off was made in terms of minimum size of firms. The sample drawn was a random sample of companies from the respective sector population in each of the countries, with the objective of fulfilling minimum strata with respect to company size class per country-sector cell. Strata were to include a 10% share of large companies (250+ employees), 30% of medium sized enterprises (50-249 employees), 25% of small enterprises (10-49 employees) and up to 35% of micro enterprises with less than 10 employees.

Samples were drawn locally by fieldwork organisations based on official statistical records and widely recognised business directories such as Dun & Bradstreet or Heins und Partner Business Pool (both used in several countries).

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 rather small population of enterprises in some of the sectors, target quota, particularly in the larger enterprise size-bands, could not be accomplished in each of the countries. 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.

[88] Construction (NACE Rev. 1.1 F 45) in total has about 2.3 million enterprises. The sub-sectors covered in 2006 (see Table 1) account for about 1.5 million out of these.

Fieldwork

Fieldwork was coordinated by the German branch of Ipsos GmbH (www.ipsos.de) and conducted in cooperation with its local partner organisations (see Table 2) on behalf of *e-Business W@tch*.[89]

The survey had a scope of 14,081 interviews, spread across the 29 countries and 10 industries covered. In 10 countries ("EU-10"), all 10 sectors were covered; in the other countries, selected industries were surveyed. In most countries, between 400 and 750 interviews were conducted. Pilot interviews prior to the regular fieldwork were conducted with 23 companies in Germany in February 2006, in order to test the questionnaire (structure, comprehensibility of questions).

Table 2: Institutes that conducted the fieldwork of the e-Business Survey 2006 and no. of interviews per country (#)

	Institute	# Int.		Institute	# Int.
BE	Ipsos Belgium, 1050 Brussels	400	MT	Misco International Ltd., Valetta VLT 04	101
CZ	Ipsos Czech Republic, Skolska 32/694, 110 00 Praha 1	750	NL	Ipsos Belgium, 1050 Brussels	400
DK	Vilstrup Research AS, 1360 Copenhagen	403	AT	Spectra Marktforschungs-gesellschaft m.b.H., 4020 Linz	400
DE	Ipsos GmbH, 23879 Mölln	800	PL	Ipsos Poland, 02-508 Warszawa	752
EE	Marketing and Public Opinion Research Centre SKDS, Riga LV-1010	314	PT	Ipsos Portugal, 1070-15 Lisbon	400
EL	Synovate Hellas, 15451 Athens	407	SI	GfK Gral-Iteo trazne raziskave d.o.o., 1000 Ljubljana	400
ES	Ipsos Eco Consulting, 28036 Madrid	754	SK	GfK Slovakia Ltd., 813 41 Bratislava 1	400
FR	Ipsos France, 75739 Paris	751	FI	Taloustutkimus Oy, 00510 Helsinki	752
IE	Landsdowne Market Research, Dublin 1	400	SE	GfK Sverige AB, 22100 Lund	400
IT	Demoskopea S.p.A., 00199 Roma	756	UK	Continental Research, London EC1V 7DY	750
CY	Synovate Cyprus, 2107 Nicosia	209		EEA and Acceding/Candidate countries	
LV	Marketing and Public Opinion Research Centre SKDS, Riga LV-1010	432	NO	Norstat Norway, 0159 Oslo	401
LT		404	BG	TNS BBSS Gallup Interbational, 1164 Sofia	400
LU	Ipsos GmbH, 23879 Mölln/20097 Hamburg	117	RO	Field Insights, Bucharest 2	440
HU	Szonda Ipsos, 1096 Budapest	772	TR	Bilesim International Research & Consultancy Inc. Turkey, 34676 Istanbul	400

[89] The survey was carried out under two different contracts. The survey in the six largest EU countries (DE, ES, FR, IT, PL, UK) was carried out as part of the e-Business W@tch contract between the European Commission and empirica GmbH; the survey in the other countries was carried out in parallel, but under a different contract (following an open call for tender for the "extended e-Business W@tch survey", issued in 2005).

Non response: In a voluntary telephone survey, in order to achieve the targeted interview totals, it is always necessary to contact more companies than just the number equal to the target. 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. Table 3 shows the completion rate by country (completed interviews as percentage of contacts made) and reasons for non-completion of interviews. Higher refusal rates in some countries, sectors or size bands (especially among large businesses) inevitably raises 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 (be it telephone- or paper-based).

Table 3: Interview contact protocols: completion rates and non-response reasons (2006, examples)

		CZ	DE	ES	FR	HU	IT	NL	PL	FI	UK
1	**Sample (gross)**	5595	7763	7730	8686	21540	8533	4576	11054	3016	11821
1.1	Telephone number does not exist	283	1055	0	186	5545	717	349	2282	139	2663
1.2	Not a company (e.g. private household)	79	80	356	66	2076	89	219	681	34	324
1.3	Fax machine / modem	56	48	0	79	1120	61	28	53	4	130
1.4	Quota completed -> address not used	43	124	660	1939	1665	2154	1002	877	66	158
1.5	No target person in company	17	359	730	142	9	178	232	959	319	736
1.6	Language problems	9	18	0	25	0	1	36	0	41	20
1.7	No answer on no. of employees	2	1	10	13	6	8	1	19	1	0
1.8	Company does not use computers	48	47	158	250	279	314	235	460	28	51
1.9	Company does not qualify	134	330	103	156	0	113	47	813	49	215
	Sum 1.1 – 1.9	671	2062	2017	2856	10700	3635	2149	6144	681	4297
2	**Sample (net)**	4924	5701	5713	5830	10840	4898	2427	4910	2335	7524
2.1	Nobody picks up phone	1071	582	1645	6	1023	647	82	513	22	1898
2.2	Line busy, engaged	83	122	57	46	89	0	3	73	1	1
2.3	Answering machine	143	145	121	1315	1200	0	9	127	1	145
2.4	Contact person refuses	2080	1125	2553	131	2011	729	1653	2009	578	2523
2.5	Target person refuses	450	1865	202	1475	2776	642	113	280	405	1618
2.6	No appointment during fieldwork period	3	11	70	182	2571	384	112	150	50	376
2.7	Open appointment	295	953	35	1896	258	1041	21	763	459	51
2.8	Target person is ill / unavailable	2	31	0	0	0	13	0	29	2	32
2.9	Interview abandoned	43	67	271	29	108	686	34	176	15	130
2.10	Interview error, cannot be used	4	0	5	5	32	0	0	38	50	0
	Sum 2.1 – 2.10	4174	4901	4959	5085	10068	4142	2027	4158	1583	6774
3	**Successful interviews**	750	800	754	751	772	756	400	752	752	750
	Completion rate (= [3] / [2])	15%	14%	13%	13%	7,12%	15%	16,48%	15%	32%	10%
	Average interview time (min:sec)	19:19	18:46	17:29	19:39	17:14	16:43	19:00	23:44	20:19	20:16

Feedback from interviewers

No major problems were reported from the fieldwork 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. Some of the more specific remarks from fieldwork organisations, which point at difficulties encountered in the local situation, are summarised in Table 4.

Table 4: Comments by national fieldwork companies on their experience (2006, examples)

Country	Comments
Belgium	• The questionnaire was very clear. • Business-to-business (B2B) research (i.e. surveys on behalf of companies or authorities amongst companies) is often difficult when the questionnaire length is longer than 15 minutes; target persons often complained that they have no time for an interview during their normal work. • Positive reaction from respondents that the results can be found on the website.
Bulgaria	• Many companies (especially within the tourism sector) have outsourced their ICT operations. Therefore, it was sometimes difficult for respondents to understand the questions.
Czech Republic	• It was difficult to fulfil quotas in several sectors which are mainly represented by very small companies, often by one-person-companies (self-employed), many of which are not willing to do a relatively long interview. There was a high percentage of refusals among micro-companies.
Denmark	• Some technical terms (such as internet protocol, LAN, W-LAN, VPN, RFID, and EDI) were hard for interviewers and respondents to understand.
Finland	• The questionnaire was quite long and that is why there were more refusals than normal. • Smaller companies often refused to answer or interrupted the interview because they thought that they did not know enough about e-business. Respondents in the pulp and paper sector were especially not interested in this topic due to comparably low ICT usage.
Germany	• As with previous e-Business surveys carried out, fieldwork ran relative smoothly overall and the questionnaire was easy to understand and interesting for most of respondents. • Respondents from small companies often had difficulty when answering questions related to specific technical terms and applications. • Respondents reacted positively to the fact that the survey was carried out on behalf of the European Commission.
Greece	• There were several cases where companies have outsourced the IT support and thus there was no person to interview. • Respondents who were not IT specialists found some of the IT terminology difficult to understand.
Spain	• Fieldwork did not run as smoothly as expected due to several bank holidays occurring during the period, therefore it was difficult to reach the target persons. • IT professionals in large companies were the most available.
France	• In general, the fieldwork went without any problems and the questionnaire was understood by the respondents. • For some sectors, the lack of contact addresses was a serious problem. • For future surveys, the case concerning new companies which cannot answer the financial questions should be considered.
Hungary	• The cooperation level in this survey was similar to other telephone surveys among companies; but a problem was that many small companies use only one computer, and only for basic functions.
Ireland	• The B2B sector (not general population or household surveys) is very over researched in Ireland; hence there was a high level of refusals. • In Ireland more than 90% of businesses employ less than 9 employees so many companies do not have the need nor use for ICT.

Italy	• Many refusals among the smallest and/or family owned business, where only one PC is available and used more for personal reasons than for business. • Respondents often lost their patience because considering the low use of the PC in their business, they had to spend time on the phone always giving the same answers ("no, do not use …").
Latvia	• The main problem was the length of the questionnaire. Although the average interview length was 16 minutes and thus the shortest of all participating countries, surveys among companies with interviews lasting more than 15 minutes are generally not recommended in Latvia. • It was rather hard for IT managers to answer about budget, market shares and so on.
The Netherlands	• The questionnaire was very clear, so positive. • Business-to-business surveys are often difficult when the questionnaire length is longer than 15 minutes. • Secretaries/receptionists in the Netherlands are very well trained in refusing the transferring of a call.
Norway	• Interviewers experienced that many respondents / businesses did not wish to participate due to the topic of the survey. Main reason was that they did not feel competent, although they qualified from the results of the screening.
Poland	• There were some difficulties in getting an interview with computer/IT specialists. In many big companies they refuse to take time for an interview. • Many small companies did not understand some of the more technical terms.
Sweden	• The questionnaire was understood by most of the respondents.
UK	• Although some of the questions do appear to be quite technical, this did not prove a particular problem for respondents. • There was a very low universe of companies in certain quota cells. Given the limited sample available in some sectors, and the need to target a high proportion of large companies, a longer field period would probably have helped to maximize the number of complete interviews. • It is becoming increasingly difficult to secure interviews with IT/DP professionals, and we suspect that this situation will only worsen in the future.

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, not allowing any reasonable presentation of results. Thus, weighting is required so that results adequately reflect the structure and distribution of enterprises in the population of the respective sector or geographic area. *e-Business W@tch* applies two different weighting schemes: weighting by employment and by the number of enterprises.[90]

- 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 that there are many more micro-enterprises than any other firms. If the weights did not take into account the economic importance of businesses of different sizes in some way, 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.

[90] 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.

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 those companies that had replied to have internet access. Thus, the question whether a company has Internet access or not serves as a filter for follow-up questions.

The results for filtered questions can be computed on the base of only those enterprises that were actually asked the question (e.g. "in % of enterprises with internet access"), but can also be computed on the base of "all companies". In this report, both methods are used, depending on the indicator. The base (as specified in footnotes of tables and charts) is therefore not necessarily identical to the set of companies that were actually asked the underlying 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.

Table 7 gives some indication about the level of accuracy that can be expected for industry totals for the EU-10[91] (based on all respondents) depending on the weighting scheme applied. For totals of all-sectors (in the EU-10), an accuracy of about +/- 3 percentage points can be expected for most values that are expressed as "% of firms", and of about +/- 2 percentage points for values that are weighted by employment.

The confidence intervals for industry totals (EU-10) differ considerably depending on the industry and the respective value; on average, it is about +/- 5 percentage points (in both weighting schemes). Confidence intervals are highest for the shipbuilding and repair industry, due to the small number of observations, and because this sector is more sensitive to weights due to its structure (i.e. the dominance of large firms in a comparatively small population). Data for this industry are therefore indicative and cannot claim to have statistical accuracy.

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, literally each and 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 borne in mind when comparing the confidence intervals of *e-Business W@tch* surveys to those commonly found in general population surveys.

[91] The EU-10 are composed of those countries in which all 10 sectors were covered by the survey. To ensure data comparability, only interviews from these countries are included in the aggregated "total" values. The EU-10 are: CZ, DE, ES, FR, IT, HU, NL, PL, FI, UK. These 10 countries represent more than 80% of the population and GDP of the EU.

Table5: Confidence intervals for all-sector and sector totals (EU-10)

		Confidence interval								
	Survey result	Weighted as "% of firms"			Weighted by employment			Unweighted		
All sectors (aggregate), EU-10	**10%**	**8.1%**	**-**	**12.3%**	**8.7%**	**-**	**11.5%**	**9.4%**	**-**	**10.6%**
Food and beverages	10%	**6.6%**	-	**14.8%**	**7.3%**	-	**13.6%**	**8.4%**	-	**11.9%**
Footwear	10%	**7.5%**	-	**13.2%**	**7.6%**	-	**13.1%**	**8.4%**	-	**11.9%**
Pulp and paper	10%	**7.8%**	-	**12.7%**	**7.5%**	-	**13.3%**	**8.5%**	-	**11.7%**
ICT manufacturing	10%	**7.9%**	-	**12.6%**	**7.6%**	-	**13.0%**	**8.7%**	-	**11.5%**
Consumer electronics	10%	**7.4%**	-	**13.4%**	**6.0%**	-	**16.2%**	**8.0%**	-	**12.4%**
Shipbuilding and repair	10%	**4.8%**	-	**19.7%**	**4.6%**	-	**20.4%**	**6.0%**	-	**16.1%**
Construction	10%	**6.9%**	-	**14.3%**	**7.6%**	-	**13.1%**	**8.3%**	-	**11.9%**
Tourism	10%	**6.6%**	-	**14.8%**	**6.8%**	-	**14.4%**	**8.3%**	-	**12.0%**
Telecommunication services	10%	**7.6%**	-	**13.1%**	**6.6%**	-	**14.8%**	**8.4%**	-	**11.9%**
Hospital activities	10%	**7.2%**	-	**13.7%**	**7.2%**	-	**13.8%**	**8.1%**	-	**12.3%**
All sectors (aggregate), EU-10	**30%**	**26.8%**	**-**	**33.4%**	**27.9%**	**-**	**32.2%**	**29.1%**	**-**	**30.9%**
Food and beverages	30%	**24.2%**	-	**36.6%**	**25.4%**	-	**35.0%**	**27.4%**	-	**32.8%**
Footwear	30%	**25.9%**	-	**34.5%**	**26.0%**	-	**34.3%**	**27.3%**	-	**32.8%**
Pulp and paper	30%	**26.4%**	-	**33.9%**	**25.8%**	-	**34.6%**	**27.6%**	-	**32.5%**
ICT manufacturing	30%	**26.5%**	-	**33.8%**	**26.1%**	-	**34.2%**	**27.9%**	-	**32.2%**
Consumer electronics	30%	**25.6%**	-	**34.8%**	**22.9%**	-	**38.1%**	**26.8%**	-	**33.5%**
Shipbuilding and repair	30%	**20.2%**	-	**42.0%**	**19.7%**	-	**42.8%**	**23.0%**	-	**38.1%**
Construction	30%	**24.7%**	-	**35.9%**	**25.9%**	-	**34.4%**	**27.3%**	-	**32.8%**
Tourism	30%	**24.2%**	-	**36.5%**	**24.6%**	-	**36.1%**	**27.3%**	-	**32.9%**
Telecommunication services	30%	**25.9%**	-	**34.4%**	**24.2%**	-	**36.5%**	**27.4%**	-	**32.7%**
Hospital activities	30%	**25.3%**	-	**35.2%**	**25.3%**	-	**35.2%**	**26.9%**	-	**33.4%**
All sectors (aggregate), EU-10	**50%**	**46.4%**	**-**	**53.6%**	**47.6%**	**-**	**52.4%**	**49.0%**	**-**	**51.0%**
Food and beverages	50%	**43.2%**	-	**56.8%**	**44.7%**	-	**55.3%**	**47.0%**	-	**53.0%**
Footwear	50%	**45.3%**	-	**54.7%**	**45.5%**	-	**54.5%**	**47.0%**	-	**53.0%**
Pulp and paper	50%	**45.9%**	-	**54.1%**	**45.2%**	-	**54.8%**	**47.3%**	-	**52.7%**
ICT manufacturing	50%	**46.0%**	-	**54.0%**	**45.5%**	-	**54.5%**	**47.7%**	-	**52.3%**
Consumer electronics	50%	**45.0%**	-	**55.0%**	**41.7%**	-	**58.3%**	**46.3%**	-	**53.7%**
Shipbuilding and repair	50%	**38.2%**	-	**61.8%**	**37.5%**	-	**62.5%**	**41.8%**	-	**58.2%**
Construction	50%	**43.9%**	-	**56.1%**	**45.4%**	-	**54.6%**	**47.0%**	-	**53.0%**
Tourism	50%	**43.3%**	-	**56.7%**	**43.7%**	-	**56.3%**	**46.9%**	-	**53.1%**
Telecommunication services	50%	**45.4%**	-	**54.6%**	**43.3%**	-	**56.7%**	**47.1%**	-	**52.9%**
Hospital activities	50%	**44.6%**	-	**55.4%**	**44.6%**	-	**55.4%**	**46.5%**	-	**53.5%**
All sectors (aggregate), EU-7	**70%**	**66.6%**	**-**	**73.2%**	**67.8%**	**-**	**72.1%**	**69.1%**	**-**	**70.9%**
Food and beverages	70%	**63.4%**	-	**75.8%**	**65.0%**	-	**74.6%**	**67.2%**	-	**72.6%**
Footwear	70%	**65.5%**	-	**74.1%**	**65.7%**	-	**74.0%**	**67.2%**	-	**72.7%**
Pulp and paper	70%	**66.1%**	-	**73.6%**	**65.4%**	-	**74.2%**	**67.5%**	-	**72.4%**
ICT manufacturing	70%	**66.2%**	-	**73.5%**	**65.8%**	-	**73.9%**	**67.8%**	-	**72.1%**
Consumer electronics	70%	**65.2%**	-	**74.4%**	**61.9%**	-	**77.1%**	**66.5%**	-	**73.2%**
Shipbuilding and repair	70%	**58.0%**	-	**79.8%**	**57.2%**	-	**80.3%**	**61.9%**	-	**77.0%**
Construction	70%	**64.1%**	-	**75.3%**	**65.6%**	-	**74.1%**	**67.2%**	-	**72.7%**
Tourism	70%	**63.5%**	-	**75.8%**	**63.9%**	-	**75.4%**	**67.1%**	-	**72.7%**
Telecommunication services	70%	**65.6%**	-	**74.1%**	**63.5%**	-	**75.8%**	**67.3%**	-	**72.6%**
Hospital activities	70%	**64.8%**	-	**74.7%**	**64.8%**	-	**74.7%**	**66.6%**	-	**73.1%**
All sectors (aggregate), EU-7	**90%**	**87.7%**	**-**	**91.9%**	**88.5%**	**-**	**91.3%**	**89.4%**	**-**	**90.6%**
Food and beverages	90%	**85.2%**	-	**93.4%**	**86.4%**	-	**92.7%**	**88.1%**	-	**91.6%**
Footwear	90%	**86.8%**	-	**92.5%**	**86.9%**	-	**92.4%**	**88.1%**	-	**91.6%**
Pulp and paper	90%	**87.3%**	-	**92.2%**	**86.7%**	-	**92.5%**	**88.3%**	-	**91.5%**
ICT manufacturing	90%	**87.4%**	-	**92.1%**	**87.0%**	-	**92.4%**	**88.5%**	-	**91.3%**
Consumer electronics	90%	**86.6%**	-	**92.6%**	**83.8%**	-	**94.0%**	**87.6%**	-	**92.0%**
Shipbuilding and repair	90%	**80.3%**	-	**95.2%**	**79.6%**	-	**95.4%**	**83.9%**	-	**94.0%**
Construction	90%	**85.7%**	-	**93.1%**	**86.9%**	-	**92.4%**	**88.1%**	-	**91.7%**
Tourism	90%	**85.2%**	-	**93.4%**	**85.6%**	-	**93.2%**	**88.0%**	-	**91.7%**
Telecommunication services	90%	**86.9%**	-	**92.4%**	**85.2%**	-	**93.4%**	**88.1%**	-	**91.6%**
Hospital activities	90%	**86.3%**	-	**92.8%**	**86.2%**	-	**92.8%**	**87.7%**	-	**91.9%**

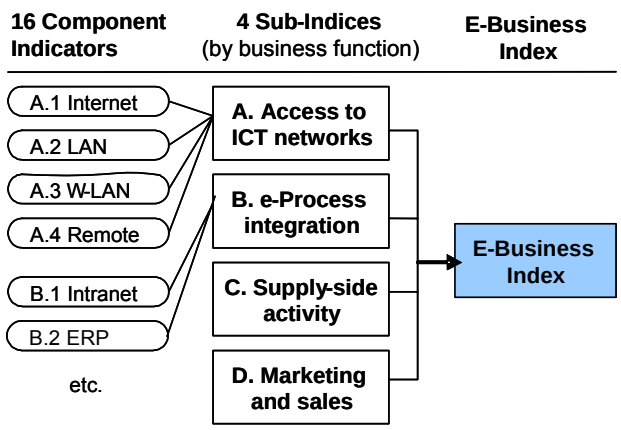
confidence intervals at α=.90

The e-Business Scoreboard 2006

The e-Business Scoreboard approach was developed by *e-Business W@tch* in 2004. It is a compound index that condenses data on ICT adoption and e-business activity, enabling comparisons across different sectors, countries or size-bands.

Conceptually, the e-Business Scoreboard owes a debt to the Balanced Scorecard (BSC) approach, which suggests that an organisation should be viewed from four perspectives, and that metrics (and targets) are to be defined for each perspective. Similarly, the e-Business Scoreboard looks at ICT use by enterprises from four (inter-related) perspectives. The Scoreboard consists of **16 component indicators** (see next page), which represent the metrics for these perspectives. Component indicators (CI) can be aggregated on several levels.

- First, CI can be aggregated into the 4 main **sub-indices** (with 4 CI each) that represent major application areas of e-business.
- Second, the four sub-indices can be further aggregated into 2 dimensions and, finally, into the overall "**e-Business Index**".



The e-Business Scoreboard takes into account the percentages (diffusion rates) from all sectors (size-bands, …) and show how a specific sector (size-band, …) differs from the all-sector-average. An index value is based on mean values and standard deviations. Thus, index values express the multiple of the standard deviation (1 or (-1)) for a specific sector and the selected indicator. 0 equals the mean value for all sectors (size-bands, …).

Indexes simplify multi-dimensional concepts. To correctly assess the validity and shortcomings of the Scoreboard and its overall index, the following notes should be taken into account:

- **Weighting**: Results are influenced by the selection of the underlying weighting scheme for component indicators. If employment-weighted figures are used, e-business activity in large firms is emphasized. If indicators are weighted by the number of enterprises (irrespective of their size), the situation in smaller firms is emphasized.
- **Component indicators**: The selection of component indicators may have a bias towards manufacturing activities, as some indicators can be more relevant for manufacturing than for service sectors (e.g. ERP use).
- **Relative comparison**: The Scoreboard results do not represent absolute measures of e-business activity, but depend on the respective set of sectors (or countries, ...) that are compared to each other, because figures express standard deviations from the *average* of the respective set.

Component indicators of the e-Business Scoreboard 2006

(Definitions for indicators weighted by employment)

A. ICT infrastructure and basic connectivity		
A.1	**Internet** connectivity	= the percentage of employees working in enterprises that are connected to the internet, with a supplementary indicator for the type of internet connection in terms of bandwidth. Enterprises that are connected with broadband (via DSL, cable, direct fibre or wireless broadband) are computed with a factor of 1.0, enterprises connected via analogue dial-up modem or ISDN with a factor of 0.5. The maximum value of 100 would be returned if all employees work in enterprises with broadband connections.
A.2	Use of **LAN**	= the percentage of employees from a sector working in enterprises that have connected computers with a Local Area Network (LAN).
A.3	Use of a **Wireless LAN**	= the percentage of employees working in enterprises which use a Wireless LAN.
A.4	**Remote access** to the company's computer network	= the percentage of employees from a sector working in enterprises where it is possible to access data from the company's computer system from a remote location.
B. Internal business process automation		
B.1	Use of an **intranet**	= the percentage of employees working in enterprises that use an intranet.
B.2	Use of an **ERP** system	= the percentage of employees working in enterprises that have implemented an ERP (enterprise resource planning) system.
B.3	Use of online technology to **track** working hours and/or production time	= the percentage of employees working in enterprises that use online technologies (other than e-mail) to track working hours and/or production times.
B.4	Companies sending or receiving **e-invoices**	= the percentage of employees working in enterprises that send and/or receive e-invoices.
C. Procurement and supply chain integration		
C.1	Companies placing >5% of their **orders to suppliers online**	= the percentage of employees working in enterprises saying that they place orders to suppliers online on the web or via other computer-mediated networks, for example via EDI based connections to their suppliers, and that these online orders account for at least 5% of their total orders.
C.2	Use of **specific ICT** solutions for e-procurement	= the percentage of employees working in enterprises that use specific IT solutions to support the selection of their suppliers and/or procurement processes.
C.3	Companies **linking their ICT system with suppliers**	= the percentage of employees that work in enterprises whose ICT system is linked with those of suppliers.
C.4	Companies managing **capacity and inventory online**	= the percentage of employees working in enterprises that that use technologies to manage capacity and inventory online.
D. Marketing and sales processes		
D.1	Use of **CRM** software systems	= the percentage of employees working in enterprises that use a CRM (customer relationship management) software to organise data about their customers electronically.
D.2	Companies receiving >5% of **orders from customers online**	= the percentage of employees working in enterprises saying that they accept orders from customers online on the web or via other computer-mediated networks, and that these online orders account for at least 5% of their total orders received.
D.3	Use of **specific ICT** solutions to support marketing and sales processes	= the percentage of employees working in enterprises that uses specific IT solutions to support marketing and sales processes.
D.4	Companies **linking their ICT system with customers**	= the percentage of employees that work in enterprises whose ICT system is linked with those of customers.

Annex III: Expanded Tables – Data by Country

General remarks on country data break-downs

The studies of *e-Business W@tch* have a sectoral perspective and focus, within sectors, on small and medium-sized enterprises; the analysis of geographic differences is not in the foreground. This decision on the study focus recognises that the e-business activities of a company are mainly determined by its business activity, the configuration of its value system and its size, rather than by the location of a firm.

For several reasons, country data on e-business adoption must be taken with a pinch of salt. They can reflect, at least to some extent, the structure of the economy rather than the overall e-maturity of firms. In Italy, for example, sectors dominated by small firms are much more prevalent than in other countries. Since large firms are more advanced in electronic business, aggregated data may point at a lower level of e-business activity in Italy. In contrast to Italy, the relative performance of French and Dutch companies is significantly better if the emphasis is on larger firms. These benchmarking results suggest that the digital divide between small and large firms could be quite pronounced in these countries.

It should also be considered that the average size of the companies interviewed in a sector can differ by country, depending on industry structure and the available business directories used for sampling. It cannot be excluded that some directories may have a bias towards smaller / larger firms. Although this effect is counteracted by weighting the answers (according to the representation of various company sizes in the population), it cannot be excluded that structural differences in the sample have an impact on results. Ideally, comparisons between different countries should only be made within the same size-band of firms, rather than on the aggregate level. However, at least within a given sector, the number of observations available does not allow a break-down by country *and* size-band.

Exhibit A3-1: Internet access and remote access to company network

	Companies with internet access		Companies with broadband internet access		Share of employees with internet access		Companies enabling remote access to their network	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**100**	**99**	**84**	**79**	n.a.	**74**	**69**	**35**
ICTM I	100	99	84	83	n.a.	83	76	39
ICTM II	100	99	84	76	n.a.	67	67	31
Micro (1-9 empl.)		99		78	n.a.	78		30
Small (10-49 empl.)		99		86	n.a.	59		47
Medium (50-249 empl.)		100		85	n.a.	54		70
Large (250+ empl.) *		100		83	n.a.	59		88
Belgium *	100	92	73	81	n.a.	81	79	46
Czech Republic	100	100	80	76	n.a.	92	55	38
Germany	100	100	87	82	n.a.	79	68	51
Estonia	100	100	98	88	n.a.	77	32	54
Spain	100	99	92	92	n.a.	75	67	37
France	100	99	92	88	n.a.	70	81	38
Ireland *	100	100	99	91	n.a.	66	79	67
Italy	99	98	86	76	n.a.	60	46	22
Latvia	100	100	74	81	n.a.	87	56	58
Lithuania	100	97	78	86	n.a.	86	45	46
Hungary	100	95	93	89	n.a.	86	57	51
Netherlands	100	100	91	94	n.a.	85	77	55
Austria	100	100	90	84	n.a.	87	100	78
Poland	100	100	71	56	n.a.	90	49	29
Slovenia *	100	100	61	96	n.a.	81	75	70
Finland	100	99	100	94	n.a.	76	61	44
Sweden	100	100	97	89	n.a.	90	74	45
United Kingdom	100	99	70	82	n.a.	74	77	45
Bulgaria *	98	97	52	70	n.a.	56	30	17
Turkey	100	100	73	89	n.a.	96	71	61
All 10 sectors (EU-10)	**95**	**93**	**76**	**69**	n.a.	**43**	**35**	**16**
Micro (1-9 empl.)		89		62		51		12
Small (10-49 empl.)		98		75		29		22
Medium (50-249 empl.)		99		83		33		43
Large (250+ empl.)		99		84		44		60
Base (100%)	firms using computers		firms using computers		firms with internet access		firms using computers	
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	A1		A3		A2		A5	
* Data only indicative due to low number of observations (N ~ 25-50).								

Source: *e-Business W@tch* (Survey 2006)

Exhibit A3-2: Demand for ICT skills and skills development

	Companies employing ICT practitioners		Regular ICT training of employees		Companies with hard-to-fill vacancies for ICT jobs in 2005		Companies using e-learning	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
ICTM (EU-10)	**52**	**31**	**39**	**24**	**8**	**3**	**28**	**20**
ICTM I	59	40	53	33	14	6	40	27
ICTM II	49	24	34	17	6	2	24	15
Micro (1-9 empl.)		29		22		3		19
Small (10-49 empl.)		34		26		4		25
Medium (50-249 empl.)		53		38		9		25
Large (250+ empl.)		58		62		11		50
Belgium *	75	40	53	25	8	1	28	20
Czech Republic	24	19	55	16	12	3	44	24
Germany	63	46	45	27	10	6	20	24
Estonia	52	46	40	38	12	8	38	34
Spain	36	22	44	32	12	6	33	28
France	58	29	28	16	5	3	13	12
Ireland *	50	43	49	37	10	11	59	47
Italy	51	28	45	28	4	3	31	16
Latvia	87	70	40	38	26	23	30	35
Lithuania	40	29	40	15	14	11	46	51
Hungary	25	22	16	15	0	3	25	18
Netherlands	62	24	27	18	25	9	34	20
Austria	60	43	77	25	0	0	39	18
Poland	66	51	51	36	13	1	28	27
Slovenia *	62	43	47	43	9	39	63	60
Finland	64	58	24	19	12	9	31	28
Sweden	90	58	27	13	8	1	8	7
United Kingdom	37	28	31	12	9	2	38	24
Bulgaria *	52	47	23	24	13	29	40	36
Turkey	47	40	45	39	24	8	61	64
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Micro (1-9 empl.)		12		9		2		12
Small (10-49 empl.)		15		16		0		11
Medium (50-249 empl.)		29		28		2		19
Large (250+ empl.)		59		41		6		35
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	1277		1277		1277		1277	
Questionnaire reference	B1		B4		B2		B5	
* Data only indicative due to low number of observations (N ~ 25-50).								

Source: *e-Business W@tch* (Survey 2006)

Annex IV: Nokia's Acquisitions

Date	Acquisition Target	Nokia Unit
February 10, 2006	Intellisync Corp.	Enterprise Solutions
October 18, 2004	Metrowerks Corporation	Nokia Corporation
November 3, 2003	Tahoe Networks	Nokia Networks
August 19, 2003	Sega.com Inc.	Nokia Mobile Phones
April 22, 2003	Eizel Technologies(TM)	Nokia Internet Communications
May 22, 2002	Redback Networks Inc.	Nokia Networks
July 25, 2001	Amber Networks Inc.	Nokia Networks
June 28, 2001	F5 Networks Inc.	Nokia Internet Communications
December 7, 2000	Ramp Networks Inc.	Nokia Internet Communications
October 20, 2000	NGI Industrial (NGI)	Nokia Mobile Phones
August 8, 2000	DiscoveryCom Inc.	Nokia Networks
February 1, 2000	Network Alchemy Inc.	Nokia Internet Communications
December 13, 1999	Security software business from TeamWARE Group	Nokia Wireless Network Solutions
October 22, 1999	Telekol Group	Nokia Internet Communications
September 2, 1999	Rooftop Communications Corp	Nokia Networks
June 30, 1999	Aircom International	Nokia Networks
May 14, 1999	R&D units from TeamWARE Group	Nokia Mobile Phones
February 18, 1999	InTalk Corp	Nokia Wireless Business Communications
February 16, 1999	Diamond Lane Communications	Nokia Networks
December 18, 1998	Vienna Systems Corp	Nokia Internet Communications
September 17, 1998	NE-Products Oy	Nokia Mobile Phones
August 20, 1998	User Interface Design	Nokia Communications Products
June 25, 1998	Matra Nortel Communications	Nokia Mobile Phones
December 9, 1997	Ipsilon Networks Inc	Nokia Networks
Source: www.nokia.com/A402761		

Annex V: Glossary of Technical Terms

Term	Definition[92]
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.
B2B e-marketplace	Electronic trading platforms on the internet where companies can sell and/or buy goods or services to/from other companies. 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.
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 *e-Business W@tch* reports, broadband is defined as the capacity to transfer data at rates of 2 Mbit/s (megabits per second) or greater.
Channel	In communications, a physical or logical path allowing the transmission of information; the path connecting a data source and a receiver.
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.
Dial-up	The process of establishing a temporary connection (to the internet) via the switched telephone network.
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.
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. The *e-Business W@tch* uses the term "e-business" in the broad sense, relating both to external and to company internal processes. This includes external communication and transaction functions, but also ICT supported flows of information within the company, for example, between departments and subsidiaries.
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-Commerce	Electronic commerce. As distinct from the broader concept of e-business, e-commerce refers to external transactions in goods and services between companies (B2B), between companies and consumers (B2C), or between companies and governments (B2G) and may therefore be seen as a subgroup or component of e-business activities.

[92] Some of the definitions in this glossary are derived from or based on definitions suggested by Whatis?com, a leading online ICT encyclopaedia and learning centre. See http://whatis.techtarget.com.

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.
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.
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.
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.
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.
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.
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.
Information security	Measures taken to protect information systems against unauthorised use and attacks
Internet	The world's largest computer communication system, with an estimated 700 million users worldwide.[93] 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.
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.
ISDN	Integrated Services Digital Network. An international telecommunications standard for transmission of voice and data over dial-up lines running at 64 Kbit/s (kilobits per second). It allows sharing of multiple devices on a single line (for example, phone, computer, fax).
IT	Information technology. IT includes hardware (computers, other data processing and transmitting equipment) and software.
KM	Knowledge Management. ICT solutions that support enterprises in systematically gathering, organising, sharing, and analysing their knowledge in terms of resources, documents, and people skills. Knowledge management software typically involves 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.

[93] Cf. Global Internet Statistics by Global Reach, www.glreach.com

Leased line	A private communication channel leased from the common carrier. It is usually a dedicated fixed-route link (e.g. point-to-point frame relay).
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.
Modem	Modulator/Demodulator. A device that modulates outgoing digital signals from a computer or other digital device to analogue signals suitable to be transmitted through a conventional telephone line (copper twisted pair telephone). The reverse procedure takes place for incoming signals.
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.
OOS	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.
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.
PLM	Product lifecycle management. 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.
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.
SCM	Supply Chain Management. Software that helps businesses to match supply and demand through integrated and collaborative planning tools.
Sector	Sectors of the economy with comparable business activities. These constitute the main research unit of the *e-Business W@tch*. Aggregated information at the industry level is used to document the diffusion of activities within the industries as well as the overall importance of the observed phenomena for changes in the economy as a whole. The definition of sectors follows NACE Rev.1.1 classifications.
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).
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	Electronic 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. Typically a transaction starts with information gathering, price and quality comparisons and possibly pre-sale negotiations. During the sale phase contracting and delivery are the core processes, and payment is the final stage of this phase. After-purchase transaction stages comprise customer service, the administration of credit payments and the handling of returns as well as marketing activities preparing for the next purchase.
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).
Value added	Gross output minus intermediate inputs. It is valued at producers' prices and includes all indirect taxes, but excludes VAT and subsidies.
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.
WAN	Wide Area Network. A network allowing the interconnection and intercommunication of a group of computers over a long distance.
WAP	Wireless Application Protocol. A communication protocol for delivering data over mobile telephone systems, allowing cellular phone sets and other mobile hand-set systems to access WWW pages and other wireless services.
Website	A related collection of World Wide Web files that includes a beginning file called a home page.
Wi-Fi	Wireless fidelity. A popular term for a high-frequency wireless local area network (W-LAN). Wi-Fi technology is rapidly gaining acceptance as an alternative or complementary infrastructure to a wired LAN.
W-LAN	Wireless Local Area Network. 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.

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