Sector Report No. 6/2006

ICT and e-Business in the

Shipbuilding and Repair 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 assessed or ordered via the Europa server or directly at the *e-Business W@tch* web site (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 shipbuilding and repair 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 shipbuilding and repair industry about the ICT use of their company.

Disclaimer

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Contact

For further information about this sector study or the *e-Business W@tch*, please contact:

DIW Berlin – German Institute for Economic Research	*e-Business W@tch*	European Commission
DIW Berlin Königin-Luise-Str. 5 14195 Berlin, Germany Fax: (49-30) 89789-104 bsoete@diw.de	***e-Business W@tch*** c/o empirica GmbH Oxfordstr. 2, 53111 Bonn, Germany Fax: (49-228) 98530-12 info@ebusiness-watch.org	**European Commission** Enterprise & Industry Directorate-General Technology for innovation, ICT industries and e-business Fax: (32-2) 2967019 entr-innov-ict-ebiz@ec.europa.eu

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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 shipbuilding and repair industry (SRI) in Europe. Its objective is to describe how companies in this industry use information and communication technologies (ICT) to conduct business, to assess the impact of this development for firms and for the industry as a whole, as well as to indicate possible policy implications. The analysis is based on literature, interviews, case studies and on a survey among decision-makers in European enterprises from the SRI about the ICT use of their companies.

The SRI, as defined for this study's purposes, covers the following business activities: building and repairing of ships (NACE Rev. 1.1, DM 35.11)[1] with an emphasis on shipbuilding. Although the SRI is composed of several different sub-sectors, with a distinction between the construction of merchant and naval ships, the repairing and conversion of ships and the different suppliers of marine equipment and engineering services, a sophisticated analysis of all these sub-sectors is beyond the scope of *e-Business W@tch.* For the survey 150 companies in the SRI have been interviewed. Out of this sample 143 observations are useable and for the EU-10 countries[2] the sample comprised 98 enterprises. Due to this small sample size the survey results should be cautiously interpreted.

Adoption of ICT and e-business in 2006 – survey results

In general, the survey results show that ICT and e-business activities are adopted by companies in the SRI and their deployment has become increasingly important for the industry. Key findings regarding ICT and e-business activities in the SRI are summarised below:

- Internet connectivity covers all enterprises and the majority of companies have broadband access.
- A relatively high fraction of companies said that they employ ICT practitioners and use open source software.
- The share of companies that reported using secure server technologies or a firewall is above the all-sectors average of the ten sectors studied this year. Security is an important issue in the SRI.
- About half of the companies reported that e-business is a significant part of the way the company operates. However, about one third of the companies said that

[1] 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.

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

interoperability is critical for e-business within the sector and for producing products and services.

- The use of Enterprise Resource Planning (ERP), Document Management System (DMS), Supply Chain Management (SCM) or Customer Relationship Management (CRM) applications is still not widespread within the SRI, but partly in line with the extent of their use in other industries.
- The share of companies in the SRI which said that they have launched new products or new processes in 2005 is lower than the average across all sectors studied this year.
- According to the surveyed companies in the SRI, their main driving forces for the uptake of e-business are "*gaining competitive advantage*" and "*customers expectations*".

Current e-business trends and implications

Due to increasing international competition, structural changes in the SRI have resulted in co-operation in engineering and production along the value chain between shipyards, subcontractors, system suppliers and suppliers for standard products. According to the survey results, companies in the SRI co-operate and collaborate online within their value system, notably with regard to the sharing of documents and in design processes.

ICT are now generally recognised as a key factor contributing to productivity. Cost reductions stemming from improved communication and data exchange, as well as lower transaction costs are the main reasons why companies implement e-business applications. However, the adoption of new IT and e-business tools in the SRI seems to be rather slow due to structural characteristics and complex production processes involving many different actors. As vessels are highly customised products that allow little if any standardisation, ICT is mostly used in engineering and product development.

The SRI is a rather traditional industry that also comprises small and medium-sized enterprises (SME) for which the possibilities of e-business currently do not seem to play a strategic role. Moreover, evidence presented in this report indicates that the cost-benefit structure of advanced e-business solutions seems to benefit to a much greater extent large companies in this industry.

The use of B2B Internet trading platforms

According to the survey results, online sales are not a common practice in the SRI, neither on the supplier nor on the customer side. However, about half of the surveyed companies reported placing orders online. A small fraction of these companies said that they use ICT solutions for e-sourcing. Most existing e-portals for the SRI are not e-marketplaces with a lively trade, but more of a catalogue to browse for suppliers and to make requests for quotes.

Large shipyards are the leaders in e-procurement. They mostly focus on aggregating orders in order to achieve more bargaining power. Suppliers, on the other hand, tend to remain sceptical towards electronic practices. Most of them fear the loss of bargaining power and thus prefer to conduct business in traditional paper-based ways or via e-mail.

e-Business and SMEs

Due to structural changes in the SRI, small and medium-sized supplier companies for maritime equipment or engineering services generate today more than seventy percent of a ship's value. Therefore, the question of what impact e-business technologies have on the sector's SMEs is quite relevant. On average, SMEs are slower in adopting ICT and e-business, because they are not able to realise economies of scale and lack expertise as well as a qualified labour force.

Furthermore, in the SRI suppliers, customers and shipyards use not compatible ICT systems which result in a relatively high rate of use of propriety standards and other standards compared to the all-sectors average for all ten sectors studied this year. Consequently, especially small and medium-sized suppliers face difficulties when they need to decide what kind of system they should implement. However, current internet solutions allow such interoperability problems to be solved.

Business impacts

In the e-Business Survey 2006, about two-thirds of the sector's companies reported that e-business constitutes "*a part of the way they operate*". In the SRI, adoption of ICT leads to structural changes in internal work processes and increased business process efficiency. The survey results also indicate a positive impact on the organisational structure of the sector's companies. However, the perceived overall influence of ICT on productivity and revenue growth appears to be lower than in other industries studied by *e-Business W@tch* in 2006. On the other side, companies in the SRI assess that ICT have an impact on competition in this sector, and, in fact, gaining competitive advantage was identified as the main driving force for their investments in ICT and e-business.

The picture is quite different for small companies in the SRI, where security issues, interoperability problems and implementation costs were identified as the major barriers for e-business initiatives. For example, small enterprises often have to make substantial up-front investments in employee training to develop the skills that are necessary to benefit from e-business. As a result, evidence presented in this report indicates that small companies in the SRI benefit less than their larger counterparts from ICT and e-business.

Policy implications

The main driving force for developing, implementing and using ICT as well as e-business in the SRI is increasing international competition, especially from Asian countries. While ICT and e-business adoption is only one possible strategy to improve the competitiveness of enterprises, some policy implications have become apparent in this respect.

- **Networking:** The complex production processes in the SRI require inter-firm interaction and collaboration among several actors along the value chain. Compared to other manufacturing industries studied this year, online co-operation and collaboration within the value system of the SRI is lower. Moreover, the stated supply chain integration using SCM systems in the SRI is lower than in other manufacturing industries. According to the survey, the reported level of both product and process innovations in the SRI was lower than the respective all-

sectors averages. Since significant benefits can be achieved by introducing innovative ways of organising inter-firm interactions, modifying business processes and integrating companies along the value chain, networking could be encouraged by inter- and intra-industry dialogues, organised by industry federations, technology platforms and the development of maritime clusters. The networking process could be supported by research programmes giving incentives for innovation networks in the SRI.

- **Interoperability** is a key issue for inter-firm co-operation and connectivity. About one third of the companies in the SRI said that interoperability was critical for e-business within the sector and for producing products and services. Although the process of standardisation lies in the hands of the SRI and ICT industry, policy makers could encourage companies to develop and adopt standardised tools. Supporting the development of uniform standards can avoid market failure resulting from co-ordination problems.

  An important survey result in this context is that more small companies in the SRI said that they see interoperability critical than medium-sized and large companies. Therefore, the interests of SMEs in general and from the SRI in particular, have to be taken into account in the standardisation process and public policy should support their specific needs.

- **Security and knowledge protection:** The e-Business Survey 2006 reveals that companies in the SRI deploy secure server technologies, digital signature and firewalls to a larger extent than companies in other industries. Furthermore, according to the survey results, security concerns and legal complications were reported by firms from the SRI as the main barriers to practice e-business.

  Moreover, knowledge protection was frequently cited in the SRI as another important barrier to practice e-business. Producing one-of-a-kind products, all actors in this industry are facing a permanent risk of violation of their intellectual property rights (IPRs) and, thus, fear product and knowledge piracy. Policy could, therefore, intervene in order to raise awareness and understanding of the risks related to e-business in general. In addition, public-private co-operation is necessary to develop legislation, standardisation and certification procedures reducing the fear of knowledge piracy in this industry.

- **Balance of power:** The question of power between customers (e.g. large shipyards) and small and medium-sized suppliers in e-procurement and supply chain management is an issue in the SRI. On the one hand, online procurement is associated with productivity gains due to price transparency; on the other, price transparency leads to negative effects for companies that sell their products online. Supplier companies fear new commercial risks resulting from incomplete information about e-market rules, business partners and possible unfair practices. Business associations should inform their members about the possibilities and risks of B2B internet-trading platforms. Competition authorities should monitor the competition on e-markets and intercede if necessary.

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.*

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

[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.

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 "*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

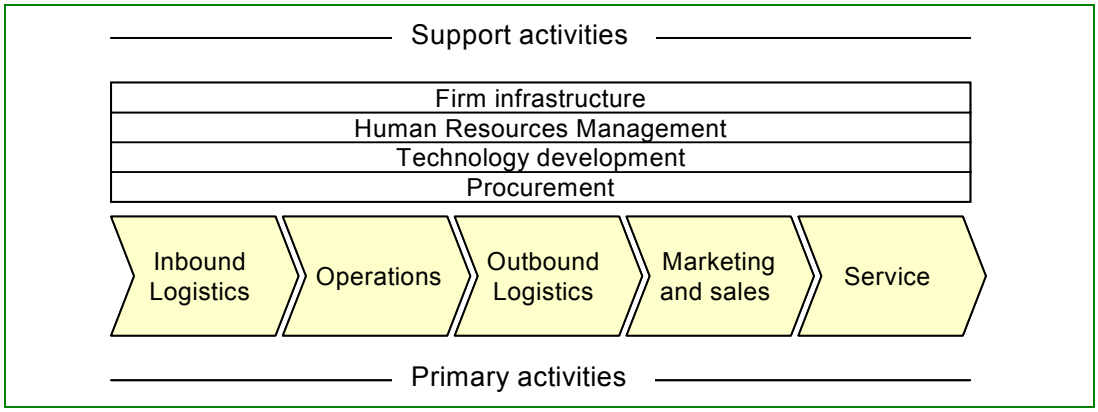
[12] This is reflected in the updated wording of the respective survey questions in 2006, when for "placing / accepting online orders" was asked instead for "purchasing / selling online".

[13] Working Party on Indicators for the Information Society

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.

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.

[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.

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 shipbuilding and repair industry (SRI) in Europe is a subsector within the transport equipment manufacturing industry (TEM), which was analysed in previous reports on behalf of *e-Business W@tch*. In this report emphasis will be placed on building rather than on the repair of ships, as the latter demonstrates different structural characteristics and a rather different picture in terms of e-business development. Moreover, the focus of the analysis lies on the construction of commercial vessels, since naval shipbuilding is governed by national policies and strongly differs from commercial shipbuilding in terms of e-business development.

The situation of naval shipyards in the EU was characterised by decreasing defence budgets and increasing costs for producing high-tech military equipment during the last decade. The desire for standardisation and cost-effectiveness within the NATO through larger series of production as well as the desire for the preservation of skills and technologies has created more incentives for collaboration in naval shipbuilding (Becker, Marx 2005; *e-Business W@tch* 2002). According to NACE Rev. 1.1[17], the activities in the shipbuilding and repair industry are defined as follows:

Exhibit 2-1: Business activities covered by the shipbuilding & repair industry

NACE Rev. 1.1		Business activities
Group(s)	Class(es)	
DM 35		Manufacture of other transport equipment
	35.11	Building and repairing of ships

The SRI is composed of several different subsectors, with a distinction between the construction of merchant and naval ships, the repairing and conversion of ships and the different suppliers of marine equipment and engineering services.

As a result of structural changes and outsourcing, the modern production processes of the SRI are complex and embedded in a network of yards, subcontractors, suppliers of marine equipment, suppliers of engineering services and classification societies. Thus, nearly seventy to eighty percent of a ship's value is generated by equipment and suppliers. Today, shipyards are the coordinating body of the shipbuilding value chain: from design over procurement, production, testing and certification to after-sales services (GartnerConsulting 1999).

The marine equipment industry is composed of manufacturers of specific equipment or of manufacturers of raw material solely for the use in ships. These suppliers manufacture both simple components and complex systems. Furthermore, there are also manufacturers of generic equipment, technologies and raw material, which are also used by other industries (Heseler, Brodda 2000). The SRI is a purchaser of basic metals, metal

[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.

products, electronics, electrical machinery, engineering as well as business and financial services.

Commercial vessels can be subdivided into bulk cargo ships (tankers, bulk carriers, container ships), other cargo carrying vessels (chemical tankers, LPG tankers, Roro and Ferry) and specialised vessels (cruise ships, LNG carriers, special ships). Although it is easier to build bulk cargo vessels than other cargo carrying ships or cruise ships, shipbuilding is an industry not suited to mass or serial production. The nature of shipbuilding is still a one-of-a-kind production with very few series-production features. In fact, the production of a ship might take up to three years (Andritsos, Perez-Prat 2000; European Community 2003).

The commercial shipbuilding market is a global market that depends on several other markets. The demand for ships is influenced by the development of world trade, the shipping industry, the cruise holiday industry, environmental standards and the demand for ships to replace obsolete ones (European Community 2003; VSM 2004).

2.2 Industry background

The European SRI faces pressures resulting from the ongoing globalisation and international overcapacities in shipbuilding: once a strong industry in Europe, employing nearly half a million workers in the mid seventies, the workforce in the shipbuilding and repair industry has more than halved (CESA 2005). In 2005 direct employment by shipyards was about 115 thousand persons (Commission of the European Communities 2006, p. 6). Moreover, formerly leading countries in shipbuilding such as Sweden and Belgium lost their position and other countries such as the UK, Finland, Greece, the Netherlands, Spain, France and Germany have seen dramatic reductions in employment. At the beginning of the 21st century, Korea became the world leader in shipbuilding although it had absolutely no involvement in international shipbuilding three decades ago. In addition to Korea, China is the upcoming competitor and currently investing in new yards (CESA 2005; *e-Business W@tch* 2002; Hengst 2000).

In response to the increased competition, the European SRI has significantly restructured itself over the last two decades. The European shipbuilding has changed from a mainly labour-intensive to a capital and knowledge dominated high-tech production. The introduction of new technologies, new production structures and new products resulted in considerable reduction in cost and lead time. Vertical co-operation is becoming more and more an essential factor in the innovation process and evolving production methods. Improvements covered all aspects of the production processes such as preparing the database for production information during the engineering stage by dedicated user-friendly software or manufacturing and assembly technologies that allow system-oriented work packages for subcontracting. Currently, European shipyards are spending on average roughly 10% of the turnover on research and development to hold their position of a technological leader in shipbuilding (Antonini 2006; CESA 2006, p. 4; Hengst 2000).

Today, the European industry of shipbuilding is specialised on high-tech niches such as container and passenger vessels or chemical carrier ships. Particularly in building cruise

ships, five European shipyard groups/shipyards have a competitive advantage on an international scale (CESA 2005, 2006).

In 2005 2,480 ships were ordered world-wide (Witthöft 2006, p. 20). Out of these orders, Korean shipbuilders had a market share (measured in cgt[18]) of 35,3%, followed by Japan (21,8%), European shipyards (18,3%) and China with a share of 15,3% (CESA 2006, p. 7). In 2005 2,045 vessels were launched world-wide, with the majority coming from Asian yards that had a share of 80% on tonnage (CESA 2006, p. 6). The share of Europe was 13% on tonnage. In the past few years the production value of Europe's launched vessels exceeded the value of those generated in Asia. This result is caused by the fact that, on average, European shipyards produce more high-graded vessels (VSM 2004, pp. 41-42). However, this European leadership in terms of value was not maintained in 2005, due to a low order intake between 2001 and 2003 and the appreciation of the euro (CESA 2006, p. 6).

Asian shipyards have a clear advantage in price-competition, especially for bulk cargo vessels, due to low labour costs and subsidies. European shipyards have an advantage in quality-competition, especially for other cargo carriers and passenger vessels, due to their specialisation on quality, supported by the usage of ICT and the engagement of specialised subcontractors and suppliers (CESA 2006; European Community 2003; European Commission 2003; VSM 2004).

The following section gives an overview of the size and structure of the European SRI, using different indicators from the Community of European Shipyards Associations (CESA), the Verband für Schiffbau und Meerestechnik e.V. (VSM) and the New Cronos database of Eurostat (June 2006). All presented statistics were prepared by the DIW Berlin, but they should be used with caution. Due to low availability and quality of statistical data at the EU-25 level this data can only give a rough idea about the analysed sector. Gaps result from missing data for individual countries or the respective year in the time-series of a country in the official statistics.

2.2.1 Size of the EU shipbuilding and repair industry

Tholen and Ludwig counted 202 shipyards in the European Union in 2004 that directly employed 127,498 persons. Thus, the size of a shipyard was on average 631 employees (Tholen, Ludwig 2006, p. 6). In the same year, CESA—representing shipyards in 15 European countries—counted 116,696 persons employed by shipyards (CESA 2005, p. 4, see Exhibit 2-3). Due to the number of shipyards Spain, Germany, the Netherlands and Italy are leading countries in the shipbuilding industry whereas Poland, Germany, France and Italy employ most of the workforce (see Exhibit 2-2).

A look at the data supplied by VSM and CESA for the shipbuilding industry shows that Germany, Italy and Poland are the most important European shipbuilding countries measured in terms of cgt in 2004 (see Exhibit 2-3). However, in terms of number of vessels Spain and the Netherlands are also important shipbuilding countries in 2004.

[18] The compensated gross tonnage (cgt) measurement is used to compare output, orderbooks, new orders, market shares or shipbuilding capacity when many ships of different types and sizes are involved (Hengst 2000).

Germany and Poland employ the largest portion of the workforce, followed by the Netherlands and Italy (see Exhibit 2-3).

Exhibit 2-2: Shipyards and employment in Europe in 2004

	Country	Number of Shipyards	Number of Employees
DK	Denmark	8	2,902
DE	Germany	35	18,498
EE	Estonia	1	1,200
EL	Greece	3	3,111
ES	Spain	36	10,850
FR	France	13	15,230
IT	Italy	22	12,033
LV	Latvia	2	1,620
LT	Lithuania	4	3,755
NL	Netherlands	28	10,000
PL	Poland	16	23,106
PT	Portugal	5	1,937
FI	Finland	6	5,565
SE	Sweden	6	1,467
UK	United Kingdom	17	16,224

Source: Tholen, Ludwig 2006; DIW Berlin 2006

Exhibit 2-3: Shipbuilding in Europe in 2004

		Orderbook		Completions		New Orders		Workforce
		Number	1,000 CGT	Number	1,000 CGT	Number	1,000 CGT	Number
CZ	Czech Republic	5	18	2	8	1	4	•
DK	Denmark	16	967	5	192	11	708	3,100
DE	Germany	117	2,342	54	874	76	1,342	22,982
EE	Estonia	1	1	0	0	1	1	•
EL	Greece	1	6	3	19	0	0	3,174
ES	Spain	130	458	76	369	64	191	5,562
FR	France	12	458	16	99	3	284	3,500
IT	Italy	78	2,093	22	688	24	1,114	7,765
LV	Latvia	9	27	4	11	6	17	•
LT	Lithuania	7	18	6	18	5	14	•
MT	Malta	0	0	1	8	0	0	•
NL	Netherlands	171	676	76	335	94	459	9,500
PL	Poland	127	2,229	42	478	63	858	15,500
PT	Portugal	9	37	6	38	2	10	1,981
SK	Slovak Republic	21	88	6	28	0	0	•
FI	Finland	6	487	4	267	4	275	4,800
UK	United Kingdom	8	15	7	8	4	9	7,000
	Europe-CESA		12,406		4,194		6,798	116,696

Source: CESA 2005; VSM 2006b; DIW Berlin 2006

The cumulative value of completed vessels was 10,463 million Euro in 2004, of which Germany had a share of 22%, Italy 21%, Spain 12% and the Netherlands 10% but Poland had only a share of 6%. The value of orderbook was approximately 23,491 million Euro in 2004. Germany, Italy and Poland together had a share of 77% of this value (CESA 2005, p. 45). In 2004 the European shipbuilding sector as a whole had a share of 37% of the value of the world shipbuilding sector (Douglas-Westwood 2005, p. 108).

In the ship repair and conversion sub-sector Germany is also the leading country with a share of 38% of the turnover in 2004 followed by the UK with a share of 22% (see Exhibit 2-4).

Exhibit 2-4: Ship repair and conversion turnover in Europe in 2004

	Country	Turnover (million €)
DK	Denmark	85
DE	Germany	620
ES	Spain	228
FR	France	86
NL	Netherlands	230
PL	Poland	186
UK	United Kingdom	428

Source: CESA 2005; DIW Berlin 2006

2.2.2 Employment, productivity and labour costs

Using the monetary data of Eurostat (June 2006) for 2001 and 2003 the sector "building and repairing of ships" (NACE 35.11) contributed in 2001 an estimated value of 24,608.3 million Euro to the production value of the overall transport equipment's industry production in Europe, resembling a share of about 16% (see Exhibit 2-5). This estimated production value equals 77% of the production value in the sector "building and repairing of ships and boats" (NACE 35.1), which contributed 32,157 million Euro in the same year to the production value of the overall transport equipment's industry production in Europe (see Exhibit 2-5). This equals a share of about 20%. Out of this sector's production, 29,758 million Euro (93% of the production value) originated from the former EU-15 member states.

Between 2001 and 2003 the production value and the employment in the sector "building and repairing of ships" both grew, but the value added at factor cost has shrunken by 1.1% (see Exhibit 2-6). In 2003 the sector employed approximately 198,700 people. This discrepancy to the reported data by CESA can be explained by the fact that CESA does not consider the workforce of the supplier companies. The majority of the mentioned jobs were located in Poland (15%), Spain (14%), France (12%) and Italy (11%) - see Exhibit 2-7.

Exhibit 2-5: Building and repairing of ships in the EU-25 (2001)

NACE Rev. 1.1	Activity	Enter-prises	Production value	Value Added at Factor Cost	Persons Employed
		Number	Mill. €	Mill. €	Number
DM 35	Manufacture of other transport equipment	22,180	158,676.1	467,69.5	842,400
DM 35.1	Building and repairing of ships and boats	15,842	32,157.3	9,695.4	258,500
DM 35.11	Building and repairing of ships	7,772	24,608.3[1]	7,037.6[2]	152,206[3]
1) EU-25 without CZ, DK,EE, GR, AT, SK 2) EU-25 without CZ, DK,EE, GR, AT, SK 3) EU-25 without CZ, DK,EE, GR, AT, SK, PL					

Source: Eurostat New Cronos/DIW Berlin 2006

Exhibit 2-6: Building and repairing of ships in the EU-25 (2003)

NACE Rev. 1.1	Activity	Enter-prises	Production value	Value Added at Factor Cost	Persons Employed
		Number	Mill. €	Mill. €	Number
DM 35	Manufacture of other transport equipment	21,922	•	•	•
DM 35.1	Building and repairing of ships and boats	15,974	•	9,299.9	259,000
DM 35.11	Building and repairing of ships	7,176*	25,003.4*	6,958.9	198,700
* EU-25 without CZ, GR, MT, SK, SE					

Source: Eurostat New Cronos/DIW Berlin 2006

The importance of the SRI for the Finnish, Lithuanian, Latvian, Estonian, Polish and Dutch economy is indicated by the larger share of the shipbuilding industry's total employment in their manufacturing industries, compared to a 0.6% share for the EU-25 average (see Exhibit 2-7). Labour costs also vary greatly among the member states. Denmark exhibits the highest labour costs, paying on average 53,231 Euro annually per employee. In Latvia, on the other hand, the SRI pays on average only 4,727 Euro annually per employee. Generally speaking, the new member states exhibit the lowest labour costs (see Exhibit 2-7).

Exhibit 2-7: Enterprises, employment, productivity and labour costs in building and repairing of ships in EU-25 countries (2003)

		Enterprises	Employment		Productivity		Labour Cost	
			number of persons employed	% of manu-facturing	value added per person employed (Euro)	% of manu-facturing	per employee (Euro)	% of manu-facturing
BE	Belgium	116	1,424	0.2	44,874	62.0	39,955	84.5
CZ	Czech Republic	•	•	•	•	•	•	•
DK	Denmark	80	3,406	0.8	63,095	108.5	53,231	129.7
DE	Germany	178	21,848	0.3	49,432	87.5	46,770	105.5
EE	Estonia	58	1,868	1.5	10,814	108.7	7,522	122.1
EL	Greece	•	•	•	•	•	•	•
ES	Spain	1548	27,297	1.0	33,674	78.5	34,453	124.4
FR	France	759	24,083	0.6	42,437	81.1	33,679	84.5
IE	Ireland	16	413	0.2	23,487	14.0	25,124	67.0
IT	Italy	1389	22,435	0.5	43,575	103.1	33,642	109.1
CY	Cyprus	8	73	0.2	30,137	125.8	18,310	113.1
LV	Latvia	73	2,583	1.6	6,620	83.6	4,727	128.9
LT	Lithuania	77	5,035	1.9	7,627	113.9	6,570	162.1
LU	Luxembourg	0	0	0	0	0	0	0
HU	Hungary	64	219	0	6,849	41.5	5,556	66.1
MT	Malta	•	•	•	•	•	•	•
NL	Netherlands	460	9,529	1.2	40,917	60.3	45,433	105.0
AT	Austria	8	124	0	68,548	113.0	45,000	110.3
PL	Poland	1295	29,279	1.2	7,596	49.4	8,971	131.0
PT	Portugal	182	4,336	0.5	15,821	76.4	17,920	133.7
SI	Slovenia	21	180	0.1	2,222	9.9	12,281	80.7
SK	Slovak Republic	•	•	•	•	•	•	•
FI	Finland	143	8,456	2.0	57,308	82.8	36,110	90.9
SE	Sweden	•	•	•	•	•	•	•
UK	United Kingdom	701	22,257	0.6	47,639	82.6	44,574	124.1
	EU-25	•	**198,700**	**0.6**	**35,022**	**75.8**	•	•

Source: Eurostat New Cronos/DIW Berlin 2006

Concerning productivity, within the EU-25 member states, Denmark, Finland, Germany and the UK have the highest productivity in the sector (see Exhibit 2-7). It should be noted that Austria is an exception within the European Union. With only 124 employees in the SRI they have the highest productivity, even though they are not one of the leading shipbuilding countries and are not a member country of CESA. Thus, this phenomenon should be neglected as it has no impact on the European SRI.

Germany, France, Italy, Spain and the UK contribute the largest share of production value of the European SRI (NACE 35.11) (see Exhibit 2-8). These countries accounted for 75% of the overall production value in the EU-20 (without the Czech Republic, Greece, Malta, the Slovak Republic and Sweden) in 2003. Furthermore, they accounted for 73% of the overall value added at factor cost in the EU-25 in the same year. Thus, the industry is concentrated with respect to regional distribution. Among the new member states, Poland had by far the largest share of the production value and the value added at factor cost in 2003 (see Exhibit 2-8).

Exhibit 2-8: Production value and value added in building and repairing of ships in EU-25 countries (2003)

		Production Value		Value Added	
		million €	% of EU-20[1]	million €	% of EU-25
BE	Belgium	176.3	0.7	63.9	0.9
CZ	Czech Republic	•	•	•	•
DK	Denmark	805.8	3.2	214.9	3.1
DE	Germany	4,900.1	19.6	1,080.0	15.5
EE	Estonia	62.4	0.2	20.2	0.3
EL	Greece	•	•	•	•
ES	Spain	3,345.9	13.4	919.2	13.2
FR	France	4,213.7	16.9	1,022.0	14.7
IE	Ireland	28.6	0.1	9.7	0.1
IT	Italy	3,675.6	14.7	977.6	14.0
CY	Cyprus	3.7	0	2.2	0
LV	Latvia	61.3	0.2	17.1	0.2
LT	Lithuania	88.1	0.4	38.4	0.6
LU	Luxembourg	0	0	0	0
HU	Hungary	3.9	0	1.5	0
MT	Malta	•	•	•	•
NL	Netherlands	2,140.1	8.6	389.9	5.6
AT	Austria	14.4	0.1	8.5	0.1
PL	Poland	1,075.2	4.3	222.4	3.2
PT	Portugal	260.9	1.0	68.6	1.0
SI	Slovenia	7.0	0	0.4	0
SK	Slovak Republic	•	•	•	•
FI	Finland	1,643.3	6.6	484.6	7.0
SE	Sweden	•	•	•	•
UK	United Kingdom	2,497.1	10.0	1,060.3	15.2
	EU-25	**25003.4[1]**	**100**	**6,958.9**	•

[1] EU-25 without CZ, EL, MT, SK, SE

Source: Eurostat New Cronos/DIW Berlin 2006

2.2.3 Trends and challenges

There are three main challenges with which the European SRI will be confronted within the next few years. Further investments in new technologies, increased co-operation among the companies and the more effective usage of e-business might be the right strategies responding to these challenges.

The Asian challenger

For the world's shipbuilding industry, the fast growing Chinese shipbuilding industry is a real challenge. China has proclaimed their goal to become the market leader by the year 2015. China specialises on inexpensive and technologically uncomplicated large cargo carrier vessels. Since their labour costs are even lower than in Korea, the Korean shipbuilding industry will have to adapt its production strategy and will encroach on the European shipyards' strategic position. Korean shipyards are already increasingly specialising—like the European shipyards before—on high value and high quality vessels such as other cargo carrier and passenger vessels. However, Korean shipyards are also investing in China and building shipyards there in order to use China's labour cost advantage. Furthermore, Korean shipyards are trying to streamline their production processes by investing in new technologies and in e-business. Even China is starting to invest in modern production technologies and e-business tools. Over the last couple of years a regional shift towards Asia could already be observed in the number of ships ordered. In addition, with a growing shipbuilding industry in China, the world's overcapacity in shipbuilding will rise further (Antonini 2006, p. 4; *e-Business W@tch* 2005c; Matschies 2006; Witthöft 2006; without author 2005).

This emerging development forces the European shipbuilding industry to become even more efficient and to further improve the quality of vessels constructed. Therefore, Europe's shipbuilders have to invest in research and development (R&D) on the one hand, as well as in new technologies to streamline their production processes and to foster production efficiency on the other.

The worldwide demand

Over the last four years, the demand for ships, especially commercial ships, has grown and, as a result, the existing overcapacity in the shipbuilding industry has not been a burning issue. Since the demand of commercial vessels is subject to considerable fluctuations, experts expect a decline in demand within the next five years. While currently European shipyards have full order books until the year 2008, it is unsure what the market will look like beyond that year (Antonini 2006; The European Community 2003; Lipinski 2006, VSM 2006a). Consequently, European shipyards have to further invest to remain competitive in a shrinking market with growing overcapacities.

Rising resource prices

The rising demand for energy, resources and semi-finished goods by emerging countries such as China, India, Russia and Brazil has lead to increasing world market prices for oil, steel and energy. This development is resulting in a disadvantage for European shipyards in contrast to Asian shipyards that can rely on a strong labour cost advantage (Frank-

furter Allgemeine Zeitung 2006; VSM 2006a). Thus, the European shipyards have to develop strategies to compensate these emerging challenges.

2.3 Review of earlier sector studies

Many issues of e-business in the SRI were analysed at an aggregate level in the previous reports within the transport equipment manufacturing sector (TEM – see *e-Business W@tch*, July 2002, February 2003, July 2003, May 2004 and August 2004). The main findings summarised below are based on the TEM sector report of August 2004.

ICT infrastructure

In 2004, internet access and standard internet applications, such as e-mail and web sites, were available to almost every company in the TEM sector. Interestingly, there were no significant differences in the adoption of these technologies between Western and Central European countries.

e-Business development

Despite being endowed with a basic ICT infrastructure, a number of factors slowed down the adoption of more advanced technologies in the TEM sector. Frequently cited reasons for the delay of e-business diffusion were legacy solutions commonly used in the industry, such as electronic data interchange (EDI) and the resulting reluctance of many industry players to implement new technologies.

Numerous initiatives aiming at establishing standards for e-business practices have failed. Contrary to initial expectations, online marketplaces had not gained wide acceptance among firms in the TEM sector. Frequently cited reasons included security concerns, a “battle of power” among customers, suppliers and operators of e-marketplaces, and a preference of powerful industry players towards proprietary systems. Consequently, the 2004 results showed that electronic marketplaces were only scarcely used in this sector and many firms preferred to stay with their established suppliers.

The completed analyses revealed that not all e-business technologies were adopted to the same extent. While companies representing two-thirds of all employees in the TEM sector, made online purchases and reported a positive impact of e-procurement on costs and process efficiency, online sales tools remained a niche application. Similarly, companies often reported exchanging documents via the internet, but hardly ever did so for contract negotiations or collaboration to forecast product demand. Although customer relationship management (CRM) systems seemed to play an important role in the automobile industry, they did not seem to matter in other transport equipment manufacturing industries. The overall adoption rate of new technologies increased with company size.

ICT and innovativeness

According to the 2004 report, the internet was considered as an important enabler of innovation (*e-Business W@tch,* August 2004). In other words, many firms made use of ICT to improve processes and to bring new products or services to market. It was reported that both ways of innovating, i.e. facilitated by ICT and carried out without the internet, might have a positive impact on turnover, profitability, and employment growth.

Size-class specific differences

In comparison to other sectors, the TEM sector displayed a significant gap in e-business development between large enterprises and SMEs. Large TEM companies reported the deployment of highly developed and complex IT systems and the use of numerous e-business applications. In contrast, the industry's SMEs seemed reluctant to engage in such practices and reported very low adoption figures over various indicators covered by the *e-Business W@tch Survey*.

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.[19]

Most of the tables in this report feature a breakdown of the population of enterprises based on the aggregate of 10 EU countries – **the "EU-10"**.[20] 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 I).

For the SRI 150 companies have been interviewed. Out of this sample 143 observations are useable and **for the EU-10 countries the sample comprised 98 enterprises**. The small size of the sample poses some restrictions on the following analysis of the SRI. Therefore, comparisons by size-bands of enterprises are reduced to two size ranges: small enterprises (1-49 employees) and medium-sized and large enterprises (more than 50 employees). The sample size for micro (1-9 employees) and large enterprises (more than 250 employees) cannot be considered as representative, due to only 3, respectively 7 observations.

As the focus of *e-Business W@tch* is on small and medium-sized enterprises (SMEs), the sample might be biased to small and medium-sized marine equipment suppliers since most of the shipyards have more than 100 employees and on average they have about 631 employees in Europe (Tholen, Ludwig 2006, p. 6; see Section 2.2). Thus, the survey results should be treated cautiously. Furthermore, the composition of the sample regarding the regional origin of the enterprises poses further restrictions on the analysis. Breakdowns by country are not possible because the number of observations within sector-country cells is below statistical significance. Consequently, the presentation of results from the e-Business Survey 2006 for the SRI is restricted to comparisons between

[19] 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).

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

these two size-bands, as well as with other manufacturing sectors and the average of all ten sectors studied this year by the *e-Business W@tch*.

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 and data on non-response rates are available in **Annex I** and on the *e-Business W@tch* website.

3.1 Use of ICT Networks

Internet access

The basic **internet connectivity** of enterprises in the SRI, meaning the number of firms with internet access, is comprehensive and, thus, above average for the ten sectors covered by the e-Business Survey 2006 (EU-10) and above the average for the five other manufacturing industries studied this year by *e-Business W@tch* (see Exhibit 3-1). In sharp contrast, the **share of employees with internet access** is low compared to the average of the ten sectors and the average of the other manufacturing industries. Furthermore, the share of employees with internet access diminishes with firm size (see Exhibit 3-1). Only one quarter of the medium-sized and large firms said that they enable their employees to use the internet compared to one third of small companies (see Exhibit 3-1).

These figures suggest that there are still some gaps in the adoption ICT in the SRI. While connectivity at the company level is one hundred percent, significantly fewer individual workers in the companies of the SRI (29% weighted by employment) have access to the internet at their workplace than in other industries (40% on average in the ten sectors studied). This indicates that there are many firms in the sector that have taken only the first step of e-business and e-commerce, namely the connectivity to the internet at the company level. However, the share of companies which said that they enable **remote access** to their network reaches 41% (weighted by employment) and this figure is above the average of the ten sectors studied (35%) (see Exhibit 3-1).

The quality of the internet connection is paramount to the development of e-business. A relevant indicator is the existence of broadband connection. This connection enables an exchange of more information per unit of time and supports the exploitation of sophisticated IT systems. The deployment of **broadband access** in the SRI is above the average of the ten sectors covered by the e-Business Survey 2006 and above the average of the other manufacturing industries (see Exhibit 3-1). Companies in the SRI representing more than four fifths of the sector's employment said that they use an internet connection technology which can be classified as broadband (see Exhibit 3-1). The share of medium-sized and large companies that reported using broadband access is slightly higher than the share of small companies.

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*		Remote access to company network	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**100**	**100**	**87**	**86**	**n.a.**	**30**	**41**	**27**
Small (<50 empl.)		100		85		32		29
Medium/large (50+ empl.)		100		89		25		22
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)	98		98		96		98	
Questionnaire reference	A1		A3		A2		A5	
* Read: "The average share of employees with internet access in a company from the SRI is 30%.								

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

Use of internal computer networks

Whereas companies in the SRI representing four fifths of the sector's employment said that they have **local area networks** (LAN), a much smaller fraction of companies representing one third of this sector's employment reported that they have a **wireless** local area network (W-LAN) (see Exhibit 3-2). While the figure for using LAN is above the average of the ten sectors studied, it is only above the average of two other manufacturing industries (food and beverages, footwear). In the SRI more medium-sized and large companies said that they use a LAN than they reported using W-LAN (see Exhibit 3-2).

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
Shipbuilding (EU-10)	**82**	**74**	**33**	**24**	**11**	**10**	**61***	**31***
Small (<50 empl.)		69		28		13		18*
Medium/large (50+ empl.)		87		12		3		80*
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
Food & beverages	69	31	30	9	15	19	65	29
Footwear	58	33	17	10	15	10	33	18
Pulp & paper	83	51	33	15	13	12	68	44
ICT manufacturing	91	71	47	34	28	20	73	47
Consumer electronics	83	54	36	27	29	22	61	39
Base (100%)	firms using computers		firms using computers		firms with internet access		Firms enabling remote access	
N (for sector, EU-10)	98		98		98		30	
Questionnaire reference	A4a		A4b		A4c		A6d	
* Data only indicative due to low number of observations								

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, has gained momentum over the past few years. Established as well as new telecommunication service companies and internet service providers offer new services based on this technology which potentially offer companies significant cost savings.

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. However, 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. Increasing broadband penetration drives the provision of VoIP.

Although broadband connections are well deployed in the SRI, VoIP is still not widely used. Ten percent of all companies from this industry reported using VoIP compared to a slightly higher average of 13% for all ten sectors (see Exhibit 3-2). In other manufacturing industries, except for footwear, VoIP is much more prevalent. Data for the SRI indicate that smaller companies from this industry are more likely than medium-sized and large enterprises to make use of Voice-over-IP telephony.

3.2 ICT Skills, Outsourcing and ICT Budgets

3.2.1 Demand for ICT skills and skills development

Skilled staff is an important requirement for successful ICT and e-business implementation. In the SRI the share of companies that reported employing **ICT practitioners** is above the weighted average of all ten sectors covered by the e-Business Survey 2006. However, it is in line with the weighted average of companies in most of the other manufacturing industries (see Exhibit 3-3). As expected, there is a significant difference between small and medium-sized/large companies. Almost half of the medium-sized and large companies but less than a third of the smaller firms in this sector said that they employ ICT practitioners.

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
Shipbuilding (EU-10)	**36**	**33**	**29**	**20**	**4**	**0**	**14**	**15**
Small (<50 empl.)		27		24		0		19
Medium/large (50+ empl.)		47		8		0		4
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
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	98		98		98		98	
Questionnaire reference	B1		B4		B2		B5	

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

In order to meet the demand for skilled ICT personnel, companies invest in **ICT training** of employees. In the SRI companies representing nearly a third of the sector's employment said that they regularly invest in ICT training (see Exhibit 3-3). This figure is above the weighted average of the ten sectors studied and above the weighted average in other manufacturing industries except ICT manufacturing (see Exhibit 3-3). As a matter of fact, technological progress requires firms to constantly increase the skill level of their employees. Nevertheless, the share of small companies in the SRI which reported regular investing in the ICT training of their employees is three times higher than the

respective share of medium-sized and large enterprises. Statistical problems taken into consideration, this result might also be explained by the fact that, as already indicated above, less small companies employ ICT practitioners, thus, having to invest more in their employees' ICT training.

e-Learning, which means supporting training with learning material in electronic format that is available on the internet or the company's intranet, is reported using by companies in the SRI that comprise 14% of sector's employees. This figure is below the weighted all sectors average and also below the weighted average of the other manufacturing industries, excluding footwear (see Exhibit 3-3). In line with investment in ICT training, there is again a difference by firm size in the reported use of e-learning. In contrast to all other sectors surveyed this year by *e-Business W@tch*, the use of e-learning was reported by almost five times more small companies than by medium-sized and large enterprises in the SRI (see Exhibit 3-3).

In **summary**, the picture that emerges for the SRI is that, in comparison to the average of all sectors studied this year, apparently there are no gaps in ICT skills that would constrain the diffusion of e-business.

3.2.2 Outsourcing of ICT services and ICT investments

Cost saving opportunities is often cited as a prime reason why companies decide to take advantage of the expertise provided by ICT companies. In this context, **outsourcing** can be considered as one of the available ways to overcome internal shortages of ICT specialists. In the e-Business Survey 2006, firms were asked whether they had outsourced any of their ICT services which had previously been conducted in-house to external service providers in 2005.

About 17% of companies in the SRI (weighted by employment) said that they have outsourced any of their ICT services in 2005 (see Exhibit 3-4). This result is almost similar to the 19% average of the ten sectors covered by the e-Business Survey in 2006. Furthermore, the figure is in line with the share of ICT practitioners employed (see Exhibit 3-3), thus confirming that companies in the SRI prefer to rely on their own ICT expertise. Compared to other industries, there is no increase of outsourcing by firm size. One quarter of small companies in the SRI said that they have outsourced a portion of their ICT services in 2005 compared to only 4% of medium-sized and large companies (see Exhibit 3-4). This result can be explained by the high share of medium-sized and large companies that employ ICT practitioners (see Exhibit 3-3).

The survey results on **ICT expenditure and investments** have to be treated cautiously due to the small number of observations. Nevertheless, according to these results, companies in the SRI reported that their annual ICT budget (including hardware, software, services and personnel) corresponds on average to approximately 3% of their total costs (see Exhibit 3-4). This average share of ICT budget is slightly below the average share in all ten sectors studied (5%). In addition, it is lower than the average share of ICT budget in other manufacturing industries (see Exhibit 3-4). This finding, however, seems to be in conflict with other survey results, showing that companies in the SRI are above the all sectors averages in terms of both internet access and employment of ICT practitioners (see Exhibits 3-1 and 3-3, respectively).

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	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**17**	**20**	**5**	**3**	**73**	**65**
Small (<50 empl.)		25		3		60
Medium/large (50+ empl.)		4		4		77
All 10 sectors (EU-10)	**19**	**14**	**6**	**5**	**65**	**50**
Micro (1-9 empl.)		8		5		39
Small (10-49 empl.)		21		5		60
Medium (50-249 empl.)		21		6		78
Large (250+ empl.)		31		6		86
Food & beverages	19	12	4	4	65	44
Footwear	16	14	5	5	53	43
Pulp & paper	17	14	5	4	77	54
ICT manufacturing	22	15	9	12	85	66
Consumer electronics	19	12	6	6	76	63
Base (100%)	firms using computers		firms using computers (excl. "don't know")		firms using computers	
N (for sector, EU-10)	98		63		98	
Questionnaire reference	B6		C1		C3	

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

Almost three-quarters of people employed in the SRI are working in companies which said that they have made ICT investments in 2005 (see Exhibit 3-4). This figure is above the average share in all ten sectors studied (65%). However, compared to other manufacturing industries the share of people employed in companies reporting that they have made ICT investments in 2005 is higher (see Exhibit 3-4). According to the survey the results confirm that ICT investments increase by firm size (see Exhibit 3-4).

Three-fourths of companies in the SRI that reported making ICT investments in 2005 said that they financed them using cash flow. This figure is below the all-sectors average of 82% (see Exhibit 3-5). Furthermore, in the other manufacturing industries the share of companies using cash flow for financing ICT investments is on average higher. Statistical problems taken into consideration, compared to the size-bands of the average of all ten sectors studied this year cash flow financing of ICT investments in the SRI increases by firm size (see Exhibit 3-5).

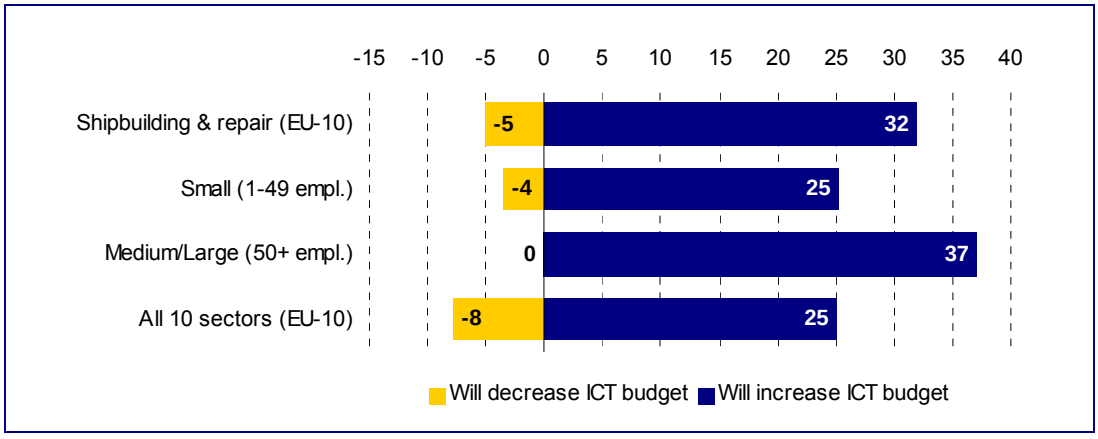
Compared to all sectors studied by *e-Business W@tch* in 2006, there appears to be a trend towards increasing ICT budget in the SRI. Overall, companies comprising 32% of the sector's employment said that they plan to increase their ICT budget in 2006/7 (see Exhibit 3-6). However, whereas 37% of the medium-sized and large companies in the SRI said that they are going to increase their ICT budget, 4% of the small companies said that they are going to reduce it (see Exhibit 3-6). The survey results on ICT investments confirm the increasing importance of ICT in the SRI, especially for this sector's large enterprises.

Exhibit 3-5: Major source for investments in ICT

	Cash-flow financing		Bank loans	
Weighting	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**78**	**75**	**4**	**2**
Small (<50 empl.)		66		3
Medium/large (50+ empl.)		97		0
All 10 sectors (EU-10)	**74**	**82**	**5**	**7**
Micro (1-9 empl.)		82		8
Small (10-49 empl.)		81		6
Medium (50-249 empl.)		70		8
Large (250+ empl.)		67		2
Food & beverages	77	90	7	5
Footwear	79	84	8	7
Pulp & paper	72	80	4	5
ICT manufacturing	75	79	7	6
Consumer electronics	75	86	2	2
Base (100%)	firms that have made investments in ICT			
N (for sector, EU-10)	66		66	
Questionnaire reference	C4		C4	

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

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) = 90. 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)

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*" (Directive 98/34/EC). Normally standards are developed in industry specific organisations or in industry independent organisations depending on technologies. 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, advanced forms of e-business (such as the digital integration of systems in B2B exchanges) are hardly possible.

3.3.1 Types of e-standards used

Due to the importance of data exchange standards for both inter- and intra-firm process integration, companies were asked what standards they use for electronic interaction with buyers and sellers. Standardised data includes electronic product catalogues, orders, invoices, delivery notes or similar business documents. Electronic data interchange (EDI) technologies is a way for unaffiliated companies to use networks for linking their businesses by using a common technical standard for exchanging business data. In earlier *e-Business W@tch* studies on the TEM sector (2002, 2003, 2004), which included the SRI as a subsector, the wider diffusion of EDI was confirmed, especially in large companies (see Section 2.3).

Therefore, the results of the 2006 survey for the SRI are quite surprising: EDI-based standards were reported by companies comprising only 6% of the sector's employees (see Exhibit 3-7). This figure is slightly lower than on average in the ten sectors covered by the *e-Business W@tch* survey 2006, which is 9% and, additionally, there are no differences by size-bands. Furthermore, the share of companies (weighted by employment) that reported using EDI-based standards in the food & beverages, pulp & paper and ICT manufacturing sectors is clearly higher (see Exhibit 3-7).

However, the former survey results for the TEM sector hold partly true with regard to the use of propriety standards. Approximately one fifth of the sector's employees work in companies that reported using propriety standards. This figure is in line with the weighted average of the ten sectors studied (see Exhibit 3-7). Moreover, it is more or less on the weighted average of the other manufacturing industries (see Exhibit 3-7). For the usage of propriety standards, there are significant differences between small and medium-sized/large companies. Propriety standards are preferred by small companies (20%). These discussed survey results, however, should not be overvalued due to the small sample (see Chapter 3, background information) and according to the survey result, on average for all ten sectors studied using propriety standards increase with the firm-size.

In the SRI, XML-based and other standards appear to be much more common (weighted by employment) than in all ten sectors covered by the *e-Business W@tch* survey 2006 or in most of the other manufacturing industries studied this year (see Exhibit 3-7). Explanations for these survey results might be, on the one hand, the fact that most of the companies in the industry started to invest in ICT since the end of the 1990s and have

then invested in the latest available technologies. On the other hand, most of the ICT solutions developed for other manufacturing industries could not be adopted by the SRI due to characteristics of the production process. Therefore, industry specific solutions and standards have been developed.

Exhibit 3-7: 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
Shipbuilding (EU-10)	**6**	**2**	**15**	**2**	**21**	**19**	**6**	**8**
Small (<50 empl.)		2		2		20		10
Medium/large (50+ empl.)		2		3		14		2
All 10 sectors (EU-10)	**9**	**3**	**11**	**5**	**19**	**12**	**4**	**2**
Micro (1-9 empl.)		2		6		10		1
Small (10-49 empl.)		4		5		13		2
Medium (50-249 empl.)		10		10		24		2
Large (250+ empl.)		29		27		31		7
Food & beverages	31	6	8	4	20	11	4	3
Footwear	7	2	6	2	18	12	2	1
Pulp & paper	20	6	15	5	19	15	2	2
ICT manufacturing	21	3	16	10	26	14	6	3
Consumer electronics	8	4	11	6	23	17	6	5
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	98		98		98		98	
Questionnaire reference	G1a		G1b		G1c		G1d	

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

3.3.2 Interoperability challenges

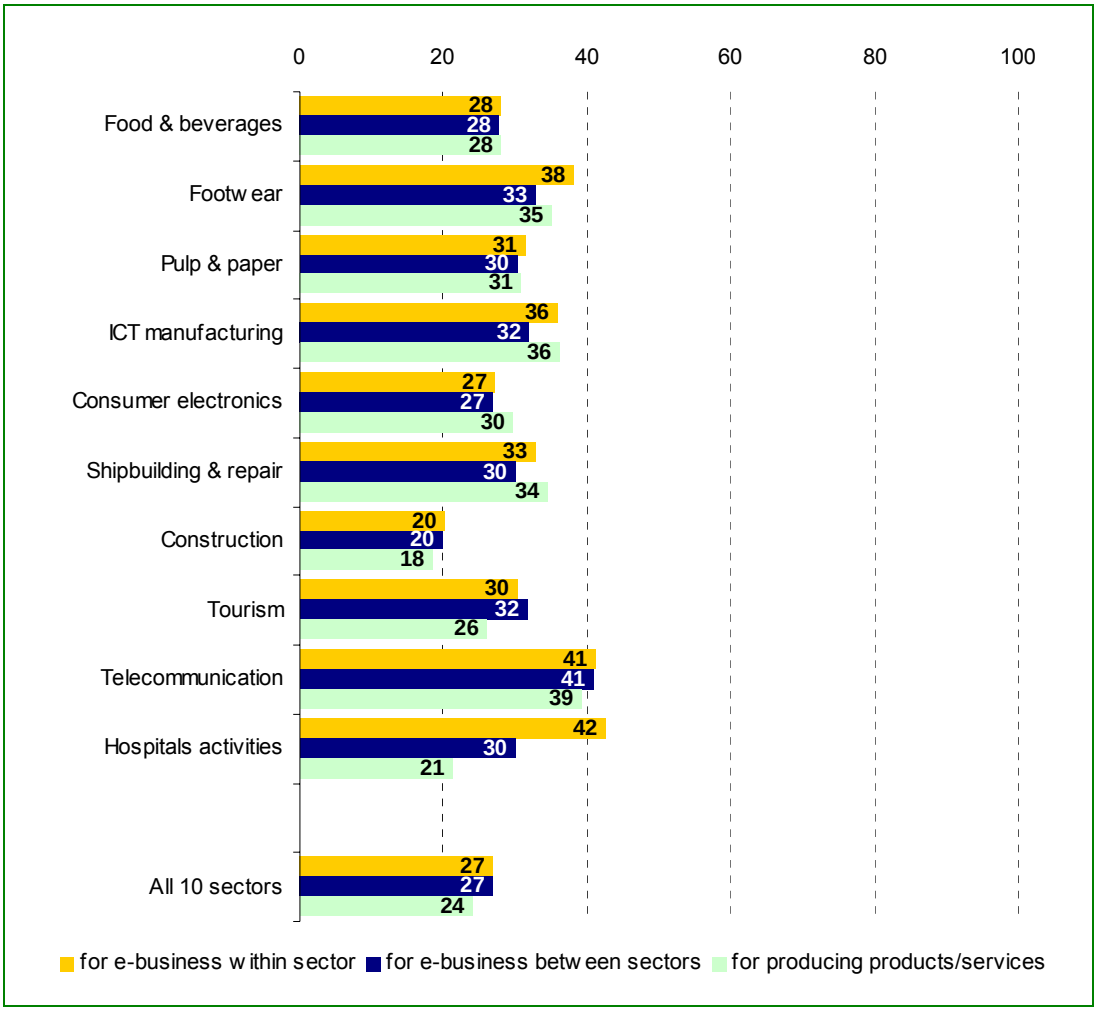
Interoperability refers to the "*ability of two or more systems to exchange data, and to mutually use the information that has been exchanged*" (e-*Business W@tch* Special Study 2005a, p. 14). An interoperability framework is a set of standards and guidelines that describe the way in which organisations have agreed to interact with each other. *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.

In the SRI, about one third of the companies see interoperability as critical for e-business between companies in the sector (see Exhibit 3-8). Especially small companies are aware of this problem. These results reflect the fact that different standard solutions are widespread in the industry (see Exhibit 3-7). Thus, small companies with different customers are more affected with problems of interoperability than the larger companies, such as shipyards that often set the standards (see also Section 4.3). In addition, 34% of the companies reported that interoperability is critical for producing and providing their products or services. This share is higher than the respective all-sectors average (24%)

and comparable only to findings for other manufacturing industries such as ICT manufacturing and footwear or the service sector such as telecommunication (see Exhibit 3-8). Again, it appears that problems of interoperability are more relevant for small companies than for medium-sized and large companies.

e-Business W@tch also asked companies whether they experienced any difficulties stemming from a lack of interoperability as regards procurement, invoicing, payment, cataloguing, technical aspects or regulatory aspects. Since this was a follow-up question, the number of observations is too small to be presented. However, one third of the companies in the SRI that answered to this question said that there are problems of interoperability regarding technical aspects. The other named problems are of minor relevance compared to the respective all-sectors average. This survey result is in line with the share of one third of companies reporting that interoperability is critical for producing products and services (see Exhibit 3-8).

Exhibit 3-8: Perceived importance of interoperability: percentage of companies saying that interoperability is critical …



Base (100%): Firms using computers. N (for sector, EU-10) = 98.
Weighting: in % of firms. Questionnaire reference: G5a-c

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

According to these results, interoperability challenges exist in the SRI and they should not be neglected. In light of the structural changes and outsourcing in the industry, efficient and frictionless communication along the value chain emerges as a critical factor for smooth co-operation between companies (see Sections 2.2 and 2.3).

One explanation for the experienced interoperability challenge in this sector could be the low deployment of e-standards (see Exhibit 3-7). This calls for activities to amend the situation in order to encourage and facilitate e-business uptake within the SRI. Projects aiming at enhancing interoperability for the exchange of computerised data should therefore be supported. Moreover, efforts could be made to spread XML standards in the SRI, since this could open up new possibilities for SMEs (see also Section 5.2).

3.3.3 Use of Open Source Software

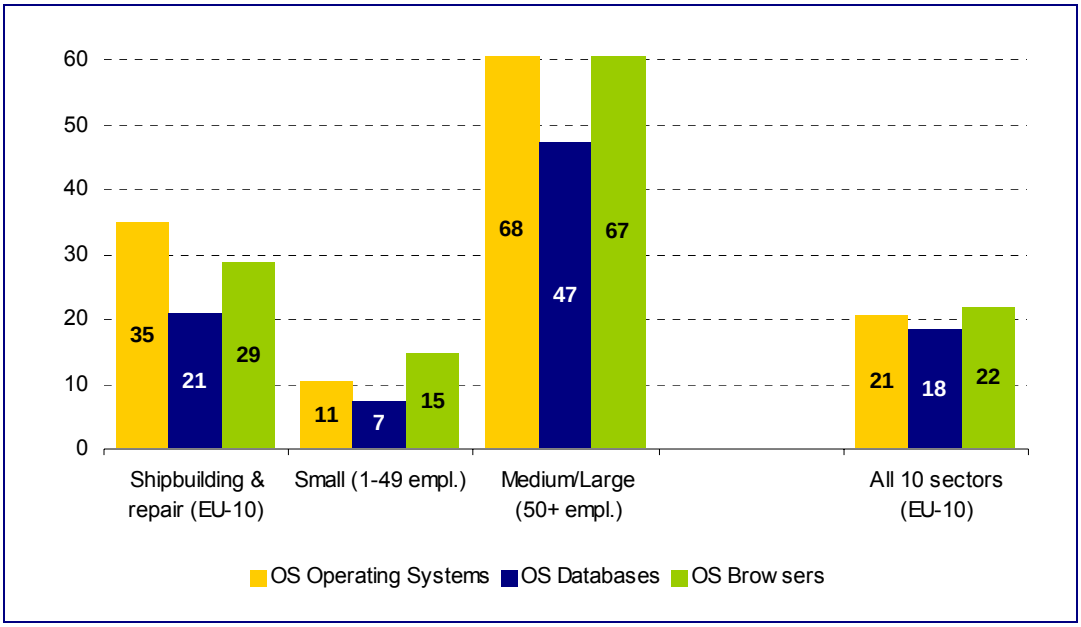
Open source software (OSS) refers to computer software under an open source license. An open source license is a copyright license for software that makes the source code available and allows for modification and redistribution without having to pay the original author. In the past years, the public 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.

e-Business W@tch asked companies whether they used OSS, either in operating systems, databases or browsers. In the SRI the usage of OSS is more widespread than in the weighted average of all ten sectors covered by the survey (see Exhibit 3-9). Thirty five percent of the sector's employees are working in companies that reported using open source operating systems compared to 21% for all ten sectors, and companies comprising 29% of sector's employees said that they use open source browsers compared to 22% in all ten sectors studied (see Exhibit 3-9). These results could be linked to the figures of Section 3.2.1 which show that companies in the SRI employ ICT practitioners above the average of the ten sectors covered by the survey (see Exhibit 3-3). Thus, it appears that companies prefer to develop their ICT solutions in-house. These results are also in line with the low incentives of ICT outsourcing (see Section 3.2.2, Exhibit 3-4). Furthermore, these survey results might also explain why e-standards are comparatively low in the SRI.

Over two-thirds of the medium-sized and large companies in the SRI reported using OS operating systems and browsers. The usage of OSS by this industry's small companies, however, appears to be negligible (see Exhibit 3-9).

Exhibit 3-9: Companies using Open Source (OS) Software



Base (100%): Companies using computers. N (for sector, EU-10) = 98. 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 analysed 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,[21] 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. The survey results show that security controls and other measures are much more widespread in the SRI than in the other sectors covered in *e-Business W@tch* Survey 2006. Moreover, the figures indicate that security seems to be an important issue in the SRI.

Secure server technology means that data exchange between computers is based on certain technical standards or protocols, for example "Secure Sockets Layer" (SSL) is a commonly-used protocol for managing the security of a message transmission on the internet.

Nearly one third of SRI companies reported the use of a secure server technology (see Exhibit 3-10). This figure is above the weighted average in all ten sectors studied (20%) and above the weighted average of companies in the other manufacturing industries such as food and beverages, footwear as well as pulp and paper (see Exhibit 3-10). The

[21] 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').

difference between small companies and medium-sized/large companies in deploying secure server technologies, the deployment among medium-sized and large firms is more than two times higher, correspond to the average situation across the ten sectors studied (see Exhibit 3-10).

In general, **firewalls** are widely used by companies in the 10 sectors studied this year by *e-Business W@tch*. Interestingly, the reported usage of a firewall by companies in the SRI (84%) is above the weighted all-sectors average (62% - see Exhibit 3-10). This figure is also clearly above the average of the other manufacturing industries (see Exhibit 3-10). Here again, security measures are more diffused in medium-sized and large SRI companies than in the sector's small companies although both size-bands have the same extent of internet access and are thus at similar level of risk. Nevertheless, this result is in line with the respective all-sectors averages (see Exhibit 3-10).

Exhibit 3-10: Use ICT security measures used by enterprises

	Secure Server Technology		Digital Signature or Public Key Infrastructure		Firewall	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**42**	**29**	**32**	**20**	**92**	**84**
Small (<50 empl.)		21		15		79
Medium/large (50+ empl.)		53		33		98
All 10 sectors (EU-10)	**36**	**20**	**21**	**15**	**78**	**62**
Micro (1-9 empl.)		16		13		56
Small (10-49 empl.)		23		17		73
Medium (50-249 empl.)		36		25		84
Large (250+ empl.)		64		39		94
Food & beverages	34	18	26	15	72	51
Footwear	21	16	25	16	64	50
Pulp & paper	40	21	24	15	86	64
ICT manufacturing	57	33	32	19	95	79
Consumer electronics	54	32	27	16	88	72
Base (100%)	firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	98		98		98	
Questionnaire reference	G9a		G9b		G9c	

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

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 which 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 for **invoices**.

One fifth of the SRI's companies reported using a digital signature or public key infrastructure compared to 15% of companies of all ten sectors studied or the average of companies in the other manufacturing industries (see Exhibit 3-10). When looking more closely at this average, however, it comes out that while 33% of the medium-sized and large companies said that they use digital signature, only 15% of the sector's small companies reported using such a security measure. According to the survey results for the respective all-sectors average this difference between the size-bands in the SRI is a normal distribution.

In general, the currently rather low levels of deployment of security measures in small companies could represent an obstacle in the evolution of interoperable solutions for many e-business processes, particularly those with strong contractual content or intellectual property such as engineering services.

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. Today, it is possible to directly link business processes with the production process using ICT. In general, ICT applications for these purposes are predominantly used by large companies and to a lesser extent by medium-sized firms.

3.4.1 Use of software systems for internal process integration

An **Intranet** is an internal network that makes information available within the company. 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. Most of the intranets are connected to the internet. Although all companies in the SRI have access to the internet, only half of them reported using an intranet for internal communication and information or data interchange. Nevertheless, 56% of the sector's employees work in companies that said that they use an intranet and this figure is well above the weighted average of all ten sectors studied (42%) (see Exhibit 3-11).

Obviously, there is a large difference between small and medium-sized/large companies using an intranet. Four fifths of the medium-sized and large companies reported using an intranet compared to 38% of the sector's small companies (see Exhibit 3-11). This difference is explicable with the cost-benefit structure of internal electronic communic-

ation networks due to strong scale effects, which for small companies is often negative. Thus, large enterprises clearly lead the adoption of intranets (see Exhibit 3-11).

In the 2006 survey, companies were asked whether they use a special **accounting software** other than spreadsheet calculation programmes such as MS Excel. In smaller companies, accounting software typically substitutes to some extent the functionality which advanced Enterprise Resource Planning (ERP) software has in larger firms, although at a much simpler level and with a lower potential for automating order related document flows.

Accounting software is widespread in the SRI compared to the average in all ten sectors studied this year by the *e-Business W@tch* (see Exhibit 3-11). Companies that reported using accounting software comprise 80% of sector's employees. In fact, accounting software seems to be crucial for medium-sized and large companies in the SRI, since 94% of companies in this size-band reported using it compared to 75% of small companies (see Exhibit 3-11).

Exhibit 3-11: 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
Shipbuilding (EU-10)	**56**	**50**	**80**	**78**	**30**	**17**	**17**	**14**
Small (<50 empl.)		38		75		10		15
Medium/large (50+ empl.)		81		94		36		9
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
Food & beverages	40	16	75	58	32	10	17	11
Footwear	27	11	69	58	23	7	12	11
Pulp & paper	53	24	79	66	45	16	16	10
ICT manufacturing	68	38	79	63	61	16	24	16
Consumer electronics	53	21	78	53	39	12	26	12
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	98		79		98		98	
Questionnaire reference	D1a		D1e		D1d		D1c	

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

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, project 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 in supporting the

connectivity between enterprises. For manufacturing companies, ERP systems are an important "hub" for much of their e-business activities with other companies.

In the SRI, the use of ERP systems is above the all sectors average, but below the average in most of the other manufacturing industries covered in the e-Business Survey 2006 (see Exhibit 3-11). One third of the sector's employees work in companies that reported deploying an ERP system. In addition, 36% of medium-sized and large companies in this sector said that they use ERP systems compared to only 10% of small companies that did so (some relevant illustrations are presented in the case studies about *ENVC*, *Uljanik* and *Meyer Shipyard* in Sections 4.1 and 4.2).

Document Management Systems (DMS) are used to track and store electronic documents or images of paper documents. Seventeen percent of this sector's employees work in companies which reported using DMS. This figure is in line with the level of adoption for all ten sectors (19%) studied this year by *e-Business W@tch*. Compared to the average distribution between size-bands, in the SRI more small firms (15%) than medium-sized and large enterprises (9%) said that they use DMS (see Exhibit 3-11). Because of the small sample, this survey result for the SRI should not be overvalued.

3.4.2 Use of ICT for cooperative and collaborative business processes

Generally, "co-operation" in business processes means splitting a common, centrally managed task into sub-tasks that are performed by different partners of the co-operation. Furthermore, "collaboration" in business processes means that several partners work together on the same task simultaneously.

Due to structural changes and outsourcing, the modern production processes of building a ship are complex and embedded in a network of yards, subcontractors, suppliers of marine equipment or of engineering services and classification societies (see Section 2). Consequently, online co-operation and collaboration should be of high importance in the SRI. However, the survey results indicate that this is currently not so. Statistical problems taken into consideration, according to the survey results, small companies in the SRI co-operate or collaborate more often online than medium-sized or large companies. Compared to the survey results for all-sectors average, these results seem to be an exemption because on average online co-operation and collaboration increased by firm-size (see Exhibit 3-12). Therefore, the survey results for the SRI on the use of ICT for cooperative and collaborative business processes should be treated cautiously.

Whereas design is a central activity in the shipbuilding production process, 7% of SRI's companies reported using online tools for **collaborative design** with other companies. This figure equals the average of all ten sectors (7%), however, it is below the average share of companies that said that they use online tools for collaborative design in the other manufacturing industries (see Exhibit 3-12). On the other side, enterprises comprising 20% of the sector's workforce reported collaborating in design processes compared to the average across all sectors this figure is higher (see Exhibit 3-12). These differences in the survey data for the SRI are explicable by the weighting scheme used by *e-Business W@tch* and the small sample for the SRI. Consequently, these survey results should not be overvalued.

Exhibit 3-12: Online co-operation 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
Shipbuilding (EU-10)	**27**	**19**	**19**	**15**	**20**	**7**	**16**	**11**
Small (<50 empl.)		23		18		8		14
Medium/large (50+ empl.)		6		9		5		4
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
Food & beverages	28	10	24	11	15	6	23	10
Footwear	18	12	17	9	11	10	11	11
Pulp & paper	27	17	32	13	16	11	19	12
ICT manufacturing	45	26	37	16	27	15	26	16
Consumer electronics	45	22	29	12	20	18	17	19
Base (100%)	firms with internet access							
N (for sector, EU-10)	98		98		98		98	
Questionnaire reference	D5a		D5e		D5d		D5c	

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

For the SRI, the **sharing of documents** in a collaborative workspace should be another crucial task in the value chain. Companies comprising 27% of the SRI's employees said that they use this tool and, again, this equals the weighted average of all ten sectors covered by the *e-Business W@tch* Survey 2006. However, the figures for the other manufacturing industries (weighted by employment) show that the share of companies which said that they deploy online tools for document sharing is higher (see Exhibit 3-12). Interestingly, more small companies reported using this technology, with 23% compared to 6% of medium-sized and large companies in the SRI. This survey result differs from the average across all ten sectors studied this year and should, therefore, be treated cautiously.

3.4.3 Deployment of 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.[22]

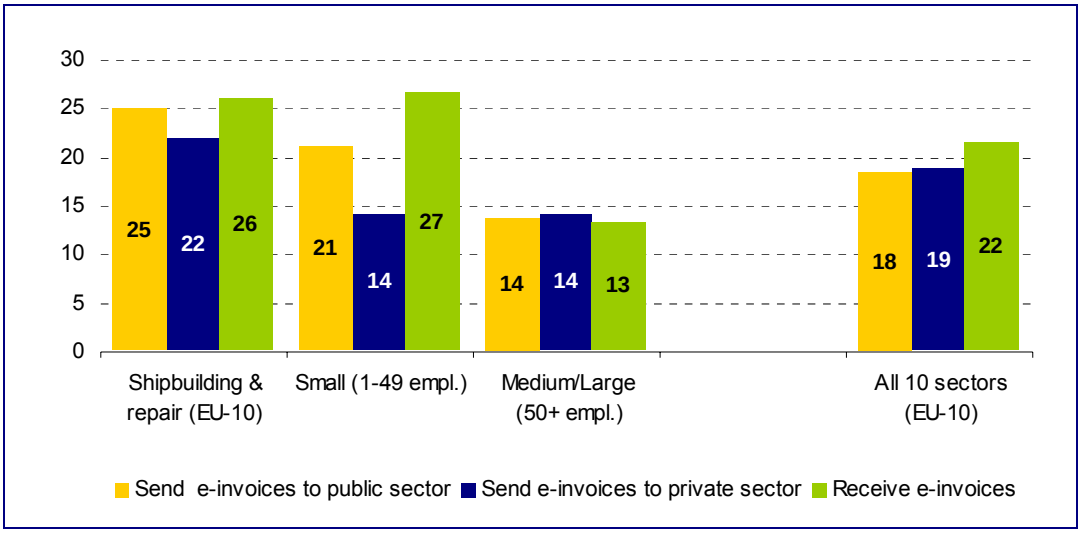
[22] For more background information on e-invoicing activities of enterprises, see *e-Business W@tch* Special Report "ICT Security, e-Invoicing and e-Payment Activities in European Enterprises" (September 2005). Available at www.ebusiness-watch.org ('resources').

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 more quickly and easily 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.

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 B2B e-invoicing) promise the highest cost-saving potential for companies.

Statistical problems taken into consideration, e-invoicing seems to be more practiced in the SRI than in other industries (see Exhibit 3-13). One quarter of the sector's employees work in companies which reported sending e-invoices to the public sector compared to a respective weighted average of 18% for all ten sectors studied. Moreover, 26% of the sector's employees work in companies which said that they receive e-invoices. On the average for all ten sectors, the respective share is 22% (see Exhibit 3-13). Again, small companies seem to be much more involved in e-invoicing than medium-sized and large companies. Twenty seven percent of the small companies said that they receive e-invoices but only 13% of medium-sized and large companies did so. However, only 14% of the companies in both size-bands reported sending e-invoices to the private sector (see Exhibit 3-13). Compared to the survey results about e-invoicing for the respective average distribution between size-bands for all ten sectors studied by *e-Business W@tch* this year, the results for the SRI indicate that there are major discrepancies. Thus, the survey results for the SRI should be treated cautiously.

Exhibit 3-13: Adoption of e-invoicing



Base (100%): Companies with internet access. N (for sector, EU-10) = 98. 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)

3.5 e-Procurement and Supply Chain Management

Efficient management of procurement is a fundamental activity along a sector's value chain, and is quite complex in the SRI. 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 irrespective of the full integration of systems with suppliers. For instance, orders can be made using a supplier's web site. This is often the first step towards a more comprehensive and integrated use of ICT in business processes. With online procurement, productivity gains result from the higher price transparency and easy identification and selection of qualified suppliers. However, e-procurement is more widespread in sectors with standardised supply goods than in other industries.

Inputs which can easily be sourced and procured online from suppliers in the SRI are Maintenance, Repair and Operating (MRO) goods and raw materials. These are for example, welding materials, anticorrosion painting or office equipment. Intermediate goods or engineering services are much more customised in this industry and thus difficult to procure online. Intermediate goods are for examples pumps, fire protection, navigation systems or piping systems. Engineering services are primarily required in the design phase of shipbuilding.

Software for Supply Chain Management (SCM) are tools to match supply and demand through integrated and collaborative planning tools. One efficient way of doing this are e-marketplaces. These are virtual online markets where buyers and sellers find and exchange information as well as conduct trade. The electronic integration of internal and external business processes along the value chain are possible using e-marketplaces (see Section 4.2).

3.5.1 B2B online trading: companies placing orders online

The survey results about B2B online trading have to be treated cautiously due to the small numbers of observations. Most of the following exhibits are only presented to give a rough picture of the current situation in the SRI.

About half of the companies from the SRI said that they **place their orders to suppliers online**. This level of adoption is slightly above the average of all ten sectors studied (48% - see Exhibit 3-14). However, most of the firms that place their orders to suppliers online do this up to a quarter of all their orders. Medium-sized and large companies reported more often (72%) than their small counterparts (47%) e-procurement of supply goods (see Exhibit 3-14). This issue is discussed in more detail in Section 4.2 and illustrated by the case study about *Meyer Shipyard*.

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. It can be assumed that companies without such software place orders mainly through web sites 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 an advanced state in these cases.

The level of using **specific ICT solutions for e-sourcing** in the SRI is above the average of other industries studied this year by *e-Business W@tch* (see Exhibit 3-14). Whereas the share of companies in the SRI is 12%, the weighted average of all ten sectors covered in the e-Business Survey 2006 is 9% (see Exhibit 3-14). In this area, however, a significant gap is observed between the sector's small (8%) and medium-sized/large companies (24% - see Exhibit 3-14). Taking into account the aforementioned statistical limitations, these results could indicate that electronic procurement is still not a systematic and digitally integrated process in the SRI. This conclusion is, in fact, illustrated in the case studies on *Finomar* and *ENVC* in Section 4.1.

Exhibit 3-14: Companies ordering supply goods online

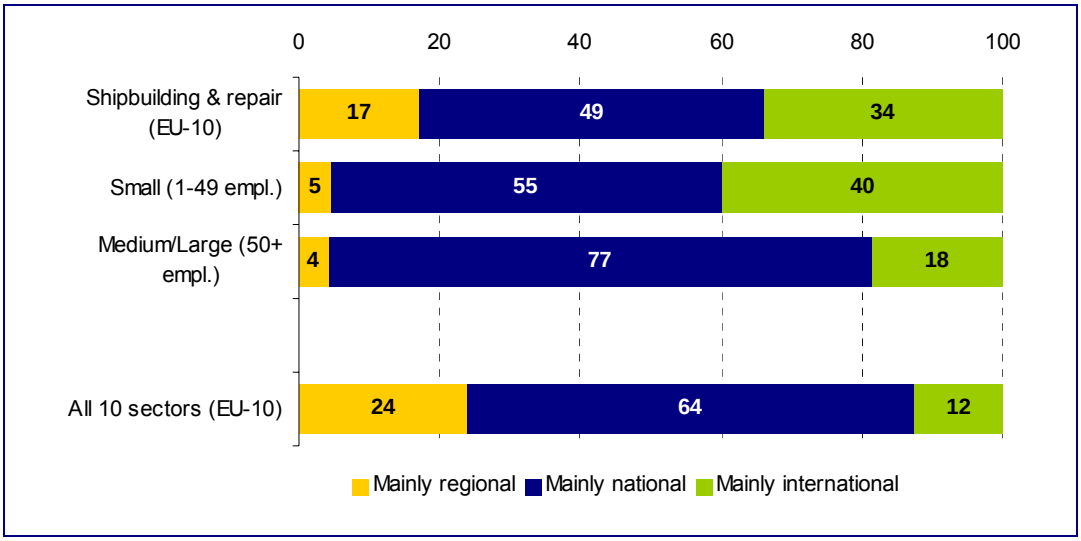
	Place orders online		**Place 1-25% of their orders online**		**Place more than 25% of their orders online**		**Use specific ICT solutions for e-sourcing**	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**62**	**53**	**78***	**69***	**22***	**31***	**18**	**12**
Small (<50 empl.)		47		54*		46*		8
Medium/large (50+ empl.)		72		97*		3*		24
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)	98		46		46		98	
Questionnaire reference	E1		E3a+E3b+E3c		E3d+E3e		E7	
* Data only idicative due to low number of observations.								

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

Companies which reported ordering online said that they do so mainly from national **suppliers** (see Exhibit 3-15). Nevertheless, well a third of the SRI's companies using e-

procurement said that they use it when buying mainly from international suppliers – and this share is substantially higher than the respective all-sectors average.

Exhibit 3-15: Main location of suppliers in e-procurement

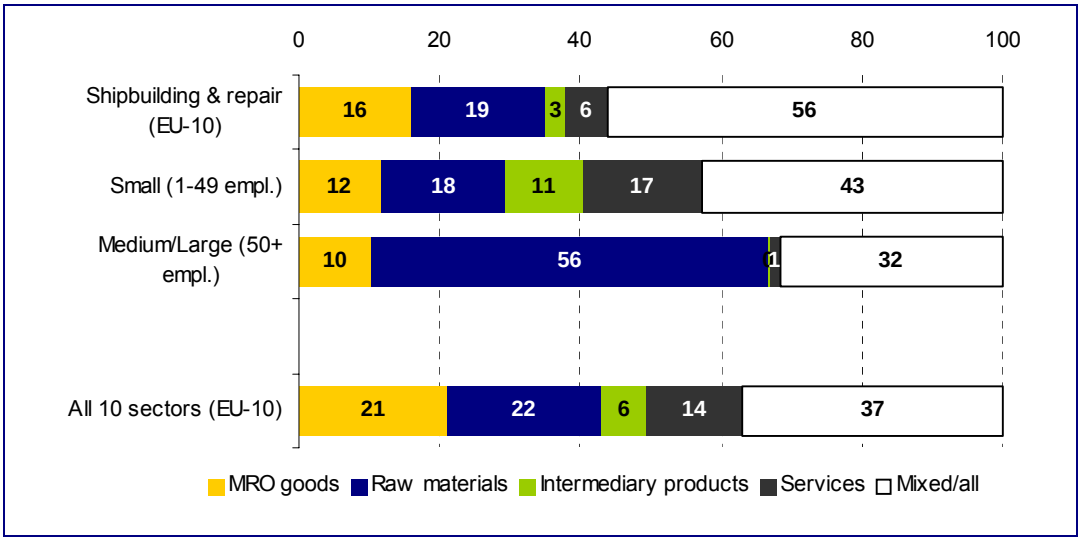


Base (100%): Companies placing orders online (without "don't know"). **N (for sector, EU-10) = 45**. Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: E5

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

Most of the companies that reported ordering online supply goods procure all **necessary goods** electronically. However, the medium-sized and large companies primarily order raw materials such as basic metals or metal products online.

Exhibit 3-16: Main type of supply goods ordered online

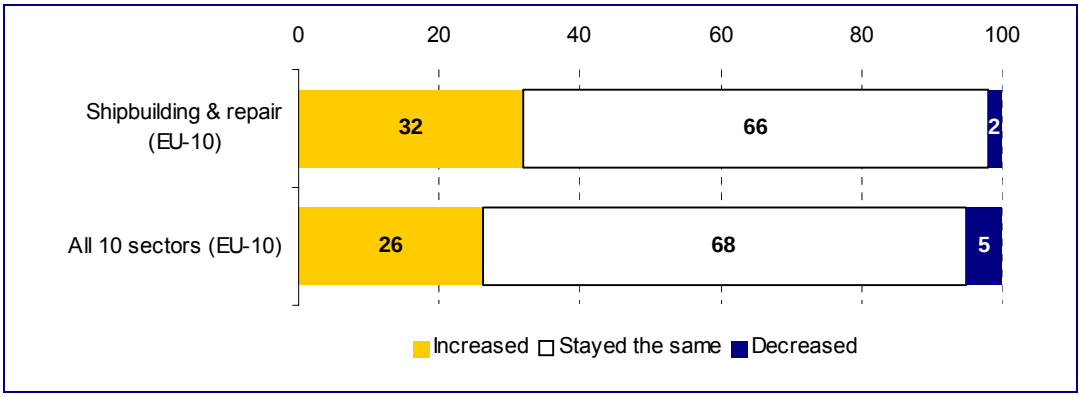


Base (100%): Companies placing orders online (without "don't know"). **N (for sector, EU-10) = 46**. Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: E4

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

The majority of the companies in the SRI that place their orders online reported that e-procurement has no **impact on the number of suppliers** (see Exhibit 3-17). One third of these companies stated an increase in the number of suppliers they use, a percentage which is relatively higher than the respective all-sectors average, but somewhat in conflict with the fact that many large firms with established sophisticated e-procurement schemes have the explicit target to streamline their supplier base. As discussed in Section 4.2, ICT empowers these companies to bundle procurement activities from different establishments or even branches in order to exploit economies of scale (see, for example, the case study on *Meyer Shipyard*). However, previous sector studies by *e-Business W@tch* have already shown that it is hardly possible to support this evidence by data from the e-Business Survey. The main reason is that supplier consolidation is a strategy which is mainly used by the largest firms, thus, results do not really show up in this SME-focused survey.

Exhibit 3-17: 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) = 45**.
Weight:ing: in % of firms. Questionnaire reference: E9

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

In **summary**, the survey results show that e-procurement is being adopted in the SRI, but is still at an early stage. In fact, it seems that e-procurement is not yet strategically integrated into the business process of the majority of companies. These results are analysed in more detail in Section 4.2, where illustrative experiences with e-marketplaces in this sector are presented.

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

SCM software can help companies in the SRI to match supply and demand through integrated and collaborative planning tools. These electronic linkages can lead to a competitive advantage for all the companies in the value chain through co-ordination and optimisation. Optimising procurement-production-delivery processes between a company and its direct suppliers and customers should increase the efficiency of these processes.

Enterprises representing 14% of sector's employment said that they use SCM systems (see Exhibit 3-18). This share is slightly below the average share of enterprises in all ten sectors studied (16%) and also below the average of most of the other manufacturing

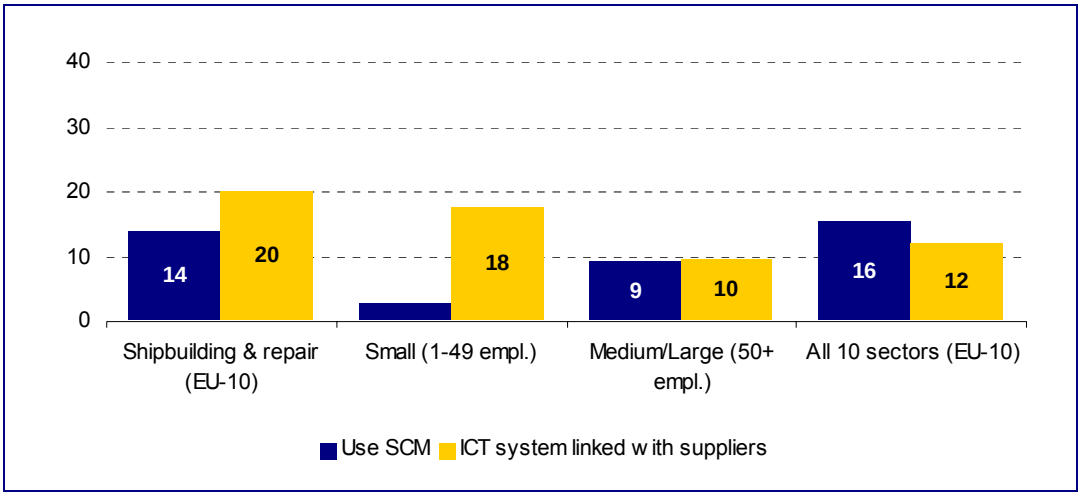
industries except footwear (see Exhibit 3-18). As expected, more medium-sized and large companies have adopted SCM systems (9% of firms) compared to small companies (3% - see Exhibit 3-18).

e-Business W@tch also asked companies whether their **ICT system was linked to that of suppliers.** In the SRI this linkage was reported more frequently than SCM systems (see Exhibit 3-18). Taking into account the aforementioned statistical limitation, this survey result is in line with the survey results regarding ordering supply goods online (see Section 3.5.1, Exhibit 3-14).

One fifth of the sector's employees are working in companies that reported having linked their ICT system with that of their suppliers. This figure is above the weighted average of all ten sectors (12% - see Exhibit 3-18). Moreover, this share is above the weighted average share in all other manufacturing industries where the share of companies reporting links of their ICT systems with those of their suppliers is between 6% in footwear and 16% in ICT manufacturing (weighted by employment). In addition, with a share of 18%, more small companies in SRI said that they have linked their ICT systems with their suppliers compared to 10% of the medium-sized and large companies which did so (see Exhibit 3-18).

In the 2006 survey, a new question was whether the **financial processes in trading** with international suppliers were mainly paper based, internally automated or externally automated. As this question is a follow-up question to companies that do online trading with suppliers, the number of observation for the SRI is too small to be presented. Due to the fact that the majority of companies conduct online trade with national or regional suppliers, international trade is still not of great importance (see Exhibit 3-15). The majority of companies that trade with international suppliers said that they use paper-based financial processes.

Exhibit 3-18: Supply chain integration: use of SCM and ICT links with suppliers



Base (100%): Companies using computers. N (for sector, EU-10) = 98. 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: D1f, F13a

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. This includes the communication with customers, offering products for sale, and developing new marketing strategies. However, previous studies on e-business in the TEM industries concluded that online sales are not a common practice in this sector.

This result also holds true for the SRI where it is unusual to sell complex contract goods such as vessels via the internet. Therefore, most shipyards use their homepage only to present pictures of several types of ships they have built and delivered in the past. This marketing strategy may help to build up trust and reputation. Thus, in general, ICT for marketing and sales or e-commerce are not widely diffused in the SRI. However, along the value chain there are a lot of companies such as marine equipment supplier companies or engineering service companies which might find the internet appropriate for their sales purposes and have started to embrace the associated technologies.

3.6.1 Companies receiving orders from customers online

In line with expectations, the survey results show that 14% of all firms surveyed in the SRI said that they accept orders from customers online (see Exhibit 3-19). The respective average across all sectors studied this year by the *e-Business W@tch* Survey is 25% and in the other manufacturing industries the level of adoption of online orders from customers is on average higher (see Exhibit 3-19).

A possible explanation for the SRI might be that as product complexity increases along the value chain, online trading becomes more difficult. According to the survey results, there are far more small companies that said that they accept orders from customers online than medium-sized or large companies (see Exhibit 3-19). This observation indicates that small companies in the SRI already started e-selling and these results are in line with the survey results about the adoption of e-invoicing (see Section 3.4.3, Exhibit 3-13). Nevertheless, as the survey data for the size-bands in the SRI again differ from the survey data for the average size-bands across all sectors studied, these results should be treated very cautiously due to the small sample. On average, accepting orders from customers online increases with the firm-size (see Exhibit 3-19).

As in 2005, *e-Business W@tch* asked companies whether they "*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.

Eight percent of all companies in the industry said that they use specific ICT solutions for e-selling (see Exhibit 3-19). This result is close to the average among all ten sectors studied (9%). Ten percent of the small companies deploy specific ICT solutions for e-selling compared to 3% of medium-sized and large companies (see Exhibit 3-19). These findings indicate a small gap between companies that accept orders online and that deploy specific ICT solutions. This might be an indicator for the fact that companies receiving orders online do this by e-mail and currently without any type of system integration.

Exhibit 3-19: Companies receiving orders from customers online

	Accept orders from customers online		Use specific ICT solutions for e-selling	
Weighting	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**18**	**14**	**12**	**8**
Small (<50 empl.)		18		10
Medium/large (50+ empl.)		5		3
All 10 sectors (EU-10)	**35**	**25**	**18**	**9**
Micro (1-9 empl.)		23		6
Small (10-49 empl.)		26		12
Medium (50-249 empl.)		29		16
Large (250+ empl.)		26		27
Food & beverages	31	19	14	4
Footwear	25	23	8	5
Pulp & paper	26	28	19	11
ICT manufacturing	26	27	24	12
Consumer electronics	25	35	20	12
Shipbuilding & repair	18	14	12	8
Construction	13	11	8	5
Tourism	49	36	28	11
Telecommunication	36	40	37	21
Hospitals activities	7	10	8	8
Base (100%)	firms using computers		firms using computers	
N (for sector, EU-10)	98		98	
Questionnaire reference	F4		F10	

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 the purpose of business intelligence. CRM systems help a 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 is 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 services, and possibly the customers themselves in their tasks. For example, customer needs can be matched with product

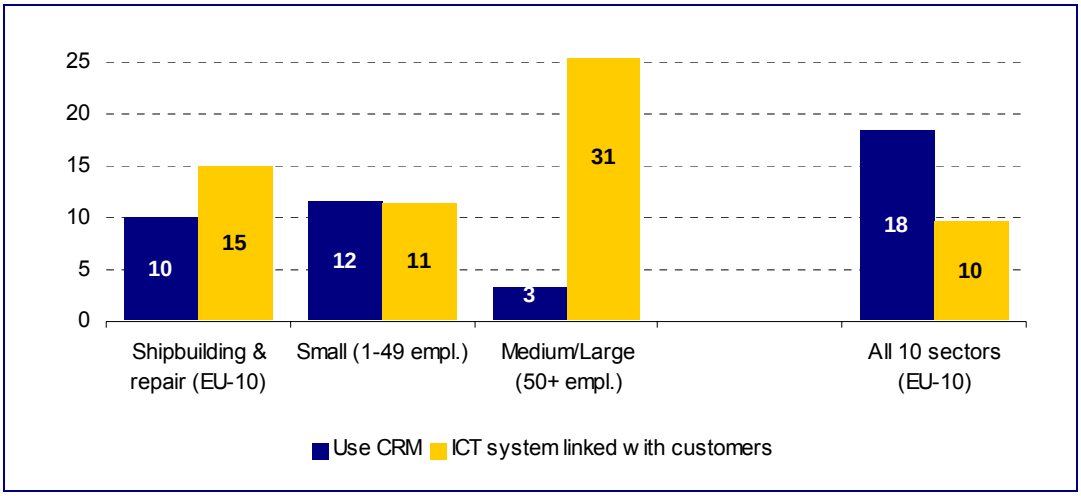
plans and offerings or, customers can be reminded about service requirements. The application of CRM is divided into three levels:[23]

- **Operational CRM**: supporting front-office work by storing basic data on customers (e.g. addresses, track record of contacts) the 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 the co-ordination of employee teams.

Nevertheless, CRM systems seem particularly beneficial for companies dealing with a large number of customers which is not the case for companies at the end of the value chain in the SRI, such as shipyards.

In line with expectations, companies representing 10% of the share of sector's workforce reported that they use a CRM system (see Exhibit 3-20). According to the survey, the respective average across all ten sectors studied this year is 18% (see exhibit 3-20). Moreover, in the other manufacturing industries CRM is more widely diffused, at least among the larger companies. Examples for comparison are ICT manufacturing (31%), consumer electronics (25%), and the pulp and paper industry (22%). In contrast to findings for other manufacturing industries studied this year, small companies in the SRI reported using CRM more often than medium-sized and large companies in this sector (see Exhibit 3-20).

Exhibit 3-20: Use of CRM and integration of ICT systems with customers



Base (100%): Companies using computers. N (for sector, EU-10) = 98. 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: F2, F13b

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

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

e-Business W@tch asked companies whether their **ICT system was linked** to that of customers. For the SRI, the same picture as for the procurement side emerges. There are far more companies that reported having linked their ICT system to that of their customers than companies saying that they use a CRM system (see Exhibit 3-20, compare Exhibit 3-18). Companies comprising 15% of the sector's employment in the SRI said that they have linked their ICT system to that of their customers (see Exhibit 3-20). This figure is above the weighted average of 10% of all companies in all ten sectors covered by the *e-Business W@tch* Survey 2006 (see Exhibit 3-20).

3.7 ICT and Innovation

Economists have studied innovation as a central element of the competitive dynamics in markets for a long time, and various scholars have stressed the importance of innovation for corporate performance.[24] In general, one differentiates between product, process and organisational innovations. Moreover, today ICT creates numerous, company-specific opportunities to improve processes and to generate new products and services for customers that previously did not exist. On the conceptual level, there exists a clear link between the adoption of new e-business technologies and innovation (Koellinger 2005). e-Business and ICT investments can enable process innovations if routines are changed. However, ICT investments can also support product or service innovations by implementing new software tools for design or sale purposes.

Previous *e-Business W@tch* studies on TEM industries, especially the sector report from August 2004 (see Section 2.3), found that ICT and the internet are important enablers of innovation in these industries. It seems as if the results of the e-Business Survey 2006 for the SRI do not support this earlier finding.

In 2006, *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 whether 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.

Although companies in the SRI invested 10% of turnover in research and development and new ICT applications enable suppliers to be an integrated part in the engineering process (CESA 2006, p. 4, see Section 2), the reported level of **innovative activities** is lower than in other industries (see Exhibit 3-21). About 16% of the companies said that they had launched **new products** in 2005. This share of companies is below the average share of companies in all ten sectors covered by the *e-Business W@tch* Survey 2006 (24% – see Exhibit 3-21). Compared to the other manufacturing industries, there are on average one third of the companies that have reported launching new products. However, there is a discrepancy between medium-sized/large firms, on the one hand and this sector's small companies, on the other. A quarter of the medium-sized and large firms

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

said that they have launched new products in 2005, but only 13% of the small firms did so (see Exhibit 3-21).

Fifteen percent of companies in the SRI said that they developed or introduced **process innovations** in 2005 and this fraction is also below the all-sectors average (20% - see Exhibit 3-21). In contrast to product innovations, however, far more small firms than medium-sized and large companies from this sector said that they have implemented process innovations (see Exhibit 3-21).

These survey results might be **explained by the characteristics** of the SRI. First of all, it is unusual in SRI to develop a prototype while producing one-of-a-kind vessels. Therefore, it is difficult to define "product innovation" in this industry. In addition, since producing a vessel can take up to three years, to develop a "product innovation" in the SRI might take a long time – longer, at least, to the time span specified in the survey question. Thus, it might have been difficult for companies in the SRI to answer the general survey question about product innovation.

Exhibit 3-21: Innovation activity

	Companies with product innovation in 2005		Companies with process innovation in 2005	
Weighting	% of empl.	% of firms	% of empl.	% of firms
Shipbuilding (EU-10)	**24**	**16**	**23**	**15**
Small (<50 empl.)		13		17
Medium/large (50+ empl.)		25		8
All 10 sectors (EU-10)	**32**	**24**	**32**	**20**
Micro (1-9 empl.)		22		16
Small (10-49 empl.)		25		25
Medium (50-249 empl.)		33		38
Large (250+ empl.)		48		53
Food & beverages	50	33	42	24
Footwear	43	38	24	18
Pulp & paper	42	30	45	27
ICT manufacturing	54	45	51	29
Consumer electronics	60	48	44	31
Base (100%)	firms using computers		firms using computers	
N (for sector, EU-10)	98		98	
Questionnaire reference	I1		I3	

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

As regards process innovations, they are centred on production and management processes, such as automated and computer-based manufacturing systems or management systems. In general, companies in this industry do not develop process innovation by their own, but they adopt process innovation from other industries. The implementation phase of such process innovations may take several years and so it might have also been hard for the SRI companies to answer the second question.

Since the question whether **product or process innovations** have been directly **related to or enabled by ICT** is a follow-up question, it is not possible to present data due to the

small number of observations. Taking the statistical limitations into account, the share of companies that said that ICT enabled process innovations is higher than the share of companies that reported that ICT enabled product innovations. In addition, the fraction of small companies that stated that ICT enabled innovations is higher than the share of the medium-sized and large companies. Compared to the ten other sectors studied by e-*Business W@tch* this year, these survey results for the SRI again differ from the respective all-sectors average. Thus, these survey results should not be overvalued due to the small sample and the bias to small companies.

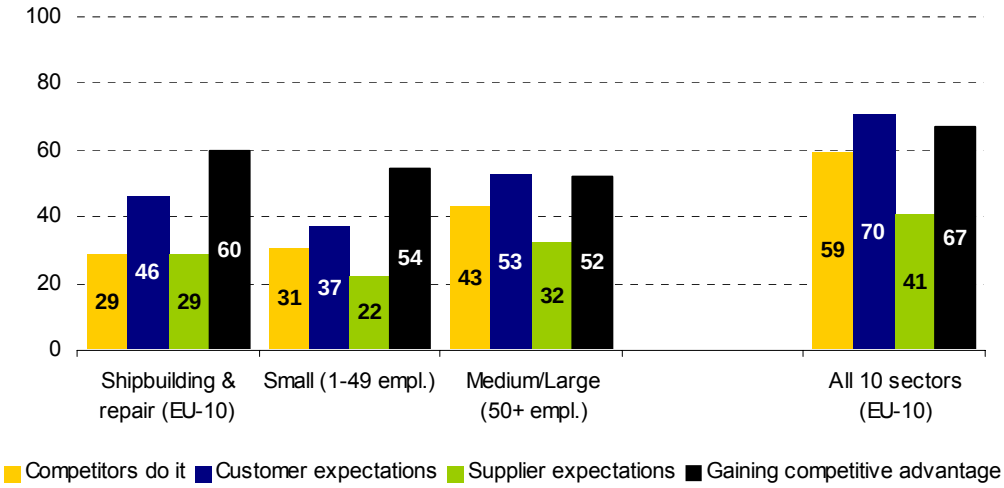
3.8 Drivers and Inhibitors for the Uptake of e-Business

In the SRI about two thirds of the surveyed companies confirmed that **e-business** constitutes "*a significant part*" or "*some part*" of the way they operate (see Exhibit 5.1). However, for the majority of these companies, e-business is currently only "some part" of the way the company operates. *e-Business W@tch* asked these companies in follow-up questions to indicate the important reasons for starting their e-business activity. Four main reasons were given in the survey, 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.

The survey results for the SRI show that the **main reason to start e-business** was a strategic one, namely to *gain competitive advantage*. This reason is slightly more important for small companies than for medium-sized and large companies (see Exhibit 3-22). This assessment by the industry's companies differs from the average across all ten sectors, where the main reported reason was—on average—pressure from outside due to *customer expectations* (see Exhibit 3-22). This reason is next most often stated in the SRI. More medium-sized and large companies said that customers expectations are a reason to start e-business (53%) compared to small companies (37% - see Exhibit 3-22). The two other arguments to start e-business, "*competitors do it*" and "*supplier expectations*", are equally assessed in the SRI although the fact that competitors do it is for medium-sized and large companies rather more important of a reason to start e-business.

The survey results indicate that customers have much more negotiating power than supplier companies to force other companies to start e-business or to introduce ICT.

Exhibit 3-22: 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) = 61. 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: H2

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

Although the number of observations is too small to present figures in detail, indicative results on why companies in the SRI **do not practice e-business** can be discussed. Those companies saying that e-business does not constitute a part of the way they operate see the main barrier in *security issues*. This supports results presented in Section 3.3.4, indicating that the adoption of security measures is above average in the SRI (see Exhibit 3-10).

The second important reason not to practise e-business mentioned by respondents of the SRI was that companies see legal complications. These evaluations differ from the cross-over assessments for the other sectors covered by the *e-Business W@tch* Survey 2006, where firms that do not conduct e-business have as their main argument that their *company is too small* to benefit from any e-business (55%). According to the survey, the second most important barrier to adopt e-business across all sectors studied is that e-business technologies are too expensive to implement. These are also the most commonly stated and well-known arguments against adopting e-business activities found in the literature, especially regarding SMEs. It is interesting that these do not appear to be the main arguments against e-business activities in the SRI.

3.9 Summary

Before summarising the main findings of the e-Business Survey 2006 for the SRI, it is necessary to remind the reader that these survey results should be treated cautiously. The sample is small and its composition in terms of firm-size might be biased to small and medium-sized supplier companies because, on average, shipyards are large companies with more than 250 employees.

Main findings

Basic internet connectivity covers all SRI enterprises and the majority of companies have broadband internet access. In addition, most companies use a LAN. However, the share of employees with internet access is lower than the average share across all sectors studied. The share of SRI companies that employ **ICT practitioners** is higher than in other sectors. However, the share of small firms employing ICT practitioners is lower than for the other size-band studied in this report. On the other hand, regular ICT training of employees seems to be much more important for small than for medium-sized and large companies in this sector. In 2005, more than half of the companies in the SRI made **ICT investments**, which indicates that ICT is becoming more and more important in this industry. Currently, outsourcing of ICT services in the SRI is in line with the respective all-sectors average.

According to the survey, the usage of proprietary or other **standards** for data exchange is higher than the average across all sectors studied this year. This, however, might be explained by the specific characteristics of the production process of vessels and the necessity of industry-specific solutions. Nevertheless, one third of the companies in the SRI see **interoperability** as critical for e-business between companies in the sector. Small companies are particularly aware of this problem. Moreover, one interesting survey result is the widespread usage of **open source software** in the SRI. In combination with the high fraction of companies employing ICT practitioners, this result indicates that companies in this industry seem to prefer to develop their ICT solutions in-house. This would also be in line with the fact that **security issues** are important for companies in the SRI. On the one hand, secure server technologies and firewalls are widespread in this industry; on the other, security issues are the main barrier for companies not to practice e-business.

About half of the companies in the SRI said that they have deployed some **e-business** technologies. For **internal process integration** the usage of an intranet, accounting software, an ERP system or a DMS is above the average usage in the other sectors studied. However, figures for this industry also indicate that the usage of ERP systems or DMS is still at an early stage. The deployment of ICT for cooperative and collaborative business processes in the SRI is in line with their reported use in other sectors studied this year by *e-Business W@tch*.

e-Procurement by placing orders online was reported by about half of the companies in the SRI, however, less than a fifth of this industry's firms use specific ICT solutions for e-sourcing. This indicates a gap which could imply that most of the companies place orders online by simply using e-mail. Currently, more companies link their ICT system to that of suppliers than deploy SCM software. Due to the structure and characteristics of the SRI,

e-marketing and online sales are not that important in this sector. Nevertheless, a small fraction of companies, especially small companies, said that they accept orders from customers online. Again, there is a gap between the share of companies which stated that they receive orders from customers online and the share of companies that reported using specific ICT solutions for e-selling. In addition, the fraction of companies which said that they link their ICT system to that of their customers is again higher than the share of companies which reported using a CRM system.

Although, today, the SRI is a high-technology industry the share of companies which said that they had launched **new products or new processes** in 2005 is lower compared to the respective all-sectors average. This might reflect that innovation processes in the SRI take a long time and that it is unusual to develop a prototype while producing one-of-a-kind vessels.

The **main drivers** for the uptake of e-business in the SRI are for gaining competitive advantage and to meet customer expectations. The first reason is strategic to the companies while the second is a reaction to pressure from outside.

The most important points resulting from the analysis of this year's statistical findings on the use of ICT in the SRI are **summarised** in the following box.

- **Internet connectivity** covers all enterprises and the majority of companies have broadband access.
- A comparably high fraction of companies employ **ICT practitioners** and use open source software. **Security** is an important issue in the SRI.
- About half of the companies reported that e-business is a **part of the way the company operates**.
- The usage of **ERP, DMS, SCM or CRM** applications is still in an infant stage, but partly in line with the extent of their use in other industries.
- The share of companies which said that they have launched **new products or new processes** in the 12 months before the 2006 survey is lower than the average across all sectors studied this year.
- The main **drivers** for the uptake of e-business are gaining competitive advantage and customers expectations.

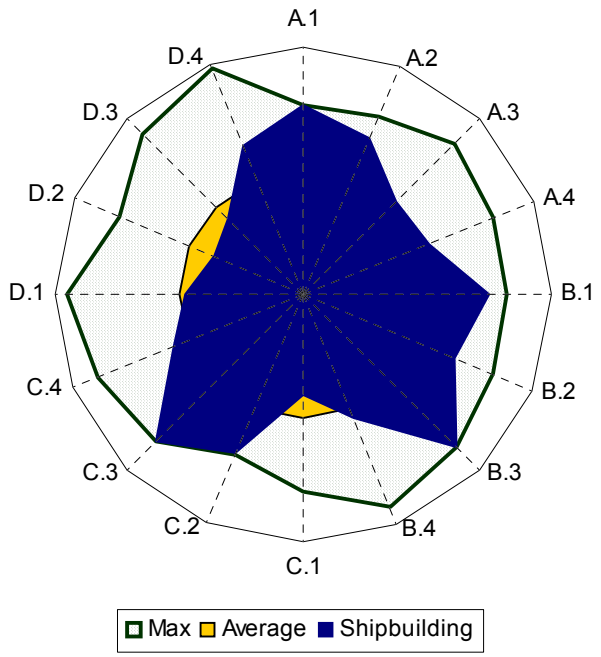
The general picture

Compared to the other sectors analysed in the *e-Business W@tch* Survey 2006, the SRI emerges as one of the e-business leaders when figures are weighted by firms. The compound indicator of ICT adoption and e-business intensity shows that the SRI is the third most advanced industry in terms of e-business development and usage. However, the situation for this industry looks different when employment-weighted data are used. When placing a higher weight on activities in larger firms, the SRI ranks seventh.

The e-Business Scoreboard shows that the SRI is above the all-sectors average for the compound indicators “ICT Networks” and “e-integrated business processes”. Also, most of the indicators concerning “e-sourcing and procurement” are above the respective all sectors averages, except of the indicator “firms placing orders online”. In line with expectations for the SRI, mainly due to this sector’s product characteristics, the indicators for e-marketing and sales are mostly below the average. In summary, therefore, the survey results indicate that the focus of e-business in the SRI is still on cutting costs and not on customer service.

Exhibit 3-23: e-Business Index and Scoreboard 2006[25]

e-Business Scoreboard 2006



Component indicators

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

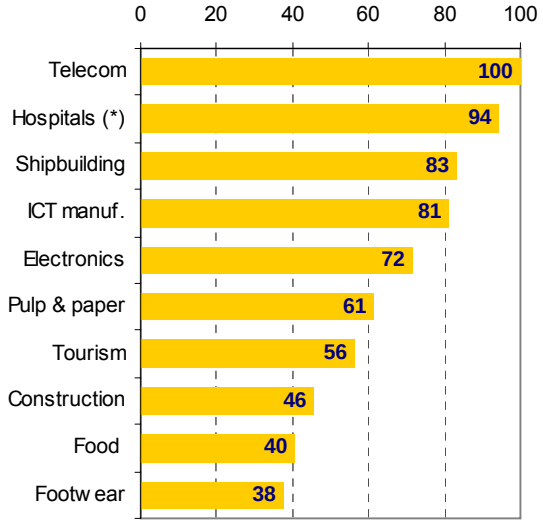
C. e-Sourcing and Procurement
C.1 Firms placing orders online
C.2 Use of ICT systems for sourcing
C.3 ICT system linked with suppliers
C.4 Online inventory management

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

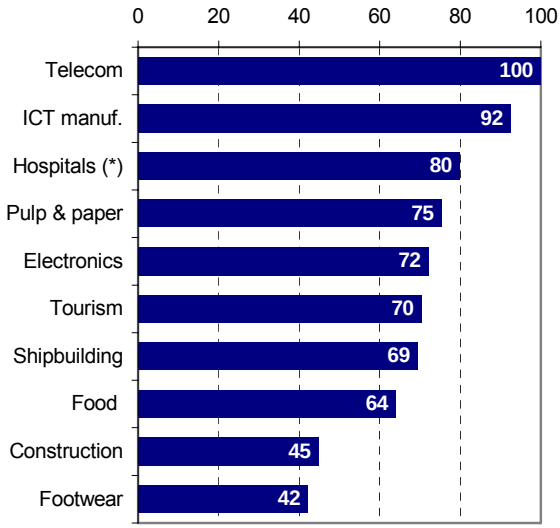
e-Business Index 2006

(based on 16 component indicators of the Scoreboard)

based on data in % of firms
(emphasizes 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)

[25] See Methodology Annex for information about the structure and computation of the scoreboard.

4 Current e-Business Trends and Implications

Information and communication technologies are generally recognised as the key factor contributing to productivity. Cost reductions from improved communication and data exchange, lower transaction costs and access to new markets are the main reasons why companies implement e-business applications. Nevertheless, not every company is able to implement appropriate ICT tools and to meet the requirements of the extended enterprise concept. A lack of awareness of e-business benefits as well as the high costs of ICT tools and implementation projects constitute barriers for small and medium-sized enterprises (SMEs) to adopt e-business practices.

The previous reports by *e-Business W@tch* on the whole TEM industry revealed that the shipbuilding industry was rather slow to grasp the concept of e-business and the opportunities it presents.

Topics in focus

This section provides further insights into current ICT usage and e-business activities specific to the SRI. Although this industry is characterised by a complex supply chain and project-oriented production, compared for example to the aircraft and automotive industry, there are also several ICT tools for the design, procurement and production phase as well as project planning developed (Andritsos, Perez-Prat 2000; Fleischer et al. 1999; Siksne-Pedersen 2000). The section does not claim to provide a comprehensive overview, as that would exceed the limits of this report. Therefore, the issues analysed and the case studies presented should rather be understood as representative examples of current practice and the related opportunities and challenges. The following issues have been selected in co-ordination and agreement with DG Enterprise and Industry and with industry federations as particularly relevant:

- **Progress in e-business usage, clusters and strategic implications**: Questions that will be of importance are the following: 1) To what extent are e-business and ICT adopted along the value chain of the SRI? 2) Are there clusters of firms with respect to their e-business usage? 3) Does e-business have an impact on the production processes in this sector? These questions will be discussed in the light of findings from the 2006 e-Business Survey, case studies presented in this section, interviews with experts and secondary literature.
- **The use of B2B trading platforms**: Section 4.2 discusses the current role of different types of B2B trading platforms in the SRI. This issue is particularly illustrative for developments in the field of e-procurement and supply chain connectivity. The case study presented in this section demonstrates that there might be advantages in using e-marketplaces, even if positive impacts could not yet be realised.
- **e-Business and SMEs:** Large shipyards play the major role in the SRI. However, these shipyards have a vast number of small and medium-sized supply companies. For example, European shipyards have up to 2,500 suppliers from which they select approximately 1,000 suppliers for a shipbuilding project (Ahlers, Brodda 1999, p. 66). Thus, e-business developments do not only have an impact on

shipyards, but also on a vast number of SMEs doing business with those yards. Section 4.3 discusses some aspects concerning whether there is a similar digital divide between SMEs and large companies as there exists in other transport equipment sectors.

Survey results presented in Chapter 3 and the analysis of selected issues in this chapter build the basis for conclusions and policy implications presented in Chapter 5.

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

Section	Company / project	Country	Topic(s)
4.1	Business example: *Shippurch.com GmbH*	Germany	A **Virtual Shipbuilding** Company
4.1	Case study: *Finomar*	Poland	**ICT reality**
4.1	Case study: *Estaleiros Navals de Viana do Castello*	Portugal	Launching an **Enterprise Resource Planning** System
4.1	Case study: *Uljanik*	Croatia	**IT system integration** to create efficiencies in the production process
4.1	Case study: *Fincantieri*	Italy	Adoption of a **Product Lifecycle Management** system
4.2	Case study: *Meyer Shipyard*	Germany	**e-Procurement** via E-Euroship
4.2	Business example: *ShipServ*	United Kingdom	The **e-marketplace** TradeNet – An example from the Shipping Industry
4.3	Business example: *Schiffbau-Versuchsanstalt Potsdam GmbH*	Germany	Developing an **e-commerce platform for engineering** in the shipbuilding industry
4.3	Case study: *LTH-Baas AS*	Estonia	ICT **cost-benefit analysis** for an SME

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

4.1 Progress in e-business usage, clusters and strategic implications

Progress in e-business usage

The structural change in the SRI over the last 20 years led to co-operations between shipyards, subcontractors, system suppliers and other suppliers in the engineering phase as well as along the whole supply chain (see Chapter 2). Consequently, the information flows between the different stages of the value chain and within firms operating at the same stage of the chain have intensified (Gartner Consulting 1999). According to the survey results, the basic internet connectivity of enterprises is comprehensive and compared to other sectors studied the share of companies deploying broadband access is high (see Exhibit 3-1). Nevertheless, ICT is more deployed and developed within

shipyards than among suppliers. Advanced applications are also more prevalent in yards that focus on shipbuilding rather than on repair (compare the case studies in Section 4.1 and *LTH-Baas AS* in Section 4.3).

During the 1980s, Computer-Aided Production systems (CAD/CAM) and Electronic Data Interchanges (EDI) were implemented in many firms (Andritsos, Perez-Prat 2000). Today, the usage of two-dimensional Computer-Aided Design (CAD) is a common standard in the shipbuilding industry. The role of CAD has traditionally been that of enhancing the various phases of the design process and assuring shorter lead times from the planning to the start of the production activities. However, other tools, such as three-dimensional CAD, Computer-Aided Manufacturing (CAM) or Computer-Integrated Manufacturing (CIM) have only been adopted by few large shipyards (Tholen, Ludwig 2006; see case study Finomar, Uljanik and Meyer Shipyard). Supply chain management (SCM) systems are also not widespread in the SRI and more often used by large shipyards that widely regard the management of their supply chain as strategic to their business performance (Fleischer et al. 1999, see Exhibit 3-18 and the case study on *Fincantieri*).

EDI techniques enable the exchange of transactional information between independent organisations based on standardised business documents. Traditional EDI systems employ specialised communication networks. Most of the implemented EDI solutions in the SRI during the eighties and nineties had no common standard (see Exhibit 3-7). This led to a fragmentation with firms being unable to communicate with each other. The large diversity of implemented applications was a true challenge for the development of a common data interchange standard as well as for the deployment of integrated communication platforms. Furthermore, the implementation of proprietary EDI systems was costly because it was not based on existing communication networks like the internet. Nevertheless, EDI communication has been accepted in the industry. Today, many firms still have high-level use of EDI but also a variety of proprietary legacy communication and information processing systems that are unable to exchange data across system boundaries. The survey results revealed that proprietary standards and other standards are the most common standards used for data exchange in the SRI. However, one third of the companies see interoperability as critical for e-business between companies in the sector (see Section 3.3.2, Exhibit 3-8).

Most shipyards are aware that the best way to increase productivity is through an efficient production planning and the rationalisation of all production and design processes (see the case studies on *ENVC, Uljanik, Fincantieri, Meyer Shipyard*). However, predominantly the large shipyards use enterprise resource planning (ERP) systems, databases, connect their workstations by local area network (LAN) and have good internet connections to their suppliers, subcontractors, classification societies and ship owners (see the case studies in this section). Nevertheless, supplier integration in order to increase the efficiency of enterprise resource planning activities still remains a difficult task, even for large shipyards. The survey results show that the usage of ERP systems and SCM systems are still in infant stage of usage in the SRI. Furthermore, the results indicate that there is a gap in adoption between small and medium-sized/large enterprises (see Exhibits 3-11 and 3-18 in Sections 3.4.1 and 3.5.2, respectively).

Since the year 2000, several major players in the SRI have launched a variety of e-business initiatives. However, no significant impacts have so far been observed (see also

Section 4.2 and the case study on *Meyer Shipyard*). Therefore, for most enterprises in the SRI, e-business is still an ICT issue with few strategic implications. These companies have adopted a "wait-and-see" approach and consequently significant changes in the supply chain as well as in the industry's structure are currently not visible. The e-Business Survey 2006 indicates that e-commerce is not widespread in the SRI (see Exhibits 3-13, 3-14, 3-19). The case studies on *Finomar* and *ENVC* are illustrative examples which support these results.

There are several networks or technology platforms, such as E-Mar, Wondermar I and II, WaterBorne and Intership, which are partly funded by the European Commission. Within these networks, large shipyards, suppliers and other companies of the maritime industry present and discuss innovative technologies and e-business tools. The goal of these networks is to improve the systematic exchange of information, to encourage the adoption of new information technologies and to exploit the possibilities of e-business tools. These research and development (R&D) projects are supposed to streamline the production processes, contribute to cost savings and increase the productivity in the shipbuilding industry in the near future. However, according to the survey results companies reported a rather low level of product and process innovations compared to the respective all-sectors average of all ten sectors studied. Since the question whether product or process innovations have been directly related to ICT is a follow-up question the number of observations is too small to derive conclusions on this issue (see Exhibit 3-21, Section 3.7). Currently, the survey results do not reflect the above described innovation activities.

Cluster and strategic implications

The production processes in the SRI have to become more flexible and shorter for the European shipyards in order to gain competitive advantages over their Asian competitors. One possibility to achieve this is an increase in co-operation along the value chain when developing engineering-intensive products. Design activities, for example, can easily amount to more than 10% of the costs of a modern passenger vessel (VSM 2004). Moreover, design activities have an impact on many other costs and factors of production like materials, production and delivery time.

An e-enabled production development, if adopted, can incorporate a broad range of different tools, including web-enabled CAD/CAM, online project management and product data management. These solutions promise a variety of benefits. Significant time savings can be realised due to reductions in the time spent for development, the reduction in the number of engineering hours required for a specific development project and the increased re-use of existing designs. Further cost savings can be achieved by lowering direct costs for communication (Andritsos, Perez-Prat 2000; BALance 2000; Krüger 2004). According to the survey, companies in the SRI co-operate and collaborate online within the value chain, however, companies in the ICT manufacturing and consumer electronics sectors do it to a larger extent (see Exhibit 3-12).

Business example:

Shippurch.com GmbH – A Virtual Shipbuilding Company

Shippurch.com GmbH is a German start-up, founded in 2000 and seated in Kiel, that develops custom-tailored web applications for the shipbuilding industry. The underlying idea is that shipyards, subcontractors, engineering services or equipment suppliers are able to collaborate smoothly via the internet, as online cooperation is supposed to enable a high degree of flexibility in working arrangements. Thus, consortia can be more flexible and responsive to the requirements of the specific vessel to be built. For example, a pump manufacturer needs to be able to extract the section of shipyard blueprint relevant to him, make adjustments, and then add it all to the shipyard drawing together with organisational data.

The "i-shippurch.com" module provides standardised shipbuilding company profiles and product lists including complete inquiry forms to allow ships to be purchased at an international level. It is based on XML. The second application, called "i-shipproject.com", is an informative project management system, dedicated to the shipbuilding supply industry. This system enables companies to manage projects and put products on the net with their specifications and prices for general viewing. Last but not least, "i-shipspec.com" can be used to incorporate supply company know-how and existing shipbuilding regulations.

The company fully customises the implementation of its services for their clients to thus better meet their needs. The web applications are financed by the subscription for the specific online services. The purchase and installation or setup of Shippurch's web applications on local intranet incurs separate costs.

Source: HANSA International Maritime Journal (2001): Virtual Shipbuilding Cpmpany, www.hansa-online.de; http://www.shippurch.com (May 12, 2006),

Increased transparency in the engineering processes may lead to fewer mistakes and better products. Additionally, e-product development tools can be used to increase the global collaboration within yards groups that often have yards in several different countries (see case study Fincantieri). Finally yet importantly, a well-functioning web-based product development environment can significantly increase the "ease" of engineering. This is comparable to the ease of using e-mail instead of sending fax messages. Web-based product development allows the real-time exchange and simultaneous use of CAD/CAM files without having to deal with data formats or the delivery of files from one office to another.

The support of product development with online technologies was hence identified as an e-business application that promised great efficiency gains for the future. However, firms currently experimenting with such solutions are still struggling with transparency and standardisation issues. Contrary ideas and differing interests of the suppliers and shipyards concerning the effects of the e-product development pose further barriers to adoption. The survey reveals that for many companies in the SRI security issues are an

important barrier to introduce e-business applications and to collaborate or cooperate electronically (see Section 3.8).

In general, most of the smaller shipyards lag behind large companies in adopting e-business, mainly because the cost-benefit structure of advanced e-business solutions seems to benefit large shipyards to a greater extent than it does SMEs. This is caused by a cost-return-structure of many e-business projects which seem to imply increasing returns to scale. Large shipyards are therefore more active in adopting e-business and seem to be in an advantageous position to realise the full potential of efficiency gains, reduced costs and a better competitive position in the market. The more complex and advanced e-solutions in particular require substantial investments in software and user training before they are "up and running" and before they can reach a positive return on investment (see case study *LTH-Baas AS* and Section 5.1).

The future e-business scenario is less determined by what is technologically feasible, but much more by how the industry and firms are organised and how they deal with the challenges and opportunities that e-business offers them. The SRI is one of the more traditional industries with conservative attitudes towards e-business, less standardisation or modularisation in the production processes, and also with mostly customised and project-oriented production. Therefore, existing long-term contracts between the shipyards and the suppliers might affect the importance of e-business in the industry as a whole while the project-dependent supplier structure sometimes leads to a short duration of co-operation.

Case studies

The four case studies are different examples for the usage of ICT in medium-sized and large shipyards. The first case study on *Finomar* describes the barriers of using advanced ICT in small and medium-sized enterprises (SMEs). However, these problems are not specific to the SRI, they are common problems of all SMEs independent of the sector.

The second case study is about the implementation of an ERP system to optimise the internal business processes. One of the direct impacts is that the former fractured approach to information storage is eliminated. Nevertheless, *ENVC* learned that when implementing an advanced ERP system an adequate amount of investment needs to be allocated to the training of all involved personnel.

The third case study is about the IT system integration in the production process at a large shipyard. *Uljanik* combined their Product Data Management (PDM), their ERP and their CAD systems to create efficiencies. Thus, *Uljanik* takes a proactive position towards ICT usage and streamlines their entire shipbuilding process in order to increase the shipyard's competitiveness.

The fourth case study describes the implementation of a Product Lifecycle Management (PLM) system and an ERP system at the large Italian shipyard group *Fincantieri*. The ERP and PLM systems enabled the integration of information for the group's eight shipyards along the management and production processes, as well as the integration of supplier companies in the design and production process.

CASE STUDY: ICT REALITY AT FINOMAR, POLAND

Abstract

Finomar *is a medium-sized shipyard operating in a labour intensive manufacturing sector that is highly dependent on steel prices. Its competitive position is derived from cost-efficient basic steel repairs and geographic proximity to large ship operators.*

The already implemented and used internet technologies proved to be useful and brought some measurable benefits due to searching new clients or advertising. World-wide communication enabled the company via internet platforms to exchange workers and to reach new clients as well as to find better prices for components without additional cost.

The stock management, design office, finance and human resource departments probably would be the ones to profit most from more ICT. However, the cost of ICT presents a major obstacle to the adoption of advanced ICT tools. Currently, ICT and e-business activities do not play a strategic role for the companies development.

Case study fact sheet

Full name of the company:	*Finomar*
Location (HQ / main branches):	*Szczecin, Poland*
Sector (main business activity):	*Ship repair and ship building*
Year of foundation:	*1994*
Number of employees:	*210*
Turnover in last financial year:	*9 million EUR*
Primary customers:	*Other businesses; shipyards in Germany, Norway and Poland*
Most significant market area:	*Germany*
Main e-business applications studied:	*Computers and design programs (CAD) for Lofting Department, plasma cutting machine operations software, basic accounting & payrolls software, web site and Windows applications*
Key words:	*Medium-sized shipyard, modernisation, competitive advantage*

Background and objectives

Finomar operates in a labour-intensive manufacturing sector that is highly dependent on steel prices. The strength of Finomar and other similar companies in Poland is a wide-spread belief that Polish smaller yards are better at basic steel components manufacturing and repairs than in the more demanding task of machinery or electrical repairs.

According to Finomar's Commercial Manager, Arkadiusz Swiech, the company sees the key source of their competitive position not in investing in advanced e-business technology but in modernising the tools and manufacturing technologies as well as workers' skills as a means to improve their products and delivery times. Better manufacturing processes and qualified labour could advance them faster into the future and help to add innovative products into the company's portfolio. Consequently, the investment goals to improve the competitive advantage were to expand the production capacities of the shipyard, the mechanisation and automation of technological processes, the improvement of working conditions and the quality as well as modernity of the products.

The implementation of advanced ICT tools is not considered as a source of competitive advantage or profit-enhancing strategy unless it would be closely integrated into the manufacturing processes to reduce human errors and aid machinery.

Arkadiusz Swiech also said that "*the customers do not put pressure on the firm to implement any new ICT technologies but put emphasise on the products' delivery time, quality, adherence to standards and competitive prices"*. The products of the company do not require a great deal of the new ICT technologies in place in order to be produced and conform to standards.

According to the management of Finomar *''the driving forces for the company to succeed with any new IT developments will be the investment in educating the skilled labour, especially welders and cutters to be able to operate computers to aid their work''*. There is a need to teach employees of the shipyard more IT skills specific to the jobs, especially in the Lofting Department, where cutting and bending of steel plates and profiling of the structures takes place. The Department already has CAD programmes but only a few engineers are involved in using them. Involving more employees in using the programme and connecting workstations with CAD stations could bring great benefits to the processes where a high degree of accuracy is needed.

e-Business activities and impacts

Despite the rather sceptical approach towards the value of e-business applications, the company's representative admits that "*Internet technologies were and will be used in searching for new clients, advertising and worldwide communication due to the positive experiences they have already had"*.

The company has a tri-lingual (Polish/English/German) web site, developed at low-cost internally using frames and Java Script. The web site is purely informative. The company realises that there is potential in developing the web presence with the possibility of customer orders' being processed via web, as well as transferring the technical data via internet and a better network within the company. However, the costs are the main problem. The firm fears that investing in e-business tools of uncertain benefits might have a negative impact on its performance and deprive it from a competitive advantage. As Arkadiusz Swiech says "*Price levels play an intricate part in the future of any shipyard, especially the small ones, cheaper prices still dominate the owners' thoughts.*"

Finomar is a member of different exchange platforms and e-marketplaces specific to the industry. Those internet platforms specifically have helped to exchange workers and to reach new clients as well as to find better component prices and needed suppliers without additional costs. As a result, the costs for advertising, finding new markets and new suppliers have been reduced. New possibilities to utilise labour across different projects and countries have been found and explored. Workers from Finomar have been contracted through shipyards across Europe via contacts made through internet and e-marketplaces.

Additionally to CAD programming in the Lofting Department, advanced ICT solutions are also used in programmes for the Plasma Cutting Machine, which can cut steel plates in very specific dimensions. Here ICT adds value, reduces delivery time and minimises human errors in processes where it is very important to obtain high efficiencies.

The management recognises that the stock management, design office, lofting, finance and human resource departments would be the ones to profit most from more ICT in place, providing that the software and ICT packages are compatible with specific requirements of the sector and are compatible to ICT tools in place at customers and suppliers. However, here again the costs of ICT present a major obstacle, as Finomar's suppliers are chiefly a couple of steel companies and many small firms whose financial situation does not allow them to make any significant investments into ICT.

Finomar's management seems to have excellent knowledge of the technology available and also a vision of how it could be implemented within the company. Nevertheless, ICT is beyond reach considering its costs and small utilisation in the whole sector. Moreover, Finomar is a manufacturing company with a strength in efficient and quality oriented manufacturing services. Again, the manager, A. Swiech says *''the company has hopes that the EU, through its Structural Funds, will help the firm to modernise, including its ICT infrastructure, as promised in the Lisbon Strategy Document and we are hoping for European support to innovate our business and production for the next 5 years.''*

Lessons learned

The company realises that software licences and hardware are not the only source of ICT expenditures. The enhancement of the workforce skills is also a necessary and, usually high, cost for ICT installations. Thus, if there were grants to buy new computers and software programmes, the company might be venturing into e-business. A grant would also be expected for financing the training of staff, since it is well recognised that new information technologies require a great increase in staff skills.

Unfortunately, according to the firm's representative, there are too many research programmes and not enough initiatives to help enterprises to implement the technology. A small budget and no clear standards in the industry, as well as a big divide between the larger and smaller shipyards (commercial and naval) are current hurdles for an increased use of ICT. As a result, e-business technologies are not a priority for this medium-sized shipyard which is trying to modernise itself and cut costs to withstand Asian competitors.

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:

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- *The shipbuilding and ship repair in the New EU countries: Poland, Estonia, the Czech Republic, Hungary and Slovenia. NOBE Independent Center for Economic Studies, Łódź, Poland*
- *Web sites*: company Finomar, www.finomar.com.pl

CASE STUDY: LAUNCHING AN ENTERPRISE RESOURCE PLANNING SYSTEM AT ENVC SHIPYARD, PORTUGAL

Abstract

Estaleiros Navals de Viana do Castello (ENVC) is a Portuguese shipbuilder located in the town of Viana do Castelo. ENVC specialises in design, construction, repair and conversion of merchant vessels up to 30 thousand DWT and non-combat military vessels of small and average tonnage. With the goal of continuously improving the company's management system, ENVC implemented the Enterprise Resource Planning (ERP) software SAP/R3 in 2002. The shipyard encountered some problems during the system's installation and use, but ultimately the positive impacts prevailed.

Case study fact sheet

Full name of the company:	*Estaleiros Navais De Viana Do Castelo*
Location (HQ / main branches):	*Viana do Castelo, Portugal*
Sector (main business activity):	*Shipbuilding*
Year of foundation:	*1944*
Turnover in last financial year (2005):	*70 million Euro*
Number of employees:	*950*
Primary customers:	*Fouquet-Sacop (FR); Jungerhans (D), Fortum (Fin), Mutualista (P), Portuguese Navy*
Most significant market area:	*Merchant vessels up to 30000 DWT and non-combat military vessels of small and average tonnage*
Main e-business applications studied:	*Enterprise Resource Planning Software (SAP/R3)*
Key words:	*Modernisation, business process efficiencies, competition*

Background and objectives

About ENVC

ENVC shipyard is well known for its quality design and construction of complex merchant ships and navy vessels. Its origins date back to 1944 and for most of its existence, a significant portion of new construction was delivered to the domestic market. In the 1970s and in the 1980s the yard built 31 standardised vessels for the former USSR and in the 1990s most of the orders came from German customers. Today, Portugal is once again its main market, representing ninety percent of sales. The majority of ENVC's suppliers come from Portugal and Germany. Its more than 200 vessels built to date, include cement carriers, container ships, multipurpose carriers, oil and chemical tankers and passenger vessels. An important addition to the yard's principal shipbuilding activity has always been conversion and repair services, where about twenty percent of the workforce is now employed.

To remain competitive in the market, ENVC has heavily invested into improvements of its productive infrastructure. Similarly, an investment into information and communication technology (ICT) is viewed as indispensable and represents a powerful contribution to both cost and time-to-market reductions. Further benefits named by ENVC are improved outsourcing and joint development activities as well as an enhancement to the company's

flexibility and responsiveness to increasingly stringent market requirements. As Mr. Sergio Fonseca, an ENVC representative, explained *"contrary to general wisdom, shipbuilding is progressively becoming a high-tech industry. Every indicator says that the knowledge content in this industry is increasing at a considerable rate. Today, ships are completely designed in an electronic format and even the manufacturing makes use of ever more IT. However, more progress has to be made before we reach the same level of automation as other industries. In response to this, IT is given a key role to maintain the competitive position of ENVC."*

ENVC's efforts are directly reflected in the level of ICT utilisation that has already been achieved. A bilingual (Spanish/English) web site, Intranet and document management system provide the framework for the company's daily operations. The technical work is backed by computer design applications such as CAD, AUTOSHIP and NUPAS. These systems are used from the initial phases of ship design and development until all the detailed drawings are complete and an interfacing with the manufacturing phase takes place.

ENVC does not employ a Customer Relationship Management (CRM) system. They reasonably state that there is no need to introduce a tool suited for communication with thousands of customers while "*we, in shipbuilding, generally deal with some dozens at most"* said Mr. Fonseca. E-mail is the standard way of communicating with customers and fully satisfies their requirements.

ENVC is highly aware of the effectiveness of e-business practices, such as participation in e-market places for procurement, subcontracting activities and the simplified access to suppliers it can grant. The company has taken some steps in this direction and envisions adopting such practices as well as a Supply Chain Management (SCM) system in the future. The tools that are used to control the flow of information inside the company are managed by their Enterprise Resource Planning (ERP) system. This allows them to integrate much of the data and processes into a single unified system. At ENVC, SAP/R3 was chosen to perform this function and has enabled them to attain an integrated management approach.

e-Business activities

Since accurate and accessible information is fundamental to efficient business operations, an investment in an ERP system was regarded by ENVC to be of strategic importance. The need was especially acute at ENVC since before the introduction of an ERP system, no other software supported the management functions. Many of the business functions were previously performed using stand-alone applications, which in some cases had interoperability issues.

The implemented ERP system runs on a single database with multiple software modules that cover some of the business functions of the organisation including finance, controlling, accounting, production (project definition, activities definition and materials specifications), management of materials, maintenance, quality, human resources, logistics and document management. This allows ENVC to combine the data from formerly disparate applications, thus standardising and reducing the number and diversity of the systems used. Some of the positive effects include the development of higher-level analysis functions and more accurate and reliable generation of financial reports.

The system is built on an Oracle database management system (DBMS) and is supported by one test/development server and two production cluster servers. ORACLE DBMS's are extensively used due to their ease of use and high reliability.

The implementation of the system was started in 2002, was carried out as a joint effort between third party vendors and ENVC's own IT department and lasted about twelve months. The installation costs including software, hardware and assistance amounted to approximately one million Euro. Additionally, there is also an annual licence fee of about 110 thousand Euro and support costs of around thirty thousand Euro for every 100 days of maintenance, which is partially supplied by third party vendors.

The amount of time and costs involved in implementing the new ERP system reflect the magnitude and extent of effort that this undertaking requires. A significant portion of ENVC's employees was in one way or another involved with the systems implementation. The end users needed to be trained in order to acquire the necessary SAP knowledge and skills. While some adaptation of the software to the existing practices was possible, a number of processes needed to be redefined. Custom tailoring of the system included the installation of additional applications and adaptation of the user exits.

Impact

By optimising the internal business processes, the introduction of an ERP system increased the efficacy of all internal users performing one or a number of tasks via the system. Estimates supplied by ENVC show the extent to which the new system had an impact on the internal organisation and business practices. The time spent on information processing was shortened by about forty percent due to more efficient data transformation. Mr. Fonseca states that while this change is not as significant as expected, ENVC anticipates the required time to decrease even further in the future.

The automation of some of the tasks previously accomplished manually resulted in a reallocation of some of the workforce. This led to about fifteen to twenty employees becoming free for other activities. However, the magnitude of the affect has been too necessitate any meaningful change in the overall internal organisation of the shipyard.

One of the direct impacts that the system has had at ENVC, is that it eliminated the fractured approach to information storage, thereby leading to the quicker and more reliable dissipation of information to the different work posts. This significantly extended the reach of business processes within the company. For instance, the ERP system enables a well-organised and consistent sharing of data between different departments, such as accounting and controlling.

All of the new system's modules are fully integrated and interoperability is assured by the systems design. The integration between the various departments and business functions as well as of certain applications is performed online and via batch processing during the night. This has resulted in a more transparent exchange of data, a faster generation of reporting as well as a consolidated view and ongoing monitoring within the company. It was also noted that the error reduction that occurred due to the significantly enhanced data storage and management has had a positive impact on annual output. However, it is not possible at this time to support this result quantitatively.

Lessons learned

As already discussed above, ENVC had to make a decision when to customise the system or modify their own processes. In some cases the ERP system was adapted to make it compatible with the company's requirements. In others, the opposite approach had to be taken and ENVC's processes were modified to bring them in line with the "best practice" methods stipulated by the system. ENVC was forced to ask such questions as "How is an offer for a client elaborated and reflected in the budget estimation?" and "How is the cost control of a particular project executed?" They learned the limits inherent to their current methods. Consequently, the encountered issues and questions resulted in a better understanding and amendment of their processes, interaction with clients and in some instances led to the emergence of new opportunities for the company.

Due to the system's complexity, some difficulties during its installation and use were expected and encountered. The efficient introduction and use of the ERP system were hampered by the cumbersome and often insufficiently flexible access policies. As a result, more work and adjustments to existing business practices, than otherwise might have been needed, were necessary.

Considering how recently the system was introduced and that occasional hold-ups do occur, there is a constant need for monitoring leading to unanticipated costs. Two further and very major drawbacks were mentioned by ENVC. A lack of better compatibility with other systems has hampered a further integration with the design and engineering systems currently in use. Furthermore, not all planning tasks at ENVC can be handled by the system thus necessitating the deployment of further tools.

ENVC learned that when implementing an ERP system, especially one as advanced as SAP/R3, an adequate amount of investment needs to be allocated to the training of all involved personnel. This includes not only training in the use of the system, but also demonstration of the concrete benefits that it brings. Both potential users and the employees responsible for the monitoring of the system and introducing and testing future changes to it were trained. While in the beginning ENVC experienced some resistance among its employees towards the acceptance of the new system, once it was fully implemented and the bugs removed, and Mr. Fonseca says that "*for now, it is over and everyone sees the benefit.*"

One of the most important effects that this project had is that the implementation of an ERP system turned out as an opportunity for ENVC to reconsider the internal flow of information and to detect areas in need of further improvement. It represents a significant step in mastering a more advanced way of doing business.

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

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CASE STUDY: IT SYSTEMS INTEGRATION TO CREATE EFFICIENCIES IN THE PRODUCTION PROCESS – ULJANIK SHIPYARD, CROATIA

Abstract

Uljanik Shipyard (Uljanik) is located in the port-town of Pula, Croatia and is considered the best-managed shipyard in the country. In order to maintain its reputation for high quality and to enhance its competitiveness in the global marine market, Uljanik launched in 1999 a far-reaching project of technological renewal of the company's existing IT systems: computer-aided design (CAD) and enterprise resource planning (ERP).

A product data management (PDM) system to upgrade the product lifecycle management was implemented in the first stage. In a subsequent step, the CAD, ERP and PDM systems were integrated. Specific outcomes of the systems integration project included the creation of an electronic link within and between shipyard's systems as well as the assurance of a high degree of data integrity, data transparency and accessibility.

Case study fact sheet

Full name of the company:	*Uljanik Shipyard Joint-Stock Company*
Location (HQ / main branches):	*Pula, Croatia*
Sector (main business activity):	*Shipbuilding*
Year of foundation:	*1856*
Turnover in last financial year (2005):	*~160 million Euro*
Number of employees:	*1961*
Primary customers:	*Ray Car Carriers Ltd, Israel; Grimaldi Group, Italy; P.D. Gram&Co. AS, Norway*
Most significant market area:	*PCC (Pure Car Carriers) and wagon carriers - app. 50% and 20% of the product portfolio respectively.*
Main e-business applications studied:	*Integration of the product lifecycle management (CAD and PDM) and ERP systems*
Key words:	*Technological rebuilding, ICT, information and data management*

Background and objectives

Overview

Founded in 1856 as a shipyard of the Austro-Hungarian navy, Uljanik leads the Croatian market. The shipyard is part of the Uljanik Group, which also includes such companies as Uljanik Engeneering Industry Js. Co, Uljanik Outfitting Equipment Works Js. Co, Uljanik Informatics Development Investment Ltd, Uljanik Accounting, Personnel, Law Services Ltd, Uljanik Finances Ltd and Uljanik Standard Ltd. Each company in the Uljanik Group performs the activities corresponding to its name.

Uljanik shipyard offers a product portfolio that includes oil and chemical tankers of up to 47000 DWT (deadweight tonnage), pure car carriers (PCC) of various sizes ranging from 4300 to 7000 cars, and wagon carriers with a capacity of up to 52 wagons. Their diverse product mix enables Uljanik to retain a considerable share of the world market. It is one of the key players in the production of PCC and the market leader in production of wagon carriers. From 2000 to 2006, Uljanik supplied, on average, nearly eleven percent of the

PCC world market, 100 percent of wagon carriers and five percent of chemical and product tankers. A closer look at Uljanik's customer base clearly shows an internationally oriented shipyard. From 2000 to 2005, Uljanik's customers included Ray Car Carriers (Israel), the Grimaldi Group (Italy) and P. D. Gram & Co. AS (Norway).

In the near future, Uljanik will continue to focus on PCC vessels, some of which will be a new prototype capable of carrying both car and container cargo. Uljanik is aware of the growing challenge that comes from the shipbuilders located in the Far East and considers Chinese, Japanese and South Korean yards, which take up about 84% of the market, as its main competitors.

Approach to ICT

As a global player, Ulajnik recognises the vital role of ICT in process optimisation and has therefore been building up its IT know-how for the last forty years. Mobile and wireless technologies, RFID and product visualisation in the production processes are regarded by the company's management as the most important technological challenges in the market today. In response, Uljanik has integrated some wireless technology into the outfitting process and is currently implementing VPN (virtual private network) capabilities. RFID, though currently not used, is planned as a replacement for the existing ID cards with magnetic strip and for tracking employees working hours.

Uljanik Shipyard is now progressively integrating technology into its fundamental processes. Among the key ICT devices widely applied at the shipyard, Mr. Koźljan, information systems development manager at Uljanik, names "*Internet and services incorporated into the company's local area network (LAN) as well as Oracle technologies such as Oracle database (DBMS).*"

The Rationale behind the IT systems integration project

The importance of ICT at Uljanik and, especially, the need for a product lifecycle management result from the complexity of both its products and processes, a common factor in the shipbuilding industry. However, with the right technologies in place, it is possible to achieve concurrency in the shipbuilding process, leading to an overlap of the shipbuilding processes phases. This helps compress the lead-time along with the attainment of high production quality and cost reduction.

To take full advantage of a concurrent approach, Uljanik launched a comprehensive project of technological renewal of the entire information system at the end of 1999. At the project's completion, the existing self-designed and programmed IT systems were redesigned. New infrastructure, hardware and software solutions such as a relational database management system (RDBMS), were also implemented. The project was completed in 2005.

e-Business activities

Existing IT systems

The first phase of the project involved the adoption of the concept of Electronic Product Definition using Optegra **PDM** provided by Parametric Technology Corporation. The PDM system encompassed a unified product data model and created the Vault, a central

repository that catalogues and stores all data for the product definition. It is primarily used to analyse the assembly of the product components and to ensure a better control of the ship's electronic model.

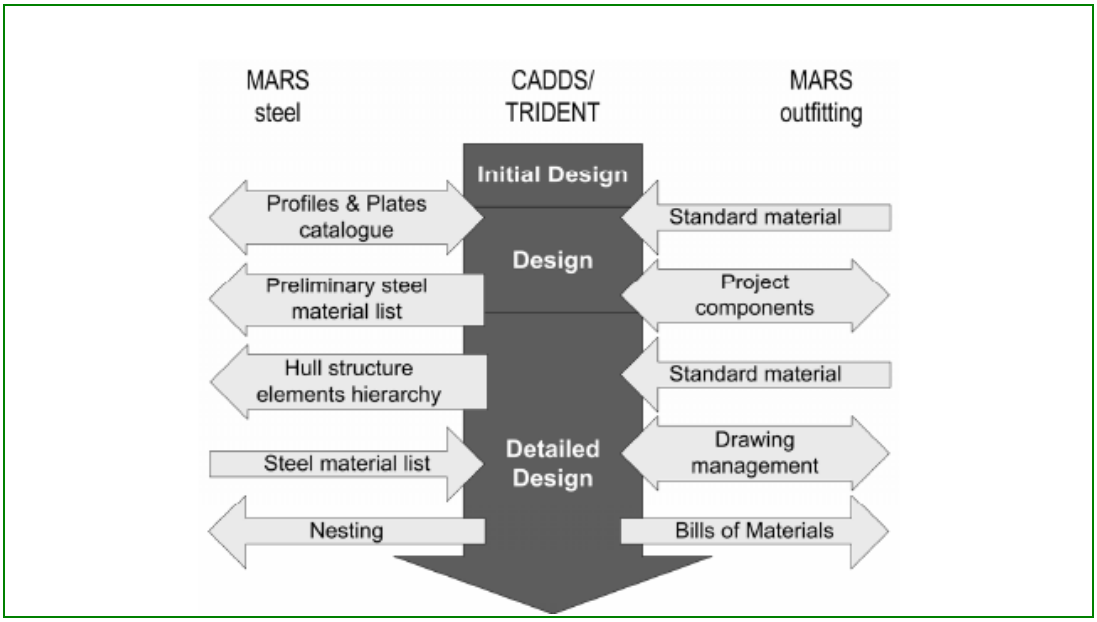
The modernisation of the existing **ERP** system followed this first phase. Prior to the project, an application called Burin which was developed in-house over more than three decades performed all ERP functions. Burin was redesigned and a new development tool, MARS provided by the Dutch company Logimatic, was added. MARS is specifically designed for the shipbuilding industry and covers project setup, budgeting control, material definition (steel and outfitting), purchase, stock, material handling (steel and outfitting) and production control.

An in-house developed **CAD** system, capable of defining 3D models, was first applied at Uljanik in 1985. Today the company's CAD system consists of two completely integrated modules, CADDS 5i and TRIDENT. Their interfaces were programmed in 2000. The first complete 3D model of a hull structure was completed in 2001. This laid the foundation for the integration of Uljanik's existing IT systems.

Integration

The integration of Uljanik's existing IT systems (CAD, PDM and ERP) was initiated in 2001 and started with the modification of the existing ERP system. Since MARS (as part of ERP) and the Product Data Management system (Optegra) both rely on an Oracle relational database, the interface between MARS and CADDS/Trident was also based on an Oracle platform. The interface consists of three main tiers. The database server, which is continuously linked to the MARS Oracle database, is necessary for normal interface operation. The CAD workstations, which read the data from the CAD model, complete the data transfer between the systems. The web server, which serves to deploy web pages with web forms, provides a framework for connection and management of the other two tiers of the interface (see Exhibit 1).

Exhibit 1: Interface data sets for steel and outfitting



Source: Milanovic, Bencic, Vitasovic (2005)

In October 2002, MARS was brought into operational use and its integration with the CAD and PDM systems was initialised. The integrated solution established a two-way communication between the CADDS hierarchical database, the CADDS/TRIDENT Oracle database, and the MARS Oracle database. Since 2004, both approval and access control are performed via PDM. Another one of the project's goals was the introduction of web-enabled applications. This was achieved through the implementation of ORACLE IAS.

Future efforts for the IT systems integration at Ulajnik will concentrate on the development of an interface with the Naval Architectural Package (NAPA) calculation software for ship design from NAPA Ltd, Finland and extended use of new visualisation tools in production.

Impact

The cohesive approach towards information management resulted in significant improvements at Uljanik Shipyard. Benefits encompass an increase in data integrity and the reduction of errors. This has had a positive impact on the quality of data used for the material definition in the CAD system, an issue of a critical importance for a shipyard since it affects the overall quality of a ship delivered and thus ensures a continuous and long-lasting relationship with ship-owners. Therefore, the integrated solution spots errors early enough to make necessary corrections bearing minimum costs and negative consequences on the finished product. Along with a better synchronisation of steel and workshop specification and nesting data, material consumption control, particularly for steel, was improved.

Other benefits consist of a twenty-five percent increase in productivity and a thirty-six percent reduction in the production lead-time. These were due to the ability of the integrated systems to bring together information from multiple sources and therefore to eliminate the manual transfer of data from one system to another.

Furthermore, the capability of the integrated system expanded allowing better data availability and accessibility, as well as enforcing enterprise-wide consistency. The interaction between different users of the system was simplified, encouraging teamwork and providing the users with a better understanding of the links between various aspects of the production process and consequences of their inputs (see Exhibit 1).

The initial design and construction as well as the production processes had to undergo some organisational adaptations. Mr. Koźljan states that *"part of the design department was transferred to the initial design department in order to better define our product as early as possible. Previously, we had two separate departments, hull and outfitting. These two departments have been changed into the two new divisions Fabrication (to construct from diverse and usually standardised parts) and Assembly and Commissioning. Those changes were completed in 2005."*

Lessons learned

Ulajnik views the integration of its existing IT systems as a vehicle for a concurrent and collaborative engineering approach. The concurrent engineering together with the full 3D model of a ship provided the desired solution to deal with multiple, often contradictory, requests coming from the contracting firms as well as requirements from various Uljanik's

departments. Visualisation with its complete 3D model definition tool significantly improved the process of model revision and approval. The users now stay abreast of all the facets of the project execution and can take appropriate action in a timely manner.

While positive experiences with the integrated solution prevail, there are some negative aspects to be considered and learned from. Saddled with a number of additional hardware and software, the interface between CAD and ERP adds on to the complexity of the system. Often this confronts the users with a broader set of functions than they are initially able to efficiently manage. Another concern was the users' education and training. This was not only a technical issue but also one related to the employees responsiveness to the changes introduced, an issue that is common to many businesses who modify and innovate their processes. As Mr. Koźljan puts it *"those problems are the consequence of the almost ten-year period without any serious investment in new concepts [during the 1990's due to political instability in the region], of the implementation speed and of staff fluctuation. The new concept required changes in behaviour from the users, a new way of thinking, new skills, teamwork and a more open collaboration. It was, at times, difficult to harmonise the implementation progress, ongoing production and adoption of new skills."*

More importantly, the integration between the CAD, PDM and ERP systems has served as an impetus to introduce a business intelligence solution at Uljanik. The project of establishing such a decision-making support system based on the Oracle Intelligence tools is scheduled for the beginning of 2007 and will take about 24 months to complete.

The company also intends to develop a knowledge management system. In June 2006 Uljanik initiated the design of a corporate portal. According to Mr. Koźljan, it is also planned to commence with an electronic documents and records management project later this year.

Armed with the appropriate technologies, resources and knowledge, Uljanik can move on with further improvements and plans to use B2B internet trading platforms for SCM and the procurement process. As Mr. Koźljan pointed out, there is still room for *"improvements in the following areas: access capability to the technical data and equipment models, better planning and tracking of the production processes with the active participation of subcontractors and cutting the procurement costs, assets cost and stock management."* As a first step, an extranet will be set up and some local (Croatian) subcontractors/suppliers will be integrated into the value chain. The latter is very appealing for the company but is hampered by the fact that presently there is no such portal in Croatia. Though such portals are available in the EU, their scope of activities is limited to either trade or technical aspects. As good examples Mr. Koźljan named *"Syx.com, which is 'trade-oriented' and Tribon.com, which is more 'technically–oriented'. Uljanik, however, is looking for a portal that will combine both trade and technical capabilities"*.

Summarising the issues discussed, it should be stressed that Ulajnik Shipyard takes a proactive position towards ICT usage and views the implemented projects as a way to refine its IT system, to streamline the entire shipbuilding process and, consequently, to increase the shipyard's competitiveness.

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CASE STUDY: ADOPTION OF A PRODUCT LIFECYCLE MANAGEMENT SYSTEM AT FINCANTIERI, ITALY

Abstract

Fincantieri Cantieri Navali Italiani S.p.A. is a large state-owned shipyard-group in Italy that builds naval and commercial vessels, especially cruise ships and large ferries. The company runs eight shipyards in different locations across Italy. To be able to interchange ships and data during the construction process between the different yards, Fincantieri introduced in 2001several modules of an Enterprise Resource Planning (ERP) system and a Product Lifecycle Management (PLM) system based upon a SAP application.

The ERP and PLM systems enabled the integration of information along the management and production processes as well as along the value chain: from basic design, detailed design and production planning to production activities. Information and data can now easily be transferred between yards and suppliers via the internet. The goal of this innovative project was to significantly reduce the production time and costs.

Case study fact sheet

Full name of the company:	*Fincantieri Cantieri Navali Italiani S.p.a.*
Location (HQ / main branches):	*Trieste, Italy*
Sector (main business activity):	*Shipbuilding*
Year of foundation:	*1959*
Revenue in last financial year (2005):	*2,218 million Euro*
Number of employees (2004):	*9,266*
Primary customers:	*Ship owners worldwide, the Peruvian Navy, the Italian navy*
Most significant market area:	*Merchant ships, cruise ships, naval vessels.*
Main e-business applications studied:	*Product Lifecycle Management system (PLM) and Enterprise Resource Planning system (ERP)*
Key words:	*PLM, ERP, internal and external communication*

Background and objectives

Fincantieri S.p.A is an Italian worldwide leading and most diversified state-owned shipyard group. It was established in 1959 as a holding group of eight shipbuilding and ship repair companies and was transformed into an operating company in 1984. In 2005 Fincantieri reported more than 51 million Euro net profits and the total value of orders to deliver amounted to 7,797 million Euro (Fincantieri 2005).

Fincantieri's headquarter is located in Trieste, Italy, where its main design office is also located. Another design centre is in Genoa, headquarter of the Naval Vessel Business Unit. The company's eight Italy-based shipyards are incorporated into three Business Units: the Merchant Ship Business Unit, the Cruise Ship Business Unit and the Naval Vessel Business Unit. However, the company is able to build complete ships at any of its eight shipyards. The Fincantieri Group also includes subsidiary companies, working in the field of research and development (R&D) and supporting the core activities of the company. Core business areas of the company are building naval vessels, cruise ships,

with a 50% share of the world market, and all kind of ferries, with a 37% share of the world market.

Fincantieri's strategy is the continual improvement of its economic and financial performance, which is seen as a basis for maintaining the company's competitive position and for targeting the world leadership in its core business areas. Market pressures, such as an intensifying competition from Asian shipyards, and new technological trends forced Fincantieri to make significant investments in information and communication technologies (ICT) to improve production processes and internal communication. Furthermore, Fincantieri attributes a crucial role to its suppliers and views them as of strategic importance for the company's competitiveness. Here the strategy is to establish a tight relationship with few trustworthy suppliers and integrate them into Fincantieri's operations via ICT.

In 1999 the company responded to these challenges by undertaking a comprehensive restructuring programme aimed to optimise its business processes. The goal was to allow for the usage of the product definition information throughout the product life cycle as well as to integrate and rationalise important management functions and information flows. Considering a dispersed location of Fincantieri's business units and its heterogeneous and constantly expanding ICT infrastructure, the renewal programme was viewed as a way to withstand cost pressures and to meet time-to-market demands.

e-Business activities

With its restructuring programme, covering the entire company, Fincantieri instituted new methodologies of work and a new business culture directed at the value creation at all levels. The central part of the programme was the information technology renewal, which involved the implementation of the Enterprise Resource Planning (ERP) and Product Lifecycle Management (PLM) systems. According to Mr. Rui, former Chief Information Officer at Fincantieri, "*We needed to optimise production and resource utilisation at the various shipyards around the country, while taking into account the special requirements of our engineering department and naval design centre, the largest of its kind in Europe*" (SAP 2001).

The need to install ERP and PLM systems was stipulated by the complexity and concurrency of ship design and production processes, as well as by the company's objective to take advantage of a tight integration of designers and suppliers. The later meant an interactive procurement tracking and expediting and a collaborative engineering management throughout the entire lifecycle of projects.

This would not have been possible with the ICT solutions running on different operating systems and hardware platforms, which were previously employed at Fincantieri. As Mr. Visintin from the Department Information Systems Development argued "*the particular nature of our business requires a strong integration of information, particularly because we are designing and constructing almost simultaneously. Moreover, our data and information have to be available for every Italian Financtieri's shipyard at the same time. We call this synchronising of activities in a very short time 'concavent engineering' or 'inclusive engineering'. For our way of production we must have IT systems that are strongly integrated and which are of strategic importance to the company*".

Fincantieri focused first on administrative processes and started with replacing its old disparate and still partially manual information management solutions with SAP/R3 selected as a broad ERP package. This system was tailored to the requirements of the shipbuilding industry and offered an integrated solution with a possibility to add or integrate other applications. These were the main reasons behind the choice. The first modules became operational in May 2001 and covered such key functional areas as *Financials, Controlling*, *Project System* and *Human Resources*.

The next step was the implementation of mySAP PLM as a product lifecycle management tool. At the end of 2001 one of the major components of PLM system, the Document Management System (DMS), was introduced taking over the coordination and management of product definition data. At the same time, the company was putting another PLM subsystem into operation, Engineering Change Management, which included two modules: Engineering Change Requests (ECRs) and Engineering Change Orders (ECOs). These components enabled efficient and prompt handling of any changes within a particular project. According to Mr. Chierici, Senior Vice President for Business Improvement at Fincantieri, "*Engineering Change Management lets us identify more precisely the additional costs that changes would incur. Modifications made during the construction phase can cause the previously estimated cost to skyrocket*" (Nagel 2002).

An important phase of product lifecycle management that supports procurement and inventory function was covered by the Materials Management module. According to Mr. Visintin, its distinctive feature was that it interconnected 700 users working in different Fincantieri's design and production sites across Italy and, thus, enabled both internal and external collaboration. This significantly optimised day-to-day business operations such as purchasing, inventory management, and reorder point processing.

The next milestone was the adoption of the Collaborative Engineering Management subsystem that allowed data interchange between Fincantieri and other parties involved in the process of ship development and manufacturing. This tool enabled a more advanced approach to external collaboration with the ship owners, authorities and the suppliers of ship's engines and components. It also brought together the knowledge and expertise needed to build a modern ship that meets all the requirements and resulted in more than 200 external users gaining access to the shipbuilder's data.

Fincantieri also implemented SAP Business Information Warehouse to store and evaluate data derived from multiple sources. This allowed to save a lot of work and to eliminate any manual data input. At the same time it provided a powerful tool for analysis of large amounts of operative and historic data used in business planning and long-term modelling. Such a parallel implementation of ERP and PLM systems gave the company the ability to standardise and interlink its management and engineering processes, an important feature for strengthening its competitive position in the global market.

Impact

The implementation of the compatible and interconnected ERP and PLM systems had an overall positive impact on Fincantieri's operations, as it led to an improved control over the key company's activities and a smoothed communication among its business units. In this context, an improved control implied an enhanced access to a wide variety of real-time data, which facilitated business decision-making and planning processes. A better communication enabled not only an electronic data exchange but also an effective knowledge sharing and skills matching, which had a positive impact on the quality of a ship produced. Together with the implemented Engineering Change Management software, it led to a faster detection, correction and subsequently reduction of errors throughout the entire ship design and manufacturing process.

To fully assess the impact of new systems on the company's business activity, it is important to note that the number of systems' users increased from initially 500 to 1,000. In 2004 cost savings of about 1.7 million Euro were estimated (Unisys Corporation 2004). Mainly, the costs were reduced due to a simplified system administration and management that required fewer personnel to support the systems. Further cost cuts are possible since the user's capacity of the systems is not yet fully utilised.

The adoption of the ERP and PLM systems had also an impact on the business processes of the company. The solutions were customised to the requirements of the shipbuilding industry. However, they were not customised to the requirements of an individual shipyard, which could be especially problematic in the case of Fincantieri. Each of the company's eight shipyards had different approaches to the manufacturing process and used techniques that were accumulated over a long period of time. That is why the processes were changed in all the shipyards and adjusted to the unified model offered by ICT solutions. Although such changes required significant efforts from the users, who had to adapt to the modified processes, the company considers the systems' standardisation brought about by the new systems as a positive impact. The unified view of the company's operations was achieved and each of the shipyards, regardless of its specialisation, can now manufacture any vessel.

New ICT systems also had important implications for the relationships with the company's suppliers. Considering the fact that around 30% of all processes at Fincantieri are performed externally, an integration and efficient collaboration with its business partners as a result of ICT systems implementation allowed to reduce throughput time and to improve quality. This was attained as a result of better connectivity with business partners, sharing of detailed product information and close collaboration with all key participants involved in designing, manufacturing and maintaining a vessel.

Lessons learned

One valuable lesson learned was that, although a ship is a unique product, a large shipbuilding group like Fincantieri can benefit from the standardisation of the processes across the entire company. Fincantieri believes that without such standardisation both internal and external integration would not be complete. Thus, to achieve a proper integration of processes and people, the company had to alter and standardise its processes.

According to Mr. Visintin, the company recognised that users' acceptance and their ability to use the new ICT systems are essential for a successful implementation and operation of these systems. This is why the company provided special training to the ICT systems' users, to allow them to familiarise themselves with the systems, as well as to understand the modified process. After five years of experience with the ERP and PLM systems, the company had learned that it is important to allow for some flexibility in ICT projects. A higher degree of "adaptability" in ICT projects improves the acceptance among stakeholders (employees, business partners), and thus facilitates introducing the required organisational changes.

Implementing the new ICT systems, Fincantieri realised that it had not been fully utilising its resources such as information, technology and its people. Yet, the solutions adopted by an Italian shipbuilding group allowed to optimise communication and production processes within the company as well as to extend collaboration outside the company, which materialised in tangible cost benefits. Therefore, Fincantieri views investments in ICT as of strategic importance for ensuring growth and operational effectiveness.

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Summary of main points and conclusions

In order to respond to the challenges described in Section 2.2.3, the SRI needs to become more flexible, to shorten production times and to improve the quality of the vessels produced. e-Business and the use of ICT can support such improvements in the shipbuilding processes and might also be helpful in reducing production costs.

Indeed, the results of the e-Business Survey 2006 show that ICT and e-business activities are important in the SRI (see Chapter 3). About two thirds of the companies interviewed in the SRI reported that they had made investments in ICT in 2005 (see Exhibit 3-4). About a third of all companies said that they would increase their ICT budget in 2006/7, while only few companies reported plans for a decrease (see Exhibit 3-6). This general trend is illustrated by the case studies on *ENVC, Uljanik* and *Fincantieri*: for these shipyards, the adoption and deployment of ICT has become a major strategic topic. They intend to further expand their ICT investments because of the benefits they have already experienced.

However, aside from CAD, the use of advanced ICT applications (such as ERP, SCM, CRM and PLM) is rather limited in the SRI (see Exhibits 3-11, 3-18). As in most other industries, survey results point at a technology divide between large, medium and small-sized enterprises in the SRI (see Sections 3.4 and 5.1). This situation is illustrated by the case studies on *Finomar* and *LTH-Baas* (see Section 4.3), which indicate that e-business is not yet perceived as a strategic advantage by small and medium-sized shipyards or by suppliers in this industry (see also Section 5.1). One could, consequently, safely conclude that e-business is still at an early stage in the SRI, if regarded from an industry-wide perspective.

- **Slow adoption**: Although the use of CAD, EDI, internet and e-mail are common in the SRI, the adoption of new ICT and e-business tools is rather slow. For small and medium-sized shipyards and suppliers the potential of e-business currently does not seem to play a strategic role.
- **Large companies moving ahead**: There is a technology gap between large shipyards and SMEs, the former being the forerunners in implementing advanced e-management tools in order to increase their productivity.
- **Complex production structure**: Many different firms are involved in the shipbuilding process. Moreover, the production processes are less standardised and unified when compared to other industries. This is so because vessels, as contract goods, are usually customised. Likewise, the product life cycles are long. Therefore, the cost-benefit structure of advanced e-business solutions seems to benefit large shipyards to a greater extent than it does for this sector's SMEs.

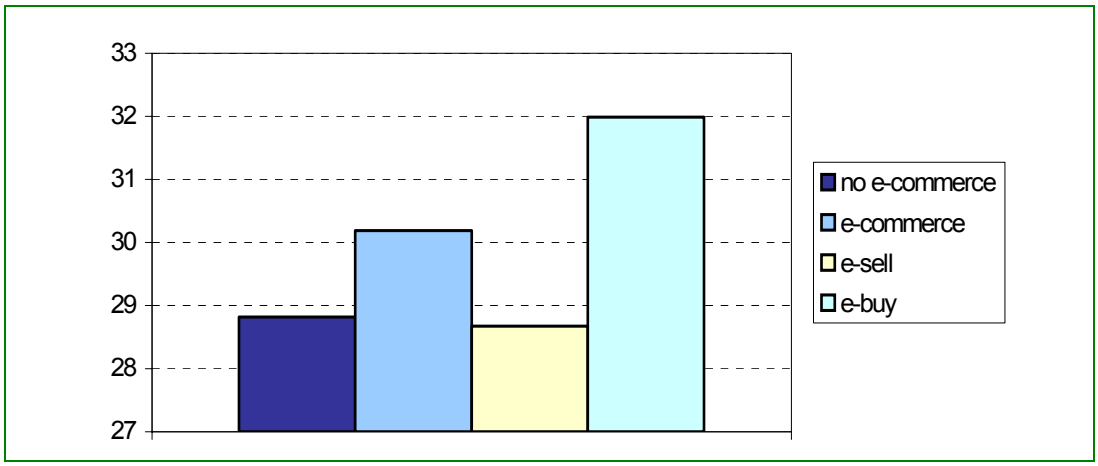
4.2 The use of B2B internet trading platforms

Online sales are not a common practice in the SRI (Andritsos, Perez-Prat 2000) and the advantages of the internet as a medium for standardised information flows does not seem to come into play for many shipyards. As shown by this year's e-Business Survey results, e-trade in the SRI is practically limited to e-procurement. According to these results, more companies reported placing than accepting orders online (see Exhibits 3-14 and 3-19 in Sections 3.5.1 and 3.6.1, respectively). In fact, 14% of the sector' companies –mainly small ones- said that they accept orders from customers online (see Exhibit 3-19). Furthermore, companies comprising about 10% of this sector's workforce reported using CRM systems (see Exhibit 3-20). Since the use of specific ICT solutions for e-sourcing and e-selling is low, it seems rather safe to assume that e-commerce in the SRI is mainly conducted by using e-mail.

A few years ago, however, electronic procurement was identified as an e-business application that would significantly change the value chain of the maritime and the shipbuilding industries (Held 2003; Kuehmayer 2002; Lundquist 2003). This scenario was also common for other industries and the heralds of online procurement promised numerous benefits: lower transaction costs, faster production development, easy identification and selection of qualified suppliers, access to the global market, real time collaboration with suppliers on product development and an efficient supply chain management (Ahlers, Brodda 1999). However, the characteristics of the SRI created significant difficulties for the development of electronic procurement. For example, suppliers that provide high value components, with a high amount of technical data to be exchanged, should be considered for collaborative engineering solutions. In contrast, suppliers that provide standard products or materials are better suited for e-procurement.

Nevertheless, a more recent study by Clayton et al. (2004) shows that the productivity effect of e-commerce differs across manufacturing sectors due to product and market efficiency. Firms using e-commerce perform better than firms not using e-commerce (see Exhibit 4-2). Electronic markets for procurement lead to reduction in search costs, broaden the potential suppliers and increase transparency of prices (Clayton et al. 2004).

Exhibit 4-2: Value added per employee in manufacture of other transport equipment (DM 35), 2000 (£000)



Source: Clayton et al. 2004, p. 34

The impacts of online procurement and online sales, however, are different (see Exhibit 4-2). Whereas productivity gains are associated with online procurement due to price transparency, electronic selling lowers productivity, as measured in terms of value added. Thus, price differences brought about by online markets are part of the value added gain or loss to firms that invest in usage of electronic markets. e-Marketplaces can be described as virtual online markets where buyers and sellers find and exchange information as well as conduct trade. Moreover, e-marketplaces can also be used as e-business tools for co-operation between suppliers and their customers or for integration of internal and external processes along the value chain (Booz-Allen & Hamilton 2001; Held 2003; Singh 2004).

Between 1999 and 2003 five e-procurement portals specifically developed for the shipbuilding industry were launched (Kuehmayer 2002). Some internet trading platforms focus on completing business transactions, while others simply provide information. The Netherlands' Shipbuilding Industry Association in co-operation with the German Shipbuilding and Ocean Industries Association supported the e-procurement portal **SeaQuipment**. However, until today the portal is only an internet catalogue for maritime products and services. SeaQuipment verifies the data of suppliers, updates software, gathers data on visitors to the web site and distributes data to the participating companies. Today, there are over 1,200 registered supply companies that have the possibility to put their company profile with a link to their homepage, an e-mail address and a company description on the web site. Companies signed up as a user can search for suppliers and their products and services plus they can make requests for data. Consequently, SeaQuipment is an information platform for the pre-purchase phase but not a real trading platform. Two other internet platforms for the SRI, **tribon.com** and **shipchurch.com**, are also internet catalogues where supplier companies offer their products.

Five out of six major European shipyards, organised in the European Economic Interest Group Euroyards (Euroyards E.E.I.G.), have launched a common internet portal called **e-Euroship**. This portal is a procurement system based on Internet technologies in order to improve business-to-business relationships between yards and suppliers. The goal is to reduce transaction costs for members, to foster a rapid adoption of e-business, and to establish a greater alignment with industry technology standards. In the following case study about the *Meyer Shipyard* the e-Euroship portal will be discussed in detail. As illustrated in this case study, the usage and acceptance of the portal within the everyday business processes is still lower than expected. In line with the 2006 survey results (see Section 3.5), it seems that suppliers prefer to communicate via e-mail until an order is made and are somewhat sceptical towards electronic practices.

Held (2003) discusses the experiences with e-procurement in four different shipyards in Germany and reinforces the experiences at *Meyer Shipyard*. The usage of e-marketplaces in the shipbuilding industry is still in its initial phase. e-Marketplaces are a useful tool to search for suppliers of maritime equipment as well as for online procurement by tender. But, particularly for system suppliers and in engineering services, trust is a necessary condition which can only be build up by face-to-face contacts.

Moreover, for the analysed shipyards, e-marketplaces are not yet seen as a management strategy but rather as an experiment.

Another e-procurement portal, called **ShipyardXchange** initiated and operated by Aker Yards, was closed in 2005 after three years of operation because the cost-benefit relationship was not satisfactory. Using this e-procurement portal was too expensive and today Aker Yards—as a member of Euroyards—plans to participate in e-Euroship (vom Baur 2006).

As already indicated, none of the above e-portals is a true e-marketplace. A real e-marketplace should support several functions such as e-procurement, e-supply chain management, internal transaction processing and online design collaboration. Current e-portals usually offer only the possibility to search for qualified suppliers and make requests for quotations. Nevertheless, they are helpful in the pre-purchase phase. Thus, significant changes in the value chain of the SRI are not yet observable. In this respect, this industry is still moving along its learning curve. Purchasing managers have to be both convinced and trained to use e-procurement portals. In addition, most of the suppliers are not yet convinced that e-procurement can be an advantage for them (see Exhibit 4-2). Apart from investments in ICT infrastructure and employee training, they are afraid of losing bargaining power towards their clients - the shipyards. Thus, most of the ship owners, shipyards and equipment suppliers still conduct their businesses in the traditional paper-based way or at most via e-mail while also building and maintaining close and longstanding relationships.

The following business example on the company "*ShipServ*" shows how an independent e-marketplace operates in the shipping industry. The beginnings of e-commerce in the maritime industry can be dated back to the late 1990s. The main driving force towards e-commerce at that time was the huge pressure on shipyards to reduce overheads and costs in order to stay competitive. The promise of online trading platforms is to support this objective by decreasing transaction costs in trade. *ShipServ* is probably the most prominent example of such a platform in the shipping industry.

ShipServ provides a trading platform and network called **TradeNet** which can be used by ship owners and their suppliers to exchange information and data involved in any trading process. Clients can access TradeNet either through their own software or via *ShipServ's* applications on the web by using the site's hosted purchasing or sales system. In this way, the use of *ShipServ's* TradeNet can change business processes and relationships in the shipping industry. The objective is to create a win-win situation by reducing processing times for both parties involved.

Business example:

The e-Marketplace TradeNet – An Example from the Shipping Industry

ShipServ Ltd. was founded in 1999 as a company that offers a trading platform for the shipping industry, neither being controlled by buyer or supplier interests, and with over 1,000,000 transactions since then. Today it is the world's leading provider of maritime e-commerce solutions with offices in London, Copenhagen, Hong Kong and New Jersey. ShipServ's trading platform TradeNet and the underlying electronic Ship Supply Management solution simplify procurement processes for shipping companies and suppliers. The electronic Ship Supply Management Solution (eSSM) provide support for sourcing, catalogue management, order management, delivery management as well as invoice management.

ShipServ's TradeNet is designed to extend a company's order management system or to provide a point of entry for consumable stores and spare parts transactions. Where in-house ship and shore-based systems already exist, ShipServ connects the system to the supplier for transactions from a shipping company, such as request for quotation or purchase order, as well as for transactions to a shipping company, such as quote, confirmation and acknowledgement. Where some of the above mentioned systems do not exist, ShipServ provides ShipLink™ and WebBuyer™.

ShipLink™ is a shipboard software that allows ships' personnel to create requisitions, re-useable templates, browse catalogues and maintain delivery statuses. Requisitions are transmitted through TradeNet to shore personnel for approval and action.

WebBuyer™ is a web-based tool that allows buyers to review requisitions, convert to requests for quotations (RFQs), solicit bids, award purchase orders, place direct purchase orders and more.

In addition, WebLogistics™ is a 'track-and-trace' tool that allows shipping companies to follow the status of products from source to delivery. Access can be granted to suppliers, freight forwarders, and agents. In order to ensure interoperability, all customer integrations are tested and certified by ShipServ to ensure compliance with the MTML standard.

The client base comprises more than 50 ship managers and owners with over 1,500 vessels, as well as 5,000 suppliers. ShipServ's revenues are based on licence and transaction fees.

Sources: Telephone interview with Paul Østergaard, CEO ShipServ, April 18,2006 and a questionnaire submitted to Lone K. Jensen, Marketing Coordinator ShipServ.

Case study

The case study, about e-procurement at *Meyer Shipyard* via the ***e-Euroship*** portal, describes the advantages and obstacles from using this portal for e-procurement. Since there are still problems to realise gains and the fact that *e-Euroship* is still at an early stage to be fully evaluated, the advantages are still smaller than expected.

CASE STUDY: E-PROCUREMENT AT MEYER SHIPYARD VIA THE E-EUROSHIP PORTAL

Abstract

Meyer Werft GmbH was founded in 1795 and today belongs to one of the major players in the shipbuilding industry. Nevertheless, the shipyard is confronted with increasing competition from Asia, especially China. In order to reinforce the yard's situation on the international market, the Meyer Werft tries to constantly improve efficiency, productivity, quality and innovativeness. Since 2004 Meyer Werft participates in the e-EUROSHIP portal, a procurement system jointly developed by five shipbuilding companies pertaining to EUROYARDS E.E.I.G.

The case study focuses on the e-EUROSHIP e-procurement portal from Meyer Werft's point of view. The company is not only a member but initiated and helped to establish the portal in 2002. The case study examines the problems faced during establishment, discusses re-occurring problems and reviews the benefits and impacts from participating in an e-procurement system.

Case study fact sheet

Full name of the company:	*Meyer Werft GmbH*
Location (HQ / main branches):	*Papenburg, Germany*
Sector (main business activity):	*Shipbuilding*
Year of foundation:	*1795*
Number of employees:	*2,200*
Turnover in last financial year:	*approx. € 600 Million*
Primary customers:	*Cruise companies from the U.S., Europe and Asia*
Most significant market area:	*Building of cruise liners*
Main e-business applications studied:	*Procurement system e-EUROSHIP portal*
Key words:	*e-procurement, bargaining power, competition*

Background and objectives

Meyer Werft -formerly known as Jos. L. Meyer GmbH- is located in Papenburg, Germany, was founded in 1795, and has been owned by the Meyer family for six generations. Since 1982, Bernard Meyer is the company's managing partner. Although the shipyard looks back on a history of 210 years, it is a modern yard by any international standard. The core of the shipyard in Papenburg is the two covered building docks for new constructions with a measurement of approximately 150,000 registered tonnage.

Core competencies

Over the past decades, the Meyer Werft has established an international reputation for specialising in ships such as luxurious car and passenger ferries, ro-ro (roll-on roll-off), passenger ships, gas tankers and livestock carriers and, above all, cruise liners. Long-standing experience in the construction of passenger vessels gained in the 1980s has been the basis for successfully entering the market of large-scaled modern cruise vessels. To-date the shipyard has delivered 19 luxury liners of different tonnages to customers all over the world.

Investments

After the shipyard moved its premises to the periphery of Papenburg in 1975, and later extended its first covered building dock (1987/1990), another massive investment, the largest in the history of the company, was made in January 2002 with the construction of a second covered building dock and new prefabrication premises featuring a laser welding plant. By taking these measures the shipyard has put itself in a position to face the stiff international competition and is able to build all sizes of ships on demand (up to 180,000 gt). "*Here in Papenburg we can cope with the highly challenging international competition only if we invest massively in research and development*" says Bernard Meyer. Further targeted investments are planned to ensure the competitiveness of the company and to increase productivity.

Competitive Situation

Today, at its Papenburg premises, Meyer Werft has a staff of 2,200 and a global market share of over 20%. The current orders go far into the year 2008. In a medium to long-term perspective, the company's management sees the world-wide shipbuilding industry to face large overcapacities, while the European shipbuilding industry is confronted with increasing competition from Asia, especially from China. To braze out this "*tsunami from China*" Meyer Werft aims at improving productivity and quality as well as being highly innovative. Furthermore, the shipyard wants to reinforce its position in the international market by further improving efficiency, in order to stand up against the Asian competitors.

EUROYARDS

E.E.I.G. EUROYARDS is an European Economic Interest Grouping seated in Brussels. Incorporated in 1992, Euroyards' members are major shipbuilding companies in five European countries: Chantiers de l'Atlantique–Alstom Marine (France), Fincantieri S.p.A. (Italy), Howaldtswerke–Deutsche Werft AG (Germany), Navantia S.L. (Spain), Aker Yards ASA (Norway) and Meyer Werft GmbH which joined in 2000. Together, Euroyards' members employ a workforce of almost 30,000 and have a production value of around 6.5bn Euro, while embodying major purchasers in various high-technology vessel types.

The aim of Euroyards is to foster the interests of its partners, both by adopting common positions with international bodies that promulgate the policies of the sector, and by implementing projects in the field of research and development as well as through purchasing policies in order to cut costs.

e-Business in the shipbuilding market

To invigorate the shipbuilding industry in Europe, Euroyards decided to create a virtual meeting place that should facilitate interaction between suppliers and shipbuilders, thus increasing overall efficiency of the players involved. Therefore, the participating companies have established a pan-European portal that shall enable them to optimise communication with their suppliers. The use of a suitable internet platform shall allow a significant expansion in the relationships and a considerable acceleration in the transactions within the network of shipyards and suppliers participating in the initiative. Reduction of costs for members, rapid adoption of e-business, reduction of connectivity costs, and greater alignment with industry technology standards are only some of Euroship's goals in order to meet the competition arising from the Asian competitors.

e-Business activities

Meyer Werft has established the largest laser technology centre in Europe where the shipyard developed the technology of laser hybrid welding as well as laser welded I-core® panels. The shipyard also uses computer-integrated manufacturing (CIM) as an important concept in designing, planning, constructing and manufacturing. Furthermore, the company already implemented IT-systems to support its business process activities in 1985. Meyer currently uses a java-based home-grown enterprise resource planning (ERP) system running on IBM's AS/400 and makes use of the toll-free procurement marketplace "simple system", a strategic alliance of leading system suppliers in the area of C-articles (www.simplesystem.com).

Establishing e-Euroship

In 2002, the members of Euroyards decided to stimulate the shipbuilding industry in Europe by creating a virtual meeting place that should facilitate interaction between suppliers and shipbuilders, streamline purchasing processes and enable shipbuilders to gain advantages from bundled purchases like in the automotive industry. Therefore, they started to develop the e-procurement system, called e-EUROSHIP portal.

Next to the general improvements of streamlined procurement processes and the possibility of finding new suppliers, Euroyards expects three main benefits of e-Euroship: cost reduction, simpler and clearer communication and global reach. Cost reductions shall be realised through streamlined and simplified processes that reduce business-cycles, leading to improvements in the effectiveness and efficiency of the yard. Furthermore, e-Euroship shall standardise and streamline communication among suppliers and yards via standardised forms and questionnaires. Thus, management processes shall be consistent, ensuring a simpler and clearer communication with little need for clarifying communications and reduced misunderstanding. Moreover, e-Euroship is expected to reduce time constraints, language differences and cultural barriers that limit transactions and communication in general via its e-network.

The portal has been operational since October 2004. The cost of establishing it amounted to approximately € 1.5 million, which were equally distributed among the five Euroyards members participating in the project. According to Mr. Thieke, Purchasing Manager at Meyer Werft, the portal's running costs (i.e. for administration and personnel) amount to approximately € 250,000 per year. Half of these costs is distributed equally across the members and the other half is distributed according to a shipyard's size (in terms of the number of employees). At present almost 800 suppliers have subscribed to e-Euroship, which can be contacted by 20 yards from all 5 participating shipbuilding companies.

The technology and ideas behind

The e-Euroship portal is an internet-based application, restricted to a community of suppliers that may apply to join and are chosen by the five participating companies according to their standards and requirements demanded from suppliers in order to ensure reliability. As a member, a supplier may use the interface for transacting with the five companies participating in the e-Euroship portal. Members are provided with "*a standardised online platform for business development, a secure environment for collab-*

oration, and a more efficient communication channel among buyers […] *and suppliers*", says Mr. Thieke.

The portal, programmed in Java, runs on a broad-vision platform and is based on the use of a standard database management system (DBMS). The procurement system is provided with a layer that manages the integration between the portal and external actors through the usage of XML data representation in order to ensure interoperability. User identification is managed via a user ID and a password, stored in the database in an encrypted field. Business data are visible only to authorised users. Moreover, anti-virus software scans each document that is uploaded to the portal. The data exchanged between the shipyard's ERP and the portal is based on encryption and signature.

Because of the portal being an internet-based platform, it works with Microsoft Internet Explorer version 6.0 or higher. However, integration between e-Euroship and an own in-house ERP system is only possible for the shipyards. Suppliers still need to transfer data from actions within the portal to their own in-house system by hand. Even the integration between Meyer Werft's ERP system and the portal is just a few months old according to Mr. Thieke. Moreover, the processes integrated in the portal end with the request for quotation. Orders and any other options, like 'track-and-trace', are yet not implemented into e-Euroship. Instead, orders still take the old-fashioned paper-based way after a tender has been accepted. e-Euroship is at an early phase with further implementations still under development.

Using e-Euroship

As already indicated, the main objective of the e-Euroship portal is to improve the relationship of the Euroyards members with suppliers. Therefore, e-Euroship features are developed in order to manage the following processes: marketing, request for quotation management, as well as qualification and vendor rating processes. However, most features are still quite simple: **marketing** processes are supported by a simple listing of all the data collected through the registration form, stored in a guest book that is available only to e-Euroship's members. "**Qualification** processes" are a simple listing of qualified suppliers for certain product groups within the "certified supplier list". The marketplace's transactions are based on **requests for quotations** (RFQ).

Accordingly, the usage and acceptance of the portal within the every-day business processes of Meyer Werft is still lower than expected. In fact, of about 2000 annual inquiries, only 450 are handled via the e-Euroship portal. The purchasing manager's tasks are expanded to the tasks of a trainer. Workshops and trainings are scheduled in order to not only teach purchasers how to handle the new tool but also, and even more important, to convince them of its advantages so that they will make general or better use of the portal. Many purchasers, for example, did not realise that the double work of entering data from actions within the portal to the ERP system was eliminated and that time-savings are now evident.

A higher reduction in workload and processes will be even more evident with the enablement of **digital orders**. However, the own in-house personnel still tend to be sceptical in adopting the e-Euroship portal for their every-day-business use. Consequently, they have to be convinced to make use of e-Euroship. Furthermore, suppliers are still affected with the transfer of data from e-Euroship to their in-house system by hand, resulting in double

work. Therefore, suppliers prefer communication via e-mail until an order is made. Thus, suppliers also have to be convinced that the use of e-Euroship will benefit them.

Impact

Meyer Werft experienced mostly reduced processing times. Moreover, the bundled purchasing power led to a better bargaining position towards suppliers, leading to further cost reductions due to lower resource prices. On the other hand, Meyer Werft experienced implementation costs and the necessity to invest in training. However, it is too early to measure any quantitative impacts since the usage of the portal is still at an early stage. Further improvements on a permanent basis have to be made. Nevertheless, the conclusion of Mr. Thieke is that "*the reality of impacts is currently lower than the company had expected".*

The goal is to develop e-Euroship to a level where orders and purchases between the shipyards and their suppliers can be made directly from one in-house system to another without the user realising the transaction handling by the portal. However, as Mr. Thieke said: "*There is still a long way to go until this is possible*".

Lessons learned

According to Mr. Thieke, the Meyer Werft strongly believes that using an e-marketplace in the shipbuilding industry is a strategic advantage. In fact, the company see e-marketplaces as a tool to strengthen the European shipbuilding industry's market position against competition from Asia via increases in efficiencies and cost reductions.

Nevertheless, some problems occurred that needed a change of mind among the involved yards. This concerned in particular the disclosure and exchange of information since a constant interchange of information and a permanent communication among the participant yards is essential.

Moreover, Mr. Thieke noted that the communication between IT developers and business users should have been more intensified, something which the company would do differently in the future. Despite these problems, Meyer Werft sees e-business activities as a state-of-the-art of modern business and fosters the implementation of ICT and e-business activities in the future.

References

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

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- *Web sites:*
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  - e-EUROSHIP portal, https://www.e-euroship.com
  - EUROYARDS E.E.I.G., http://www.euroyards.com

Summary of main points and conclusions

Launched e-procurement portals, particularly developed for the SRI already exist. However, these existing portals are not yet e-marketplaces that would support several functions for e-business. Their functionality is usually limited to a search for qualified suppliers and requests for quotations. Thus, e-trade is limited to e-procurement. Therefore, significant changes in the value chain of the SRI due to e-marketplaces are yet not observable. The SRI is still in a learning phase to adapt to e-procurement.

However, the survey results indicate that there is an adoption of e-invoicing, online co-operation and collaboration within the value chain and that placing orders online is also common (see Sections 3.4.2, 3.4.3 and 3.5.1). Nevertheless, the use of specific ICT-solutions is less diffused (see Exhibits 3-14, 3-19).

The case study on *Meyer Shipyard* reveals that both in-house purchasers as well as supplier companies have to be convinced to use e-Euroship. Currently, the benefits of e-procurement are lower than expected by the shipyard. Supplier companies remain sceptical towards electronic practices. Most of them prefer to conduct business on a paper-based way or via e-mail. Moreover, supplier companies fear to lose their bargaining power since large European shipyards as members of EUROYARDS try to bundle their orders via e-Euroship and increasing their customers' bargaining power.

- **Slow development**: The SRI is still in a learning phase to adapt to e-procurement. The current functionalities of e-procurement portals are limited to a search for qualified suppliers and requests for quotations.
- **Large companies are the forerunners**: Again, large shipyards are the leading actors in e-procurement. Furthermore, they use e-procurement in a strategic way in order to enhance their bargaining position towards supplier companies.
- **Suppliers:** The supplier companies remain sceptical towards e-commerce. Most of them prefer to conduct business on a paper-based way or via e-mail.
- **Impacts**: e-Procurement via the existing e-portals still has a smaller impact on the production processes and on transaction costs in the SRI than expected.

4.3 e-Business and SMEs

In order to improve firm performance and increase productivity by use of and investment in ICT complementary investments in skills, organisation and innovation are necessary. Thus, for small firms to adopt e-business and e-commerce strategies and tools, the benefits must outweigh investments and maintenance costs (OECD 2004). Sometimes SMEs may be able to see the advantages of e-business and e-commerce but they may not have the resources or the competence to act upon it (Kjolseth 2005, see case studies on *Finomar* and *LTH-Baas*). ICT and e-business tools may provide SMEs with opportunities to participate in new supply chains and markets. On the other side, using these tools increases the competition in and conflicts with established channels and established markets. Consequently, the benefits of using ICT are much more uncertain and risky for SMEs than for large enterprises.

In the SRI, large shipyards offer most of the jobs and they are the strategic forerunners. However, small and medium-sized shipyards represent the majority of yards. Moreover, most marine equipment suppliers are SMEs that provide approximately 70% of the production value of a vessel (BALance 2000; VSM 2004). Therefore, the question of what impacts e-business technologies have on SMEs is very relevant. As already discussed, large shipyards are leading the use of e-business technologies (see case studies on *Uljanik*, *Fincantieri*, *Meyer Shipyard*). Other shipyards are far slower in adopting ICT and e-business technologies, which is also true for marine equipment suppliers (see case studies on *Finomar*, *ENVC*, *LTH-Baas*). Four reasons can be identified to explain the current observations:

- Small firms have no meaningful use for many tools that streamline production and management processes in large entities (e.g. PLM, SCM).
- Economies of scale in the establishment and use of e-business systems make it relatively more expensive for small firms to engage in these technologies.
- Small firms lag behind because they lack the expertise and qualified labour to introduce complicated e-business schemes (see Exhibit 3-3).
- Many SRI firms are reluctant to deviate from their traditional way of doing business and this results in a low level of e-business adoption. Moreover, the survey results indicate that SMEs are concerned about security issues and legal complications with regard to e-business – these are perceived as the most important barriers for adoption (see Section 3.8).

Furthermore, SMEs in the marine equipment industry and other suppliers of engineering services face a further obstacle since their customers use different EDI systems (BALance 2000). According to the survey, proprietary standards and other standards are more widespread in the SRI than EDI-based standards or XML standards (see Exhibit 3-7). Moreover, one third of the companies, especially small companies, said that they see interoperability as critical for e-business within the sector (see Exhibit 3-8).

Many B2B internet trading platforms, in particular in the area of e-procurement, are based on different requirements and technical specifications. Consequently, in addition to the up-front investment costs, SMEs have difficulties choosing a system for data exchange that is compatible with all their different customers' needs. Therefore, e-mail represents the most widespread technology for information and data exchange along the supply chain (see Section 3.5 and 4.2). With some suppliers also offering CD-ROM catalogues, internet applications are mainly focusing on low-level company presentations (see case studies on *Finomar* and *LTH-Baas*).

Interestingly, the e-Business Survey 2006 suggests that small companies are more involved in online co-operation and collaboration as well as in online sales than medium-sized and large companies in the SRI (see Exhibits 3-12, 3-13 and 3-19). As far as e-commerce is concerned, it is quite clear that online marketing and sales are better suited for suppliers from the industry that offer their services to the large shipyards than for the large players themselves.

Moreover, these differences between small and larger enterprises with regard to some applications need to be viewed on a low overall adoption base. From an industry-wide

perspective, the use of advanced ICT systems for enhancing co-operative partnerships between shipyards and their small and medium-sized suppliers is not yet fully developed. From a broader perspective, the survey results show that medium-sized and large companies in the SRI perceive more benefit from ICT than small companies (see Exhibit 5-3 in Section 5.1.1).

The following business example shows that there are cases of engineering service suppliers such as the *Schiffbau-Versuchsanstalt Potsdam GmbH* which are developing e-commerce tools in order to solve some of the discussed problems. Furthermore, the *Schiffbau-Versuchsanstalt Potsdam GmbH* is interested in upgrading the collaboration with different companies in the SRI.

Business example:

Developing an e-commerce platform for engineering in the shipbuilding industry

The Schiffbau-Versuchsanstalt Potsdam GmbH (SVA), a company specialised in research for the shipbuilding industry, developed from 2001 to 2004 the e-commerce platform ePING that offers engineering assistance in naval hydrodynamics. Customers are able to use prediction tools online, get quotations for standard orders and may also check the progress of larger projects. This innovation project was implemented in co-operation with the University of Potsdam, Faculty of Computer Sciences, and funded by the German Ministry of Education and Research (BMBF).

The goal of the R&D project was to design and develop an e-commerce platform for business-to-business (B2B) communications, assignment, transaction and settlement of engineering services in the shipbuilding industry. e-Trade with engineering services is still rare due their characteristics. Engineering services are mostly unique and consists of multiple parts which require more information exchange. Furthermore, the corresponding order specifications are more comprehensive.

The platform ePING offers well-known and established prognosis tools in ship design to anonymous customers free of charge. Data transfer between client and server is not encrypted. For registered customers a password-protected working area with limited amount of server storage space is set up. Registered customers receive additional benefits: encrypted data transfer, background information and access to extended features of tools. However, working in the individual domain is only possible after written license agreement and paying a license fee. Customers who are registered and have paid a license fee may use additional software applications or access SVA's data bases. The target group of this service are customers with a long-term business relation to the SVA.

The online platform runs since 2003. In order to improve the service the platform is permanently extended by new functions.

Source: Wuttke, H. (2004): Entwicklung einer E-Commerce-Plattform für Ingenieurleistungen im Schiffbau, Schlussbericht zum FuE-Vorhaben, Potsdam

Case study

The following case study on *LTH-Baas* is an example illustrating how small yards in the ship-repair and conversion industry use ICT tools for their internal organisation. In fact, SMEs in this industry have to overcome a lot of hurdles to implement ICT systems for inter-organisational collaboration or co-operation. Furthermore, they are currently not being forced to do this by large shipyards or customers, as is the case for smaller firms in several other sectors studied this year by the *e-Business W@tch*.

CASE STUDY: ICT COST-BENEFIT ANALYSIS OF AN SME –THE CASE OF LTH-BAAS, ESTONIA

Abstract

Based in Tallinn, LTH-Baas AS is a small shipyard specialised in ship repair, shipbuilding and conversion. The firm is characterised by an ICT strategy and pattern of utilisation which are typical for the shipbuilding and repair sector. Having implemented a number of applications to support the firm's internal work organisation, such as the accounting system or project and inventory management tools, the company finds it difficult to overcome barriers regarding the adoption of more advanced applications that would facilitate increased inter-organisational collaboration.

In order to remain competitive, LTH-Baas focuses on improving its manufacturing processes and quality, as well as on increasing the qualifications of its workforce.

Case study fact sheet

Full name of the company:	*LTH -Baas AS*
Location (HQ / main branches):	*Tallin, Estonia*
Sector (main business activity):	*Ship repair, shipbuilding*
Year of foundation:	*1998*
Number of employees:	*120*
Turnover in last financial year:	*n.a.*
Primary customers:	*shipyards, ship owners*
Most significant market area:	*Ship repair and conversion*
Main e-business applications studied:	*Internet presence, internal applications such as the accounting system, project and inventory management applications and warehouse management system*
Key words:	*barriers to adoption, internal work organisation*

Background

LTH-Baas AS (LTH-Baas) is an experienced cruise and passenger ship repair company and shipbuilding subcontractor. The company is located at Tallin (Baltic Sea) but has worldwide operations. The company's staff of 120 includes highly qualified and skilled cruise repair specialists.

LTH-Baas's main clients are ship owners and larger shipyards, mainly from Finland and Estonia (for example Talink Group Estonia, Aker Shipyard, Rauma, Eckerö Line, Viking Line, Marioff Corporation, Algots Varv). However, recent projects include on-board conversions in Sweden, Norway, France, Italy, the UK, Japan, Russia and the USA. At the same time, the company is also involved as subcontractor in new building projects for cruise vessels in Finland and Norway.

LTH-Baas provides total solutions for all kinds of modifications and conversion projects. A combination of wide experience and up-to-date technology enables the company to meet their client's specific requirements. To withstand the pressure of its main competitors (SRC, Estonia and Finland; BLRT, Estonia; Riverco OY, Finland and USA; Almaco LTD, Finland, France and USA), LTH-Baas steadily invests in the latest ship repair and

shipbuilding technologies, as well as in human resources development. The company's goal is to achieve further stable growth in the Estonian and Baltic markets, growth in exports to the Mediterranean, Scandinavia and the USA by offering the best options regarding price and quality.

Apart from investing in tools, knowledge, skills development and infrastructure, the company recognises the benefits of e-business, ICT and the internet. The usage of web pages, e-mail and voice over internet protocol (VoIP) services (such as of Skype) proved to be efficient tools in finding and communicating with suppliers, clients and other organisations.

e-Market platforms specifically designed for this industry's needs are broadly used by the company because it saves time with the identification of appropriate suppliers and for checking the suppliers' inventory.

e-Business activities

Progress in e-business usage

The company has a web site, which is in English and was developed internally at low cost using frames and Java Script. This web site serves very well as an advertising tool.

The company has recently also developed and implemented an advanced project management software and warehouse management programmes which are integrated within the company's IT system. These solutions enable LTH-Baas to accurately monitor tasks over the entire project chain, to keep record of its inventory and manage it efficiently according to production plans. The obvious benefits of the application are better management of the inventory and the production steps, increased quality and higher customer satisfaction.

The ICT solution within the company now consists of some off-the-shelf programmes and new sets of tailor-made solutions ordered from their IT provider. "*The main goal for implementing better ICT tools was to improve the flow of information within the organisation, to make necessary data accessible to all who need it with different levels of access and to make processes faster and more effective"* said Ms. Inna Nosach, a company representative.

The costs for the newly implemented ICT system amounted to 10,000 euro and it required about one year for the software programme to be developed, tested and fully implemented in the organisation. It is envisaged that the programme can be enlarged by additional modules and expanded when necessary*. "The great advantage to this solution is that it is not a standard programme, but rather custom-made especially for our company. That is why it meets well our needs and requests"* said Ms. Nosach. "*However, it is still too early to calculate and measure the benefits in real terms, as the programme has only been fully operational for less than a month".*

Ms. Nosach also added that *"there is a motivation and positive attitude of our staff that help to overcome common problems like additional personnel training, mistakes and failures encountered in the initial stages of operation."*

The finance department uses accounting software but the invoicing is done in the traditional, paper-based manner. Though there are plans to introduce electronic invoicing,

this depends on the future acceptance and diffusion of such applications in the value chain. So far, the company does not see any necessity or benefit from implementing such an application as the format has not gained wider acceptance in the industry.

Despite the short operational period of their new ICT solution, some results can already be estimated. According to Ms. Nosach *"sales have increased by 10%, customer satisfaction has improved by 15% and procurement /stock cost have been reduced by 5%"*.

Future plans, barriers and drivers to the ICT development

The company plans to create an extra network to communicate with customers. This would include the functions of sending files, designs, invoices and log-books of work-in-progress. Again, the **lack of wider diffusion** of these applications in the Estonian industry hampers the diffusion of inter-organisational systems. Currently, business partners of LTH-Baas adopt a low level of e-business activities which prohibit further investments in e-business technologies at LTH-Baas. According to Ms. Nosach, "*when exports and the number of foreign customers is increasing, there are new challenges to the company concerning management, supply, marketing and client service. Evidently, in the near future, the company will need more IT solutions to organise effective supply chain management and to become more competitive".*

The company also identifies the **costs** for both ICT applications and their implementation as a **main barrier** to increase its ICT usage. Any additional costs are likely to deprive the firm of competitive advantages and the profits derived from lower labour costs when compared to western European shipyards. Technology is costly, so is the training of staff and the maintenance of ICT and that would further increase the costs of LTH-Baas. Thus, the company's management is not sure whether implementing more ICT would help to increase the productivity and profit. The company knows that additional ICT could streamline and speed up paperwork and documents' processing but it is not convinced that it will raise the quality and profitability of the completed repair work.

Interestingly, according to the company's representative, the customers (larger shipyards and ship owners) do **not** exercise any pressure on the firm to implement additional ICT technologies. Even when customers order products and services online via e-mail, their main concern is that the final product meets the required quality standards – not whether the company is using any advanced ICT tools to conform to such standards. This was also observed in other transport equipment industries which were studied by *e-Business W@tch* in previous years.[26] In contrast to this case, however, it was also observed in these studies that, especially in the automobile industry, large enterprises were forcing their suppliers and component manufacturers to implement particular ICT applications.

Lessons learned

This case study illustrates a typical ICT strategy and pattern of utilisation in a small yard in the ship repair sector. LTH-Baas has already implemented a number of ICT applications to support internal work organisation, such as the accounting system, as well as project and inventory management tools. According to the firm's representative, there

[26] See, for example, *e-Business W@tch*: "Transport Equipment Manufacturing - key issues, case studies, conclusions", August 2004. Available at www.ebusiness-watch.org ('Resources').

are **three significant reasons** to explain why they are currently not planning to develop further their ICT infrastructure:

- **Costs** for ICT applications, implementation and employees' training;
- **Lack of wider acceptance** of e-business solutions along the value chain in the Estonian shipbuilding industry;
- Deriving **competitive advantage from improving the quality** of their manufacturing processes and not from automating their workflows.

Whereas the first two issues are well known barriers to ICT usage, the last one indicates that the company is able to remain competitive and profitable by following a rather traditional business strategy.

Despite the cost barriers, the company recognises the benefits of ICT tools and closely follows new technological trends. Consequently, ICT *is* on their future purchases list but will not be further implemented until an additional need arises and it is considered to be beneficial for business operations. The company's vision of how ICT tools could fit into their operations is about developing an integrated management system throughout the whole enterprise and an extranet to co-operate with customers.

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 with Ms. Inna Nosach a company representative, April and May 2006*
- *e-Business W@tch sector reports 2004 and 2005*
- *The Shipbuilding and Ship Repair Sectors in Poland, Estonia, the Czech Republic, Hungary and Slovenia, NOBE Independent Center for Economic Studies, Lodz, 2004/05*
- *Web sites: company LTH-Baas, www.lth.ee*

5 Conclusions

In this section conclusions regarding the use of e-business in the SRI will be discussed. These conclusions are drawn from the quantitative and qualitative analysis which were presented in the previous three sections. At first, the importance of e-business for the companies' operations and its impact on companies' performance will be presented. Next, the level of the ICT adoption in the industry and its impact on the SRI structure will be assessed. Finally, policy implications will be given.

5.1 Business impacts

5.1.1 Implications for enterprises

One can view e-business as a set of related technological tools that are jointly based on one unifying paradigm—the internet. Each of these tools serves the purpose of supporting specific activities within and/or between enterprises. The adoption of these new technologies often requires the reorganisation of the internal processes which may have positive effects on company performance.

However, not all e-business tools necessarily have the same potential for generating economic value for an enterprise. Furthermore, the adoption of many applications depends on firm characteristics. For example, primarily large firms have the financial resources needed to implement e-solutions, are able to spread the costs across the entire enterprise and can thus achieve a positive return on investment. This has an impact on the adoption of such applications as 3-dimensional CAD, CIM, SCM, ERP or PLM[27] which are found to be mainly adopted by large shipyards in Europe (see Exhibits 3-11 and 3-18 and case studies in Sections 4.1 and 4.2).

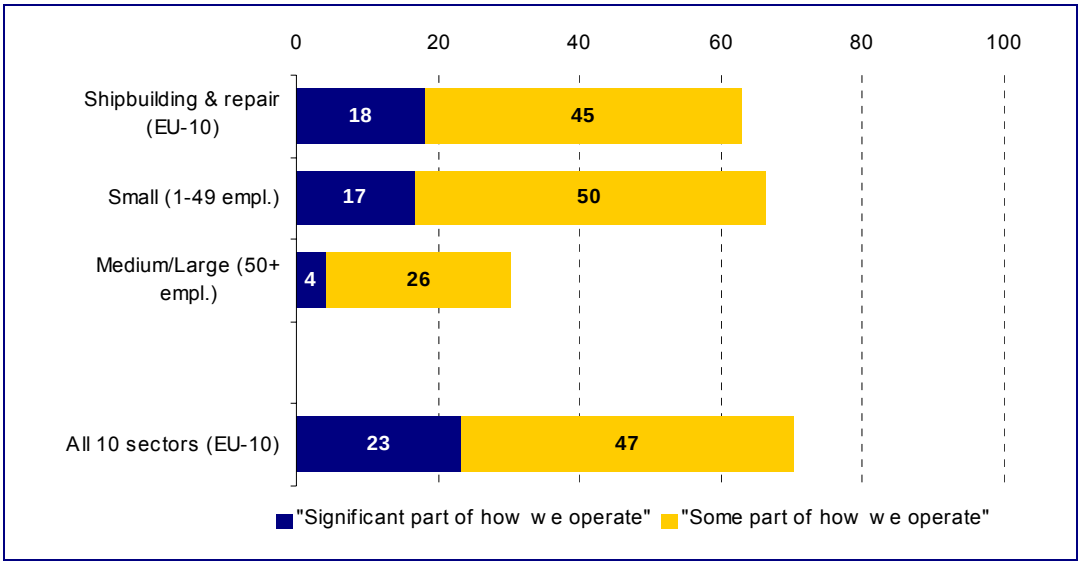
The survey results reveal that about two-thirds of the companies in the SRI confirmed that e-business constitutes "*a significant part*" or "*some part*" of the way they operate (see Exhibit 5-1). This figure is lower than the all-sectors average (70% - see Exhibit 5-1). Taking statistical limitations into account, e-business was reported more often as important by this sector's small companies (67%) than by their medium-sized and large counterparts (30%) (see Exhibit 5-1). This result differs from the average assessment for all ten sectors studied by *e-Business W@tch* this year. According to the survey, the overall importance of e-business for companies operations increases, on average, with firm-size. This survey result confirms that typically, e-business is more important for large companies than it is for small companies.

Furthermore, the survey result for the SRI seems to be in conflict with experiences described in the case studies that are presented in this report (see Section 4.1 and 4.3). For example, smaller shipyards such as *Finomar* or *LTH-Baas* have just started to adopt ICT and e-business applications. For these shipyards ICT and e-business applications do not yet play a strategic role. However, the survey results for the SRI indicate that some

[27] Computer-aided Design (CAD), Computer-integrated Manufacturing (CIM), Supply Chain Management (SCM), Enterprise Resource Planning (ERP), Product Lifecycle Management (PLM)

small companies in the industry, probably supplier companies for equipment and engineering services, are already well electronically integrated into this industry's value chain (see Section 3.4.2 on ICT for cooperation, and Section 3.6 on e-marketing).

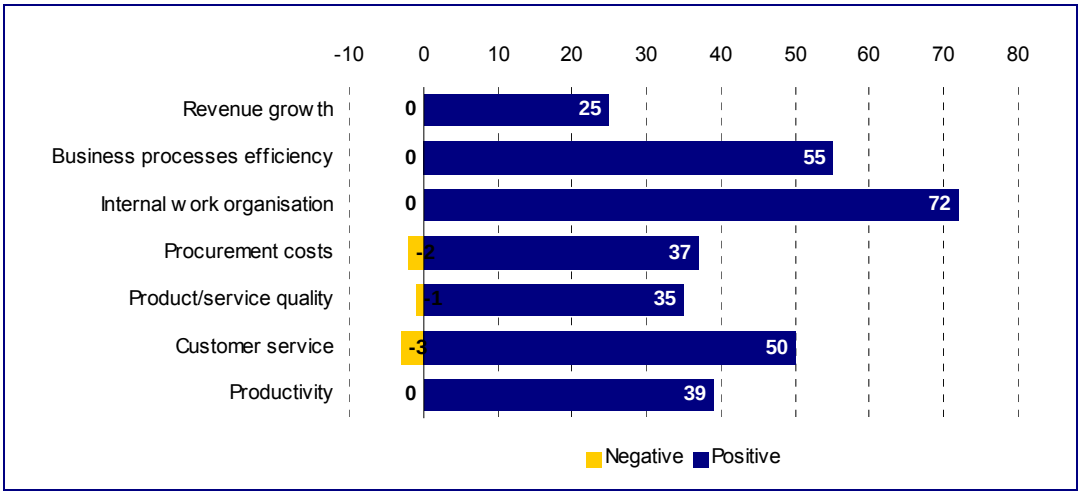
Exhibit 5-1: Perceived overall importance of e-business for company operations



Base (100%): Companies using computers (excl. "don't know"). N (for sector, EU-10) = 96. 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: H1

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

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



Base (100%): Companies using computers. N (for sector, EU-10) = 98.
Weighting: in % of firms. Questionnaire reference: H4

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

Most firms in the SRI (72%) reported that ICT had positive impacts on their internal work organisation and more than half of the companies surveyed in this industry stated that they gained their business process efficiency by ICT (see Exhibit 5-2).

In contrast, a few firms from this sector reported a negative impact of using ICT on procurement costs (2%), product or service quality (1%) and customer services (3%) (see Exhibit 5-2). A small share of this sector's companies reported positive impacts of ICT on productivity and revenue growth. This could be interpreted as revealing that ICT has primarily indirect positive impacts on company's performance (see Exhibit 5-2). Due to the small size of the sample, however, the numbers presented should be cautiously interpreted.

Impact on specific business areas and competitiveness

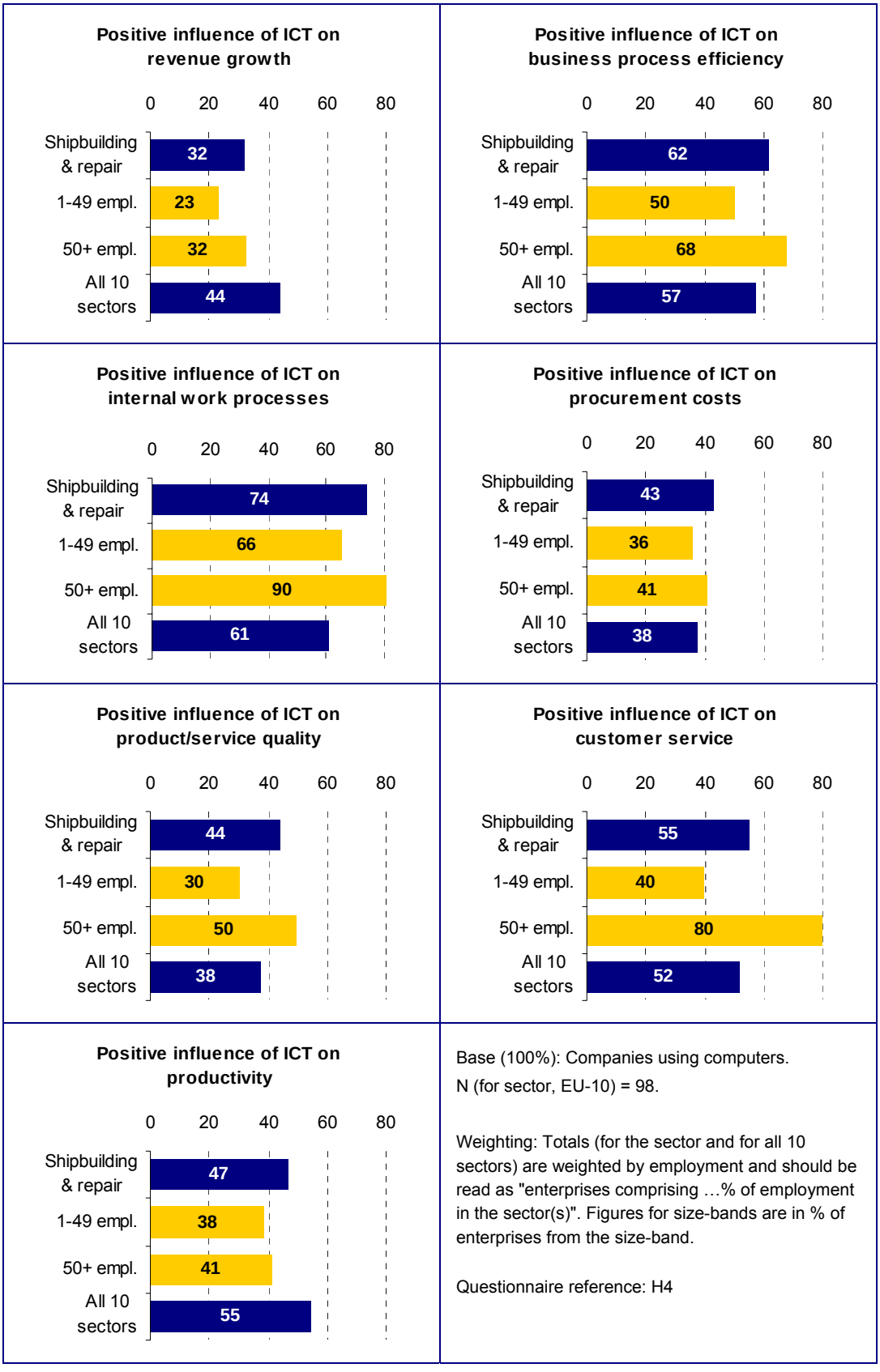
In the SRI positive impacts of ICT on business process efficiency, internal work processes, procurement costs, product or service quality and customer services are all above the average assessed by companies in the ten sectors studied (see Exhibit 5-3). This indicates that internet-related technologies successfully optimise routines and information flows. These technology-induced changes may even lead to significant cost-savings potentials by optimising repetitive procedures.

Consequently, the use of ICT and the adoption of e-business in the SRI lead to streamlined business processes and reduced production costs, thus supporting the competitiveness of companies. Whereas a positive influence of ICT on productivity was evidenced by less than half of the companies surveyed in this sector, positive impacts on internal work processes and increased business efficiencies may improve the competitiveness of the companies (see Exhibit 5-3).[28] The four case studies on medium-sized and large shipyards (*Finomar, ENVC, Uljanik, Fincantieri*) presented in Section 4.1 support this assessment.

Furthermore, according to companies in the SRI, their main driving force for taking up e-business is to gain competitive advantage (see Exhibit 3-22, Section 3). However, the positive influence of ICT on productivity and revenue growth in the SRI is below the stated average impact for the ten sectors studied this year by *e-Business W@tch* (see Exhibit 5-3). Thus, due to particular economic environments and competition, the actual use of ICT and the involvement into e-business by this industry's companies seem to be influenced by structural differences and sector-specific characteristics. In line with the analysis in Section 4, figures shown in Exhibit 5-3 confirm that medium-sized and large companies in the SRI perceive more benefit from ICT than small companies, although the latter reported greater importance of e-business in their business operations (see Exhibit 5-1).

[28] For more information on ICT impact on productivity, 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').

Exhibit 5-3: Companies observing a positive influence of ICT on …



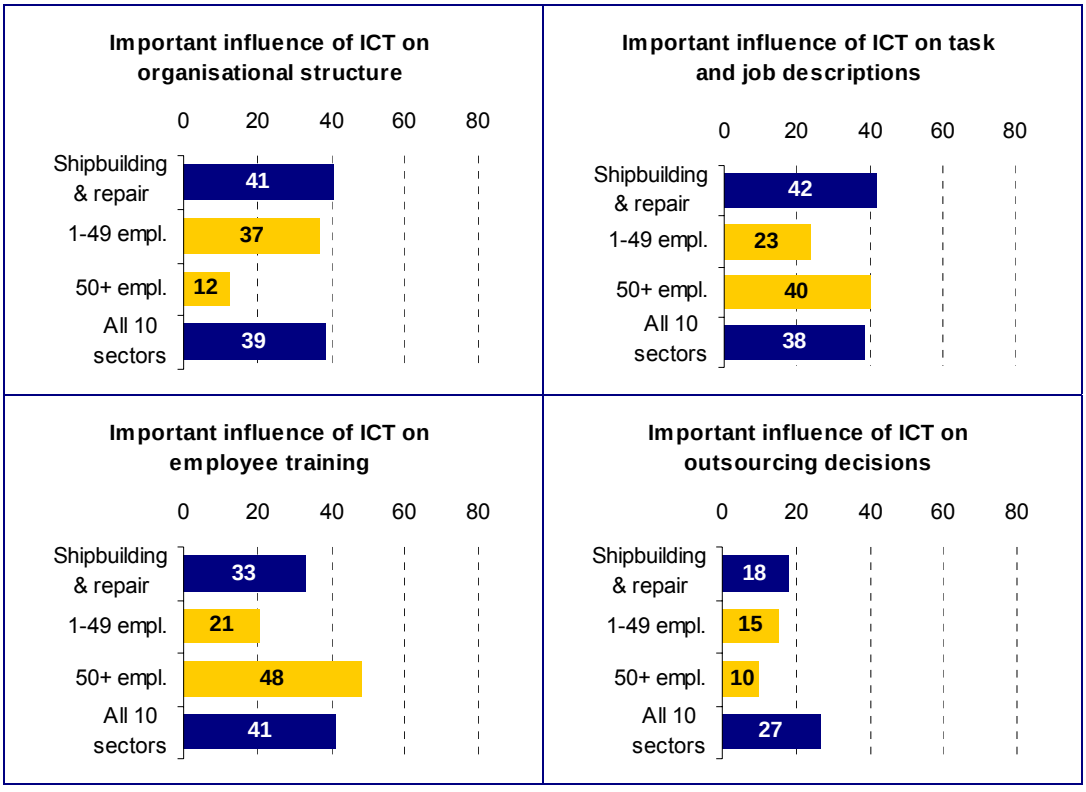
Source: *e-Business W@tch* (Survey 2006)

Impact on organisation

In the SRI, ICT has a higher influence on the organisational structure, task and job descriptions than on employees' training or outsourcing decisions (see Exhibit 5-4). These results confirm that companies in this industry assess a higher positive impact on internal work processes. It seems that small companies in this sector have restructured their internal work processes and outsourced business processes to a higher extent than medium-sized and large SRI companies (see Exhibit 5-4).

These survey results are also confirmed by findings presented in Chapter 3 (see Exhibits 3-4, 3-11, 3-12 and 3-19), which indicate that small firms in this sector are involved in e-business and e-commerce activities to a larger extent than their medium-sized or large counterparts. However, in medium-sized and large companies in the SRI ICT has important influence on task and job descriptions, as well as on employee training (see Exhibit 5-4). These perceptions are in line with the fact that medium-sized and large companies in the SRI reported having more SCM or ERP systems and also more ICT practitioners than the smaller firms in this sector (see Exhibits 3-3, 3-11, 3-18 in Chapter 3).

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



Base (100%): Companies using computers. N (for sector, EU-10) = 98. 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

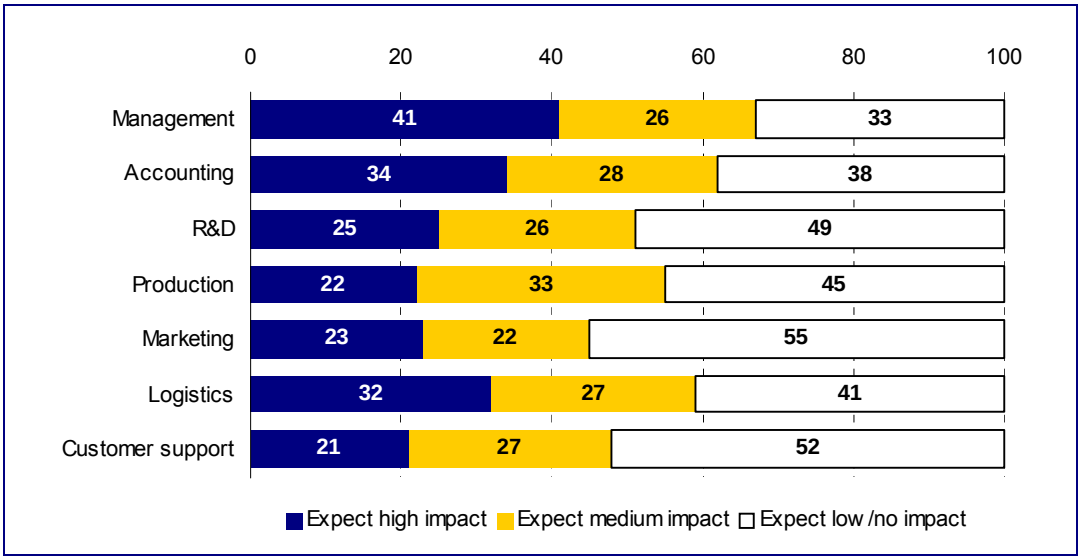
Source: *e-Business W@tch* (Survey 2006)

Future impact

According to the e-Business Survey 2006, more than half of the companies in the SRI expect that the role of ICT and its impact on the way they work will be important for all business activities in the future, except for marketing and customer support services (see Exhibit 5-5). This is plausible, considering the production processes in the SRI and the characteristics of vessels: the use of ICT for project management tasks (e.g. coordination of a network of suppliers, managing production schedules) is clearly more relevant in this industry than marketing products to potential customers. In this respect, the SRI shares common characteristics with, for example, the construction industry.[29]

Another area where ICT are expected to be important in the future is management and accounting. Companies comprising over 60% of this sector's employees expect either high or medium impact of ICT in these areas (see Exhibit 5-5). Furthermore, logistics and production are the business areas where companies representing about 55% of the sector's employment expect high or medium impact of ICT. These expectations confirm that companies in the SRI use ICT and e-business tools to streamline their business and production processes in order to gain competitiveness over their Asian challengers which have cost advantages due to low labour costs (see Section 2.2.3).

Exhibit 5-5: Anticipated future impact of ICT



Base (100%): Companies using computers. N (for sector, EU-10) = 98.
Weighting: in %of employment. Questionnaire reference: H8

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

Concluding assessment

Exhibit 5-6 summarises the main impacts of ICT and e-business on individual enterprises. The assessment is based on survey results and the analysis of key topics as presented in Chapters 3 and 4. The scores should not be understood as the 'exact' results of a quantitative computation; they are tentative and merely indicative, reflecting the

[29] See e-Business W@tch Sector Study (2006) on the Construction Industry, available at www.ebusiness-watch.org (

impression the study team gained from interviews, case studies and the literature review. Therefore, they should be mainly regarded as an instrument to stimulate debate on e-business trends and ICT impacts in this industry.

Exhibit 5-6: Impact of ICT and e-business on the shipbuilding and repair industry

	Business areas where ICT and e-business can have an impact	Observed impacts on large firms *low < > high*	Observed impacts on 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)

It is quite obvious that the extent of ICT impacts in the SRI is related to the size of a company. Generally, large companies are the forerunners in adopting of ICT and e-business applications due to economies of scale and the larger benefit attained as compared to small companies. Thus, it can be expected that ICT will continue to affect companies of different sizes in different ways. Taking statistical limitations into account, the survey results indicate that small companies in the sector are more involved in conducting e-commerce[30] than medium-sized and large companies. On the other side, medium-sized and large companies deploy more e-business tools such as ERP or SCM, systems that have a direct impact on the organisational structure.

An important point from the entire analysis is the relatively low 'innovation activity' in the SRI, notably in comparison with the other manufacturing sectors studied this year and in terms of ICT-enabled process innovation (see Section 3.7 and Exhibit 3-21 – statistical limitations to be taken into account). Furthermore, companies comprising 49% of the sector's workforce said that ICT has an expected low or no impact on research and development in the future (see Exhibit 5-5). On the one hand, although these survey results should be treated cautiously, it seems that companies in the SRI undervalue the importance of innovations and the related role of ICT for innovation processes. On the other hand, the importance of innovations and the related role of ICT may be different in the different SRI sub-sectors (see Section 2.1), such as construction of merchant and naval ships or repairing and conversion of vessels. Therefore, a differentiated analysis

[30] More small companies said that they co-operate and collaborate online, send and receive e-invoices, link their ICT with those of their suppliers, accept orders from their customers online and use CRM systems (see Section 3).

not only in terms of size-bands but also in terms of sub-sectors would allow a more exact interpretation. However, such a deepened analysis of the SRI was beyond the scope of the present *e-Business W@tch* study.

5.1.2 Implications for the industry structure

This section assesses the impacts of the ICT and e-business adoption on the structure of the SRI. As in 2005, we use the 'Five-Forces-Model' developed by Michael E. Porter (1980) to discuss and assess the e-business influences on the industry 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. Porters model is based on the insight that a corporate strategy should meet the opportunities and threats in the organisation's 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. Porters 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 shown in the analysis, ICT has impacts on the competitiveness of the European SRI, especially when considering the challenges from the Asian competitors (see Chapters 2 and 4). Following Porter's Five Forces Model, this section offers an assessment of the major influences of e-business on the economic dynamics in this sector supplemented by the e-Business Survey 2006 results. Exhibit 5-7 lists the five competitive forces with their importance within the SRI.

Exhibit 5-7: Impact of ICT and e-business on competition in theSRI

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

During the last two decades enterprises from Asian countries such as Korea, China, India and Vietnam entered into the world's shipbuilding market. These Asian countries -mainly China- are fast growing competitors that increase the production capacities in the SRI (see Section 2.2). Due to price competition, Korean shipyards are already changing their production strategy and are entering the market for specialised and more valuable vessels such as cruise vessels (see Section 2.2). Whereas, ICT and e-business do not directly lead to new market entries in the SRI, they have an impact on the competitiveness of companies in the industry. In this sense and as already discussed in Section 2.2, Korean shipyards also start to invest in ICT and e-business tools such as ERP system or 3-dimensional CAD to reduce production costs and to improve the quality of their products (see Section 2.2; Daewoo Shipbuilding & Marine Engineering 2006; Douglas-Westwood Limited 2005; Witthöft 2006a).

Substitution of products / services

A threat from substitutes exists when there are alternative products or services at lower prices or better quality, which will then gradually replace the existing types of products or services.

The international shipping industry is responsible for the carriage of around 90% of world trade. As long as world trade continues to grow, the demand for vessels will maintain on a high level. The transport of goods across oceans and seas with its inter-modal connections is far more efficient than air transport (Maritime International Secretariat Services 2006). Thus, for world trade there is no major substitution between different modes of transport to be expected. However, for national and intra-European trade the transport of goods is dominated by road transport. Nevertheless, more than 40% of European internal trade goes by sea. On the other hand, the importance of inland water transport decreased over the last decades.

Evidence from this study does not indicate that the decision on the mode of transport for international trade is directly influenced by ICT or e-business. For example, ICT does not have a major influence on transport time, which is (depending on the durability of products) a key factor for substitution of transport services by other means.

Bargaining power of suppliers

With a structural change in the SRI, marine equipment manufacturers took over responsibility for a number of activities, and consequently increased their shares in the value added to the final products (see Chapters 2 and 4). An immediate conclusion would be that they simultaneously increased their bargaining power. However, the implementation of e-procurement, which tends to enhance the bargaining power of shipyards or customer companies (see following section), counterbalanced this development.

e-Procurement portals enable yards or other customer companies to compare prices and product characteristics at no costs. Thus, e-procurement leads to reduction in search costs, enlarge the choice of potential suppliers and increases transparency of prices (see Section 4.2). Furthermore, large shipyards try to aggregate orders to raise their bargaining power for achieving lower factor prices (see case study on *Meyer Shipyard* in Section 4.2). However, supplier companies also try to maintain their bargaining power because they prefer to do business in the traditional paper-based way or via e-mail (see Sections 3.5, 4.1 and 4.2).

Bargaining power of customers

With regard to the ICT impact on bargaining power of customers, a distinction must be made between various segments of the value system: first, the situation of ship-owners (as customers) vis-à-vis the shipbuilding industry; second, the power of large companies vis-à-vis their supply firms.

The SRI is operating globally, and competition in this industry is intense. The bargaining power of the demand side is therefore significant. Ship-owners have the option to order comparatively cheap vessels in Asia, while at the same time forcing Asian shipyards to procure from the European marine equipment manufacturers for their high-quality products (Witthöft 2005; VSM 2006b). However, research conducted for this study does not indicate that the bargaining power of customers (such as ship-owners) is significantly influenced by e-business developments.

With regard to the second situation (shipbuilders – suppliers), ICT and e-business enable shipyards and other companies along the SRI's value chain to build up substantial customer power due to e-procurement. In fact, according to survey results, the second most important driver of e-business adoption reported by SRI companies was customer expectations (see Exhibit 3-22). It is likely that this finding was largely shaped by suppliers to shipyards. As already described, e-procurement reduces transaction costs and increases price transparency (see Section 4.2), which strengthens the position and negotiation power of customers.

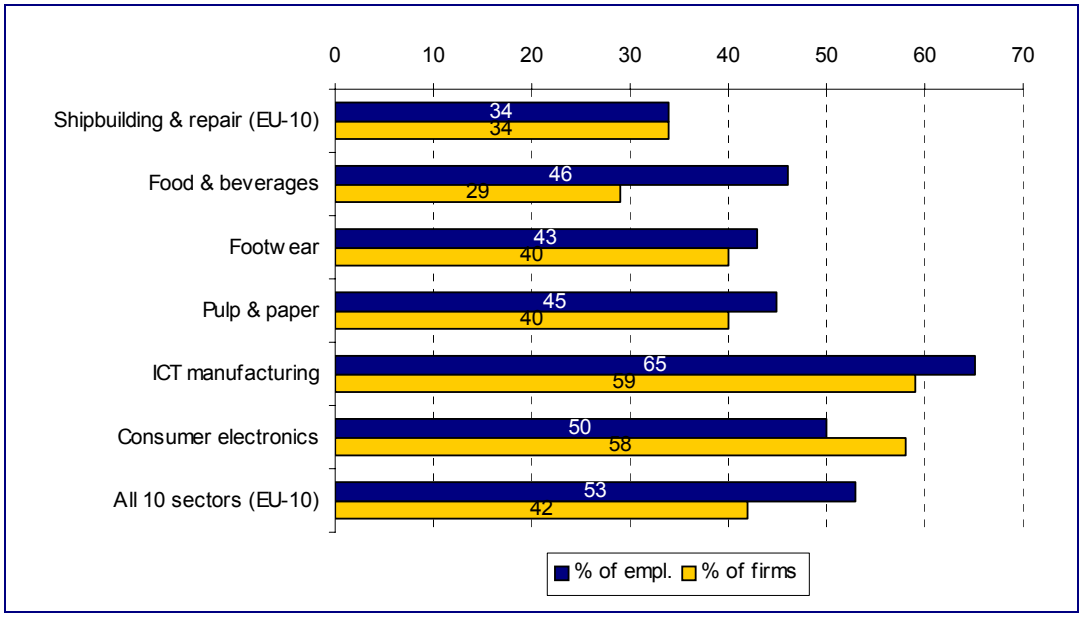
Thus, ICT and e-business have some impact in this context, which could even increase in the future, if advanced solutions for e-procurement gain further momentum.

Rivalry in the market

Competition in the SRI is extremely high due to globalisation, new market entry by Asian countries and fluctuations in demand. Thus, there is a fierce price competition for cargo carrier vessels and a competition on quality for specialised vessels. Under these circumstances, ICT and e-business take on strategic importance, because they can lead to more streamlined production processes, integrate suppliers and to allow firms to become more flexible in the production life cycle (see Exhibits 5-2, 5-3 in Section 5.1.1 and case studies on *Uljanik* and *Fincantieri* in Section 4.1). Consequently, companies will increase their productivity and their competitiveness by exploiting e-business technologies.

The results of the e-Business Survey 2006 show that about a third of the companies in SRI assessed that ICT has an impact on competition in the industry. This figure is below both the weighted all-sectors average and the respective averages for the other manufacturing industries studied this year by the *e-Business W@tch* (except for food and beverages - see Exhibit 5-8).

Exhibit 5-8: ICT has an impact on competition in the industry

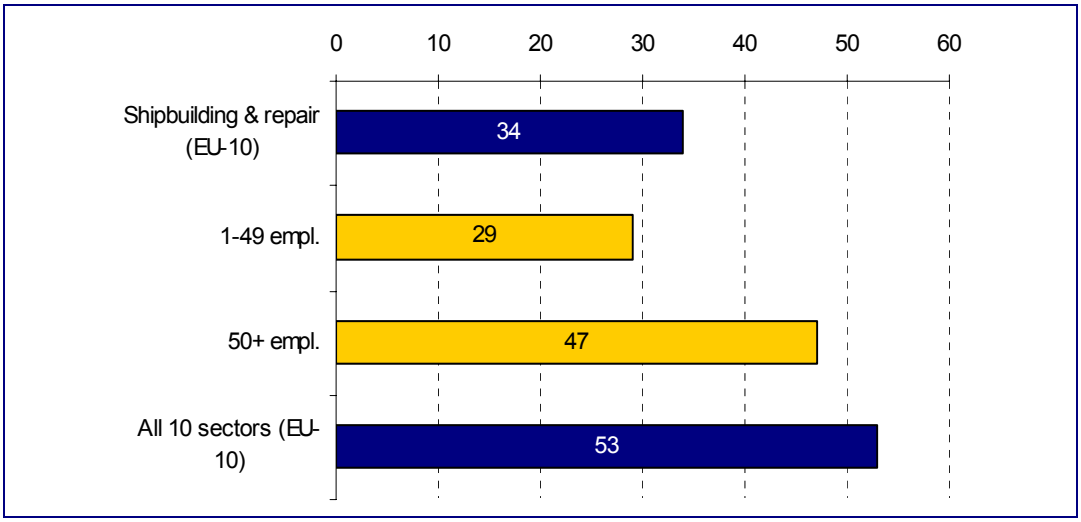


Base (100%): Companies using computers. N (for sector, EU-10) = 98. Questionnaire reference: H5

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

Furthermore, Exhibit 5-9 shows that small companies in the SRI and medium-sized/large ones assess the impact of ICT on competition differently. Due to high adoption rate of ICT and e-business by medium-sized and large companies, they are able to reduce their production costs and improve the quality of their products to a larger extent than the small companies (see Exhibit 5-3 in Section 5.1.1). Therefore, in their view, ICT strengthens their competitiveness and has an impact on competition in this industry.

Exhibit 5-9:Companies saying that ICT has had an impact on competition



Base (100%): Companies using computers. N (for sector, EU-10) = 98. 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: H5

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

5.2 Policy implications

Introduction

e-Business developments can have implications for several policy areas. Relevant considerations made in this context can be grouped around two main overall objectives:[31]

- **Promote ICT adoption**: 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.
- **Counteract ICT induced 'flaws' or market failure**: Policy interventions to counteract the areas where deployment of ICT in business leads to undesirable effects on the aggregate level.

Possible policy initiatives in the SRI

The main driving force behind the development, implementation and use of ICT and e-business technologies in the European SRI is the international competition, particularly from Asian competitors. By adopting ICT and e-business applications, European companies in the SRI expect to gain competitive advantage (see Exhibit 3-22). However, the survey results show that the deployment of e-business systems such as ERP or SCM is still not widespread in the SRI (see Exhibits 3-11, 3-18). This suggests that there is a

[31] European Commission (2005): More Research and Innovation – Investing for Growth and Employment: A Common Approach, Communication from the Commission, COM(2005) 488 final

further potential for this sector's companies to increase their productivity and competitiveness by investing in ICT.

On the other hand, making the required investments in such advanced e-business technologies involves significant uncertainties (e.g. in terms of return-on-investment and different scenarios on the future technological development). Thus, ICT investments, while necessary, are at the same time a risky strategy, particularly for small companies. This is illustrated by the case studies on *Finomar* and *LTH-Baas* (see Sections 4.1 and 4.3). While small enterprises may be able to see the advantages of e-business applications, they may not have the resources or the competences to implement them.

Although this 'dilemma' cannot be entirely solved by policy, the European Commission has initiated several projects and policy measures to support the structural change of the European SRI over the last years. This included programmes to support SMEs in the SRI to implement e-business technologies (E-Mar 2002). One of the latest initiatives, in co-operation with the European shipbuilding industry, especially with the Community of European Shipyards' Associations (CESA), was the development of the strategy "LeaderSHIP2015"[32] to improve the competitiveness of the European SRI (CESA 2006; European Commission 2003).

With a view to the SRI, four areas are identified in this section where policy initiatives could be considered. Two of these areas concern the objective of promoting ICT adoption among the smaller and medium-sized companies from the industry, two suggestions concern the objective to create a favourable framework for e-business adoption. The suggested areas are summarised in Exhibit 5-10 and explained in more detail in the following paragraphs.

Exhibit 5.10: Policy implications arising from e-business activity in the SRI

	Policy issues	Possible initiators	Policy leverage *low < > high*
Promote ICT adoption			
1	Promote networking	Industry federations National Governments European Commission	
2	Promote interoperability	Standardisation bodies Industry federations	
Counteract ICT induced 'flaws' or market failure			
3	Security	Industry federations European Commission National Governments	
4	Balance of power	Industry federations National competition authorities	
Maximum: 3 points (or)			

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

[32] European Commission (ed.) (2003): LeaderShip 2015. Defining the Future of the European Shipbuilding and Shiprepair Industry, prepared by the LeaderShip 2015 High Level Advisory Group, http://ec.europa.eu/enterprise/maritime/maritime_industrial/leadership_2015.htm

Networking

The complex production processes in the SRI require inter-firm interactions and co-operations between several actors along the value chain in order to improve productivity and to develop innovations. Significant benefits can be achieved by introducing innovative ways of organising inter-firm interactions, modifying business processes and integrating companies along the value chain. Applications linking inter-firm processes such as collaborative product design and inventory management tools 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 research and development activities are more likely to produce superior outcomes, compared to stand-alone efforts.

Compared to other manufacturing industries studied this year, online co-operation and collaboration within the value system of the SRI is lower (see Exhibit 3-12). Moreover, the stated supply chain integration using SCM systems is also lower than in the other manufacturing industries, but in line with the all-sectors average (see Exhibit 3-18). Considering the already discussed characteristics of the SRI, the level of innovations reported by companies was lower than the all-sectors average reported on both product and process innovations (see Section 3.7, Exhibit 3-21).

In general, networking in the SRI could be encouraged by inter- and intra-industry dialogues organised by industry federations or via technology platforms such as Waterborne[33] or Wondermar[34] (see Section 4.1). Such initiatives demonstrate to companies that they can benefit from a more intensive co-operation and collaboration. Policy could enhance this process by collecting and disseminating best practice examples of ICT-enabled co-operation .

Moreover, co-operation for research and development in the SRI could be supported by European or national research programmes giving incentives for innovation networks and the development of industry specific e-business applications. In order to properly address these issues, however, an in-depth analysis would be needed to identify innovation mechanisms in the SRI and how they are related to ICT.

Interoperability

A key issue for inter-firm co-operation and connectivity is interoperability. Indeed, about a third of companies covered by the 2006 e-Business Survey in the SRI said that interoperability is critical for e-business within the sector and for producing products or services (see Exhibit 3-8). As the survey reveals, however, proprietary (and other) standards are more common in this industry than in other sectors studied this year by *e-Business W@tch* (see Exhibit 3-7). This could partly explain existing interoperability problems.

[33] See CESA 2006, p. 10

[34] www.wondermar.net

Another point to be considered in this context is that SMEs normally rely on ICT vendors offering packaged solutions, which may not necessarily result in interoperable products and data. Large companies, on the other hand, continue to promote their own standards, so that small and medium-sized supplier companies are forced to adapt their systems to the various standards of their customers (see Exhibit 3-22, Sections 3.3.1, 3.3.3, 4.2 and 4.3).

This calls for an industry-wide coordination. Interoperability and standardisation are crucial for the further adoption of ICT and e-business in the sector. Although the process of standardisation lies in the hands of the SRI and ICT industry, policy makers could encourage companies (or associations) to actively contribute to this process and thus accelerate the development. Supporting the development of uniform standards could help to avoid market failure resulting from co-ordination problems. The interests of SMEs in general and from the SRI, in particular, should be taken into account in the standardisation process.

Policy makers could enhance related developments by increasing the awareness of interoperability problems in the sector. One instrument to do this would be to organise workshops with representatives of the industry. The European Commission, together with the European Standards Organisations and relevant other bodies such as CESA, could establish an advisory group, considering ways how to inform SMEs about e-standards in the SRI and applications based on them, and how to ensure that their interests in this context are properly articulated.

Security and knowledge protection

The e-Business Survey 2006 reveals that security issues are important in the SRI: Despite the fact that companies in the SRI said that they deploy secure server technologies, digital signature and firewalls to a larger extent than companies in other industries, security and legal complications were reported as important barriers to use ICT and e-business applications (see Sections 3.3.4 and 3.8). In the SRI, an industry that produces one-of-a-kind products, all actors are facing the permanent risk of violation of their intellectual property rights (IPRs). Online co-operation and collaboration, especially in the design phase of a new vessel, may lead to an increase in knowledge piracy. As a result, companies are concerned about how to ensure the protection of knowledge.

Policy makers might counteract these negative effects in two ways. First, they could increase the awareness and understanding of the risks related to e-business in general and intellectual protection in particular. Second, policy makers might develop legislation and appropriate execution mechanisms to reduce the fear of knowledge piracy. In order to properly address these issues, however, an in-depth analysis would be needed to identify the extent to which knowledge protection is indeed a barrier to e-business in the SRI.

Balance of power

According to the survey results, in the SRI as in other sectors studied this year, the share of companies saying that they place orders online is significantly higher than the share of companies that reported accepting orders from customers online (see Exhibits 3-14 and 3-19). This applies in particular for medium-sized and larger enterprises.

In this context, the question of power between large shipyards and small and medium-sized suppliers in e-procurement and supply chain management is prominent (see Sections 4.1 and 4.2). As discussed in Section 4.2, developments in e-procurement could have an impact on the distribution of bargaining power between buyers and sellers, normally strengthening the position of the buyer (for example by increasing price transparency).

This could have a negative impact for many of the small supply firms in the sector. Many suppliers fear that their margins will be squeezed more effectively than in the past if large shipyards aggregate their orders,[35] run auctions or benefit from a degree of information transparency that could reveal suppliers' cost-structures during price negotiations. This scepticism towards e-commerce from the suppliers' side is additionally strengthened by their fears of new commercial risks resulting from incomplete information about market rules, business partners and possible unfair practices.

To respond to these challenges, policy could encourage business associations, such as CESA, to better inform their members, especially SMEs, about the risks and unfair commercial practices related to B2B internet trading platforms[36].

Furthermore, industry associations might encourage the process of trust-building for participants of e-markets and electronic transactions. Last, but certainly not least, competent authorities should monitor competition in electronic markets and intercede if necessary.

[35] See an illustrative example in the case study on *Meyer Shipyard* in Section 4.2.

[36] See DLA Piper Rudnick Gray Cary (2006): Legal Study on unfair commercial practices within B2B e-markets, Final report, European Commission, May 2006 – available at http://ec.europa.eu/enterprise/ict/policy/legal/index.htm.

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Michael vom Baur, Senior Vice President and Chair of COREDES, Aker Yards ASA, 2006-04-05

Joachim Brodda, Project Manager WONDERMAR II, BALance Technology Consulting GmbH, 2006-05-11

Dr. Reinhard Lüken, CESA Secretary Genral, 2006-05-10

Ronald Vopel, European Commission, Enterprise Directorate-General, 2006-01-24

Verband für Schiffbau und Meerestechnik, Mr. Lundt and Mr. Bischoff, 2006-05-10

Annex I: 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.[37] 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.[38] This should be considered when comparing figures over the years, as figures either represent a percentage of "all companies" (as in 2002 and 2003)

[37] 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.

[38] Non-computer users include typically small craft firms (textile, construction), bars, restaurants or pensions (in tourism), and small food producing companies.

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.[39] 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.

[39] 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*.[40]

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

[40] 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.[41]

- 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.

[41] 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[42] (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.

[42] 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%**

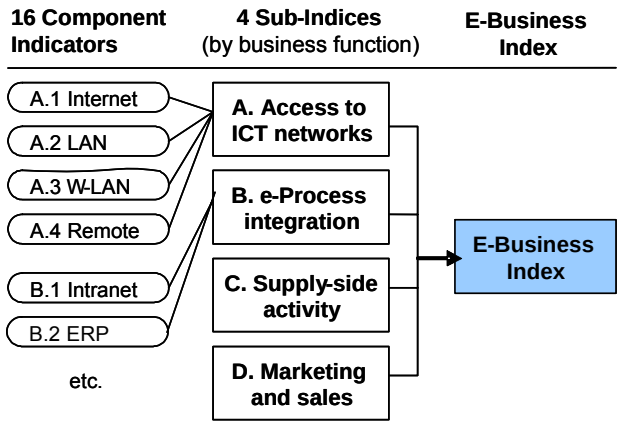
confidence intervals at α=.90

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 II: Glossary of Technical Terms

Term	Definition[43]
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.
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.

[43] 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.

Term	Definition[43]
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.[44] 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.
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.

[44] Cf. Global Internet Statistics by Global Reach, www.glreach.com

Term	Definition[43]
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.

Term	Definition[43]
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.

Contact information:

European
Commission

Enterprise and Industry Directorate-General
Unit D4 "Technology for Innovation /
ICT industries and e-Business"
1040 Brussels, Belgium

Fax: (32-2) 2967019
e-Mail: entr-innov-ict-ebiz@ec.europa.eu
Web: http://ec.europa.eu/enterprise/index_en.htm

e-Business W@tch
c/o empirica GmbH
Oxfordstr. 2
53111 Bonn, Germany
e-Mail: info@ebusiness-watch.org
Web: www.ebusiness-watch.org