Sector Report No. 7/2006

ICT and e-Business in the

Construction Industry

ICT adoption and e-business activity in 2006

e-business w@tch

European Commission

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

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

This document is a sector study by *e-Business W@tch*, focusing on the construction industry (CI). 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 CI about the ICT use of their enterprise.

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Executive Summary

Objectives and scope of the study

This sector study by *e-Business W@tch* focuses on the **construction industry (CI)**. It describes how enterprises in this industry use information and communications technology (ICT) for conducting business, assesses the impact of this development for firms and for the industry as a whole, and indicates possible implications for policy. Analysis is based on literature, interviews, case studies and a survey among decision-makers in European enterprises from the CI about the ICT use of their enterprise.

The sector covers the business activities specified in NACE Rev. 1.1 Groups F 45.2 and 45.3.[1] The building of complete constructions (or parts thereof) and civil engineering (NACE 45.2) is dominated by large construction and engineering enterprises, whereas the building installation industry (NACE 45.3) is predominantly made up of small and medium-sized enterprises. There are approximately 2.4 million construction enterprises in EU-25, of which 97% are micro or small enterprises with fewer than 20 employees. The industry employs about 14 million people, corresponding to about 7% of the European work force and 28.5% of industrial employment.

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

The CI is a sector where ICT and e-business are used to a lesser extent than in most of the other sectors studied by *e-Business W@tch* in 2006. There are two main reasons for this comparatively low ICT uptake:

- the high concentration of SMEs in the CI and
- the typical nature of the service provided in construction which, being an on-site and often highly customised service, does not lend itself to the typical e-business concept which is rather adapted to manufacturing industries.

Looking into the two sub-sectors covered by this report, complete construction enterprises demonstrate, in general, a higher level of ICT uptake than building installation enterprises. In addition, complete construction enterprises are larger enterprises, employ ICT practitioners more often, use ICT more to support innovation and spend more on ICT than companies from the building installation industry.

The 2006 e-Business Survey data also suggest that large construction enterprises are increasing their focus on ICT issues, as they have started introducing more advanced ICT solutions such as e-procurement systems, collaborative design systems and collaborative document sharing. This trend is in line with the findings and case studies presented in Section 4 on the use of specific ICT solutions for the CI.

[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.

The same statistical findings, however, indicate that there is still a sort of "digital divide" between the CI and the weighted averages of all sectors covered this year by *e-Business W@tch*. Examples are the low percentage of firms employing ICT practitioners, as well as the low adoption of enterprise resource planning (ERP) systems and advanced e-procurement solutions. This cannot be entirely attributed to structural factors, i.e. the dominance of small firms, but is also explained by the nature of the services in the CI.

Another worth-mentioning finding from this year's survey is that construction enterprises have little focus on hiring ICT practitioners and ICT training. Furthermore, the use of e-standards is limited in the CI but about in line with the weighted all-sectors average, indicating that interoperability is a common issue across different sectors. The CI lags behind on both product and process innovation when compared to the cross-industry total (EU10). However, the reported shares of ICT-enabled product and process innovation in CI are more or less the same with the respective cross-industry totals for the ten sectors covered this year by *e-Business W@tch*.

Important e-business trends and implications

Important developments are taking place in the CI in the areas of **e-procurement, 3D technology and project web**. These technologies carry **significant economic potential** for the industry, particularly with regard to process efficiency. The study shows that **large construction enterprises** and the **public sector** drive the development. Large enterprises, on the other hand, clearly possess the financial resources, human capital and ICT capabilities which are necessary to benefit from these technologies at this point in time. The public sector, on the other hand, could enhance and further accelerate development, both as a major buyer of construction services and via policy initiatives.

e-Procurement

This study investigates two issues related to e-procurement: e-procurement conducted by construction enterprises and e-procurement (e-tendering) of construction services conducted by public authorities. The main trends identified this year confirm findings from the 2005 sector study on the CI:

- **Developments are mainly driven by the broad introduction of e-procurement in large European construction enterprises.**

  e-Procurement is used as a tool to enhance new procurement concepts such as strategic procurement. Centralisations of tendering, establishment of framework contracts, consolidation of the supplier base are aspects of strategic procurement, and construction enterprises use e-procurement to optimise the price/quality ratio.

- **The benefits of e-tendering are first and foremost on the buyer side and the development is mainly driven by the public sector (public e-tendering)**

  The public sector is a driver for promoting e-procurement, due to the overall procurement volume and the –usually large- size of projects which are tendered by public services. As the electronic notification of tenders and the on-line publication of tender material generate more savings for the procurer than for the supplier, public services are also likely to benefit more from e-tendering.

This study suggests that **change management** is pivotal for the successful implementation of e-procurement systems in a construction enterprise. This involves commitment by the company's senior management and a focus on employee training. The correct set-up and outstanding business cases for electronic procurement, however, are still not easy to identify. Thus, for smaller enterprises in particular, the absence of a clear business case is a barrier for many types of e-procurement.

3D technology

3D technology (also called Building Information Modelling) is a significant tool for the CI. Two relevant issues are discussed in this study, based on recent literature and expert interviews: **interoperability** and **compatibility**. The study shows that the benefits of using 3D technologies in the CI include cost reduction through risk minimisation, more precise communication between stakeholders and earlier detection of miscalculations and deviations. However, the study also shows that there are still barriers to a successful uptake of 3D technology by CI companies:

- The strong adherence to **traditional workflow** processes in the industry and a lack of competences in 3D design;
- The lack of European-wide **standards** increases the problem of system incompatibility, both internally between different 3D technology solutions and externally with other ICT applications.

Project web

Project web solutions can enable more efficient and secure exchange of information between the stakeholders in construction projects. This study focuses on four areas: usability, workflow processes, economic incentives and a discussion on the drivers for development. The discussion presented in this report indicates that:

- **Project web solutions are complex**. The uptake of project web solutions is constrained by its technical complexity and lack of user-friendly interfaces. Project web solutions require specific ICT competencies, which European CI SMEs do not always possess.
- **Project web solutions lack integration possibilities with existing ICT systems**. Project web solutions are normally not compatible with already existing ICT systems such as electronic document management EDM and ERP systems. This incompatibility reduces the uptake of project web solutions in the CI.
- **Project web solutions are tailor-made for the existing workflow processes**. Traditional workflow processes in the CI are usually maintained in an effort to reduce implementation barriers, but this may prevent reaping the full technology benefits.

Business impact

The increased uptake of e-procurement will require a further strengthening of **ICT skills** among employees of European CI enterprises. Despite the currently rather slow uptake of 3D technologies and project web solutions, these developments will eventually require

large companies and SMEs in the CI to **invest** not only in the technologies themselves, but also in ICT training to ensure that the required skills are in place.

Once the uptake of project web and e-procurement systems has gained momentum, this is expected to affect **organisational structures** and **workflow processes** in the CI.

The increasing use of e-procurement by the public sector in calls for tenders for construction services will have an impact on SMEs that contribute as **sub-contractors** to these services. Again, one of the effects is that even smaller enterprises need to familiarise themselves with using related ICT systems, i.e. they need to develop ICT capabilities which many small CI enterprises are currently lacking.

Policy implications

In the previous *e-Business W@tch* sector study on construction (September 2005), the issues of improving ICT skills, increasing the awareness of ICT benefits and potentials, and facilitating interoperability, were identified as relevant policy initiatives. Findings from this year's survey and the discussion of the three major technology trends in this report suggest that these implications are still relevant, with slight adjustments and elaborations:

- **Focus on identifying ICT skills gaps**

  Having the right ICT skills has been identified as a challenge for SMEs both in general and in respect to the three specific areas of ICT use in the CI. Most importantly this concerns the transition to 3D technology, which is a rather complex technology and contains many software features. Focus should be given to defining the required ICT skills in the CI and to whether market imperfections exist with regard to the training offered by public and private educational institutions.

- **Raise awareness of ICT benefits and e-business policies**

  It is important to raise awareness about ICT and e-business among CI enterprises and business associations, in particular with regard to new technologies discussed in this report (project web, 3D technology). In this context, the public sector can play an active role by supporting initiatives to promote best practice examples based on successful ICT implementation in construction enterprises. Industry operators could facilitate such "peer-to-peer" demonstrations of successful cases to improve awareness about ICT solutions in this industry.

- **Facilitating the process of interoperability**

  Setting standards and promoting interoperability is an important area to address. On-going work towards common e-standards has promising benefits for the uptake of ICT in the CI. Nevertheless, on the basis of the statistical findings and within each of the three ICT application areas presented in this study, there is a number of standardisation-related issues that should be addressed at international and European levels. The European Commission could, for example, consider analysing the benefits of introducing standard transfer protocols, and disseminating the results of this analysis.

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*".[2] *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[3], 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**[4] 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

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

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

[4] "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

broader policy context, two further important facets regarding the mission of the initiative 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.[5]

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.

[5] 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[6] 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.[7]

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

[7] 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.[8]

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.[9] 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.

[8] 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.

[9] 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:[10] 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.*

[10] In 1999, the OECD Working Party on Indicators for the Information Society (WPIIS) established an Expert Group on Defining and Measuring Electronic Commerce, in order to compile definitions of electronic commerce which are policy relevant and statistically feasible. By 2000, work of the Group had resulted in definitions for electronic commerce transactions.

The addendum regarding payment and delivery is an important part of the definition, but can be debated. The difficult question is which processes along the different transaction phases constitute e-Commerce and which do not (see Exhibit 1-2). The OECD definition excludes the pre-sale or purchase phase and focuses on a specific part of the sale / purchase phase, namely the ordering process. *e-Business W@tch* follows the OECD position on this issue.[11]

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[12] 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

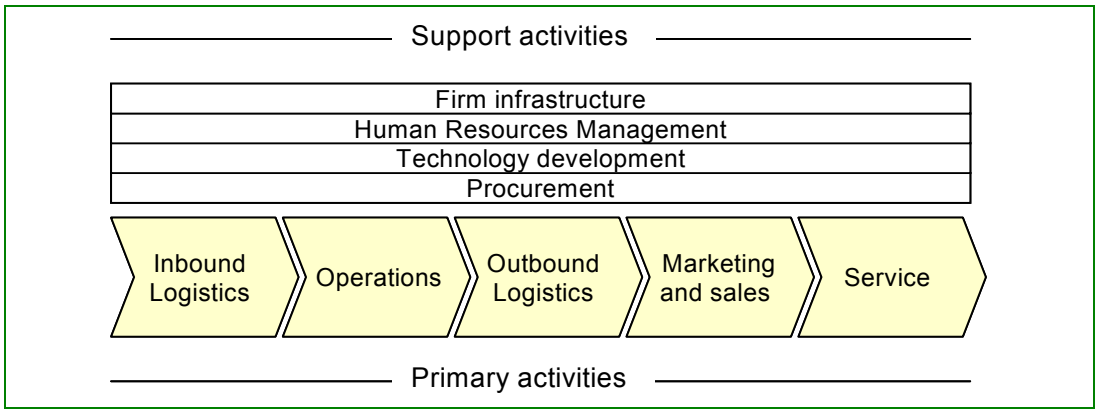
[11] This is reflected in the updated wording of the respective survey questions in 2006, when for "placing / accepting online orders" was asked instead for "purchasing / selling online".

[12] Working Party on Indicators for the Information Society

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

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

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



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

Key dimensions of this framework (notably inbound and outbound logistics, operations, and the value system) are reflected in the **Supply Chain Management** (SCM) concept. Here, the focus is on optimising the procurement-production-delivery processes, not only between a company and its direct suppliers and customers, but also aiming at a full vertical integration of the entire supply chain (Tier 1, Tier 2, Tier n suppliers). In this concept, each basic supply chain is a chain of sourcing, production, and delivery processes with the respective process interfaces within and between companies.[13] 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.[14] 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.

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

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

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

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

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

However, as more companies strive to exploit the innovation potential of ICT, it becomes more difficult for the individual company to directly gain competitive advantage from this technology. e-Business is becoming a necessity rather than a means to differentiate from competitors.[15] 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).

[15] 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

Business activities covered

This study explores the development of e-business in the European CI. The main focus is on engineering and construction enterprises working as main- and sub-contractors. The study also covers other important players in the construction value chain, such as material suppliers and architects, when this is relevant for the analysis. Engineering and construction enterprises constitute a rather homogeneous group in terms of value-adding activities in the construction value chain, enterprise set-up and organisation, and ICT capability level.

With this scope in mind, the study covers business activities specified by NACE Rev. 1.1 groups F 45.2 (except 45.22) and F 45.3 (except 45.34).[16]

Exhibit 2-1: Business activities covered by this study (NACE Rev. 1.1)

NACE Rev. 1.1		Business activities
Group(s)	**Class(es)**	
F 45.2		Building of complete constructions or parts thereof; civil engineering
	45.21	General construction of buildings and civil engineering works
	45.23	Construction of motorways, roads, airfields and sport facilities
	45.24	Construction of water projects
F 45.3		Building installation
	45.31	Installation of electrical wiring and fittings
	45.32	Insulation work activities
	45.33	Plumbing

As mentioned above, engineering and construction enterprises are interlinked with other stakeholders in the CI. Exhibit 2-2 below illustrates a non-exhaustive example of a value chain in the CI and indicates the links between the engineering and construction enterprises and other industry stakeholders.

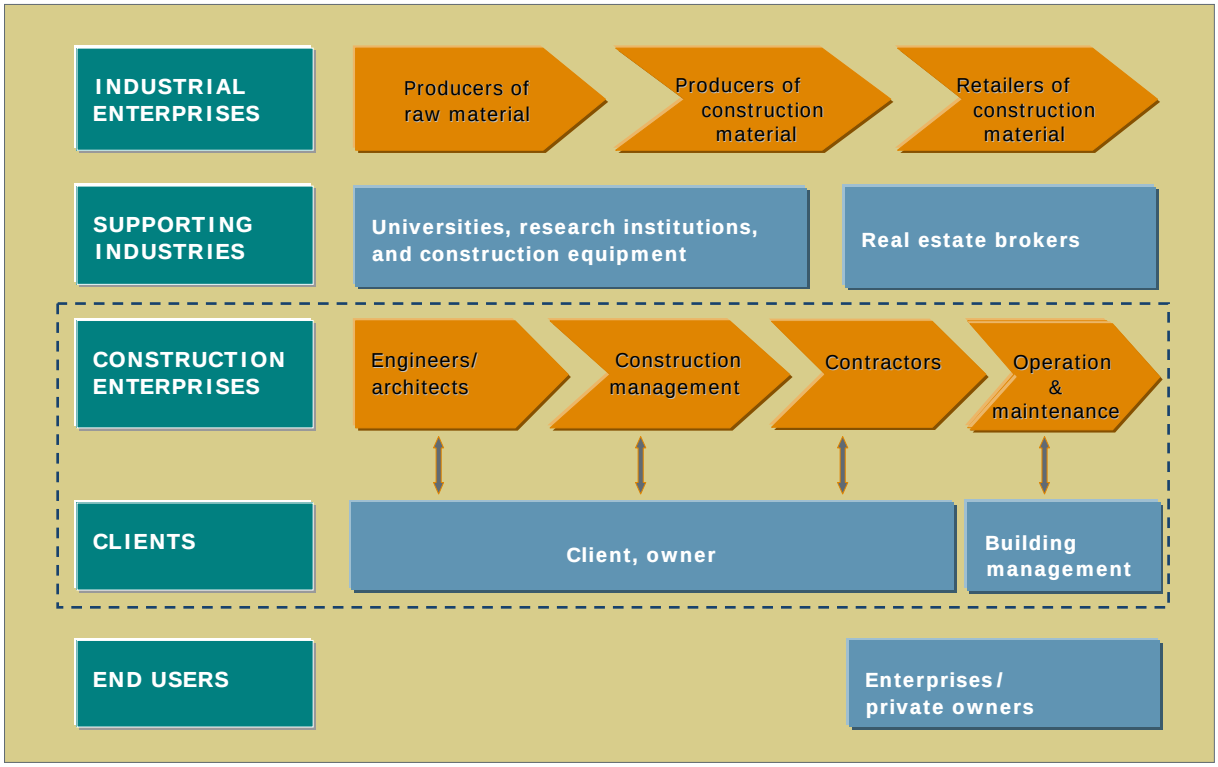
The sector value system

The CI value system consists of a large number of stakeholders. It is widely spread across many value-adding activities including raw material discovery and retrieval, construction material manufacturing, drawing, design, engineering, construction, and supervision. This study focuses on engineering and construction enterprises and construction clients/owners. However, as shown below in exhibit 2-2, these stakeholders are interlinked with other stakeholders such as manufacturing enterprises and supporting industries. The vertical value system represented in this exhibit starts with industrial

[16] 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.

enterprises producing and selling raw materials and ends with the users/owners of the infrastructure.[17]

Exhibit 2-2: The CI value chain



Source: Inspired by Danish National Agency for Enterprise and Construction, Building – House; a Business Analysis (Bygge – Bolig, en erhvervsanalyse), 2004

N.B: exhibit 2.2 above represents a simplified version of the construction supply chain. Economic operators such as certification and inspection bodies, insurance enterprises and administrations could be added to give a more detailed picture of the value chain.

2.2 Industry background

The European CI is currently experiencing a period of growth in production following a decade of limited growth. The growth in production has been estimated at about 1.8% for the year 2005 (CIFT 2006, p. 1). In the second quarter of 2006, the CI's seasonally adjusted production grew by 1.9% in EU25, compared to the previous quarter. Compared to the second quarter of 2005, output in the second quarter of 2006 in the sub-sector of building construction rose by 3.9% in EU25, after increases of 2.9% in the first quarter of 2006. The sub-sector of civil engineering grew by 0.4% in the EU25 after a fall of 3.9% respectively in the previous quarter (European Commission, STAT/06/116, Sep. 2006).

[17] The industry also includes stakeholders like official organs, construction industry think tanks, and trade- and industry associations.

The growth in production in the CI is, however, not evenly distributed across the EU Member States. Certain Member States have experienced high rates of growth in production (Ireland, Latvia, Slovakia, Slovenia, Czech Republic and, to a lesser extent, Austria, the United Kingdom, and Romania). On the other hand, the German and Portuguese CI have been subject to low growth in production for several years now (EBS 2005, p. 14). The new Member States are expected to see the highest growth rates in the CI over the years 2003-09, as their governments invest heavily to upgrade large sections of their infrastructure (Camecon, www.camecon.com, April 2006).

2.2.1 Size of the EU construction industry

According to recent figures from the European Construction Industry Federation (FIEC), the CI is the largest industrial cluster in the EU, representing some 9.9% of Gross Domestic Product (GDP), corresponding to one-quarter of the total European industrial output (FIEC 2006, p. 1). According to the European Commission, about 910bn euros were invested in construction in 2003, representing approx. 10% of the GDP and more than 50% of the Gross Fixed Capital Formation of EU-15.[18]

The estimated construction investment in EU-15 for 2004 is 1.004bn euros (FIEC 2006, p. 1). There are approximately 2.4m construction enterprises, of which 97% are micro or small enterprises with fewer than 20 employees. Enterprises with fewer than 250 employees (SMEs) account for 78% of the turnover and employ about 80% of the work force. According to FIEC, the industry employs 14m people equal to 7.1% of the European work force and 28.5% of industrial employment[19]. 26m workers in the EU depend, directly or indirectly, on the CI (FIEC 2006, p. 2).

The main activities in the European CI are house-building (26%), non-residential building (29%), civil engineering (20%) and rehabilitation (25%) (FIEC 2006, p. 2). Other sources indicate that the total European turnover is generated from new residential buildings (22%), maintenance and renovation of residential buildings (23%), new non-residential buildings (20%), maintenance and renovation of non-residential buildings (14%) and public procurement (21%) (European Builders Confederation, September 2006).

The new EU Member States also have large CIs. In Poland, the Czech Republic and Hungary alone, the turnover was about 38bn euros in 2003 and the market is estimated to grow significantly at an average rate of 4.2% per year.[20]

[18] European Commission, http://europa.eu.int/comm/enterprise/construction, April 2006

[19] Figures from the European Commission estimate the employment at around 11.8 m people.

[20] European Commission, http://europa.eu.int/comm/enterprise/construction, April 2006

2.2.2 Trends and challenges

The European CI currently faces some challenges brought on by globalisation, cross-border job migration and new ICT requirements. The industry is confronted with a trend towards consolidation among industry stakeholders, increased use of sub-contractors, increased focus on environmental issues and the impact of globalisation on the manufacturing of construction materials. The following section provides an overview of these trends and challenges.

Globalisation affecting procurement behaviour

Globalisation affects the European CI as the production of building materials is increasingly internationally based. Measures to offset the effects of globalisations are promoted by EU initiatives for certification of all products to be sold or traded in the European market. Globalisation is expected to lead to decreasing material prices, in particular for larger enterprises that purchase large volumes of building materials. Construction SMEs may have to collaborate in order to increase purchase volume, or charge customers higher material prices (EBS 2005, p. 14).

Large construction enterprises are already altering their procurement behaviour from decentralised site-specific procurement to centralised bulk procurement of frequently used building materials. This centralisation of procurement is, however, often a time-consuming process that requires organisational changes in order to be successful. Globalisation of the markets is, by some, expected to help improve quality in construction materials, and related additional costs can be shared across a broader market (EMCC 2005, p. 20).

Consolidation among industry stakeholders

Another - related - trend in the European CI is consolidation among construction contractors and engineering enterprises (Ricaud, www.pwc.com, April 2006). The market for construction materials is increasingly dominated by large enterprises with international operations, capable of profiting from standardisation efforts in the field of product norms. As a client of such enterprises, the CI is forced to acquire the appropriate market clout by creating mega-enterprises and entering alliances, thus presenting a counterweight to the growing bargaining power of its suppliers (UBS 2006, p. 1).

For larger construction enterprises, increasing customer demand – public, private, and public-private partnerships – will strengthen the consolidation of the industry. Enterprises require a broad range of qualifications, as well as a solid financial base, to be able to interact with the customer to develop customised building solutions.

To complement the full-service enterprises, small specialised suppliers will evolve. Their function will be to offer highly specialised and qualified products and services which the large enterprises do not regard as one of their key competencies. Due to the size of projects and the local character, continuous building maintenance will still mainly be carried out by small, local enterprises (EMCC 2005, p. 21).

Increased use of sub-contracting

Another trend in the European CI concerns the use of sub-contractors. According to one source, construction enterprises have, in recent year, increased the use of third parties to handle incoming orders (UBS 2006, p. 1). The continuity of resources – both human and material – that are crucial to managing the flow of work, can often be assured only by passing on some of the work to partner enterprises or by hiring temporary staff. This means, however, that construction enterprises face increasing demands in terms of quality assurance, cost planning and project monitoring.

Increased focus on environmental issues

Environmental issues have also gained importance in the European CI. The focus on environment and sustainability is continuously increasing among public and private building owners and users. This trend spans the whole life cycle of a building. In the construction process, many aspects should be taken into consideration: re-using existing physical assets; designing for minimum waste; minimising energy use throughout the life cycle; avoiding pollution; adding to bio-diversity; conserving water resources; respecting people and communities (EMCC 2005, p.19).

This trend is supported by the European Union Directive on energy efficiency. This directive is targeted at achieving a 1% yearly energy saving in the retail, supply and distribution of electricity, natural gas, urban heating, and other energy products including transport fuels. The Directive will further support the trend toward construction of energy efficient buildings and the promotion of energy-efficient construction processes. This theme is also relevant when renovating large urban areas in the new EU Member States. In these large-scale infrastructure projects, increasing emphasis is put on sustainable construction.

2.3 Review of earlier sector studies

The 2005 *e-Business W@tch* sector study on the CI concluded that ICT was not considered by the CI itself to be an essential parameter for business competitiveness.[21] Two sets of explanations for the low use of ICT were presented in the 2005 *e-Business W@tch* sector study on the CI:

- Construction services consist of unique projects with a natural manual element (labour-intensive). Customers generally demand tailor-made solutions and a close customer relationship over a longer period of time is typical for the construction process. Construction services thus seemed less suited for e-commerce than, for example, IT services and/or industries dealing with mass produced, standardised physical products.

[21] To access the 2005 e-Business W@tch sector study on the CI please visit www.ebusiness-watch.org

- There is a predominant oral culture in the CI with a conversation-based rather than a textual, information-based cooperation form. Traditions and habits seemed to form a barrier to ICT uptake in the sector. At the same time, in comparison with enterprises in some other sectors studied by the *e-Business W@tch*, construction enterprises to a higher extent employed staff with limited ICT skills and offered only irregular ICT training to their employees. Consequently, many enterprises demonstrated limited ICT competence levels.

The 2005 *e-Business W@tch* sector study also concluded that production improvements via ICT in the CI as a whole lagged behind other industries. The reportedly low ICT usage in construction SMEs, despite the purported availability of ICT solutions with good return on investment (ROI), implied that something was missing in these enterprises – either awareness of these systems or the competencies to use them (*e-Business W@tch* 2005b). Furthermore, it was concluded that in terms of internal integration, SMEs faced different challenges than the larger CI enterprises. Small companies did not usually have as many types of ICT applications as their larger counterparts and, thus, the issue of integration did not have a strong resonance among SMEs. On the other hand, findings of the 2005 survey indicated that many CI SMEs had neither a consistent ICT strategy nor sufficient skills and competencies to ensure an efficient integration of the ICT systems they already had. Other problems for SMEs in this sector included handling conflicting demands from various external customers and a tradition of using “home-made” systems.

External collaboration, in the form of business-to-business (B2B) cooperation, was identified as an area of high relevance and potential for SMEs in construction. Most SMEs were quite dependent on external relations with other enterprises in the industry. However, as demonstrated by case studies on the standardisation and interoperability initiatives from Denmark, Luxembourg and the Netherlands, there was still a long way to go before reaching more advanced solutions. Thus, many construction enterprises, especially SMEs, were left with less complicated ICT solutions, whereas larger enterprises were more active in this application area (*e-Business W@tch* 2005b, p. 66).

Finally, the field of e-procurement had thus far been driven primarily by the industry’s large enterprises which were found using e-purchases to support a broader rationalisation of procurement workflows. In last year’s sector study it was argued that SMEs were only involved to a limited degree in e-procurement of building materials. The most important challenge identified in this respect was supplying services to clients who were increasingly oriented towards electronic tendering. Participation in e-tendering meant that enterprises needed to have certain minimum ICT knowledge and literacy (*e-Business W@tch* 2005b, p. 66).

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.[22]

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"**.[23] 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).

In the CI 2.654 interviews were conducted; out of these, 754 with companies from the EU-10. Some data are broken down into the two main sub-sectors, i.e. the two NACE groups which make up the total CI as defined for this study (see Section 2.1): 45.2 (Building of complete constructions or parts thereof; civil engineering) and 45.3 (Building installation).

When representing data for the two NACE groups in Chapter 3, the abbreviation "*Comp. con.*" will be used to describe NACE group 45.2 and the abbreviation "*Installation*" will be used when referring to NACE group 45.3. It should be noted that the average size of surveyed "comp. con." enterprises was 411 employees and, respectively, 95 employees for "installation" companies. This difference in size indicates that complete construction enterprises have larger human and financial resources to invest in ICT. In addition, large construction enterprises more often take on the role of prime contractor and, hence, more often need ICT to communicate with project stakeholders and project management.

[22] 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).

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

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

3.1 Use of ICT Networks

Internet access

About nine out of every ten construction enterprises that were interviewed in 2006 said that they **have internet access**. This share is slightly below the weighted average for the 10 sectors covered by the e-Business Survey 2006. Almost all construction enterprises with 250 employees or more said that they have access to the internet, while a little less than 9 in 10 of this sector's micro-enterprises (i.e. with nine or less employees) did so. By share of employment, enterprises representing about 95% of the CI workforce reported having internet access.

Looking at different enterprise size-bands, the *e-Business W@tch* survey indicates that complete building enterprises have access to the internet more often than building installation enterprises. This difference can be attributed to the average size of the enterprise in the two different sub-sectors (see 'Background information about the e-Business Survey 2006').

CI enterprises representing about three quarters of the sector's workforce said that they have a **broadband internet connection**. Compared to the weighted average of the 10 surveyed sectors, the CI is placed just below the average, which is 76%. Compared to other sectors studied this year by *e-Business W@tch*, the CI has one of the lowest uptakes of broadband internet access, both in terms of percentage of employees and of firms. This can, to a large extent, be explained by the large number of SMEs in the CI and the nature of the work which does not involve the same amount of ICT as many other production sectors. Almost 9 in 10 of the large enterprises (250+ employees) have adopted broadband, compared to about 6 in 10 of the micro enterprises (1-9 employees).

This difference may be attributed to the fact that many micro-enterprises are sub-contractors to larger enterprises in this sector. When operating as a sub-contractor, the need for broadband internet may not be as high as when operating as a prime contractor with responsibility for project management, interaction and communication with the building's owner and the like.

In the two sub-sectors, adoption of broadband internet access is, again, more widespread among complete construction enterprises than among building installation enterprises. The explanation is the same as above, namely the higher share of large enterprises among the complete construction enterprises, with larger human and financial resources to invest in ICT, and a higher propensity to undertake assignments that require more sophisticated information systems.

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

	Companies with internet access		Companies with broadband internet access		Average share of employees with internet access*		Remote access to company network	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**95**	**90**	**72**	**64**	**n.a.**	**47**	**25**	**13**
Micro (1-9 empl.)		89		60		48		10
Small (10-49 empl.)		99		73		28		23
Medium (50-249 empl.)		99		86		38		40
Large (250+ empl.)		98		87		42		56
NACE 45.2 (Comp. con.)	97	93	80	71	n.a.	55	31	13
NACE 45.3 (Installation)	92	89	65	61	n.a.	43	20	12
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)	754		754		715		754	
Questionnaire reference	A1		A3		A2		A5	

* Read: “The average share of employees with internet access in a CI company is 47%”

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

According to the survey results, about half of **employees in the CI enterprises have access** to the internet. This is slightly above the weighted average of the 10 industries analysed this year. In comparison to other sectors studied by *e-Business W@tch* in 2006, companies in the CI appear to be better performing than footwear or food & beverages enterprises. In fact, only about a quarter of the employees in the footwear and food & beverages industries were reported having internet access. Companies in the tourism industry, however, appear to be performing better than CI ones in this field. This could be explained by the tourism sector’s focus on e-marketing / e-reservation which require increased access to the internet.

Concerning size-bands, data from this year’s survey indicate significant differences. SMEs in CI have reported a lower share of employees with internet access than both micro-enterprises and large enterprises. As regards micro-enterprises, the reported

higher share of employees with internet access could be explained by the fact that even small changes in the number of internet accesses in these companies would influence the percentage of employees with internet access. Concerning large enterprises, the higher representation of employees with internet access can be explained by the larger number of skilled employees in addition to the greater availability of resources to invest in ICT.

As regards differences between the two sub-sectors, less than 6 out of every 10 employees of complete construction enterprises have internet access, compared to slightly more than 4 in 10 working in building installation enterprises. Often only owners and key administrative personnel of small building installation enterprises use the internet which helps explaining the lower number of employees with internet access in this case.

Use of internal computer networks

Local Area Network (LAN) can be seen as a basic indicator of the minimum infrastructure requirements necessary to enable companies to conduct e-business on a substantial level (*e-Business W@tch*, Sector Study, 2003/2004, p. 25). According to the survey results about 4 in 10 surveyed enterprises in CI reported having a LAN. Compared to the weighted average of the 10 surveyed sectors, the CI is about in line. The average, however, covers significant differences between companies of different sizes, with a clear relationship between enterprise size and the uptake of LAN. About 9 in 10 large enterprises have implemented LAN as opposed to about a third of micro-enterprises. This relationship can largely be explained, again, by the larger resources and need for advanced ICT among large enterprises.

Complete construction enterprises also apply LAN technologies more often than building installation enterprises. Again, this should mostly be due to the larger share of prime contractors among complete construction enterprises.

Looking at wireless technology that can interlink computers with internal networks and the Internet – i.e. **Wireless Local Area Networks** (W-LAN) – the survey results show that about 1 in 10 of the CI enterprises has implemented such technologies. Compared to the weighted average of the 10 sectors included in the survey, the CI is slightly below. Again, a relationship between enterprise size and the uptake of WLAN can be identified, since about a third of the large enterprises reported having a WLAN, whereas only about 1 in 10 micro-enterprises did so.

However, while all CI company sizes lag behind the all-sector average, the lower uptake of WLAN in the CI is particularly pronounced for the larger size-groups. In the CI, enterprises representing 20% of the employment said that they use WLAN as opposed to enterprises representing about a third of employment in the weighted average of the 10 surveyed sectors. This lower uptake of WLAN in the CI can be partly explained by the large proportion of micro-enterprises in the CI often lacking financial resources for investment in WLAN. Indeed, it should be kept in mind that the sector – and thus the survey sample – has a high share of micro-enterprises which would account for the close proximity between the sector's and the micro-enterprises' averages.

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
Construction (EU-10)	**58**	**43**	**20**	**13**	**13**	**11**	**52**	**34**
Micro (1-9 empl.)		36		10		10		24
Small (10-49 empl.)		57		19		10		30
Medium (50-249 empl.)		86		29		11		60
Large (250+ empl.)		88		35		29		77
NACE 45.2 (Comp. con.)	65	50	22	11	14	11	53	12
NACE 45.3 (Installation)	52	40	18	14	12	11	50	45
All 10 sectors (EU-10)	**65**	**46**	**32**	**16**	**16**	**13**	**57**	**26**
Micro (1-9 empl.)		35		12		14		20
Small (10-49 empl.)		59		21		11		32
Medium (50-249 empl.)		84		37		13		57
Large (250+ empl.)		96		47		22		79
Base (100%)	firms using computers		firms using computers		firms using computers		Firms enabling remote access	
N (for sector, EU-10)	754		754		754		228	
Questionnaire reference	A4a		A4b		A4c		A6d	

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

Voice-over-IP

The use of telephony services over the internet has gained momentum over the past few years. Established as well as new telecommunication service companies and internet service providers offer new, cost-efficient services based on this technology. These services are commonly referred to as "Voice-over-IP" (VoIP) services, as they have in common that they use the Internet Protocol (IP) to transfer voice calls.

The uptake of VoIP in the CI is, in line with findings for the other sectors studied, not very high. About 1 in 10 construction enterprise reported using VoIP telecom services. This is roughly in line with the all-sectors weighted average. Furthermore, no significant differences are observed between the two CI sub-sectors or different size-classes, except for a significantly higher uptake among the largest enterprises – both in CI and across all sectors studied this year by *e-Business W@tch*. This may be attributed to the fact that VoIP is still an emerging technology.

Virtual Private Network

Production activities in the CI are often physically separated from supporting functions such as administration, accounting and other back-office activities. **Remote access to company networks** via virtual private networks (VPN) enables continuous information retrieval, and could therefore provide added value to the construction enterprises by

enabling employees to access enterprise systems on-site. Basically, VPN is a technology that uses public communication infrastructure to provide employees with a secure connection to the enterprise's network.

Enterprises representing 52% of employment in CI said that they use VPN for remote access to company networks. On this indicator, the CI is in line with the weighted 10-sector average and, again, the data show a clear relationship between enterprise size and VPN uptake. About 8 in 10 large enterprises have implemented VPN technology compared with about 1 in 10 of the micro enterprises. Besides the obvious explanation relating to financial and human resources for ICT growing with company size, another reason could be that construction SMEs mainly do business locally, while the geographical market reach is bigger for larger enterprises. Larger enterprises are, therefore, more dependent on remote access to stay in contact with their employees and may thus choose to a higher degree to invest in remote access systems.

Interestingly, the usual relationship between sub-sector and ICT uptake does not apply when looking at the number of enterprises using VPN. Employment-weighted data confirm the relationship between enterprise size and uptake of ICT in the two sub-sectors but, when looking at the number of enterprises, it appears that only about 1 in 10 complete construction enterprises reported using VPN compared to more than 4 in 10 building installation enterprises which did so. If not caused by statistical errors, this discrepancy would be difficult to explain without further investigation.

3.2 ICT Skills, Outsourcing and ICT Budgets

3.2.1 Demand for ICT skills and skills development

About 15% of construction enterprises surveyed by *e-Business W@tch* in 2006 said that they **employ ICT practitioners**, a percentage which is in line with the all-sectors average. Not surprisingly, there is a straight-forward relationship between company size and the employment of ICT practitioners, ranging from 14% among micro-enterprises up to more than half of the large firms. Again, the main explanation is that the larger the enterprise, the greater the capacity to take on more complex assignments which may require the company to be able to handle e.g. 3D technologies for construction design, different types of document management and other advanced ICT systems. These types of systems require ICT practitioners to implement and maintain. Compared with the other sectors covered by this year's survey, the CI is one of the four sectors reporting low rates of employing ICT practitioners, both when looking at the employment-weighted numbers (between 20 and 27%) and in terms of the share of firms (between 11% and 14%).

Another important element of ICT skills development is the use of **ICT training of employees**. In the CI, 12% of enterprises said that they carry out regular ICT training of their employees, which is again very close to the weighted average of the 10 surveyed sectors. However, when looking at employment-weighted figures, the CI is somewhat below the all-sectors average. Also in this case, the survey results show differences in the use of regular ICT training across different enterprise sizes. About one third of the

surveyed large CI enterprises reported regular ICT training, a percentage which is about three times as high as among this sector's micro-enterprises. This confirms that there seems to be more limited need for, and focus on, ICT skills development among construction SMEs. Interestingly, building installation enterprises reported regular ICT training more often than complete construction enterprises. This observation is interesting because, if confirmed by further analysis, it could indicate that there is a movement towards reducing the ICT gap between the two sub-sectors.

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
Construction (EU-10)	**22**	**14**	**18**	**12**	**2**	**1**	**12**	**8**
Micro (1-9 empl.)		14		10		1		9
Small (10-49 empl.)		19		18		0		7
Medium (50-249 empl.)		28		28		2		14
Large (250+ empl.)		52		32		6		30
NACE 45.2 (Comp. con.)	24	14	16	7	2	0	14	9
NACE 45.3 (Installation)	20	14	19	15	1	2	11	7
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Micro (1-9 empl.)		12		9		2		12
Small (10-49 empl.)		15		16		0		11
Medium (50-249 empl.)		29		28		2		19
Large (250+ empl.)		59		41		6		35
Food & beverages	26	11	26	14	2	0	16	9
Footwear	20	13	14	6	1	0	7	5
Pulp & paper	35	16	29	12	3	1	21	13
ICT manufacturing	52	31	39	24	8	3	28	20
Consumer electronics	35	17	21	16	4	2	23	18
Shipbuilding & repair	36	33	29	20	4	0	14	15
Construction	22	14	18	12	2	1	12	8
Tourism	27	12	21	11	3	2	29	15
Telecommunication	63	33	52	21	12	5	41	28
Hospitals activities	57	39	39	34	5	3	26	22
Base (100%)	firms using computers							
N (for sector, EU-10)	754		754		754		754	
Questionnaire reference	B1		B4		B2		B5	

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

e-Learning, i.e. the support of training with learning material in electronic format (for example material that is available on a company's intranet or the internet), is another interesting indicator for the uptake of ICT in the CI. According to the survey results, a limited number of enterprises reported e-learning practices: 8% of CI enterprises, representing 12% of employment, which is below the weighted all-sectors average, where enterprises representing 21% of employment said that they use e-learning.

In terms of differences between size-classes, about every tenth micro or small CI enterprise reported using e-learning compared to about every third large enterprise. These figures can, to a certain extent, be explained by the fact that many construction SMEs conduct the bulk of their employee training on-site and on-the-job. Larger construction enterprises may, due to a larger organisation, more resources and higher numbers of administrative personnel, have a higher propensity to prefer a more standardised employee training programmes which can include e-learning.

Another interesting indicator is the share of companies which reported **hard-to-fill ICT jobs**. This indicator may, on the one hand, indicate the condition of the current labour market for ICT professionals and, on the other, provide useful insights about the demand for ICT practitioners. Survey findings show that the reported number of hard-to-fill vacancies for ICT jobs is limited in the CI, with only 1% of enterprises saying that they have problems filling such vacancies. This picture is fully in line with the respective all-sectors average and similar to most other sectors studied in 2006, except for the ICT-intensive ones. This limited demand for ICT skills is further supported by the analysis in Section 4, suggesting that SMEs have difficulties in identifying the benefits of using ICT systems and employing ICT practitioners.

3.2.2 Outsourcing of ICT services and ICT investments

Outsourcing

In 2006 *e-Business W@tch* asked enterprises whether they had outsourced during the previous year any of their ICT services which they were previously conducting in-house. Outsourcing of services can be a solution when internal resources are not readily available and/or when it is economically sound to place parts of the business process outside the traditional boundaries of the enterprises.

14% of CI enterprises, representing a fifth of employment in this sector, said that they had **outsourced ICT services** which they had previously conducted in-house. This figure is in line with the weighted average of the 10 sectors both in terms of number of enterprises and in terms of employment.

Looking at enterprise sizes, there are two interesting observations. Firstly, all CI enterprise groups except the micro-enterprises are, for once, above the all-sectors average when it comes to outsourcing ICT services. However, this is actually consistent with the other indicators showing that CI in-house ICT capabilities are generally lower than in other sectors studied this year, thus making it quite natural to outsource some ICT processes. Secondly, there is a considerable gap between micro-enterprises, which rarely outsource ICT services, and all other types of enterprises, which reported doing so fairly regularly. This observation may be explained on the following grounds: when outsourcing services, the volume, in terms of contract sum, must be high enough for ICT service providers to be willing to engage in an outsourcing agreement. Many of the operations in a micro-enterprise may not be large enough for outsourcing.

Exhibit 3-4: Outsourcing and spending on ICT

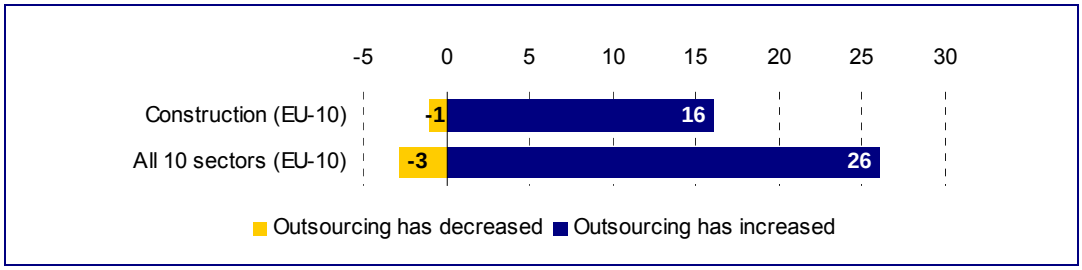
	Have outsourced ICT services in 2005		Share of ICT budget as % of total costs		Have made ICT investments in 2005		Difficulty to draw funds for investments	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**20**	**14**	**5**	**4**	**58**	**45**	**(7)***	**(11)***
Micro (1-9 empl.)		8		4		38		(13)**
Small (10-49 empl.)		24		4		60		(0)**
Medium (50-249 empl.)		23		5		79		(0)**
Large (250+ empl.)		41		8		85		(0)**
NACE 45.2 (Comp. con.)	24	14	5	3	64	52	(0)*	(0)*
NACE 45.3 (Installation)	16	14	5	4	51	42	(15)*	(18)*
All 10 sectors (EU-10)	**19**	**14**	**6**	**5**	**65**	**50**	**19**	**15**
Micro (1-9 empl.)		8		5		39		25
Small (10-49 empl.)		21		5		60		3
Medium (50-249 empl.)		21		6		78		6
Large (250+ empl.)		31		6		86		29
Base (100%)	firms using computers		all firms (excl. "don't know")		firms using computers		Firms with external funding sources for their ICT investments	
N (for sector, EU-10)	754		482		754		28	
Questionnaire reference	B6		C1		C3		C5	
( )* numbers are only indicative due to low number of observations (< 50) ** numbers are not of statistical value because of low number of observations (< 25)								

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

In addition, the articulation and optimisation of internal business processes may not be as highly prioritised among micro-enterprises. The same pattern to the one described above can be identified for the all-sectors average, thus indicating that this is more of a general pattern related to company size rather than a specific case for the CI. It could, consequently, be argued that outsourcing follows a time sequence: large enterprises, due to size and business volume, will be the first movers and medium, small and micro enterprises will gradually follow for business processes useful for outsourcing in the CI.

The increased focus on outsourcing in the CI is further supported by the finding that 16% of enterprises said that the amount of ICT outsourcing has increased in 2005 (compared to the year before) while a very limited number of enterprises stated that outsourcing has decreased. However, the trend toward outsourcing is much stronger in other industries, indicated by the weighted average of the 10 surveyed sectors, where 1 in 4 companies has reported increased outsourcing activities. In eight of the ten sectors studied this year by *e-Business W@tch*, the share of enterprises that reported an increase in ICT outsourcing is higher than in the CI.

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



Base (100%): Companies that have outsourced ICT services. N (for sector, EU-10) = 117

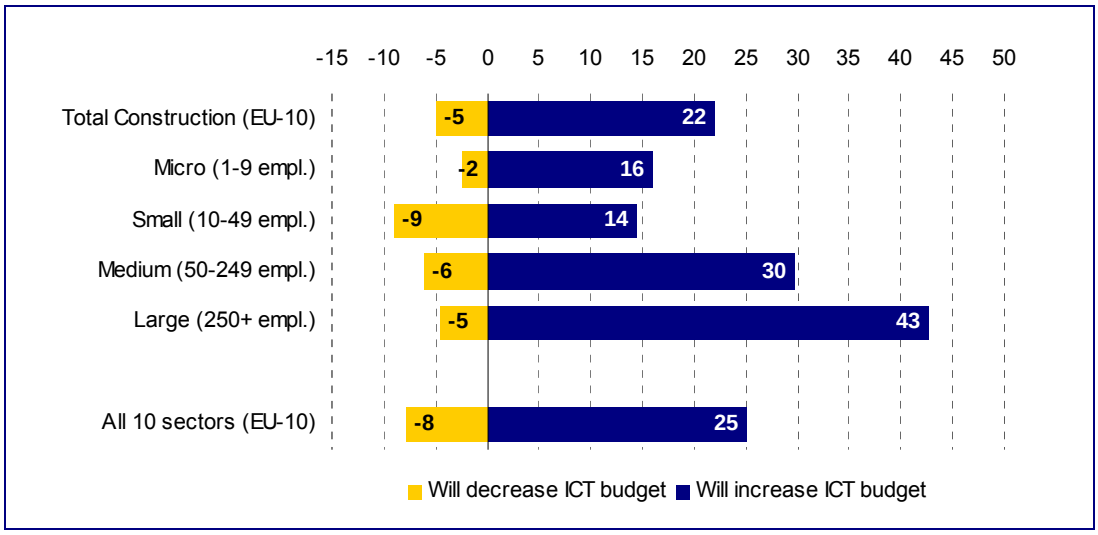
Weighting: in % of firms. Questionnaire reference: C2

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

ICT investments and expenditure

Surveyed CI companies stated their **ICT budget** corresponds to about 4% of their total expenditures (see Exhibit 3-5). This figure is in line with the respective weighted average across all the studied sectors. Large CI enterprises use about twice as much of their total budget on ICT compared to the sector's micro-enterprises, clearly indicating that large enterprises have more focus on ICT as a source of competitive advantage.

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) = 718.

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)

This is confirmed by the survey results on **ICT budget trends** (see Exhibit 3-6). Overall, about 1 in 5 construction enterprises is expected to increase its ICT budget and only about 1 in 20 expects to decrease it in the coming year. According to the same findings, however, more than 40% of large CI enterprises intend to increase their ICT spending in the coming year, while only about 15% of the sector's micro and small enterprises said that they will do so. This should be viewed in conjunction with findings shown in exhibit 3-5, according to which only four in ten micro-enterprises and about 6 out of every 10 small CI companies reported having made **ICT investments** in 2005 compared to nine in ten among the sector's large enterprises. It, therefore, seems likely that, if no major changes occur in companies' investing behaviour, the already identified –negative- relationship between enterprise size and ICT uptake in this sector will continue if not intensify.

About 1 in 10 enterprises has experienced **difficulties in drawing funds** for their ICT investments, which is slightly below the all-sectors average. However, this figure is only indicative due to statistical uncertainty (low number of observations).

Looking into the **sources of finance** for ICT investments, 74% of CI firms said that they use cash-flow financing which is a little below the 82% of firms in the weighted 10-sectors average, but exactly in line in terms of employment-weighted figures (see Exhibit 3-7). Only about 1 in 10 CI firms reported using bank loans for ICT investments, while venture capital and public funds are rarely used as financial source for ICT investments by this sector's companies.

Exhibit 3-7: Major source for investments in ICT

	Cash-flow financing		Bank loans		Venture capital		Public funds and other	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**74**	**74**	**10**	**13**	**2**	**2**	**2**	**3**
Micro (1-9 empl.)		73		15		2		2
Small (10-49 empl.)		76		8		1		2
Medium (50-249 empl.)		77		6		0		0
Large (250+ empl.)		79		0		3		0
NACE 45.2 (Comp. con.)	72	68	8	12	3	4	2	4
NACE 45.3 (Installation)	78	78	11	13	1	1	1	3
All 10 sectors (EU-10)	**74**	**82**	**5**	**7**	**1**	**1**	**9**	**7**
Micro (1-9 empl.)		82		8		1		2
Small (10-49 empl.)		81		6		1		2
Medium (50-249 empl.)		70		8		1		2
Large (250+ empl.)		67		2		1		8
Base (100%)	firms that have made investments in ICT							
N (for sector, EU-10)	458		458		458		458	
Questionnaire reference	C4		C4		C4		C4	

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

Compared to the respective all-sectors weighted averages, CI enterprises in general, and in particular micro and small enterprises, seem to be using cash-flow financing less often

and bank loans more frequently as the main source for their investments in ICT. However, this is not the case for the medium-sized and large companies in this sector, which have reported more cash-flow financing and less bank loan financing. This may be a contributing factor to the rather low level of ICT budget especially among this sector's SMEs: ICT investments often require rather high once-off investments, which can be difficult to finance through cash-flow, thus explaining the higher level of bank loan financing among SMES.

Looking into the two sub-sectors analysed in this report, it is evident that building installation companies use cash-flow financing more often than complete construction enterprises. This may be partly explained by the latter's greater awareness of external funding opportunities such as venture capital and public funds, also taking into account their usually larger average size and more regional, national and international activities.

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*"[24]. The agreement on shared technical standards is an instrument to achieve compatibility between different systems. Without interoperability of ICT systems, which requires standards and compatibility between standards, advanced forms of e-business (such as the digital integration of systems in B2B exchanges) is hardly possible.

3.3.1 Types of e-standards used

The use of ICT-related standards is not widespread in the CI. Enterprises representing about 3% of employment reported using EDI-based standards which is three times lower than the weighted all-sectors average. In addition, enterprises representing 8%, 15% and 2% of the sector's employment reported using XLM-based, proprietary and other standards respectively. On all types of standards, the CI is below the respective all-sectors weighted averages. The reported use of e-standards is much higher among large CI enterprises, a finding which further supports the notion that larger enterprises apply more advanced ICT solutions than the smaller size-bands. While no substantial differences can be observed between the two sub-sectors, it is interesting to notice that the share of large CI firms which reported using XML-based and/or proprietary standards is quite high and practically in line with the respective all-sectors averages.

[24] Directive 98/34/EC of the European Parliament and the Council of 22 June 1998, laying down a procedure for the provision of information in the field of technical standards and regulations, see http://europa.eu.int/eur-lex/pri/en/ oj/dat/1998/l_204/l_20419980721en00370048.pdf

Exhibit 3-8: Use of e-standards

	EDI-based standards		XML-based standards		Proprietary standards		Other standards	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**3**	**2**	**8**	**4**	**15**	**10**	**2**	**2**
Micro (1-9 empl.)		2		4		12		2
Small (10-49 empl.)		2		6		8		0
Medium (50-249 empl.)		3		3		22		0
Large (250+ empl.)		11		32		26		7
NACE 45.2 (Comp. con.)	4	3	9	3	15	5	4	5
NACE 45.3 (Installation)	2	1	7	5	16	12	1	1
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
Base (100%)	firms using computers		Firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	754		754		754		754	
Questionnaire reference	G1a		G1b		G1c		G1d	

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

Overall, in view of the all-sectors average, CI companies do not seem to implement ICT-related standards to the same degree as their counterparts in other sectors. This could prove an obstacle to advanced forms of e-business. The slow uptake of ICT standards which is shown by the survey results is also supported by the analysis presented in Chapter 4. There, it is concluded that the slow uptake of ICT standards in the CI is primarily due to the lack of international cross-sector standards.

3.3.2 Use of Open Source Software

The Open Source model

Open Source Software (OSS) refers to computer software under an open source license. An open source license is a copyright license for software that makes the source code available and allows for modification and redistribution without having to pay or seek permission from the original author(s). 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 and the internet browser Firefox (a Mozilla browser) have each achieved significant market shares.

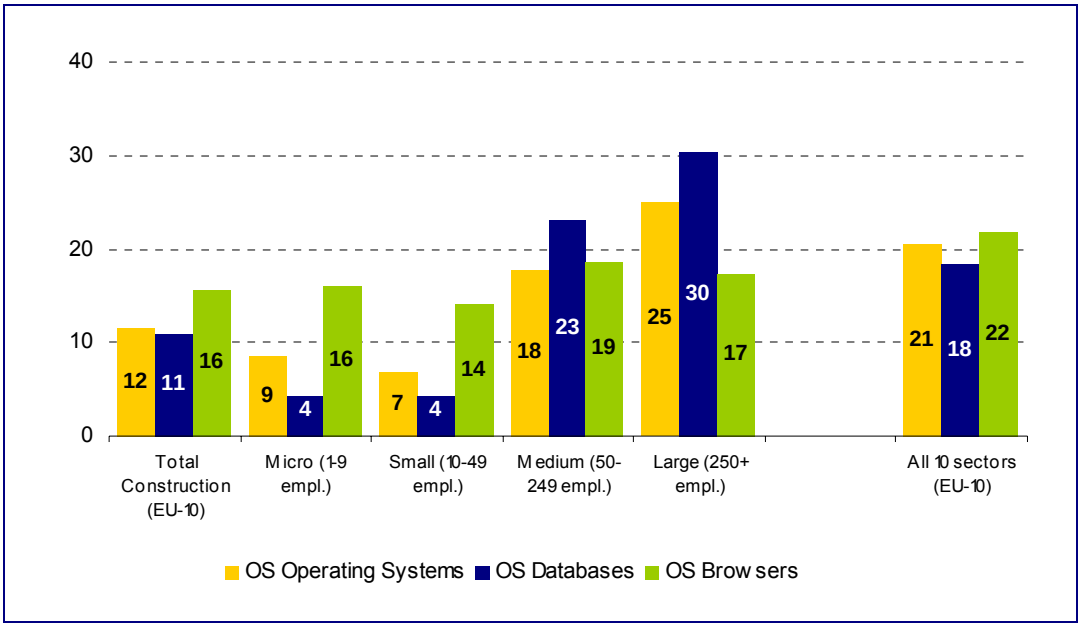
Policy-makers are interested in monitoring OSS developments and the uptake among companies for several reasons. There is some debate and different views on whether the use of OSS-based operating systems could reduce ICT costs for SMEs, at least in the

long run. Another aspect is whether OSS systems may help to "unlock" companies from specific ICT service providers in the future.

Deployment of Open Source Software

In 2006, *e-Business W@tch* asked enterprises on their use of OSS in operating systems, databases and browsers. As illustrated in Exhibit 3-9, OSS is not widespread in the CI. About 1 in 8 firms in this sector reported using OS operating systems, about 1 in 9 said that they use OS databases and about 1 in 7 did so for OS browsers. In terms of different enterprise sizes, it is evident that the uptake of OS browsers is almost the same for all enterprise sizes, whereas the use of OS operating systems and databases tend to increase with company size. This is not surprising, since databases and, in particular, operating systems, are generally both more complex and more significant to key business processes than internet browsers. Thus, using OS versions of these systems will often require more ICT skills than proprietary systems. These findings are in line with the analysis presented in Chapter 4 where it is argued that large enterprises apply more advanced ICT solutions and technology and, in addition, they are more aware of the potential for increased competitive advantage through the use of ICT.

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



Base (100%): Companies using computers. N (for sector, EU-10) = 754.

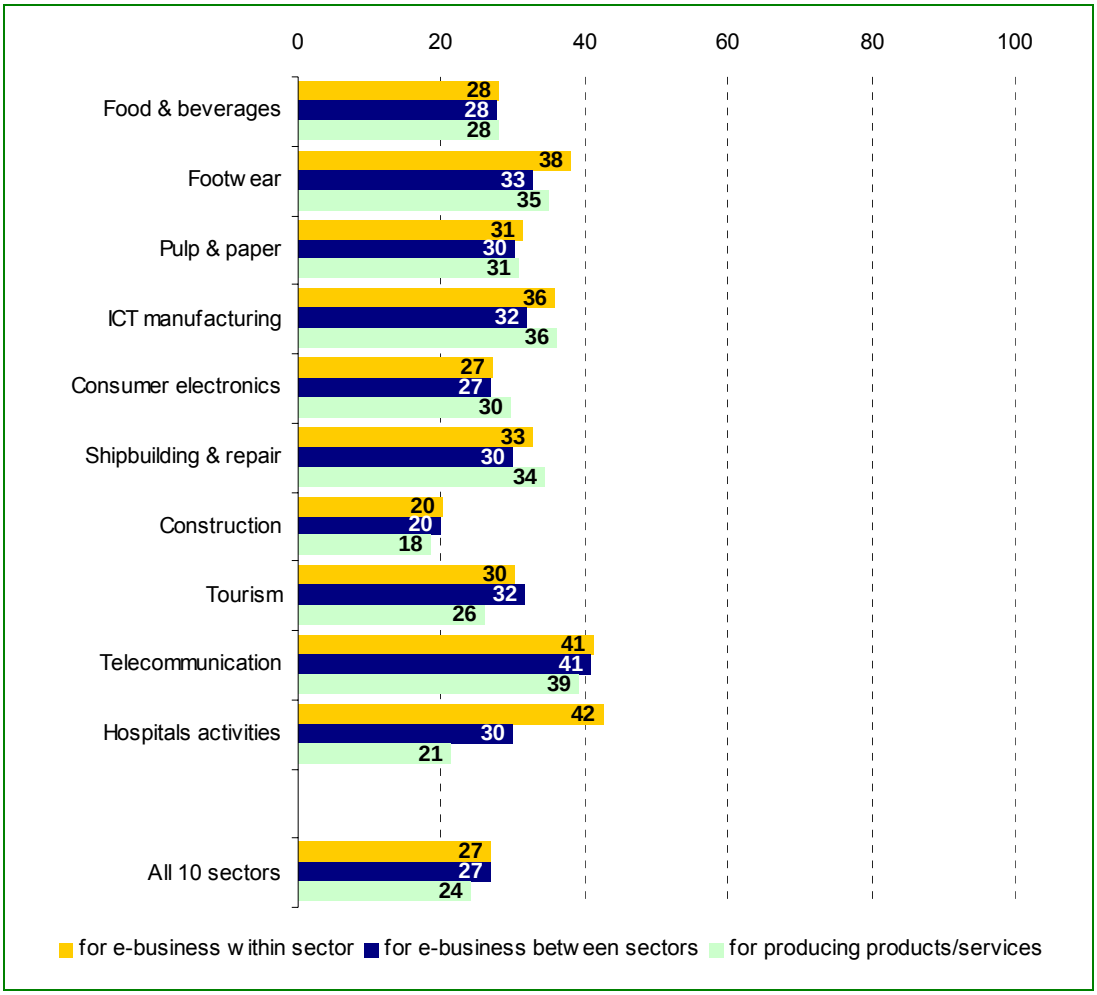
Weighting: Totals (for the sector and for all 10 sectors) are weighted by employment and should be read as "enterprises comprising …% of employment in the sector(s)". Figures for size-bands are in % of enterprises from the size-band. Questionnaire reference: G8

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

3.3.3 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*."[25] As illustrated in Exhibit 3-10, only about 1 in 5 of the CI enterprises found the issue of interoperability critical for conducting different types of e-business. Interoperability is seen as less important for producing products/services than for e-business in and between sectors. Of all ten sectors surveyed this year by *e-Business W@tch*, the CI appears to be the one putting – by far- less focus on the importance of interoperability. This observation is in line with the overall analysis of ICT uptake in the CI.

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



Base (100%): Firms using computers. N (for sector, EU-10) = 769.
Weighting: in % of firms. Questionnaire reference: G5a-c

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

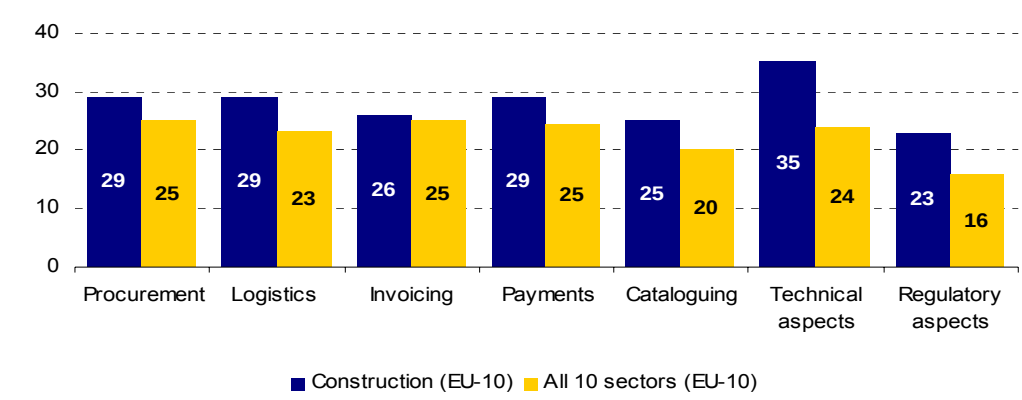
[25] Definition by IEEE and ISO, cf. *e-Business W@tch* Special Study on e-Business Interoperability and Standards, September 2005, p. 14. Available at www.ebusiness-watch.org ('resources').

Taken at face value, this does not support the notion that interoperability issues are a barrier to the CI. What is important to take into consideration, however, is that many micro and small enterprises have not yet had any experience with e-standards and interoperability issues and, hence, may have difficulties in assessing their importance. Due to the limited uptake of advanced ICT solutions among this sector's micro-firms and SMEs, only a few –mostly large– construction enterprises have been faced with the possible challenge of interoperability for e-business.

In line with the findings presented above, Exhibit 3-11 shows that between one in four and one in three of the CI enterprises who said that interoperability is critical to their business reported difficulties stemming from a **lack of interoperability**. This is more than the weighted average of the 10 sectors studied this year by *e-Business W@tch*. On all factors, more CI respondents have indicated problems related to interoperability than in the weighted average of all sectors.

The CI enterprises especially reported problems with the technical aspects of interoperability. This could be attributed to the use of advanced ICT applications among some large enterprises (mainly engineering and prime contractors, and specialist enterprises). Here, applications such as 3D technology, electronic procurement systems and document management systems are more widespread. As will be further discussed in Chapter 4, to reap the full benefits of these types of ICT applications interoperability is required. It could be supposed that the relatively high number of CI enterprises saying that they have experienced interoperability problems in respect to technical aspects stems from the development and implementation of these systems.

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



Base (100%): Firms that say that interoperability is critical for their e-business. N (for sector, EU-10) = 255.
Weighting: In % of firms. Questionnaire reference: G6

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 detail in its survey of 2005. Results, which were presented in a special report,[26] 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 of particular policy interest were also included in the e-Business Survey 2006.

Secure Server Technology

"Secure server technology" refers to data exchange between computers based on certain technical standards or protocols, for example "Secure Sockets Layer" (SSL); this is a commonly used protocol for managing the security of a message transmission using the internet. SSL has recently been succeeded by Transport Layer Security (TLS), which is based on SSL, but the latter is still widely used[27].

One in five CI enterprises (representing about a quarter of the sector's employment) reported using secure server technology, which is in line with the weighted all-sectors average but rather lower than the all-sectors average of 36% for employment-weighted data (see Exhibit 3-12). Half of the sector's large enterprises said that they use secure server technology, compared with one in five micro-enterprises. Again due to the less advanced ICT solutions implemented in micro-enterprises, the need for secure server technology may not be as pronounced. In addition, awareness among micro-enterprises of the usefulness of SSL is not deemed as high as among larger enterprises.

When looking into the application of **firewalls,** close to six in ten enterprises apply this rather simple form of data protection. This is, again, slightly below the weighted 10-sector average. Looking at the employment-weighted data, the difference is more pronounced and again the CI is performing worse than the all-sectors average. This might mainly be attributed to the relatively low uptake of ICT in general and, especially, to the low level of e-commerce, e-marketing and other e-practices applied by CI enterprises. A relationship between enterprise size and ICT uptake is visible as almost 9 in 10 large enterprises in this sector reported using firewalls but only five in ten CI micro enterprises did so.

[26] 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').

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

Exhibit 3-12: 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
Construction (EU-10)	**26**	**19**	**19**	**12**	**69**	**56**
Micro (1-9 empl.)		19		10		52
Small (10-49 empl.)		18		18		72
Medium (50-249 empl.)		31		24		83
Large (250+ empl.)		53		32		89
NACE 45.2 (Comp. con.)	29	16	21	17	73	61
NACE 45.3 (Installation)	23	20	18	10	64	54
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
Base (100%)	firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	754		754		754	
Questionnaire reference	G9a		G9b		G9c	

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

Digital signature

e-Signature is electronic information attached to or associated with a contract or another message used as the legal equivalent to a written signature. Electronic signature is often used to mean either a signature imputed to a text via electronic means, or cryptographic means to add non-repudiation or 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 in the integration of business processes between different enterprises, specifically for the legal recognition of documents sent electronically, as is the case for invoices[28].

The percentages of CI enterprises which said that they use digital signature or public key infrastructure are slightly below the all-sectors averages when looking at either the number of enterprises or the share of employment (see Exhibit 3-12). Again, substantial differences are observed between different size-classes but this is also in line with

[28] To this end, in 1999, the European Union issued the e-Signature Directive (Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures. OJ No L 13 p.12 19/1/2000. 12 February 2000)

findings across all sectors studied this year by *e-Business W@tch*. As illustrated in the case study about *e-Vergabe* and discussed in Chapter 4, however, digital signature or an equivalent can sometimes be a prerequisite for engaging in e-tendering procedures with public authorities. If digital signature becomes a prerequisite in many electronic interactions, the identified gap in the use of digital signatures may widen the ICT gap between micro and large enterprises in this sector.

3.4 Internal and External e-Integration of Processes

The use of ICT and e-business to support and optimise intra-enterprise processes has become increasingly important in many European sectors, especially in manufacturing. Through **digitization of formerly paper-based processes**, information and documents related to incoming or outgoing orders can be **seamlessly processed** along the enterprise's value chain; orders can be linked with production and inventory management, and the underlying software systems support controlling and management by enabling full transparency of all business processes. Furthermore, **collaborative processes** within and between companies are supported, such as information sharing among employees (for example by use of an intranet), planning and demand forecast, organising and archiving documents, and human resources management. In general, ICT applications for these purposes are predominantly used initially by large enterprises, and eventually also by SMEs.

Large enterprises in the CI are increasingly focusing their attention on the potential of digitalisation of the workflow processes. In particular for document sharing and accounting purposes, some European construction enterprises have implemented advanced ICT-based systems. The survey results on collaborative design processes (3D technology) are presented in Section 4.2.

3.4.1 Use of software systems for internal process integration

The use of **intranet** enables employees to share information within the organisation. In the CI, 22% of enterprises reported having an intranet (see Exhibit 3-13). Compared with the all-sectors average, the CI is about in line when focusing on the number of enterprises, but lagging behind on the employment-weighted averages: enterprises representing about a third of employment in CI reported having an intranet, compared to more than 40% across all sectors studied this year by *e-Business W@tch*.

As concerns the two sub-sectors, observed differences are not marked. Although a higher share of building installation enterprises than of complete construction enterprises said that they have an intranet, the picture is inverted when looking at the employment-weighted figures. Differences between size classes are more distinct: about 7 in 10 large CI enterprises reported having an intranet compared to only two in ten micro enterprises. This observation is mainly due to the need for more formalised (ICT-based) knowledge-sharing in large enterprises.

In smaller enterprises, **accounting software** typically substitutes the functionality of enterprise resource planning systems (ERP), although on a much simpler level and with a lower potential for automating order-related document flows. The small share of ERP systems may hamper advanced forms of B2B integration, for instance e-invoices. About 6 in 10 CI enterprises out of those not using ERP have implemented accounting software. Overall, the share of CI enterprises which reported using accounting software is completely in line with the all-sector average (in terms of both firm- and employment-weighted data).

Compared to the uptake of accounting software, about one in ten CI enterprises reported using **ERP systems**. This is in line with the weighted average for all 10 sectors studied this year by *e-Business W@tch*. The overall figure, however, covers some differences between size-bands: 37% of large enterprises said that they use ERP systems compared to only 8% of micro-enterprises doing so. In continuation of the above observations on accounting software, it can be argued that enterprises often start with more simple accounting software and, when the enterprise grows, introduce more advanced solutions such as ERP. This observation, however, cannot be directly supported when looking into the use of ERP systems in the two CI sub-sectors. The survey shows that building installation enterprises more often have ERP systems than complete construction enterprises. This observation does not fit the general picture of the sub–sector, where complete construction enterprises are generally larger and perform better on a number of other indicators.

Document management systems (DMS) provide the ability to keep track of a large quantity of documents and offer relatively easy access to the filing system. In the CI, 15% of enterprises (representing 17% of the sector's employment) said that they use DMS, which is in line with the weighted all-sectors averages. As indicated by the employment-weighted data, differences between enterprises of different sizes are small as concerns the use of DMS. Similarly to findings for ERP use, the pattern usually observed between the two sub-sectors does not apply to this indicator either. Again, results show that building installation enterprises use DMS more often than complete construction enterprises – but there are no obvious explanations for this change in the pattern.

One observation is, however, common for all the above-mentioned ICT systems (intranet, accounting, ERP and DMS): micro, small and medium-sized CI enterprises are well in line with the respective all-sectors averages, but large CI companies appear lagging behind their counterparts across all sectors studied this year by *e-Business W@tch*. A similar trend can be detected on a number of other indicators, but the pattern is much more pronounced for these internal process integration systems. This indicates even more strongly than before that ICT use in the CI has a tendency to lag behind, since large enterprises in all sectors are usually first-movers and the ones that set the standards for the rest of the sector. The lagging behind of the large CI enterprises on these indicators may, incidentally, also help in explaining the unusual patterns for the two sub-sectors, since the complete construction sector has more large enterprises than the building installation enterprises.

Exhibit 3-13: 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
Construction (EU-10)	**31**	**22**	**68**	**58**	**18**	**11**	**17**	**15**
Micro (1-9 empl.)		19		54		8		15
Small (10-49 empl.)		28		75		20		14
Medium (50-249 empl.)		36		88		26		16
Large (250+ empl.)		67		71		37		22
NACE 45.2 (Comp. con.)	33	16	74	63	17	7	14	10
NACE 45.3 (Installation)	29	24	63	56	20	13	19	18
All 10 sectors (EU-10)	**42**	**23**	**70**	**57**	**19**	**11**	**19**	**13**
Micro (1-9 empl.)		19		50		7		11
Small (10-49 empl.)		28		70		16		13
Medium (50-249 empl.)		43		85		25		19
Large (250+ empl.)		76		88		45		42
Base (100%)	firms using computers		Firms not using an ERP system		firms using computers		firms using computers	
N (for sector, EU-10)	754		624		754		754	
Questionnaire reference	D1a		D1e		D1d		D1c	

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

3.4.2 Use of ICT for cooperative and collaborative business processes

Sharing of documents in a collaborative workspace can be used to disseminate relevant information about construction projects to the involved partners, and make possible the retrieval of vital information – construction plans and drawings – from the partners at all times. Collaborative software supports project management and improves productivity through effective online document handling, workflow coordination, drawing mark-ups and knowledge management[29].

Looking into the 2006 survey results, less than one in ten CI enterprises said that they share documents in collaborative workspaces. This is well below the weighted all-sectors average and can probably be explained by the traditional workflow processes in this sector. Documents' sharing in a collaborative work-space is much more frequent among large enterprises than micro-enterprises, again supporting the strong relationship between enterprise size and the uptake of ICT in this sector.

Management of capacity/inventory online is not widely used in the CI. Less than 10% of CI enterprises (representing about 15% of the sector's employment) reported using such applications – but these figures are practically in line with the respective all-sectors'

[29] Cf. e-Business Sector Study on the Construction Industry, July 2005, www.ebusiness-watch.org ('resources'), p. 34.

averages. Again, as would be expected, online capacity/inventory management is more frequently used by medium-sized and large enterprises than by smaller CI firms. The explanation lies mainly in this industry's nature, with raw materials and semi-finished products being often ordered directly from building sites as they are consumed.

Exhibit 3-14: Online cooperation and collaboration within the value system

	Share documents in collaborative work space		**Manage capacity / inventory online**		**Collaborative design processes**		**Collaborative forecasting of demand**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**22**	**9**	**14**	**8**	**9**	**5**	**14**	**8**
Micro (1-9 empl.)		8		8		4		6
Small (10-49 empl.)		20		13		8		13
Medium (50-249 empl.)		30		17		9		16
Large (250+ empl.)		49		22		29		32
NACE 45.2 (Comp. con.)	27	15	14	7	13	6	17	8
NACE 45.3 (Installation)	17	6	14	8	5	4	11	8
All 10 sectors (EU-10)	**27**	**14**	**22**	**10**	**15**	**7**	**20**	**11**
Micro (1-9 empl.)		10		8		5		10
Small (10-49 empl.)		19		14		8		13
Medium (50-249 empl.)		31		21		13		19
Large (250+ empl.)		47		41		25		41
Base (100%)	firms with internet access		firms with internet access		firms with internet access		firms with internet access	
N (for sector, EU-10)	723		723		723		723	
Questionnaire reference	D5a		D5e		D5d		D5c	

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

Overall, the CI scores lower –but not much- than the respective all-sectors averages for most aspects of e-collaboration. This rather low uptake of e-collaboration systems and tools can be mainly attributed to the often low-tech nature of the CI which is especially observed among micro-enterprises, whereas large enterprises are mostly on a par with the respective all-sectors averages. This observation probably reflects the increasing uptake among industry leaders of new collaborative tools such as 3D and project webs, which will be discussed in more detail in Section 4.

3.4.3 Deployment of e-invoicing

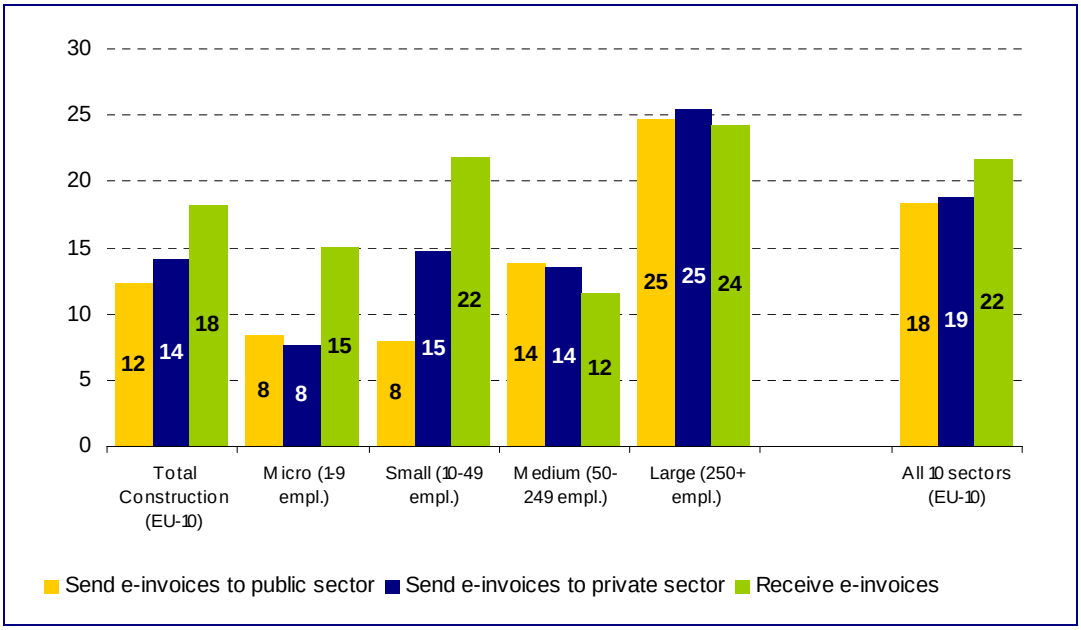
e-Invoicing is a computer-mediated electronic transaction between a seller and a buyer, which replaces traditional paper-based invoicing processes. The use of e-invoicing promises cost savings to both parties due to faster processing compared to the traditional invoicing process. In order to benefit from e-invoicing, these processes have to be integrated with ERP systems or be conducted in a web-based environment. Enterprises representing 12% of CI employment reported sending e-invoices to the public sector;

14% said that they have sent invoices electronically to other private companies and 18% said that they receive e-invoices. Comparing these findings to the weighted all-sectors averages, where about 1 in 5 enterprises use different kinds of e-invoicing, it is evident that the CI is lagging behind in this respect.

Figures again show a relationship between the uptake of e-invoicing and the size of the enterprise. Among large CI enterprises, about a quarter said that they have sent and/or received e-invoices. This figure is about twice as high as the respective share of micro-enterprises, thus confirming previous arguments that the CI is characterised by a larger uptake of ICT among large enterprises than micro enterprises.

Interestingly, it seems to be more common among construction enterprises to receive e-invoices than to send them. This could indicate that the use of e-invoices is primarily driven by sectors trading with/into the CI. Enterprises from these sectors may require the construction enterprises to use e-invoicing, which could accelerate adoption of this e-business application in the CI. Pressure to adopt e-invoicing could come, for example, from suppliers of raw materials and/or suppliers of semi-finished building products.

Exhibit 3-15: Adoption of e-invoicing



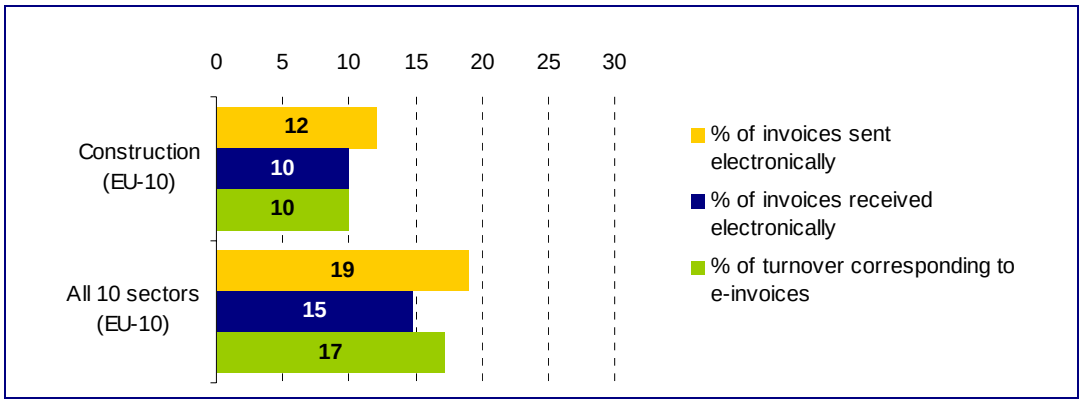
Base (100%): Companies with internet access. N (for sector, EU-10) = 723.

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)

CI enterprises responded in the survey that 12% of their total number of invoices was sent electronically and 10% received electronically. In total, invoices corresponding to about 10% of total turnover were e-invoices. These figures are all significantly below the corresponding all-sectors averages.

Exhibit 3-16: Share of e-invoices as % of total invoices



Base (100%): Companies sending/receiving e-invoices (without "don't know"). N (for sector, EU-10) = 95/107/75. Questionnaire reference: D6, D7, D8

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

3.5 Supply Chain Management

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

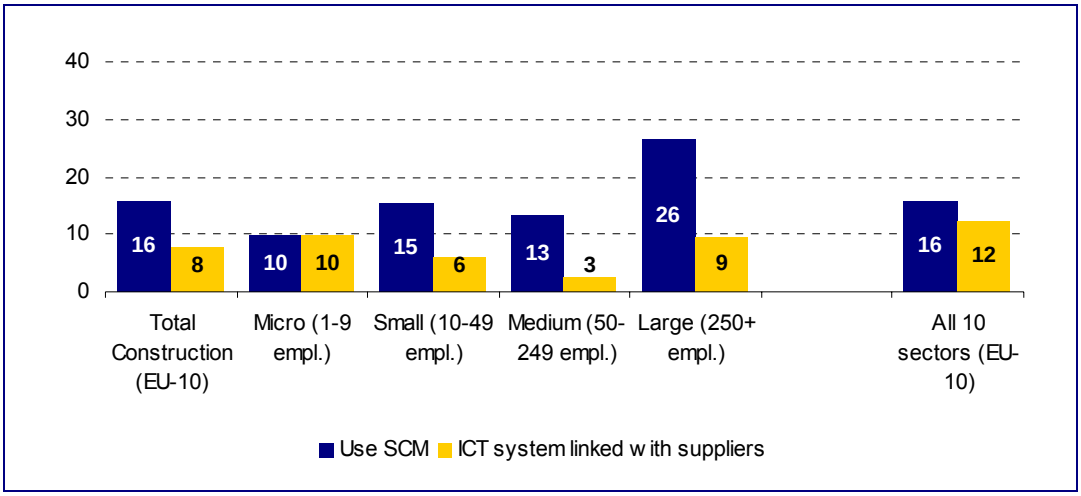
SCM – Supply Chain Management

Supply Chain Management (SCM) software can help enterprises match supply and demand through integrated and collaborative interaction tools. SCM provides an overview of the flows of products, materials, information, and finances, as they move through the value chain. SCM coordinates and integrates these flows both within and among companies. One of the key objectives of any effective SCM system is to reduce inventory (with the assumption that products are available when needed).[30]

Enterprises representing about 16% of employment in CI –and across all sectors studied this year by *e-Business W*@tch- reported using an **SCM system**. However, in terms of **linking their ICT system with that of their suppliers**, the respective figure in CI was less than 10% which, again, is below the weighted average of all the surveyed sectors (see Exhibit 3-17). Thus, the CI seems to be on a par with the weighted all-sectors average concerning use of SCM, but the share of enterprises in the CI which have ICT systems linked with suppliers is significantly below the all-sectors average. Traditionally, ICT links with suppliers would be a prerequisite for the efficient use of SCM systems. The finding may, however, be explained by enterprises using their SCM systems for internal purposes only but not to interact with suppliers. With this approach, enterprises will not fully reap the benefits of SCM through online supply chain integration.

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

Exhibit 3-17: Supply chain integration: use of SCM and ICT links with suppliers



Base (100%): Companies using computers. N (for sector, EU-10) = 754

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

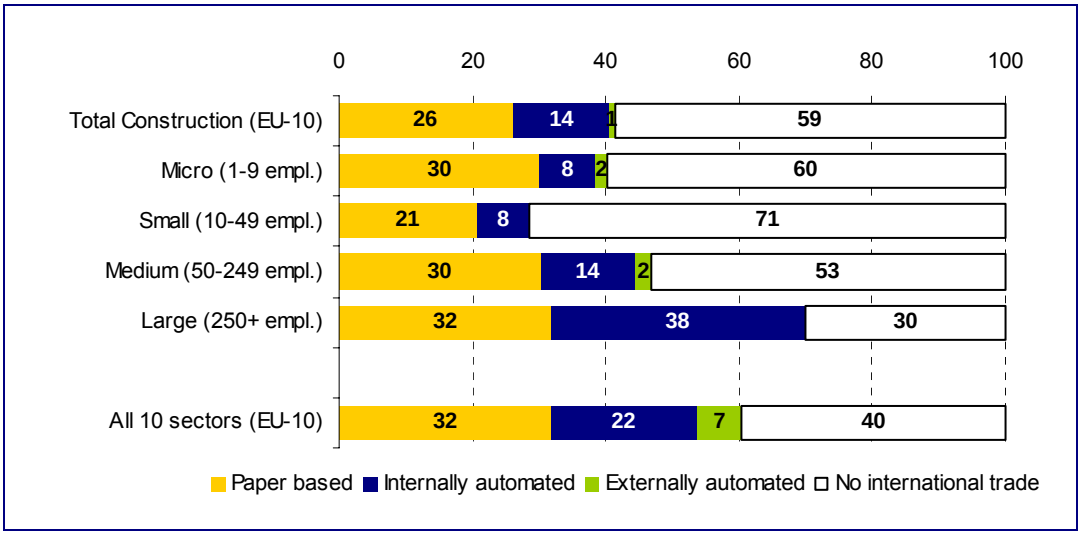
Source: *e-Business W@tch* (Survey 2006)

The 2006 survey results also indicate that the use of SCM systems in CI is –again- not evenly distributed across size-bands. Looking at micro-enterprises, about 10% reported using a SCM system compared to 26% of large enterprises which did so. This substantial variation in ICT usage among small and large construction enterprises is also illustrated in the case study about *Skanska* in Section 4.1.

Integration of financial processes in international trade

About 6 in 10 CI enterprises said that they do not have international trading activities (see Exhibit 3-18). This is about 50% more than the all-sectors average, confirming that construction is a geographically limited sector (see also Exhibit 3-21). More than half of those enterprises which reported international trading said that their respective financial processes are paper-based – a share which is almost in line with the all-sectors average. Overall, less than 15% of this sector's firms said that they use internally automated financial procedures when trading at the international level and practically none reported externally automated relevant processes. As would be expected, percentages of companies reporting some form of international trading and of integration of their related financial processes increase with size.

Exhibit 3-18: Integration of financial processes in international e-trade



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 391

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: E6

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

3.6 e-Marketing and Sales

ICT, and in particular the internet, can be used in various ways to support marketing activities, including the communication with customers, offering products for sale, and developing new marketing strategies. Normally, CI enterprises do not sell directly to consumers (B2C) but more often offer their services to other enterprises. The exceptions to this are the clients building their own private houses. In these cases, a B2C relationship exists. However, the uptake of online solutions for marketing, promotion, PR and sales is not yet widespread in the CI.

3.6.1 Enterprises receiving orders from customers online

About 10% of CI enterprises said that they accept orders from customers online which is significantly lower than the all-sector average of 25% (employment-weighted shares are 13% and 36%, respectively). Compared to other individual sectors analysed in this year's survey, the CI has **one of the lowest** acceptance rates of orders online. The reported levels of accepting orders online are not significantly greater for large CI enterprises compared to micro and small enterprises. Nevertheless, among those enterprises saying that they do accept online orders, large enterprises tend to receive a larger share of their orders online – and this share is comparable to the respective all-sectors average.

When taking the nature of the service provided by the CI into consideration, this observation should not be surprising. Most construction and building projects are **relatively long-term, customised projects**, which require much interaction between client and contractor, as well as high degrees of flexibility and adaptability. It can be argued that the internet may not be fully suited to handle these types of orders, which would explain the low uptake of online ordering in CI.

Exhibit 3-19: Companies receiving orders from customers online

	Accept orders from customers online		Receive up to 25% of orders online		Receive more than 25% of orders online		Use specific ICT solutions for e-selling	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**13**	**11**	**84**	**88**	**16**	**12**	**8**	**5**
Micro (1-9 empl.)		12		90		11		4
Small (10-49 empl.)		11		87		13		6
Medium (50-249 empl.)		14		83		17		8
Large (250+ empl.)		13		78		22		16
NACE 45.2 (Comp. con.)	13	9	75	75	25	26	9	4
NACE 45.3 (Installation)	12	12	93	93	7	7	7	5
All 10 sectors (EU-10)	**35**	**25**	**73**	**75**	**27**	**25**	**18**	**9**
Micro (1-9 empl.)		23		79		21		6
Small (10-49 empl.)		26		76		24		12
Medium (50-249 empl.)		29		75		25		16
Large (250+ empl.)		26		74		26		27
Food & beverages	31	19	82	87	18	13	14	4
Footwear	25	23	86	88	14	12	8	5
Pulp & paper	26	28	78	77	22	23	19	11
ICT manufacturing	26	27	55	64	45	36	24	12
Consumer electronics	25	35	90	66	10	34	20	12
Shipbuilding & repair	18	14	100	100	0	0	12	8
Construction	13	11	84	88	16	12	8	5
Tourism	49	36	68	72	32	28	28	11
Telecommunication	36	40	66	63	34	37	37	21
Hospitals activities	7	10	93	83	7	17	8	8
Base (100%)	firms using computers		firms accepting orders online		firms accepting orders online		firms using computers	
N (for sector, EU-10)	754		123		123		754	
Questionnaire reference	F4		F6a+b+c		F6d+e		F10	

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

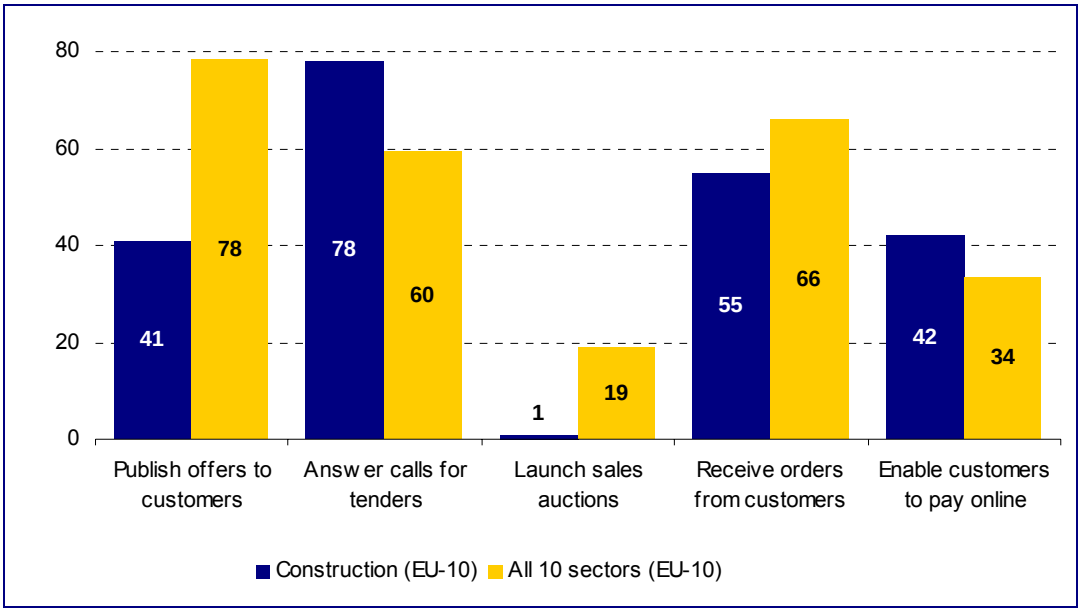
Looking into the two sub-sectors covered by this survey, more building installation enterprises tend to accept orders online than complete construction enterprises. The difference is, however, not very significant. On the other hand, among those enterprises that do accept orders online, significantly more complete construction firms than building installation enterprises tend to accept a larger share of their orders online. The observed difference may, again, be explained by the difference in the services provided by the two sub-sectors.

According to the survey results about the use of **specific ICT solutions for e-selling**, findings for the CI are in line with the previous observation on online orders: About 1 in 20 enterprises, representing only 8% of employment in this sector, said that they use a specific ICT solution for e-selling. This is about half of the all-sectors average but can, again, be partly explained by the nature of the product/service provided. Looking into size spans, large enterprises are four times as likely to have a specific ICT solution for e-selling as micro-enterprises. This is in line with previous findings, confirming once more that construction SMEs do not use ICT to the same degree as large enterprises. Compared to other sectors studied this year by *e-Business W@tch*, the CI is positioned in the lower end along with the shipbuilding and hospitals sectors whose products and services are also difficult to sell online.

ICT solutions can support various **marketing and sales processes**. As shown in Exhibit 3-20, about 4 in 10 of CI enterprises said that they use specific ICT tools to publish orders online. This is about half as many as the weighted all-sectors average. In contrast, the share of CI companies which reported using specific ICT tools for answering calls for tenders online is significantly higher than the respective all-sectors average. Differences between these two findings may be explained by the introduction of e-tendering systems among many public clients (see a more detailed discussion on this topic in Section 4.1). Lastly, it is quite evident that e-auction is not widely used in the CI and that the majority of enterprises do not find this format useful for selling construction services.

Interestingly, about 4 in 10 enterprises from the CI that use specific ICT tools for e-marketing purposes said that these tools are enabling their customers to pay online. This is above the weighted all-sectors average and represents an interesting finding. Since the number of respondents is relatively small (N=62), however, this finding should be cautiously interpreted.

Exhibit 3-20: Marketing and sales processes supported by specific ICT solutions



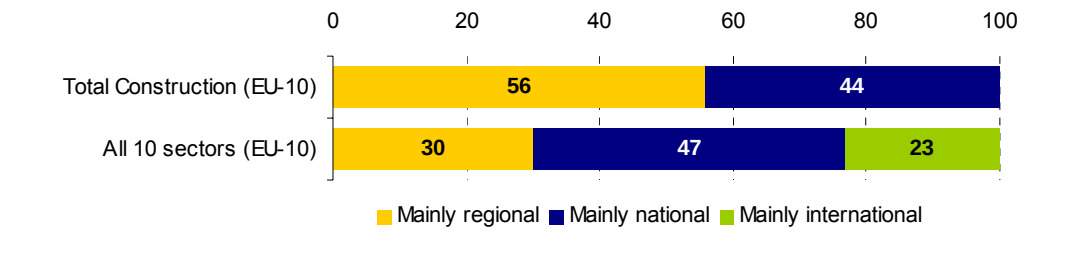
Base (100%): Companies using specific ICT solutions for marketing / sales. N (for sector, EU-10) = 62.
Weighting: In % of firms. Questionnaire reference: F11

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

Location and type of customers placing online orders

In the CI the reported **location of customers** which order online is mainly regional and national, with a 56% majority being regional. This figure is about twice as high as the all-sectors average. There are practically no international customers ordering in the CI, compared to more than 20% for the all-sectors average. The main explanation for this is that more than 90% of the construction companies are SMEs which mainly operate at regional/national level. The description of the industry presented in Chapter 2 clearly indicates that CI is a locally/regionally-oriented sector. The seemingly non-existing international online sales, illustrated in Exhibit 3-21, could be an additional indication that a single European market for construction services is underdeveloped.

Exhibit 3-21: Main location of customers that order online

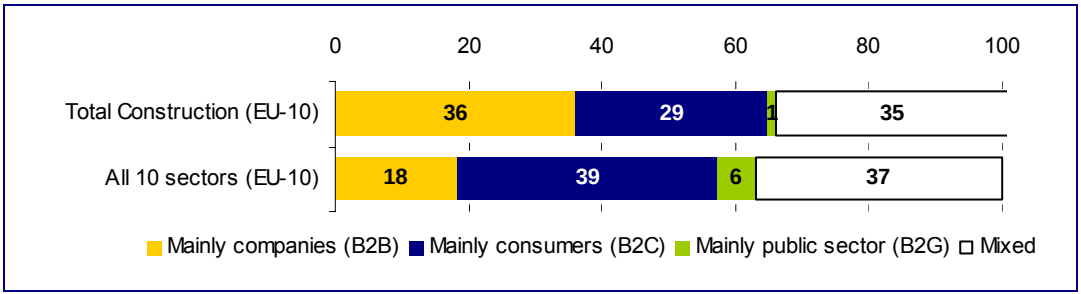


Base (100%): Companies accepting orders online (without "don't know"). N (for sector, EU-10) = 121.
Weighting: In % of firms. Questionnaire reference: F7

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

Interestingly, the survey findings on the type of customers ordering online indicate that in public clients rarely order online. As illustrated in Exhibit 3-22, more than a third of CI companies which accept orders electronically said that the majority of their online customers are other companies, while about 30% said that these are mainly private customers. According to the survey, a very limited number of online customers are from the public sector. The most plausible explanation is that many public clients either have their own e-tendering systems or, as is still very common, require a more traditional paper-based tendering procedure for construction projects.

Exhibit 3-22: Main type of customers that order online (B2B / B2C / B2G)



Base (100%): Companies accepting orders online (without "don't know"). N (for sector, EU-10) = 121.
Weighting: In % of firms. Questionnaire reference: F8

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

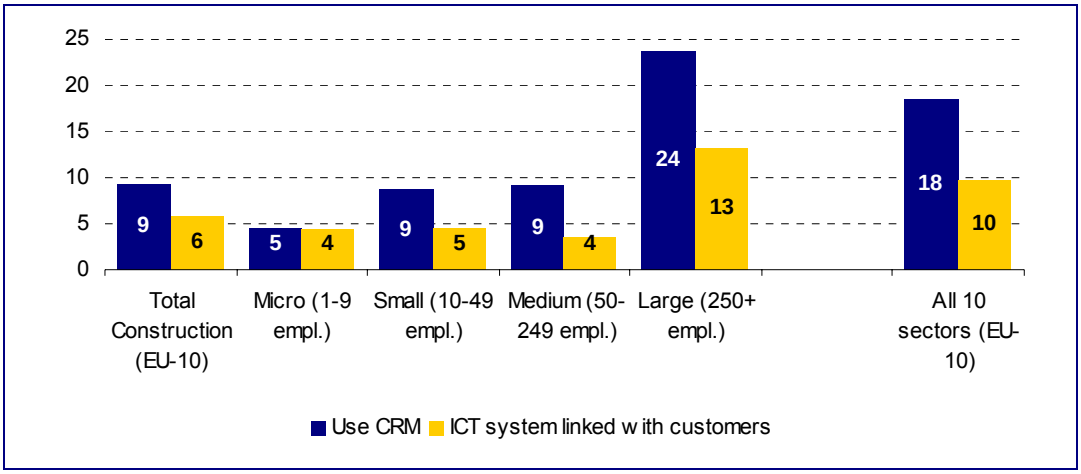
3.6.2 e-Integration of marketing processes: CRM and ICT links with customers

Customer Relationship Management (CRM) systems promise an enterprise the capability to systematically increase knowledge about customers and their profitability, and to build and adapt marketing strategies on the basis of this intelligence. CRM is a term that refers to a broad range of methodologies and software applications that help an enterprise manage customer relationships in an organized way. Normally, this will be based on some kind of database with systematic information about customers and the business record the enterprise has with them.

On average, about 1 in 10 enterprises in the CI reported using a CRM application which is about half as much as the weighted all-sectors average. This may to some extent be explained by the relatively limited number of customers normally constituting the client base of a construction enterprise. Especially for SMEs, this rather low number of customers, in connection with often limited marketing activities, makes the use of ICT-based CRM systems redundant.

Large CI enterprises reported having a CRM system much more often than their smaller counterparts. They also more often reported having an ICT system that is interlinked with that of their customers in the form of project webs and similar (for more information on the use of project webs and collaborative systems, see Section 4.3).

Exhibit 3-23: Use of CRM and integration of ICT systems with customers



Base (100%): Companies using computers. N (for sector, EU-10) = 754

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)

3.7 ICT and Innovation

e-Business W@tch asked enterprises whether they had launched any new or substantially improved products or services during the 12 months prior to the interview. Surveyed companies were also asked if they had introduced new or significantly improved internal processes in the same period of time. Enterprises that indicated that they had introduced any such innovations were then asked follow-up questions on the role of ICT in their innovation activity.

Exhibit 3-24: ICT and Innovation activity

	Companies with new product innovation in 2005		**Share of ICT-enabled product innovations**		**Companies with process innovation in 2005**		**Share of ICT-enabled process innovations**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**21**	**17**	**53**	**49**	**25**	**14**	**70**	**67**
Micro (1-9 empl.)		20		47		13		65
Small (10-49 empl.)		13		38		19		57
Medium (50-249 empl.)		23		50		37		67
Large (250+ empl.)		36		70		49		86
NACE 45.2 (Comp. con.)	19	14	63	67	29	14	70	52
NACE 45.3 (Installation)	22	18	44	43	21	14	69	74
All 10 sectors (EU-10)	**32**	**24**	**50**	**45**	**32**	**20**	**75**	**63**
Micro (1-9 empl.)		22		41		16		69
Small (10-49 empl.)		25		42		25		57
Medium (50-249 empl.)		33		45		38		71
Large (250+ empl.)		48		49		53		81
Base (100%)	firms using computers		firms with product innovation		firms using computers		firms with process innovation	
N (for sector, EU-10)	754		151		754		171	
Questionnaire reference	I1		I2		I3		I4	

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

In the CI, 17% of enterprises experienced **product innovation** in 2005. This is, both in terms of number and percentage of employment, lower than the weighted all-sectors average. This may be explained by generally less focus on innovation in the CI compared to other sectors, such as ICT manufacturing, consumer electronics and other manufacturing sectors in this year's survey. In addition, the data show that about 4 in 10 large enterprises have made product innovations in 2005 compared to two in ten micro enterprises. As many micro enterprises work as sub-contractors to larger enterprises, they will more often tend to perform standardised and predefined work that more rarely gives rise to product or service innovations.

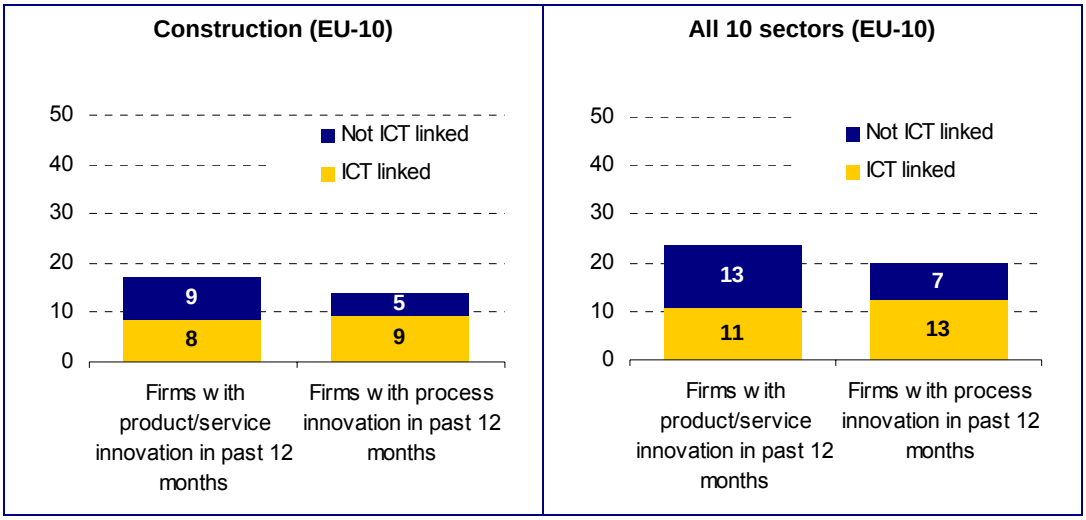
Interestingly, among those firms which experienced some form of product or service innovation, the reported **share of ICT-enabled product** innovations is slightly higher in the CI than the weighted all-sectors average. However, these average figures conceal some interesting findings at the sub-sector level: Complete construction enterprises said that they use ICT much more often when innovating products compared to building installation enterprises. This could be explained by the generally lower ICT uptake among building installation enterprises along with the higher number of SMEs in this sub-sector. This argument is further supported when looking into the data spread on different enterprise size classes. Again, the large enterprises more often use ICT to support product innovation. Actually, whereas there is little difference between size groups in the all-sectors average, the large CI enterprises stand out with an unusually high share of ICT-enabled product innovation (70% of companies).

Looking at the indicator for **process innovation**, fewer CI enterprises reported making process innovations in 2005 compared to the weighted all-sectors average. This is in line with the results on product innovation above but, again, among those CI enterprises saying that they made some process innovations, ICT is more often used as an enabler compared to the weighted all-sectors average. Also looking at size spans, large enterprises more often reported process innovations and also more often said that they used ICT for this, compared to micro and small enterprises.[31]

The figures and findings from the table above are also illustrated in Exhibit 3-25, which shows the share of enterprises that have conducted product/service and process innovation in the 12 months before the survey and how much of these activities were linked to ICT. As stated above, for both product/service and process innovation, fewer CI enterprises make innovations compared to the weighted all-sectors average, but a larger share of these innovations are ICT-enabled. This can partly be explained by the nature of the services offered in the CI and partly by the fact that most innovation in the CI is made by large enterprises which, however, constitute a small fraction in terms of total number of enterprises in this sector.

[31] For more information about e-business and innovation, see also the *e-Business W@tch* special report (2006) on “The role of new companies in e-business innovation and diffusion”, available at www.ebusiness-watch.org ('resources')."

Exhibit 3-25: The role of ICT for product and process innovation



Base (100%): Companies using computers. N (for sector, EU-10) = 905/925
Weighting: In % of firms. Questionnaire reference: I1 – I4

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

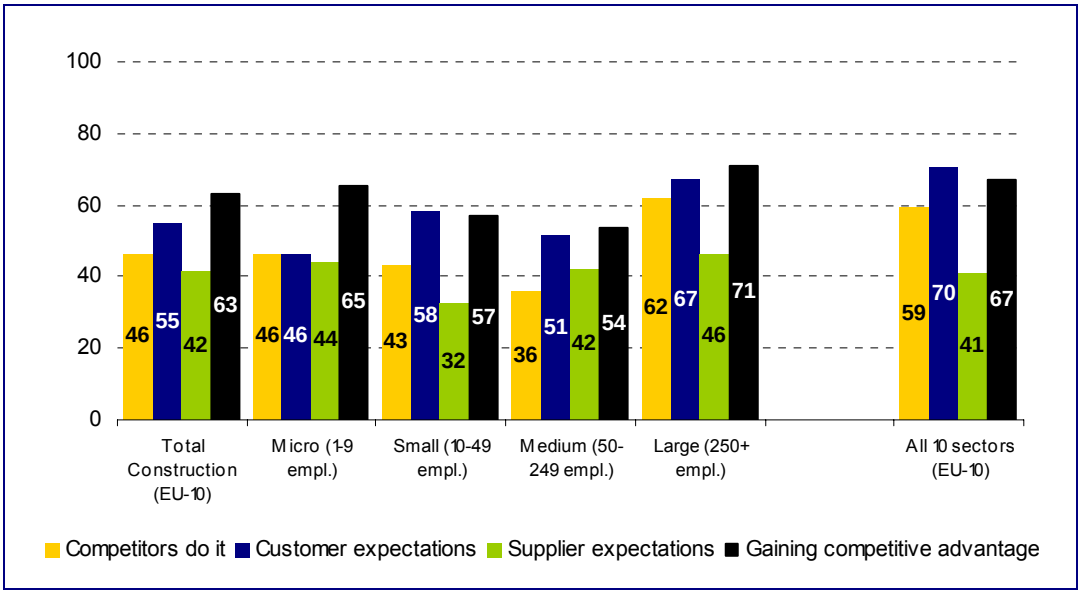
3.8 Drivers and Inhibitors for the Uptake of e-Business

3.8.1 Drivers of e-business adoption

The survey confirms an expected slow uptake of e-business in the CI. Differences in drivers for uptake of e-business clearly prevail between the CI and the weighted average of the 10 sectors covered in 2006. In the CI, about 6 in 10 large enterprises adopt e-business due to the use of e-business by competitors, which is only slightly higher than the weighted all-sectors average. Especially for the larger CI enterprises, customer expectations constitute also a main driver; this is actually the most important reported driver across the 10 sectors studied this year by *e-Business W@tch*.

However, the most important driver for the CI enterprises is the desire to gain competitive advantage – especially as regards micro-enterprises. Given the generally low uptake of e-business in this sector, it is not surprising that gaining competitive advantage is a relatively more important motive in the CI. Apparently, there are still “first-mover” advantages to be exploited for those that take the leap and invest in e-business solutions.

Exhibit 3-26: 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) = 379. 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)

3.8.2 Barriers to e-business adoption

As perceived by enterprises in both the CI and across the 10 sectors covered in the 2006 e-Business Survey, the most common barriers to e-business adoption are company size, complicated and costly technology. Interestingly, the largest deviations between findings for the CI and the weighted all-sectors average can be found on the issues of system compatibility and technology complexity. In fact, both of these issues seem to be perceived much more as a barrier in the CI than across the 10 sectors as a whole. This finding could indicate that the issue of interoperability is the main barrier for the uptake of ICT in the CI. This observation is supported by the discussion put forward in Section 4.2 on 3D technologies and system and software interoperability.

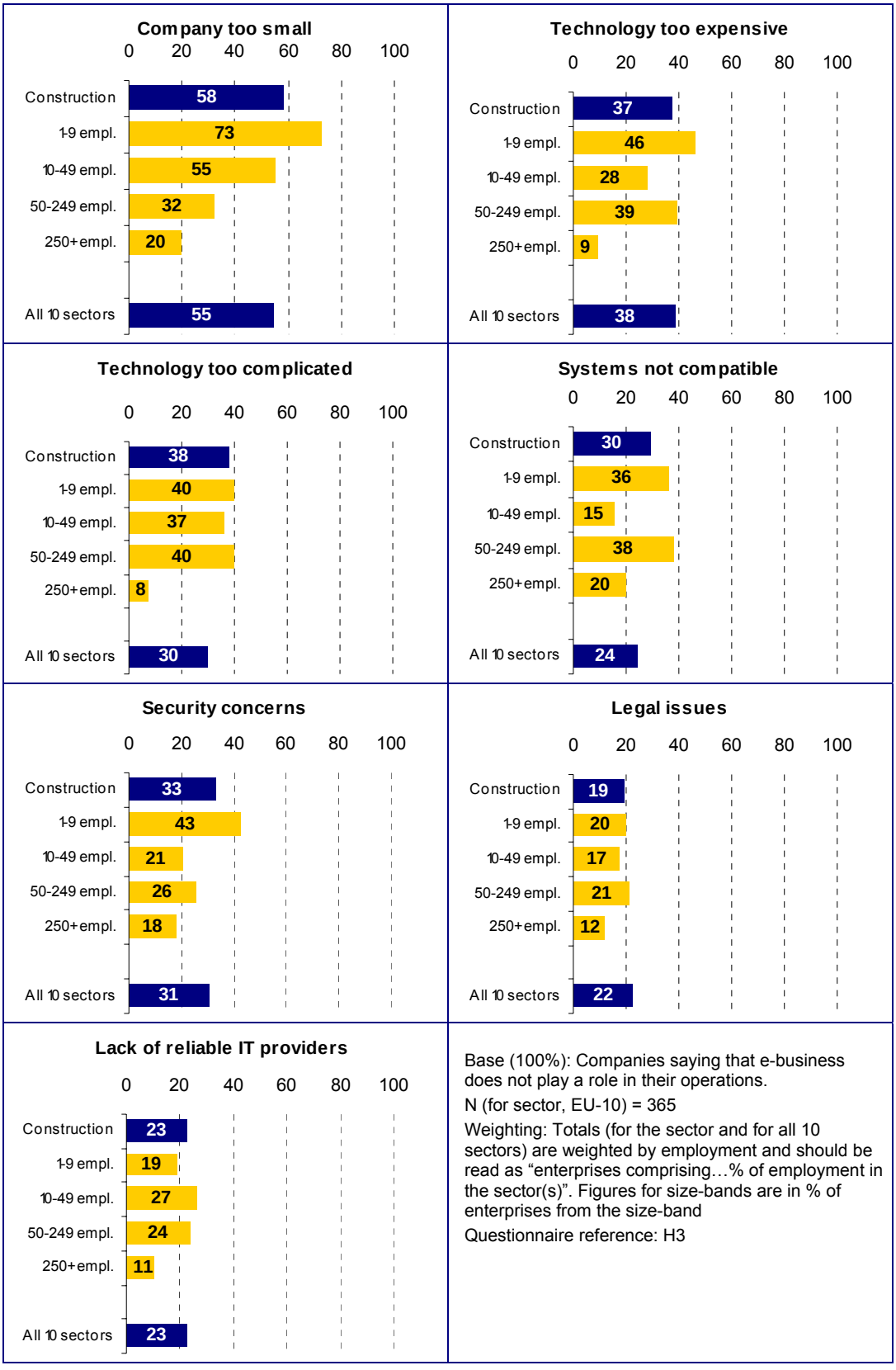
SME-typical barriers

Special attention is given to the barriers reported among SMEs in this year's survey. Based on the findings presented in Exhibit 3-27, it can be argued that the main barriers for SMEs are company size, technology costs and security concerns.

Looking into the issue of company size, it is obvious that the size of an enterprise can be a barrier to ICT uptake. Small enterprises have fewer needs but they usually also have less resources to put into ICT - they employ fewer ICT practitioners and have less financial resources than their larger counterparts. As illustrated in Exhibits 3-3 and 3-6,

respectively, few micro and small CI enterprises employ ICT practitioners and most use cash flow financing for their ICT investments. Findings shown in Exhibit 3-12 also indicate that micro and small enterprises rarely have installed secure server technologies. Viewed together, these three observations support the enterprises' own perceptions that company size, technology costs and security concerns are barriers to SMEs.

Exhibit 3-27: Barriers to e-business adoption as perceived by companies



Base (100%): Companies saying that e-business does not play a role in their operations.

N (for sector, EU-10) = 365

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: H3

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

3.9 Summary

Main findings

CI is a sector where ICT and e-business are used to a lesser extent than in most of the other sectors studied by *e-Business W@tch* in 2006. There are two main reasons for this comparatively low ICT uptake:

- first, the high concentration of SMEs in the CI and
- second, the typical nature of the service provided in construction which, being an on-site and often highly customised service, does not lend itself to the typical e-business concept which is rather adapted to manufacturing industries.

Looking into CI **sub-sectors** covered by this study, complete construction enterprises have in general a higher level of ICT uptake than building installations enterprises. For example, complete construction enterprises are usually larger enterprises, use ICT more to support product innovation and spend more on ICT than building installation enterprises. However, there also some interesting exceptions: building installation enterprises reported having VPN, intranets and document management systems more frequently than their counterparts in complete construction. Excluding statistical reasons, such as bias in the survey sample, there are no obvious ways to explain findings where building installation companies seem to have greater ICT uptake compared to complete construction enterprises.

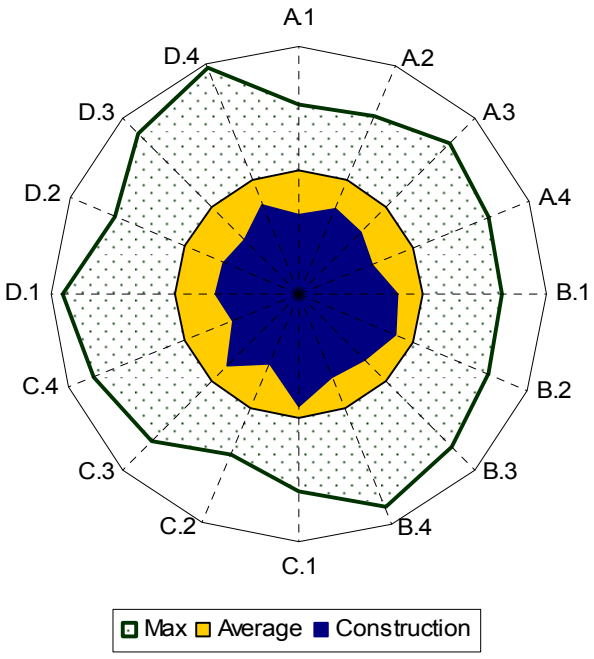
According to the survey data, **large construction enterprises** are currently **increasing focus on ICT issues**, as they have started introducing more advanced ICT solutions such as e-procurement systems, collaborative design systems (3D technology) or collaborative document sharing (project webs). This is in line with the discussion and case studies presented in the following chapter of this report.

In summary, therefore, the condensed presentation of survey results in the "**e-Business Scoreboard**" should be carefully interpreted. Since the survey instrument used on the CI was adapted from the e-business concept for manufacturing enterprises, it is quite clear that the CI would not be among the intensive users in application areas such as supply chain management or online marketing and sales. However, there are other areas –not included in the Scoreboard– such as collaborative systems, where the CI is, to some extent, ahead of many other sectors studied this year by *e-Business W@tch*. This being said, the Scoreboard nevertheless provides plenty of valid evidence that there is still a sort of "digital divide" between the figures for the CI and the weighted all-sector averages. Examples are the low percentage of firms employing ICT practitioners, as well as the low adoption of ERP systems and advanced e-procurement solutions. This cannot entirely be explained by structural factors, i.e. the dominance of small firms, but must also take into consideration the nature of the services being offered by the CI. In this context and in light of the 2006 e-Business Survey findings, the most important conclusions about the use of ICT by CI companies are summarised in the following box.

- **ICT practitioners:** Construction enterprises have little focus on hiring ICT practitioners and on ICT training.
- **ICT standards:** The use of e-standards is limited in the CI but is about in line with the weighted all-sectors averages. This indicates that interoperability issues are widespread across different sectors.
- **Innovation:** The CI lags behind on both product and process innovation when compared to the respective cross-industry totals. However, the share of ICT-enabled product and process innovation is more or less the same between the CI and the cross-industry total.

e-Business Index and Scoreboard 2006 [32]

e-Business Scoreboard 2006



Component indicators
(based in data in % of firms)

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

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

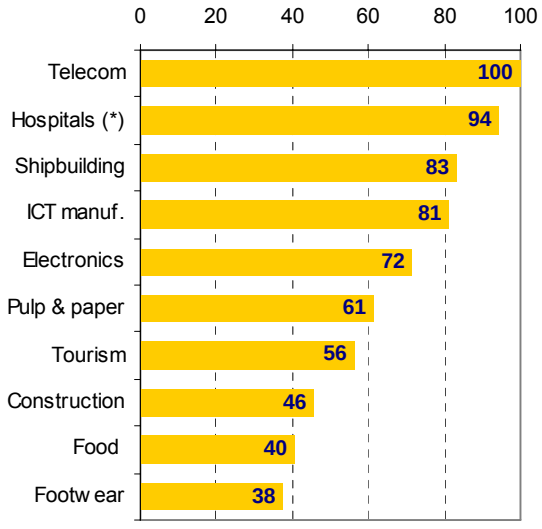
C. e-Sourcing and Procurement
C.1 Firms placing orders online (>5%)
C.2 Use of ICT systems for sourcing
C.3 ICT system linked with suppliers
C.4 Online inventory management

D. e-Marketing and Sales
D.1 CRM use
D.2 Firms receiving orders online (>5%)
D.3 Use of ICT systems for marketing/sales
D.4 ICT system linked with customers

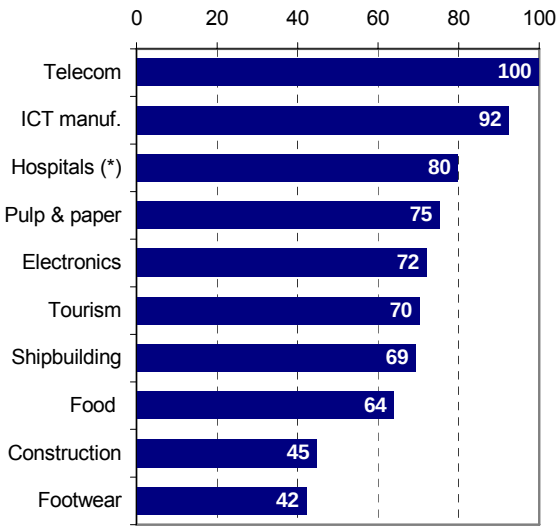
e-Business Index 2006

(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)

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

4 Current e-Business Trends and Implications

The previous chapter presented the results of the 2006 *e-Business W@tch* survey for the CI. The aim of this chapter is, based on the analyses presented in Chapter 3, to provide industry-specific insights into current ICT use and e-business activities. This chapter does not claim to offer a comprehensive overview of the topics discussed, as that would exceed the limits of this report. In fact, it would be difficult to achieve, as ICT and e-business are relevant to nearly all core business areas of the CI. The issues analysed, as well as the case studies presented in the following sections, should be understood as representative examples of current practice and the related opportunities and challenges.

The following paragraphs introduce the issues that have been selected for in-depth study, and explain the main reasons for their selection. This selection was made in co-ordination and agreement with DG Enterprise and Industry, and with relevant industry stakeholders.

Solutions for electronic procurement

The 2005 *e-Business W@tch* sector study, as well as industry experts highlighted the need to increase focus on benefits from centralised procurement initiatives. Due to rising competitiveness among this industry's players, CI enterprises focus increasingly on internal processes in their search for business optimisation and cost savings. Some large European construction enterprises have already introduced e-procurement initiatives and the first experiences point to substantial benefits achieved in terms of cost savings and quality improvement.

The first section of this chapter, therefore, looks into the topic of e-procurement activity among construction enterprises. A special section focuses on the issue of public e-procurement in CI, as a follow-up to the 2005 *e-Business W@tch* sector study which highlighted the potential of public e-procurement solutions for promoting the uptake of ICT solutions among this industry's enterprises.

Relevant developments are described in Section 4.1. Analysis is supported by case studies of the Swedish construction enterprise *Skanska,* the German public e-procurement solution *e-Vergabe,* the Greek e-procurement portal *E-Construction* and the UK based public e-tendering solution *SCMS*.

Solutions for 3D technology

According to interviews with industry experts from construction enterprises, IT and software producers, supporting trades and academia, the development and uptake of advanced drawing and simulation software like 3D technology is driven both by public requirement and by the potential benefits of error reduction in the design and construction phases for engineering enterprises. For instance, the Danish Government requires the use of 3D technology in all public construction projects as of January 1, 2007. Furthermore, several construction enterprises have pointed to the benefits of virtual models with parametric data attached to the 3D elements and more efficient communication. Based on these considerations, Section 4.2 describes relevant developments and implications in the area of 3D technology. It also explains barriers for

the further adoption of 3D technology among European construction enterprises. It provides, as examples, case studies of the Lithuanian construction enterprise *Constructus* and the construction project of the Norwegian A*kershus University Hospital*.

Project web solutions for electronic collaboration

The 2005 *e-Business W@tch* sector study addressed the issue of e-collaboration. According to the discussion in that study, electronic collaboration could be a tool that enables quicker data transfer, advanced visualisation, and faster alterations during the planning process. This would be achieved through the sharing of building plans, time schedules, calculations, technical specifications and other project data (European Commission 2004, p. 7) (Ricaud 2006).

Following-up the discussion on these conclusions, the last section in this chapter describes the use of collaborative systems known as *project webs,* where the stakeholders in a construction project communicate and share information via an electronic portal. Section 4.3 analyses the impact of project webs on the various stakeholders, as well as the requirements and benefits of implementing project webs. It is supported by a case study on the French construction enterprise *Spie SCGPM*.

Case studies and business examples

The survey data presented and analysed in Chapter 3 along with the case studies/ business examples (summarised in Exhibit 4-1), and secondary literature, form the basis for the conclusions and policy implications presented in Chapter 5 of this report.

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

Section	Enterprise / project	Country	Topic(s)
4.1	Case study: *e-Construction*	Greece	Implementation of a construction **e-procurement** solution
4.1	Case study: *e-Vergabe*	Germany	Implementation of **public e-procurement** on federal level
4.1	Case study: *Y&H RCoE*	United Kingdom	Implementation of a **regional public e-tendering** solution
4.1	Business example: *Water Services Belfast*	United Kingdom	Implementation of a **local public e-tendering** solution
4.1	Case study: *Skanska*	Sweden	Implementation of an **e-procurement** system in a large international construction enterprise
4.2	Case study: *Constructus*	Latvia	Implementation of **3D technology** in a small East European construction enterprise
4.2	Case study: *Akershus University Hospital*	Norway	Implementation of 3D technology and the use of **IFC standards** in a large hospital project
4.2	Business example: *Autodesk France*	France	**Online solutions** for the construction industry
4.2	Business example: *Bentley*	Denmark	The **opportunities in 3D** modelling technology
4.2	Business example: *Micrograf*	Portugal	**Impacts of 3D** technology on construction enterprises
4.2	Business example: *NCC Construction*	Denmark	**3D technology** in a European construction enterprise
4.2	Business example: *Raiffeisen/Strabag/4D Books*	Hungary	Experiences from **implementation of 3D** technology in a Hungarian construction enterprise
4.3	Case study: *SPIE SCGPM*	France	Implementation of a **project web** solution in a Paris-based construction enterprise
4.3	Business example: *Byggeweb A/S*	Denmark	Use of **project web** solutions
4.3	Business example: *Prosys SA*	France	Use of **project web** solutions
4.3	Business example: *Bouygues Construction*	France	**Project web** in a construction enterprise

4.1 e-Procurement

4.1.1 Introduction

This section describes the current use of e-procurement in the CI and analyses the benefits, barriers and business implications within two specific areas of e-procurement in the CI: e-procurement among construction enterprises and public e-procurement of construction products.

These two topics represent two trends in the use of e-procurement in the European CI, which were briefly touched upon in the *e-Business W@tch* 2005 sector study. The first trend refers to buyer-driven e-procurement solutions that are mainly implemented and operated by large construction enterprises (illustrated through the Skanska case below). The second trend involves the benefits for construction enterprises when entering into public e-tendering. Although the benefits of this development accrue to the buyers - i.e. the public institutions - in the short run, improvements in accessibility to information and transparency in the tendering processes benefit the construction enterprises in the long run (illustrated through the *e-Vergabe* case presented after Section 4.1.7).

4.1.2 Definition of e-procurement

e-Procurement is generally defined as the use of the internet for requisitioning, authorising, ordering and payment of products and services (Lootah 2006, p.3). e-Procurement is hence the application of a span of digital technologies to expand the front-end and back-office integration of contracting, service, transportation and payment of the products and services through electronic processes, decisions, and transactions (Andersen et al. 2003, p. 963).

However, e-procurement can be more than just a system for online procurement. An e-procurement system can connect a construction enterprise and its business processes directly with suppliers while managing all interactions between them. This includes management of correspondence, bids, questions and answers, previous pricing, and multiple e-mails sent to multiple participants.

Enterprises can also engage in e-tendering which is the use of electronic means throughout the tendering processes, i.e. finding and selecting suppliers of works or services (European Commission working group on e-construction Phase II, 2004). When the buyer is a public authority, the term *public e-tendering* is used, which is defined as the acquisition of high value, low volume goods, works and services by seeking bids (proposals) via a public process followed by the evaluation of bids and award of contracts (IADB 2002, p. 4).

An integrated part of e-procurement is e-purchasing (also called e-ordering), which is the use of electronic means in the process of procurement of goods, works, services and utilities (This includes the processes from finding a product to invoicing and payment). Thus, procurement includes the process of ordering, but also the final stages of the procurement process, i.e. payment (European Commission 2004, p. 12).

4.1.3 Use of e-procurement in the construction industry

A study from the UK Construction Federation estimates the possibility of annual cost-savings for clients from producing, copying and distributing tender documents through the use of electronic tendering by as much as 90% (UK Construction Federation 2006).

The introduction of e-procurement by European construction enterprises and the introduction of e-tendering by public clients have an effect on the dynamics between members of the construction value chain. According to recent research by eMarket Services, an enterprise engaging in electronic procurement could cut procurement costs by as much as 8 to 15% (eMarket Services 2005a, p. 2 and 2005b, p. 2).

According to the 2006 *e-Business W@tch* Survey, more than half of the interviewed enterprises said that they place **orders online**. The frequency is slightly lower for micro and small enterprises than for large enterprises. A slightly greater number of enterprises in the CI place orders online compared to the average for all sectors. More specifically, sectors such as tourism, footwear and food & beverages, that the CI can be compared with concerning ICT uptake, are positioned lower in terms of enterprises placing orders online.

The uptake of e-procurement is, among other things, driven by the rather high number of e-market places available for construction enterprises in many Member States. As shown in Exhibit 4-2, about half of the responding enterprises place orders online. This is on a par with the weighted all-sector average. Looking into enterprise sizes, there is no clear relationship between enterprise size and the number of enterprises placing orders online. Among building installation enterprises, more than half place orders online, compared to about 1 in 3 complete construction enterprises. This observation may indicate that building installation enterprises use the internet more often to place orders online but the difference may also be explained by the fact that more large enterprises have implemented their own e-procurement solutions and hence do not buy products over the open internet.

About 7 in 10 enterprises placing orders online, said that these concern less than 25% of their total purchase activities. In other sectors, the relative share of e-procurement is somewhat higher; particularly in ICT-related sectors, but also in shipbuilding and tourism, more than a quarter of those companies that procure online said that this activity accounts for more than 25% of their total orders.

Exhibit 4-2: Companies ordering supply goods online

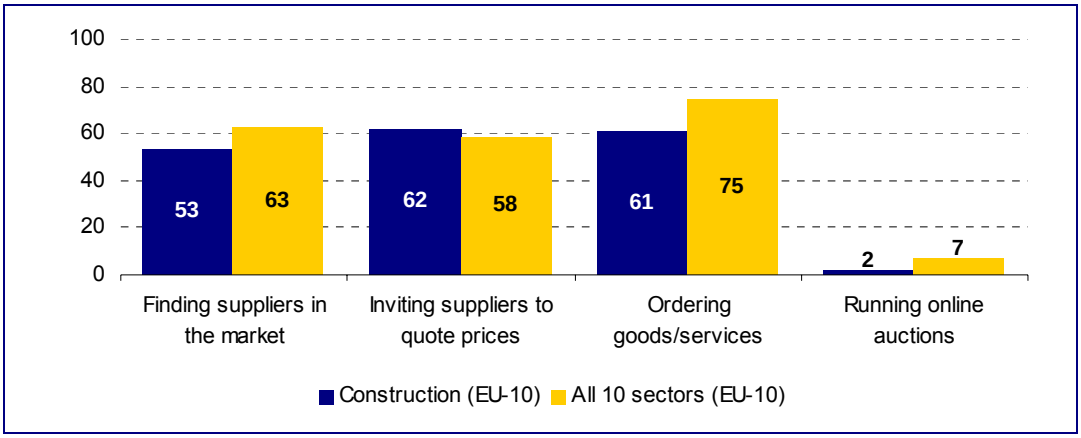
	Place orders online		Place up to 25% of orders online		Place more than 25% of orders online		Use specific ICT solutions for e-sourcing	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**53**	**51**	**74**	**72**	**26**	**28**	**12**	**6**
Micro (1-9 empl.)		51		72		28		4
Small (10-49 empl.)		54		76		24		10
Medium (50-249 empl.)		57		80		20		17
Large (250+ empl.)		58		69		31		26
NACE 45.2 (Comp.con.)	49	37	76	83	23	17	14	7
NACE 45.3 (Installation)	57	58	73	69	27	31	9	6
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)	754		401		401		754	
Questionnaire reference	E1		E3a+E3b+E3c		E3d+E3e		E7	

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

As displayed in Exhibit 4-2, less than 1 in 10 enterprises reported using a specific ICT solution for e-sourcing. It would be safe to assume that the rest might use internet or supplier-driven solutions for online procurement, but not any specific system or specialised software. In comparison with the portion of enterprises placing orders online, it could be inferred that firms in the CI currently use more simple solutions for e-procurement that do not require specific software or extensive ICT skills among employees. Interestingly, results seem to be in the same range (50-60%) for all size-bands, but differences appear when looking at the two sub-sectors: surprisingly, it is building installation enterprises which come higher, both in terms of number of firms and in terms of employment-weighted data.

Enterprises using such specific solutions use them mainly for finding suppliers in the market (53% of firms), inviting them to quote prices (62%) and ordering goods/services (61%) – see Exhibit 4-3. The use of e-auctioning is very limited in the CI which, based on the nature of the provided service, is not surprising. These findings should, however, only be seen as indicative since the sample size is limited (*N=87*).

Exhibit 4-3: Sourcing and procurement processes supported by specific ICT solutions



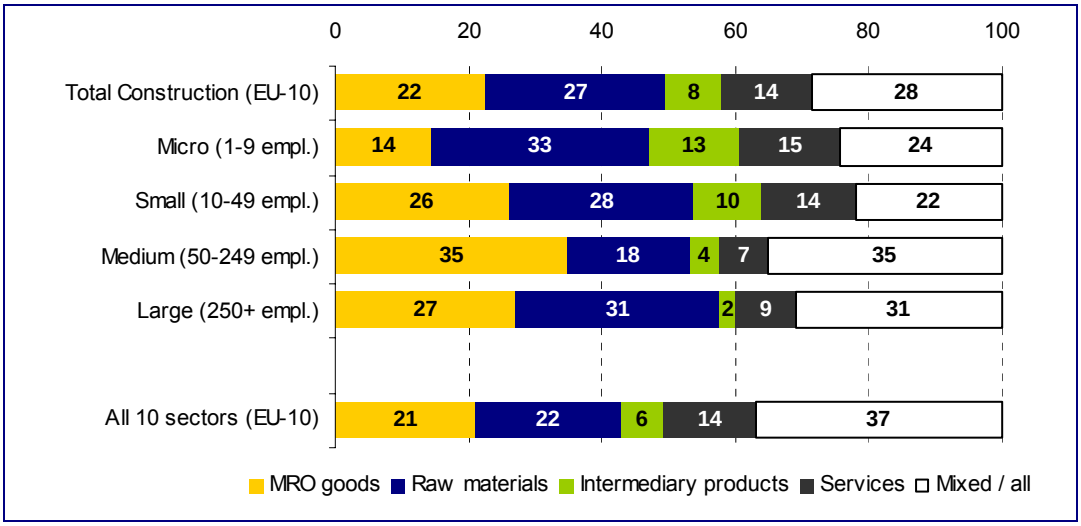
Base (100%): Companies using specific ICT solutions for e-procurement. N (for sector, EU-10) = 87

Weighting: in % of firms. Questionnaire reference: E8

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

The sourcing of products online can relate to different types of products / commodities. As illustrated in Exhibit 4-4 below, about 1 in 3 of the responding enterprises source online for a combination of MRO products, raw materials, and intermediary products. Among micro and small enterprises, the largest group - about a third – primarily order raw materials. Among the medium and large enterprises, the largest group – again, about a third – primarily source mixed products. Compared to the weighted all-sectors average the CI is more focused on online purchase of raw materials. This reflects the CI characteristics illustrated in Section 2, where it is argued that the main inputs into the CI production process are raw material, machinery and intermediary products.

Exhibit 4-4: Main type of supply goods ordered online



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 406

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

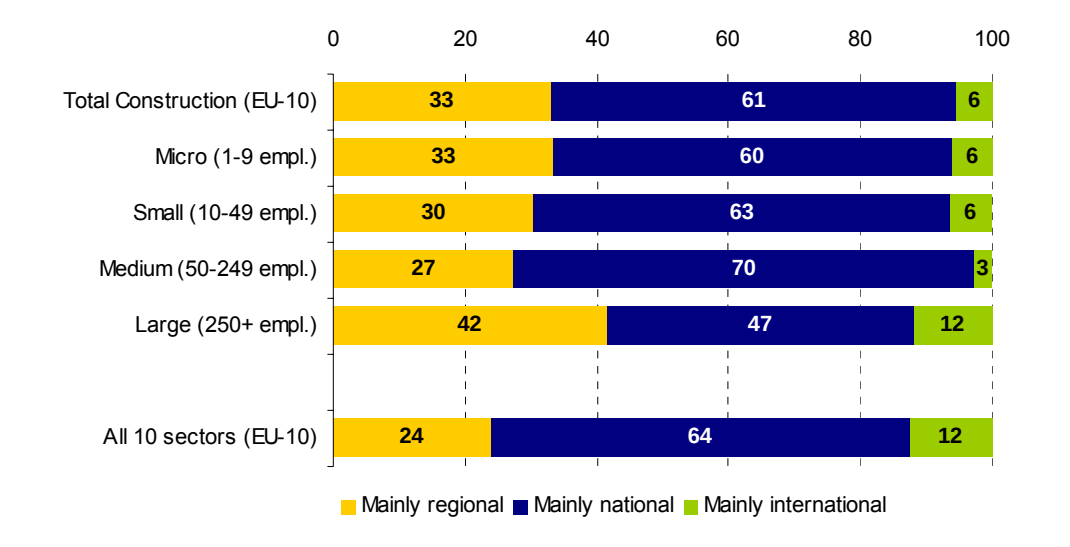
Source: *e-Business W@tch* (Survey 2006)

Main location of suppliers in e-procurement

National suppliers are, by far, the most common type of suppliers when construction enterprises procure online. 94% of the enterprises in the CI report that they mainly procure from regional and/or national suppliers. Only 6% use international suppliers when purchasing online.

These findings highlight the local and regional focus of the CI where local raw materials, due to transportation and storage costs, have traditionally been preferred. Compared to the weighted average of the industries surveyed, the CI is more regionally and nationally oriented, and international suppliers are only half as common in the CI as the average of the industries surveyed. Interestingly, the use of local suppliers was reported more by large enterprises than by micro and small enterprises. This further highlights the local focus of CI companies when procuring essential raw materials. Apparently, however, large enterprises also have a comparatively higher tendency to use international suppliers than their smaller counterparts in this sector. This could be a result of their expected higher purchasing volume and geographically more far-reaching operations.

Exhibit 4-5: Main location of suppliers in e-procurement



Base (100%): Companies placing orders online (without "don't know"). N (for sector, EU-10) = 415

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)

4.1.4 Potential benefits of e-procurement

The potential efficiency gains from e-procurement are especially expected from savings related to:[33]

- Procurement prices
- Administrative costs for the buyers
- Administrative costs for the suppliers.

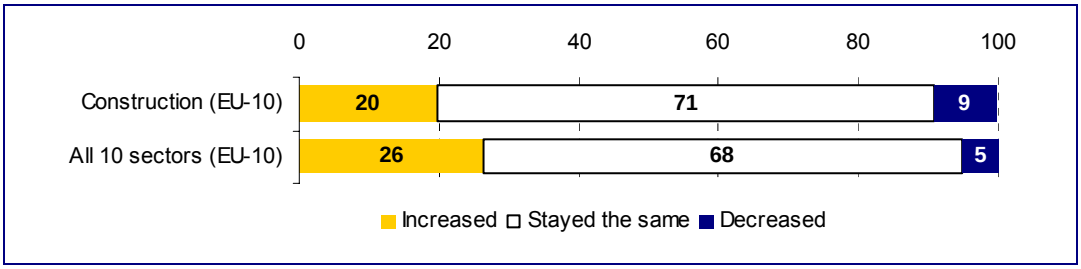
These savings can be achieved by using e-procurement and in public e-tendering. The potential savings in the CI when using e-procurement were illustrated by expert comments arguing that the construction sector will be able to lower the cost of individual items purchased by 20-30% (Cederblad 2001, p. 110). According to Farzin Saber, Professional Relations Manager of IBX, the estimated savings are in the area of 12%. Another analysis by e-Market Services of e-procurement in European enterprises showed the average payback period for the investment in e-procurement to be less than a year (eMarket Services 2005b, p. 2). However, the survey results presented in Section 3 showed that the European CI only uses e-procurement to a limited degree, and that only the large enterprises are engaged in e-procurement. These two findings could indicate that there is still untapped potential for CI enterprises in implementing e-procurement.

More specifically, the case study on *Skanska* in this section illustrates the fact that the economic gains are centred on a general improvement of procurement practices, including a decrease of the supplier base. The introduction of e-procurement will enable enterprises to limit the number of suppliers used. This reduction can lead to better price agreements with suppliers and the creation of a framework for long-lasting supplier relationships. The potential benefits from a limited supplier base include the possibility of lower negotiated prices in framework contracts. This is the case when a construction enterprise can designate a supplier to be the sole provider of specific materials (single sourcing). The limitation of supplier bases and the potential use of single sourcing will increase the collaboration between supplier and buyer.

As discussed in the above paragraphs, an expected impact from e-procurement is the limitation of the number of suppliers, leading to a closer relationship between buyers and suppliers. A large majority of the enterprises in the CI, however, do not seem to have experienced any change in the number of suppliers as a result of their e-procurement strategy (71%). In fact, 20% of enterprises have experienced an increase in the number of suppliers and only 9% have experienced a decrease in the supplier base (see Exhibit 4-6). This development could be founded in the rather large number of suppliers traditionally associated with a construction enterprise in order to meet specific needs for clients concerning raw material selection and use of special intermediary products.

[33] See *e-Business W@tch* 2005a, p. 38.

Exhibit 4-6: 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) = 395
Weighting: in % of firms. Questionnaire reference: E9

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

This development may, in the long run, improve the relationship between the two parties; lead to lower transaction time as well as better quality of procurement catalogues. The reduction of the supplier base through e-procurement is expected to lead to procurement savings, compliance increases and procurement process optimisation. To ensure that construction enterprises can remain competitive in the long run, occasional renegotiations of terms with the single sourcing supplier are of course required.

An e-procurement system must have several *call-off* methods, i.e. ways in which a user of the e-procurement platform can communicate with suppliers. Traditional supplier-updated catalogues are the main call-off method. According to the case studies conducted for this study, this may yield 20-40% of the total purchase being channelled through the e-procurement system (Interview with Farzin Saber, March 2006). The most common call-off method in e-procurement is an e-catalogue which offers the same value-added features as a traditional paper-based catalogue, i.e. an overview of different products with detailed information on products, pricing agreements and discount criteria.

e-Catalogues with an e-form are also used. This type of catalogue allows the user to browse through an online catalogue and then place a request for the standardised items presented in the catalogue. This type of call-off method provides the possibility of a free text option where the buyer can specify extra requirements such as special design features (customisation of the product) or special delivery terms. Applying these different call-off methods, the percentage of the total purchase being channelled through the e-procurement systems (also called the e-procurement ratio) of a construction enterprise can increase to as much as 80-90%.[34]

[34] Interview with Farzin Saber, conducted in March 2006, in the context of the *Skanska* case study.

4.1.5 Barriers

A recent study by eMarket Services has shown that 83% of the enterprises in the European CI procure online through supplier web pages. According to the same study, 21% use B2B e-marketplaces and 20% use extranets, whereas none of the surveyed enterprises used Electronic Data Interchange (EDI) for procurement purposes (eMarket Services 2005c, p. 7). This is supported by the findings of this year's e-Business Survey which also showed that the use of EDI in the CI was very low.

Most traditional processes, such as accounting, have been automated, but relatively few core processes (10%) have been re-engineered to be aligned with the potential of IT-based technologies. Even fewer such processes (0.5%) have been transformed through web-enabled inter-organisational collaboration (eMarket Services, 2005c, p. 7).

The CI is process-oriented and dependent on a high level of information. Standards vary within and across national borders, e.g. there are various standards for describing components, exchanging business documents, and for digital signature (*e-Business W@tch* 2005a, p. 66). Moreover, the 2005 *e-Business W@tch* sector study on the CI revealed that the main barriers to e-procurement adoption are cost, lack of standards, decentralised organisation and resistance among suppliers (*e-Business W@tch* 2005a, p. 7). Based on this, it can be argued that the lack of common standards and e-standards is a barrier to e-procurement uptake. This argument is also supported by the findings presented in Exhibit 3-27.

The interviews conducted for the 2006 report highlighted some new barriers to the introduction and successful use of e-procurement among European construction enterprises. These new barriers are discussed in the following paragraphs. Common for the barriers discussed below is that they make an otherwise solid business case for ICT investment in e-procurement appear unclear to especially small and medium-sized construction enterprises.

One such barrier is the discrepancy between short-term costs and long-term benefits. The benefits of e-procurement, such as increased sales volume and single sourcing partner status, are often gained in the medium-to-long term whereas price reductions affect the supplier in the short term. This hampers the supplier's desire to engage in the e-procurement solution and may diminish the supplier's resource allocation for e-procurement catalogue updates. In short, the introduction of e-procurement in a construction enterprise mainly benefits the buyer side, especially in the short run.

Another barrier refers to the lack of ICT competencies among site and line managers on the construction sites. Due to the specific nature of the procurement situation in a traditional construction enterprise, the site and line managers handle much of the procurement. ICT competencies among these employees are generally not very high and this constitutes a barrier to the implementation of e-procurement.

To some extent, a culture-based resistance to change among site managers also hampers the introduction of e-procurement (interview with Farzin Saber, March 2006). As the daily purchase decisions in a construction enterprise are often made by site and line managers, a change in business processes from traditional procurement to e-procurement should be accompanied by extensive e-procurement training of the site and

line managers to optimise e-procurement system use (Aberdeen Group 2005, p. 32). Furthermore, most SMEs do not have ICT skills and competencies to handle e-procurement demand specification, system configuration and purchase and operation (see Section 3.2). In addition, the introduction of new workflow processes may be an obstacle especially for construction SMEs because they tend to operate with traditional workflow processes and may be less open to change.

Finally, another barrier to the uptake of e-procurement in the CI is the issue of transparency introduced by e-procurement. E-Procurement has the advantage of making all transactions traceable and a procurement audit can be conducted based on objective procurement data. This may not be in the interest of some stakeholders. This assertion, however, is not fully supported by the available findings and would need more data collection and analysis before being confirmed.

4.1.6 Business implications

The implementation of e-procurement in the CI will have an impact on the workflow process and the industry dynamics among construction enterprises and suppliers in the value chain. By implementing e-procurement, the construction enterprises will be able to negotiate better prices with their suppliers, thanks to a decrease of the administrative costs associated with conducting business at both sides of the transaction (eMarket Services 2005, p. 7).

This transfer of bargaining power from the supplier to the construction enterprise is supported by the case studies about *Skanska* and *Spie*, presented in this report. This possibility of lower prices through buyer-driven e-procurement is, however, not as evident for small construction enterprises because limited procurement volume and economic resources may hamper the introduction of such e-procurement solutions.

One implication is that a buyer-driven e-procurement solution may not be applicable or feasible for all enterprise sizes. There are indications that buyer-driven e-procurement can only be implemented by large construction enterprises with enough procurement volume to activate suppliers and enough economic resources to invest in software purchase, employee training and re-organisation. The case study on *Skanska* is a good example of the requirements for organisational and workflow process changes that are needed to take full advantage of the benefits of e-procurement. Change management then becomes one of the key factors for successful e-procurement implementation in a construction enterprise.

An opportunity for construction SMEs to use e-procurement would be to engage in supplier-driven e-procurement. Supplier-driven e-procurement is a solution where a construction product supplier creates an electronic marketplace for its products - and, possibly, others. The construction SME can then be given access to this supplier-driven solution. By using this option, a construction SME may not gain the same scale advantages as from a buyer-driven e-procurement solution because the e-procurement solution is controlled by the supplier. On the other hand, the supplier bears all the cost of maintenance, catalogue update, and the like.

Thus, a supplier-driven e-procurement solution does not require a large one-off investment from the CI SME. In addition, the use of supplier-driven e-procurement solutions may allow the CI SMEs to increase their ICT capabilities through the interaction with the suppliers. Furthermore, the limited adoption of e-procurement among European construction SMEs may result in a strategic focus of some European construction suppliers towards the large buyer-driven e-procurement systems. This would imply that small and medium-sized construction enterprises operating supplier-driven solutions could experience difficulties in activating enough suppliers to their individual solutions. The suppliers may engage in framework contracts with a limited number of large, closed, buyer-driven e-marketplaces and as a result, SMEs may have difficulty in attracting suppliers.

The main driver for some providers of e-procurement systems is the procurement volume. If construction SMEs do not join forces on cross-enterprise-operated procurement solutions, some of them may face difficulties in attracting software providers to invest in the creation of a buyer-driven e-procurement solution.[35]

4.1.7 Implications of public e-procurement for construction enterprises

This section looks into the impact of public e-procurement developments for the CI, i.e. procurement processes conducted via ICT where a public authority/body is the prospective buyer and a construction enterprise is the tenderer.

Market size of public procurement

According to the UK Construction Federation, the total public procurement in the EU – i.e. the purchase of goods, services and public works by governments and public utilities – was estimated at about 16% of the – then - EU-15 gross domestic product (GDP), or 1,500 bn euros, in 2002. The purchase volume as a percentage of GDP varies between Member States, ranging between 11% and 20% of the GDP. In addition, in 2004, about 21,000 tenders with an estimated total value of 95-105 bn euros were published in the Official Journal of the European Union (OJEU) (Wakeling 2006 p. 1). This represented 34% of the total value of public procurement in OJEU in 2004. In 2004 public procurement represents about 40% of the total construction production value, i.e. 400bn euros per year (Wakeling 2006 p. 1).

Development of e-procurement in the public sector

The opening up of public e-procurement within the Internal Market has increased cross-border competition and improved prices paid by public authorities. For enterprises there are, however, still opportunities for further competition in procurement markets and for further savings.[36] According to a report commissioned by the European Commission, if e-procurement is generalised, it can save governments up to 5% in expenditures and up to 50-80% in transaction costs for both buyers and suppliers (European Commission 2004, p. 3). Based on the information provided by the case studies of *E-Vergabe* and *Yorkshire*

[35] Interview with Farzin Saber (March 2006), conducted in the context of the *Skanska* case study.

[36] Cf. European Commission, www.europa.eu.int/comm/internal_market, April 2006

& Humber Regional Centre of Excellence, the introduction of advanced elements of e-tendering, such as e-negotiation, is not yet under way. The *E-Vergabe* solution represents a best practice example but still only applies the elements of e-procurement that do not present high ICT skills requirements to the supplier side (in this case, the construction enterprises). The business example of Water Services in Belfast sheds further light on the benefits of public e-procurement and especially e-tendering.

Business example:

Water Services in Belfast

The Water Services in Belfast uses public e-tendering with the tender production software Qumi) to create and export the tenders. This allows the tender documents to be returned electronically, thus increasing the speed, confidentiality and effectiveness of tender analysis. Analysis has highlighted some of the potential electronic tendering benefits as, for instance, per tender of 150 pages:

Material (paper and copying) = 110 UK pounds

Staff time (pre tender) = 90 UK pounds

Total savings (pert tender) = 200 UK pounds

Total cost savings = Est. 90% as compared to paper traditional notification, publications and submission of tender.

Source: UK Construction Federation, A Beginner's Guide to e-business in Construction, 2006

If the CI is to engage in public e-procurement, the most likely method would be public e-tendering. Reports indicate that the annual costs of producing, copying and distributing tender documents to clients can be cut by as much as 90% through the use of e-tendering (UK Construction Federation 2006, p. 16). It is argued that one advantage of public e-tendering for construction enterprises is that enterprises trading with the public sector develop an e-business capability (eMarket Services 2005d, p. 2).

Based on this evidence, it could be argued that public clients can, through their selection of suppliers and their demand for ICT capabilities, increase the uptake of ICT among construction enterprises and, in the long run, increase the competitiveness of the sector. As enterprises move along the e-business learning curve, their knowledge and application of e-business is expected to have a spill-over effect on other enterprises. Seen from an enterprise perspective, the use of public e-tendering would lower the information search requirements for enterprises because tender information would be readily available online (e.g. through the OJEU). The introduction of public e-tendering is also expected to reduce possible infringements of rules and regulation by increasing transparency in the marketplace for public tenders (eMarket Services 2005b, p. 2).

Implications

The use of public e-tendering affects the relationship between construction enterprises and their public clients. If the public client introduces an e-tendering process, the supplier is forced to possess specific ICT skills in order to be able to interact with the buyer. The introduction of public e-tendering also moves some of the bargaining power from the construction enterprise to the client. The advantages of introducing public e-tendering are lower prices through greater competition, more transparent tender processes and better control of public spending (eMarket Services 2005c, p. 4). The case study of *E-Vergabe* presented in this sector study highlights the above benefits of public e-procurement.

Public e-procurement is widespread in many EU Member States, but in general is limited to electronic notification of tender and tender publications. The more advanced public e-procurement solutions (such as tender delivery, e-negotiation and e-auctions) are not yet widespread. These solutions are designed to optimise the buyer side of the transaction which means that construction enterprises (acting as sellers) do not yet have strong incentives to engage in public e-procurement (Interview with Marc-Christopher Schmidt, Beschaffungsamt des Bundesministeriums des Innern, March 2006).

A result of this lack of incentives from construction enterprises to move into more advanced solutions for e-procurement could be that the public sector, both as law maker and large procurer, should play a more active role in the support and development of ICT capabilities in the CI. This could, possibly, be done both through articulated ICT demands to current/potential suppliers and through support in ICT skills development initiatives.

On the following pages, the case studies related to e-procurement are presented. The case study of the German e-procurement portal for public procurement illustrates the use of e-tendering and e-procurement for public construction tenders. The case study furthermore highlights the barriers to uptake of public e-tendering for construction tenders. The second case study concerns the international, Swedish-based construction enterprise *Skanska* and illustrates their experiences with e-procurement. The last case study is on the Greek e-procurement portal provider *E-construction* and discusses the uptake and implementation of e-procurement in the Greek CI.

CASE STUDY: E-VERGABE, GERMANY

Abstract

E-Vergabe is a procurement/e-tendering platform for the federal public administration in Germany (Vergabeplattform des Bundes). The main features of the platform include the publication of public tender notices and tender documents, receipt of tender documents and communication between buyer and supplier.

The main objective of the German Government for developing the procurement platform was to improve the efficiency of the procurement process, including higher transparency and better access to public services, by reducing dependency on paper-based procedures. The e-Vergabe system is in place at 33 German federal tender offices and numbers about 600 users (suppliers), including about 60 firms related to the CI.

The impact of using e-Vergabe has two main aspects: the impact on the buyer side (public authorities) which are cost savings and modernisation of the administration system; and the impact on the seller side (construction enterprises) which is better transparency leading to equal opportunities for tendering. Cost savings of about 10% and better communication within the Government and with businesses were also expected.

Case study fact sheet

Full name of the enterprise:	*e-Vergabe*
Location (HQ / main branches):	*Germany*
Sector (main business activity):	*Public procurement*
Year of foundation:	*2001*
Number of employees:	*-*
Turnover in last financial year:	*-*
Primary customers:	*33 German federal tender offices*
Most significant market area:	*Germany*
Focus of case study:	*e-procurement, e-tendering*
Key words:	*Procurement platform, transparency of procurement practices*

Background and objectives

E-Vergabe is part of the BundOnline 2005 project and belongs to the Öffentlicher Eink@uf Online (Public Purch@sing Online) programme, which was initiated in 2000 with the aim to offer all internet-enabled services of the federal administration from a single platform by 2005. Following this initiative, the German Interior Ministry's Procurement Agency decided to develop its own online contract bidding system. They chose the enterprise CSC Ploenzke to develop the e-Vergabe platform through a contract signed in May 2001. CSC Ploenzke is the German branch, based in Cologne, of CSC, an American enterprise providing IT consulting services worldwide, with a turnover of 14.6bn US dollars (about 11.6bn euros) by the end of 2005.[37]

[37] For more information on CSC, visit www.csc.com

Today, the Öffentlicher Eink@uf Online programme consists of three elements (www.bescha.bund.de, July 2006):

- The Tendering Module (Vergabe-Modul "DOMEA®"), facilitating the work of buyers at the Procurement Agency who invite tenders and award contracts
- The e-Tendering platform (e-Vergabe)
- The one-stop eGovernment shop (Kaufhaus des Bundes) is based on an electronic catalogue. Federal authorities can request any item available from the suppliers with whom the Procurement Agency has made a framework agreement.

Today, the e-Vergabe platform has 600 users, including about 60 firms related to the CI, and is in place within 33 public authorities, at all three levels of government: federal, state, and local. Another 22 authorities are expected to join shortly (Activity Report 2004/2005 Beschaffungsamt des Bundesministeriums des Innern, 2005). Furthermore, 1000 public tenders have been published on e-Vergabe in 2005 and this number is expected to increase sharply in 2006 (Interview with Marc Christopher Schmidt, Beschaffungsamt des Bundesministeriums des Innern, 27 March 2006).

The main objective for the German Government of introducing e-tendering is to improve the efficiency of the entire tendering process by substituting all the paper-based processes with electronic ones. This is expected to generate a better classification and a more efficient retrieval of documents. In addition, by publishing all tenders online, all enterprises have access and can apply for them. Through lowering the barriers to participation, competition among enterprises is increased and is expected to lead to lower procurement prices.

Finally, cost savings as a result of fewer paper-based processes and higher transparency are expected by the Government. Contracts in tender by German public authorities are worth 250bn euros annually (about 13% of the Germany's GDP).

Overall, the Government expects to save 10% of this figure by using e-Vergabe (IDABC, E-Procurement Case studies, 2002). This is supported by to the German Association of Towns and Municipalities (Deutscher Städte und Gemeindebund), especting the costs of public procurement should fall by 10 to 15%. As for the processing costs, according to the Bund, both the contracting authorities and the suppliers can expect to save as much as 50 to 80%.

e-Business activities

Technical requirement

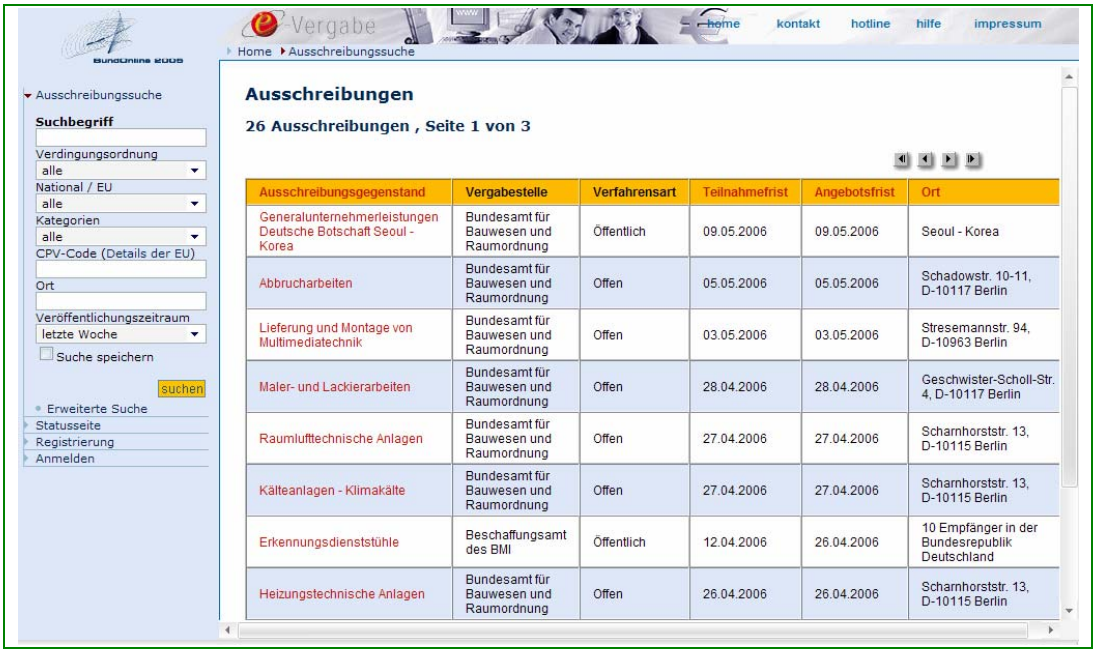
The entire e-Vergabe system runs on an application server. JBoss, an open source software, supports applications like Java and is free to download.[38] The database (where all documents, tenders and contracts of e-Vergabe are stored) is based on the Oracle Database 10g Release 2 version.[39]

[38] For more information on JBoss application server:, visit www.jboss.com

[39] For more information on Oracle Database 10g, visit www.oracle.com

The e-Vergabe system is divided in two main parts: a notification platform and an intercommunication platform. On the first platform, enterprises have access to all the tenders published through e-Vergabe. A search function is used to identify specific tenders. Furthermore, enterprises have access to the economic partner register. The following screenshot shows an example of the classification of construction-related tenders published on the notification platform:

Exhibit 4-7: Screen shot of the E-Vergabe user interface



The second platform is used for communication using a Java Webstart software solution, embedded in the application server JBoss. This communication includes correspondence of questions and upload/download of documents in a secure manner. For example, the Procurement Agency can communicate with single economic partners or with certain groups, such as all the economic partners who are invited for a call for tender or all those who have requested tendering documents.

The training provided by e-Vergabe is composed of an e-learning module provided by the federal German Government, an online training platform for self-training, information campaigns regarding implementation and usage of e-Vergabe and a phone and e-mail based hotline. The main driver behind the development of e-Vergabe has been the desire to create a secure channel for the distribution of public procurement tenders and contracts. The development of a secure platform for e-Vergabe has undergone an evolution from digital signature cards using a card reader towards software certificates. Upon introduction in 2001, e-Vergabe used digital signature cards where each user needed a smart card with two personalised digital certificates. Combined with a card reader plugged into a computer, the user can sign a contract encrypted with his own key. The supported trust centres (providing certificates) where users can obtain a digital certificate are: Signtrust, DATEV, TeleSec, D-Trust and A-Trust. The client computers need to have a class 3 or class 2 key card readers. Class 3 readers feature displays as well as key panels and thus prevent attacks against unauthorised PIN use through input logging. This solution can, however, create problems with interoperability of card readers and signature cards as the e-Vergabe system supports 13 different card readers and 6

different cards among 16 existing in Germany. The cost of this security system is approx. 200 euros per user and the card can last 2 or 3 years.

This initial solution was partly replaced by a secure system of software certificates and the new system has been in operation since the beginning of 2006. Through this system, each computer using e-Vergabe owns one unique personalised signature. The new system requires fewer electronic features because the card reader and signature cards are not relevant, except when the enterprise wants to sign a tender electronically. By using software certificates, enterprises have access to the notification and intercommunication platforms. There are no direct costs associated with using the new software certificates for the users: e-Vergabe provides an online service that enables enterprises to download a personalised software certificate directly onto their computer by filling out and sending a form. The only requirement for this software solution is a computer with a Windows operating system (Version 2000 or newer). The format used to open and read contract files is PDF from Adobe. The e-Vergabe Software that enables the user to bid online is available free of charge on the web site.

The e-tendering process is based on qualified signatures: the enterprise tendering must have a signature card and a card reader installed on its computer to carry out the e-tendering process. First, the buyer (public authority) prepares the tender documents. The tender document is created using a PDF format identical to the traditional tender offer form. The documents are then sent to all suppliers which have applied for participation in the electronic tender process. Due to the use of qualified signature, the tenderer only has to download the tender-offer document, fill out the contract and sign it by using the signature card that is legally equivalent to a paper signature under German law.[40] Then they can submit their bid as usual on the platform, where it is stored and locked as a digitally signed PDF file. Exhibit 4-8 illustrates the e-tendering process on e-Vergabe.

The platform guarantees the following security features through its tasks in the process:

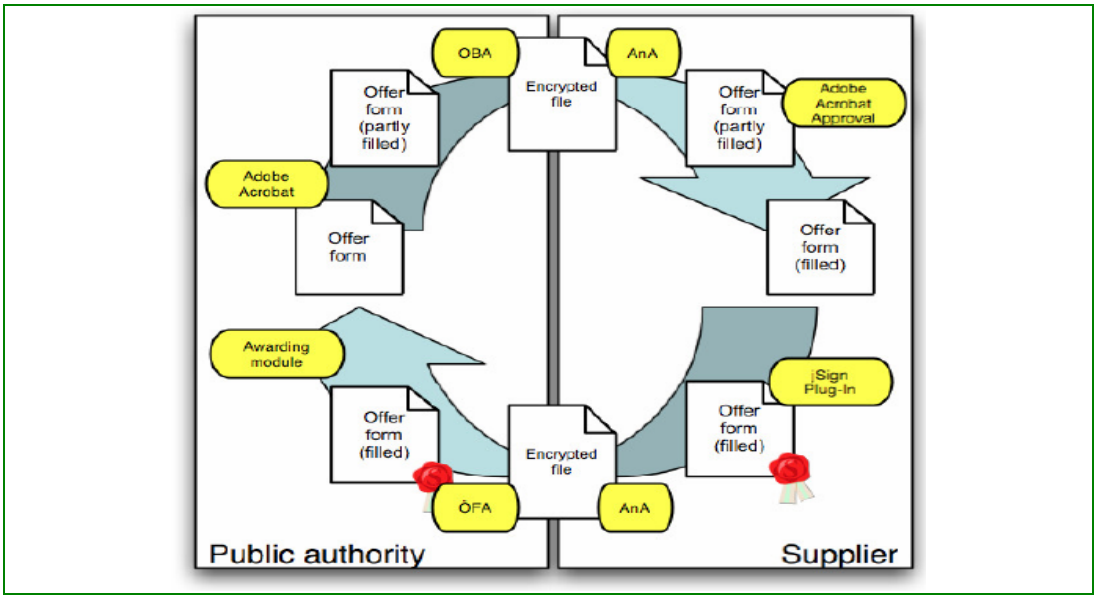
- Access to publishing (buyer) and receiving (supplier) bid invitations
- Time registration of confirmation notice
- Time registration of the tender
- Integrity verification of the tender documents
- Secure locking of tenders from the buyer and other tenderers until deadline.

The feature enables e-Vergabe to meet its security objectives which are:

- Integrity and authenticity of tenders
- Confidentiality of exchanged documents
- Legally binding tenders.

[40] For further information see www.bundesnetzagentur.de

Exhibit 4-8: E-Vergabe tender process



Source: E-Vergabe 2006

Enterprises may still print contracts and send them by traditional mail but the German federal Government plans to stop acceptance of this process. Thus, according to e-Vergabe, by the end of 2011, all tenders will be electronic. In addition, e-Vergabe expects in the near future to replace qualified signature by advanced signature. This tendering process will be easier for the enterprises as advanced signatures can be generated by e-Vergabe using software smart cards.

Impact

The implementation of e-Vergabe has not yet had a substantial impact on the buyer side, although this is expected to be achieved in the near future. Even though enterprises are forced to use the e-Vergabe platform because the web site www.bund.de is the only German information source concerning public tenders, only 5% of the German enterprises use the platform today. This limited use should be viewed in the context of the German administrative structure: the German local governments and administrations (municipalities and Länder) are still using their individual platforms. Furthermore, cities generally use platforms where enterprises have to pay if they want to have access to information.

This use of many different platforms across municipalities, Länder and the federal government hampers the merging and centralisation into one single platform for the country, as different vendors of the pay-for-use platforms will not be interested in missing out on this income in order to merge with one free federally run procurement platform. According to e-Vergabe, no statistics that measure the impacts on costs and efficiency of the system have yet been established. The impact is expected to be analysed in more depth by the Federal Government in the next couple of years according to Marc Christopher Schmidt. Preliminary analysis indicates that the new security features

including software certificates, described above, will support the increased use of e-Vergabe in the coming years.

The e-Vergabe platform also has an impact on construction firms. Among all the enterprises using e-Vergabe, 10% to 20% are construction firms. Thus, public e-tendering begins to be more widely used within the CI. In volume, however, the CI is the main player in public tendering. This is due to the high individual cost of construction projects.

According to Ms Bettina Schneider from the Federal Government, impact is the same for SMEs and big enterprises, as they use exactly the same e-tendering process. The use of e-Vergabe brings about faster processes since procedures that would last several days using traditional mail, only take a few hours to complete using e-Vergabe. In addition, they require less administrative work which can lead to a much simpler work organisation concerning tendering.

Information and services provided by e-Vergabe are free, except for the signature card and card reader. Thus, the e-tendering process is cheaper than the traditional paper and mail-based process. In addition, according to the German Procurement Agency, electronic tendering is a means to prevent corruption. In fact, in all the important steps of the tendering process, all procedures are double-checked by two different employees so that no enterprise can be preferred over another for subjective reasons. Managers are also trained to be more aware of corruption problems. Finally, as all tenders are published on the e-Vergabe platform, all enterprises, either SMEs or large firms, have equal access and an equal opportunity to apply for tenders online.

Lessons learned

The first challenge of e-Vergabe has been to make public authorities adhere to using the e-procurement system instead of their traditional systems. Now 33 different public authorities use e-Vergabe and 22 new users are expected by the end of the year. Thus, the new challenge of the Procurement agency is to focus more on the buyer side: e-Vergabe can be modified to bring about more benefits in the e-procurement process of authorities.

Moreover, during the implementation phase of the e-tendering platform, no workflow system was included. This therefore enables the German Procurement Agency to be more flexible in its choice of workflow.

Finally, to optimise security and usability an e-tendering platform should use software certificates as opposed to digital signature cards. It is more likely that enterprises will use a platform where they do not have to work with signature cards. But on the other hand, it is important to make sure that the public authority can rely on the electronically signed bid from the tenderer.

The use of the platform among construction enterprises is driven by a push from authorities more than a pull from enterprises.

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CASE STUDY: IMPLEMENTATION OF PUBLIC E-PROCUREMENT / Y&H RCOE, UNITED KINGDOM

Abstract

In 2005, Leeds City Council and the Yorkshire & Humber Region implemented a Supplier and Contract Management System (SMCS). The SMCS handles supplier management, electronic tendering and contract management and is implemented in 22 local authorities in the region. The initial cost savings amounted to about 3.75m euros and are expected to increase in the future.

The primary impacts are related to the collating of information on suppliers and contracts across the region, which can be carried out faster and more cost-effectively. Furthermore, information sharing between authorities has become easier.

The lessons learned are 1) Clarity, simplicity and minimal graphics are essential when drawing up specifications to be used electronically 2) Procedures and documentation need to be standardised across different public departments (acting as procurers) for maximum effect 3) The process must allow for resistance to change, especially at a practical operational level and 4) Electronically enabling an imperfect manual system may make it faster, but will not improve it.

Case study fact sheet

Full name of the enterprise:	*Leeds City Council and The Yorkshire & Humber Regional Centre of Excellence (Y&H RCoE)*
Location (HQ / main branches):	*Leeds, United Kingdom*
Sector (main business activity):	*Public procurement*
Year of foundation:	*2004*
Number of employees:	*-*
Turnover in last financial year:	*App. 1.8m euros*
Primary customers:	*Public sector (local government)*
Most significant market area:	*Local government municipalities*
Focus of case study:	*Public e-procurement/ public e-tendering*
Key words:	*Supplier and Contract Management system, interaction between public authorities*

Background and objectives

In 2005, the UK Government set out the target to improve the efficiency of UK local governments and local/regional public authorities. Regional centres of excellence (RCoEs) were established as the lead efficiency change agents for local governments. Based on this initiative, the Yorkshire & Humber Regional Centre of Excellence (Y&H RCoE) was created to provide support to 22 Local Authorities and to the Fire Police Services and National Parks in the Yorkshire & Humber region (Leeds and surrounding areas).

One of the projects promoted by Y&H RCoE was the introduction of public e-procurement and public e-tendering. To support the implementation and use of public e-procurement, Y&H RCoE supervised the purchase of an electronic supplier and

contract management system (SCMS) which serves as the basis for all public e-procurement activities. The SCMS is based on a system implemented by Leeds City Council called the Electronic Tendering System (ETS), which was in operation from 2001 to 2005.[41] During the period of operation the ETS had about 10,000 registrations, 2,600 tenders placed, 1.1bn British pounds worth of contracts placed, 28,319 tender documents downloaded and more than 9 out of ten users rated the ETS as "good" or "very good".

e-Business activities

In the past, the authorities in the Yorkshire & Humber region used stand-alone systems for supplier and contract management. The scope of the SCMS project was the specification and procurement of a web-based service to deliver public e-procurement and make it available to any contracting authority within the Yorkshire & Humber region. The objective was to make contracting with local authorities in the region easier and more accessible, and to remove many of the obstacles, real or perceived, in relation to finding procurement information quickly and easily.

The SCMS system joined all 22 Local Authorities in the region together with any supplier associated with the Y&H RCoE. The objectives of the SMCS project were:

- To give contracting authorities in the region immediate access to quality procurement information, pre-qualified suppliers, and professionally procured contractual arrangements
- To give suppliers access to local authority procurement information - including self-registration, current and forward contracting opportunities, and the suppliers' own historical records
- To provide a catalyst for standardisation, aggregation and collaboration across the region
- To improve the efficiency and effectiveness of procurement within each user authority
- To share the back office elements of supplier and contract management.

An IT system supplier was selected through a competitive tendering procedure. Authorities in the region worked jointly to agree on the specification for the SCMS and, following the competitive tendering procedure, Alito Limited was nominated as the preferred bidder. Leeds City Council, acting in its capacity as host authority of the Y&H RCoE, formally accepted the tender on 11th January 2006 for a five-year period.

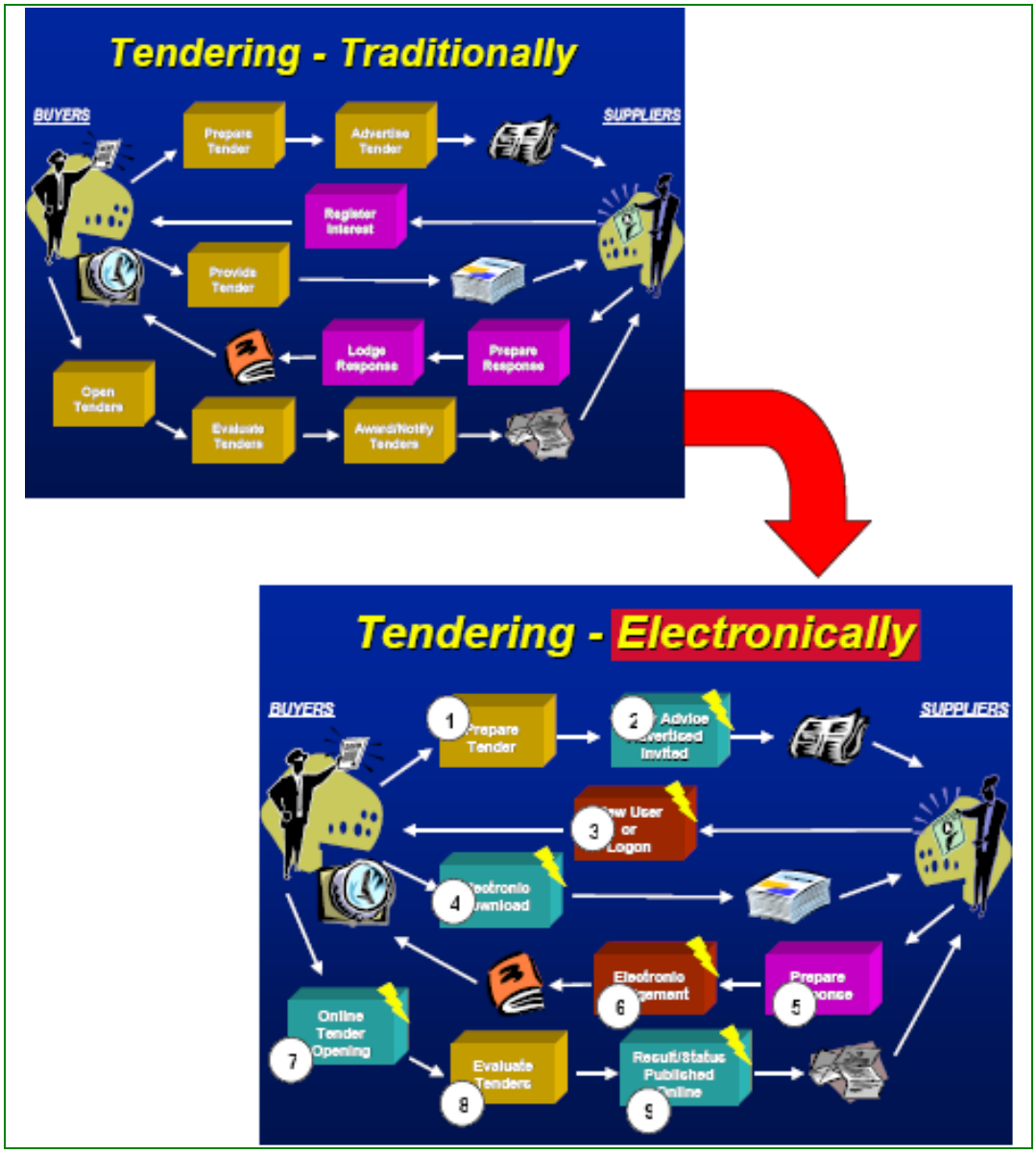
Implementation and roll-out of the system was undertaken in two phases, with ten authorities using the system by the end of June 2006, and the remaining authorities 'going live' in October 2006. Access to the public e-procurement website (http://scms.alito.co.uk) is provided to all approved buyers and suppliers and the system is in effect the central 'core' database for local authority procurement requirements

[41] The existing electronic tendering system (ETS), which was used by twelve councils from 2001, was shut down in July 2006. In the 22 local authorities in the region a variety of legacy systems existed in varying degrees of sophistication.

throughout the region. As of August 2006, the project is entering the third phase of implementation which is aimed at getting service managers to use the system and suppliers to adopt the system as part of their way of doing business. All 22 municipalities will be online by the end of 2006.

The system involved a cost of approximately 750,000 euros and Y&H RCoE acquired an already developed software solution (off the shelf) rather than one that was to be developed. The common electronic tendering process is illustrated in Exhibit 4-9.

Exhibit 4-9: Common electronic tendering process



Source: Electronic Tendering from BVR to Counciltenders.net, Leeds City Council, 2003

The SMCS system contains three core elements. The **supplier management module** (including supplier performance management) is an information system that automates sourcing, purchasing and the management of daily supplier relations. It provides modules for vendor identification and selection as well as direct procurement. The **electronic tendering module** sends requests for information and prices to suppliers

and receives the responses of suppliers using the internet. The **contract management module** encompasses all the activities that a local authority engages in while entering into a business transaction with one or more construction enterprises and fulfilling all the obligations related to the contract.

As an integrated part of the e-procurement procedure when using the SCMS system, the client departments (acting as procurers) are requested to review and revise their standard contract documentation to take account of the SCMS process. This includes not only file configuration (bearing in mind the size of the file), but also file format (MS Word or PDF), of how individual files are compiled and what documents must be returned to the tenderer.

Impact

Based on the experiences from the implementation of the SCMS system, the Y&H RCoE estimates that the region is now better equipped to conduct collaborative procurements through pooling of information on similar requirements and joining forces to run procurements. The SMCS project contributes to efficiency gains by providing a common resource that can be used to support procurement activities. The expected impacts from the introduction of SCMS system are:

- Cost reduction of 3.75m euros through efficiency gains (with a potential for significant savings increase in the future)
- Collating information on suppliers and contracts across the region is quicker and more cost-effective.
- Information sharing between authorities has become easier
- Suppliers only have to pre-qualify once for one, several or all authorities in the region, and can maintain their own details online
- Because the system is transparent it has "demystified" the public procurement process.

In addition to the above-mentioned impacts and benefits for the procurer, the Y&H RCoE has collected information on the impacts of the SCMS system seen from a supplier perspective. The following paragraphs sum up the impacts experienced by two UK-based construction enterprises using the SCMS system:

- **SEC Building services**

SEC Building Services (SEC) is a construction enterprise owned by Scottish and Southern Energy plc. SEC had a turnover of 257m euros in 2002/2003. Today, approximately 5% of the total turnover of SEC is handled electronically. SEC has used the SCMS system to tender for a Communal Heating system in Rothwell. SEC found the system to be a quick and efficient way of submitting a tender and received an automated receipt by return. Using this system saved time and costs and also removed the worry as to whether the tender had arrived by the due date and time. Positive measurable savings have been identified in delivery while additional costs have incurred in printing. According to SEC, the clients are the driving force for the

development of the SCMS concept because the clients experience the benefits in the short run. The relationship with the client has remained the same.

- **Hobson & Porter**

Hobson & Porter (H&P) is a medium-sized construction contractor employing around 150 people and with an annual turnover of around 22m euros (2003). H&P have been working with the SCMS since its launch. H&P log onto the site to download information about tender opportunities, including prequalification questionnaires and tender documents, and to be alerted to any extra information as it arises. H&P completes submissions and return them electronically. According to H&P the e-procurement system from the Y&H RCoE saves the enterprise time and money and enables them to share information quickly and access it remotely. H&P have found the e-procurement system simple to use and navigate, and they will continue to use it in the future.

Further development of the public e-procurement system

Many of the initial problems with the system were related to firms attempting to submit documents which included electronic versions of glossy brochures, aerial photographs, enterprise logos, or scanned images. Such actions dramatically increase the file sizes of electronic documents and can result in submissions being unsuccessful. Despite the file size warnings built into the SCMS system and in the guidance documents, some enterprises still attempt to submit large files that exceed this limit. Efforts are now made to address this via training and awareness sessions. Immediately prior to submitting a tender electronically the tenderer is also requested to check the electronic files making up the tender for viruses using fully current virus checking software, and to remove all viruses from the files.

A significant part of the next phase of the SCMS system will be to get public service employees and managers (acting as procurers) to use the system more frequently. The workflow elements of the SCMS system will make public administration of tenders easier. Public service employees working in parts of the public administration where ICT is more widespread are expected to be more likely to embrace e-procurement technologies. This may indicate that the uptake among public civil servants working with public construction, infrastructure or the like will be more reluctant to use the SCMS system. Concerning the second large stakeholder group, the suppliers, the natural next step is to promote the SCMS system towards SMEs and not-for-profit organisations. The current promotion activities have proved a success when addressing SMEs. Without buy-in from both sides of the procurement process, the success of the SCMS system will be limited. Procurers need to streamline and simplify tender documents to make them user-friendly, as well as produce and maintain them electronically.

Lessons learned

Over the period of operation a number of lessons have been learnt:

- If there is a political requirement to run parallel systems (i.e. hard and soft copy options), the cost and resource savings will not be reduced. It would obviously be beneficial to insist that all future tenders are dealt with electronically.

- Leeds City Council and the Y&H RCoE have experienced that the regional aspect of suppliers and procurers is critical to the success of SCMS system. The more national the SCMS system becomes the less effective it becomes because of cultural and geographical differences among the procurers and suppliers.
- The SCMS system is based on an old public e-procurement system (ETS). It has thus been possible to gradually eradicate outstanding technical and operational issues.
- Clarity, simplicity and minimal graphics are essential when drawing up specifications to be used electronically.
- Procedures and documentation need to be standardised across different public departments (acting as procurers) for maximum effect.
- Electronically enabling an imperfect manual system may make it faster, but will not improve it. Simply e-enabling an existing inadequate tendering process will not make it measurably better.
- Tenderers need to be convinced of the benefits, simplicity of use and security of using the system, and all parties will continue to require training and support. The amount of resources required has been above that originally estimated.
- The process must allow for resistance to change, especially at a practical operational level. Those public servants (acting as procurers) that have used the SCMS system have been surprised at its ease of use and have been converted to doing things electronically.
- Electronic signatures are unnecessary due to the security built into the system.

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CASE STUDY: SKANSKA, SCANDINAVIAN COUNTRIES

Abstract

Skanska AB is one of the world's largest construction enterprises. With headquarters in Sweden, the Skanska group employs 54,000 people worldwide and provides construction-related services and project development. Skanska began to implement e-procurement solutions in its Nordic branches in 2004. The main objectives were to reduce procurement costs and improve efficiency of the procurement process while developing closer cooperation with suppliers. This project was divided into five phases: e-procurement, collaborative commerce, e-tendering, logistics, and e-invoicing.

Skanska has considered the e-procurement implementation as a change management process rather than technology deployment. The two main focus points for the development of the project so far have been support from top management and internal change management including the training of staff and suppliers. The implementation of e-procurement has already had an impact on cost savings: new procurement contracts signed by the Swedish branch of Skanska (first to implement e-procurement) generated about 5m euros in savings in 2005. As of September 2005, about 50% of Skanska's total monthly procurement spending in Sweden was channelled through the Skanska/IBX e-procurement solution.

Case study fact sheet

Full name of the enterprise:	*Skanska*
Location (HQ / main branches):	*Sweden*
Sector (main business activity):	*Construction*
Year of foundation:	*1887*
Number of employees:	*54,000*
Turnover in last financial year:	*13.4 bn euros*
Primary customers:	*Government and businesses*
Most significant market area:	*Sweden, USA*
Focus of case study:	*e-Procurement*
Key words:	*e-procurement processes, change management as key success factor*

Background and objectives

With a turnover of 13.4bn euros in 2005 and 12,000 ongoing projects, Skanska is the largest Nordic construction enterprise and the second largest construction enterprise in Europe. The enterprise generates 41% of its revenue in the Nordic countries (including 20% in Sweden), 23% in the other European countries and 32% in the United States. The enterprise has about 54,000 employees worldwide. According to the Skanska Annual Report 2005, 54% of the group's customers are public authorities. In its annual report 2005, Skanska identifies 4 different business streams:

- Construction (91% of the group global revenue): building construction, including non-residential and residential, and civil construction
- Residential development (5% of the group global revenue)

- Commercial Development (4% of the group global revenue)
- Infrastructure development (less than 1% of revenue).

The main objective of the "Project Effect" initiated in Skanska's Nordic branches in 2003 was to reduce procurement costs and improve the efficiency of the procurement process while developing closer cooperation with suppliers and implementing better logistics solutions.

e-Business activities

Skanska Denmark has just begun to implement e-procurement in 2006, while Norway did so several months before Denmark. The Skanska branch with the most experience in implementation and use of e-procurement is Sweden.

The timing of the implementation of electronic procurement process, according to Skanska Sweden, is as follows:

- 2004-2006: e-procurement (the responsibility for the activation of suppliers and the improvement of the catalogue quality was handed over to a permanent organisation by April 2006)
- Started in fall 2005: sourcing tools for frame agreements
- Started in fall 2005: e-invoice (implemented by IT organisation)
- Fall 2006: request (support project specific sourcing)
- 2007: matching of e-invoice and e-order.

Skanska's strategy is to increase coordination of procurement volumes; i.e. to buy more on common contracts. The enterprise wanted, therefore, to start with the implementation of a tool which could support this procurement strategy. Thus they started directly with the implementation of e-procurement, and already in 2004, e-procurement represented more than 75% of the procurement volume of Skanska Sweden.

In the design and supplier selection process, Skanska wished to work with an e-procurement software provider that was capable of hosting the e-procurement platform and also provide essential supplier activation and ongoing procurement consultancy services. For this task, Skanska finally chose to contract the Swedish enterprise IBX as e-procurement partner.

The implementation of the e-procurement solution began in Sweden at the beginning of 2004. Based on a SAP system, the implementation focused on two aspects: the internal change management and the supplier activation.

The internal change management concentrated on employee training. By spring 2006, the status was as follows (Aberdeen Group, Best Practices in E-Procurement, 2005 p. 31-33):

- A total of 3,000 users had been trained in Sweden
- 1,000 users out of a total of 1,200 had been trained in Norway
- 675 users out of a total of 700 had been trained in Finland.

The task of training Skanska personnel is divided between Skanska and the e-procurement provider IBX, which is responsible for a "train-the-trainers" programme. Skanska handles the education of super-users and normal users, using internal Skanska personnel as trainers. The "train-the-trainers" programme includes approximately 20 hours of teaching. The reason for this strong focus on training is to support the internal change management process in order to alter the traditional work-flow processes. According to Skanska, the main challenge is that the entire enterprise and all employees take part in the system and adhere to the implemented solution as they are going to use it daily. The daily procurement decision is often made by site and line managers who are situated in the individual construction sites. These managers have traditional procurement work-flow processes that need to be aligned with the requirements of the e-procurement solutions.

The other important aspect of the implementation of e-procurement at Skanska has been the involvement of suppliers. The solution from IBX includes a supplier quality programme where each supplier is rated on a scale based on the quality of the e-catalogues uploaded to the Skanska e-procurement solution. This rating of suppliers enables Skanska, in cooperation with the suppliers, to address the improvements needed to achieve high quality e-catalogues. In addition, the supplier quality assurance feature of the e-procurement solution also offers Skanska several different "call-off" methods. A "call-off" method is the format/way a Skanska user interacts with the suppliers. Traditional e-procurement buyer/supplier interaction takes place through an electronic product catalogue. IBX personnel checks the uploaded supplier product catalogues continuously to ensure the catalogues' compliance with predefined standards for information, description and alike.

According to IBX, this call-off method only covers 20-40% of the procurement. The Skanska solutions also support, among others, free text call-offs where individual customisations are communicated. In total, the Skanska e-procurement solution offers 9 different call-off methods and this increases the potential e-procurement flow to 90-100% of all procurements. In Sweden, 145 suppliers to Skanska are currently interlinked with the e-procurement solution using catalogues.

Impact

The positive impact of the introduction of e-procurement in Skanska is clear. In Sweden alone, new contracts signed in 2005 have generated about 5m euros in savings. The impact on logistics can be illustrated by the fact that as of September 2005, about 50% of Skanska's total monthly procurement of goods and services in Sweden was flowing through the e-procurement system. This figure is expected to reach 100% by the end of 2006.

The e-procurement system has allowed for greater transparency of spending as it provides full documentation of the purchase orders. Furthermore, through the work provided by IBX, e-procurement has had an impact on business relationships with suppliers. The online catalogue updated by IBX is a way to maintain competition among suppliers, who are continuously compared to each another. Thus, they have to make a difference if they want to obtain contracts with Skanska. That enables Skanska to have

more influence over them and thus more discounts and favourable framework contracts can be negotiated.

Moreover, according to Skanska, the transparency in relation to the supplier generates a major impact on the procurement process of the enterprise. In fact, a better knowledge of the procurement behaviour improves the sourcing process and thereby the procurement organisation. In addition, higher contract compliance, a higher degree of procurement of the right assortment and better e-procurement discounts can be achieved.

Lessons learned

The following lessons can be learned from the introduction of e-procurement in Skanska:

- Internal change management with focus on employee training programmes is key to successful implementation of e-procurement. One of the success factors of e-procurement implementation was to have train-the-trainer programmes run by the software provider and to hold internal training sessions for the rest of the staff.
- Focus should be placed on system support with hotlines and other relevant help initiatives. This will increase the amount of Skanska staff using the e-procurement solution instead of traditional procurement methods (such as letter, e-mail, and phone).
- Top management dedication and support is essential for the roll-out and usage of the system. If senior management supports the system, the employees will adopt the new work-flow processes faster.
- Focus on the creation of an efficient procurement department to centralise the larger procurement projects and to support any e-tendering activities.
- Communication of the benefits to all employees will help in the adaptation of the programme.
- Use key performance indicators (KPIs) on site and line management to increase system utilisation. By using measurable indicators, senior management can promote and support the usage of the system.

Based on the experiences gained in 2005-2006 the objective of Skanska Sweden is to achieve 100% spending flow through the IBX system by the end of 2006.

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CASE STUDY: E-CONSTRUCTION, GREECE

Abstract

E-Construction was founded in May 2002 by the three largest Greek construction enterprises in order to provide electronic B2B solutions. In February 2003, E-Construction launched the first Greek construction e-marketplace, www.b2bconstruct.gr. This construction e-marketplace offers three main e-procurement options, being a commercial catalogue of products offered on the site, an e-sourcing solution and online auctions. During its 3 years of operation (2003-2006) www.b2bconstruct.gr has supported transactions of construction goods exceeding a value of 220m euros. As of 2006, 629 construction suppliers have subscribed to this e-marketplace.

The construction enterprises using www.b2bconstruct.gr have experienced better communication between stakeholders through a more secure e-procurement system, changes in their human resource policy as more IT skilled employees have been hired to carry out procurement and reduced procurement costs.

Case study fact sheet

Full name of the enterprise:	*E-Construction SA*
Location (HQ / main branches):	*Greece*
Sector (main business activity):	*E-Marketplace*
Year of foundation:	*2002*
Number of employees:	*22*
Turnover in last financial year:	*701,300 euros (2005)*
Primary customers:	*Construction enterprises*
Most significant market area:	*Greece*
Focus of case study:	*e-procurement*
Key words:	*Electronic B2B solutions, e-marketplace*

Background and objectives

E-Construction SA was founded in May 2002 by the three main Greek construction enterprises in order to improve their procurement process. Elliniki Technodomiki, J&P Hellas and Terna S.A. are all shareholders of the society (they hold respectively 37.5%, 37.5% and 25% of the capital) and are the main actors in the use and development of the e-marketplace[42].

E-Construction employs 22 people in 2006 and its turnover in 2005 exceeded 700,000 euros. The project was launched in 2002 due to the construction boom that was generated by the – then forthcoming - 2004 Summer Olympic Games in Athens.

[42] For more information on the participating enterprises, see www.etae.gr, www.jandp-group.com and www.terna.gr, respectively.

The objective of E-Construction was to substitute traditional paper-based procurement processes and call-off[43] methods with modern electronic solutions for both construction enterprises and suppliers. In order to achieve this goal, the two first objectives were to introduce and train the construction enterprises' employees to the new e-procurement process, and then to make the existing suppliers of these enterprises use the system by providing training to them as well.

The efficiency of this solution was expected to be achieved though real-time information dissemination improving communication between buyers and suppliers. Moreover, up-dated electronic catalogues were envisaged to ensure quality of procurement on the buyer side and to give construction firms reliable references for their procurement.

e-Business activities

In 2002, after having studied all the alternative e-procurement solutions, the three Greek construction enterprises chose the Commerce-One SA[44] platform (now Perfect Commerce SA) to develop their own e-procurement solutions based on this technology. Commerce One was selected for its good usability, its security, and because the platform was already widely used in many countries and known among clients. The next step was to create the independent enterprise E-Construction SA and www.b2bconstruct.gr to implement adaptable e-procurement solutions for the three construction enterprises.

The services provided by E-Construction SA can be divided in three main parts:

- Commercial e-Catalogue
- e-Sourcing
- e-Auctioning

Furthermore, additional services such as direct e-mail campaigns or printed catalogues have been introduced.

The Commerce One platform is based mainly on JAVA, XML, Visual Basic and SQL. However, the electronic commercial catalogue differs from e-sourcing and e-auction as it has been created and developed in Greece on the basis of ASP technology that interfaces with an SQL server. The main feature of the electronic commercial catalogue is to advertise supplier enterprises on the E-Construction platform. Each supplier is listed with data including enterprise name, address, and other contact details, as well as its logo and profile, in the product categories it chooses. 629 suppliers are registered in 120 different product categories. Through a search engine, a construction enterprise can find all the suppliers that can provide a certain product. A supplier can also be found according to its name or location. Thus, a construction firm can access a list of all suppliers registered according to its search criteria.

Another important feature of E-construction is the e-sourcing element. The e-sourcing solution developed by E-Construction SA was implemented first and is based on the

[43] A call-off method is the way a procurer interacts with a supplier. E-procurement solutions uses a variety of different call-off methods including electronic commodity catalogues, online auctions, reverse online auctions, customised Q&A interaction and alike.

[44] For information on Perfect Commerce SA, please visit: www.perfect.com

Commerce One Platform. The e-sourcing process can be described as follows: First, the construction enterprise fills out and signs electronically a form for the required product. The enterprise then chooses the relevant suppliers from the electronic catalogue and sends the request and form electronically to each of the suppliers through the platform. The supplier receives the request and form via e-mail. Using the form which is now also signed by the supplier, an offer is submitted to the construction enterprise through the platform. The construction enterprise can now easily compare the offers and make its choice by sending an electronic order through the platform to the selected supplier.

The third important element of E-Construction is the e-auction feature. The goal of this electronic solution is – for the procurer - to find the lowest possible price for a product. The procedure of an e-auction runs as follows: Suppliers are first invited to participate in an online auction for which they have usually already submitted an offer through the e-sourcing process mentioned above. Then the purchasing enterprise defines the opening price of the auction and the supplying enterprises are put into contest without any further interference. An e-auction usually lasts 30 minutes but recurrent extensions of 3 minutes are added every time a supplier bids during the last 3 minutes of the auction. Furthermore, a supplier can underbid as many times as he wants. Finally, the order goes to the lowest bid.

All these electronic procurement solutions have a cost that can be divided into two main parts. First, both the supplier and the construction enterprise pay an annual standard fee. The fee amounts to 1,500 euros for a supplier enterprise. The fee includes the registry in the electronic commercial catalogue, the creation of an account for 2 users, training for these users (1 hour), participation in the e-sourcing and e-auction services, and phone support.

For the construction enterprises, the annual standard fee is between 3,000 and 10,000 euros depending on the size of the firm. This fee includes the creation of an account, technical phone support and training (3 hours). Moreover, some fees are added for each service: for example any new request costs 10 euros, and every new e-auction launched costs 800 euros.

Impact

The implementation of E-Construction e-procurement solutions has many impacts for the stakeholders of this process, both on the supplier and construction enterprises' side. For the suppliers, the electronic commercial catalogue is a way to keep in touch with construction enterprises. For instance, they can present their special offers through e-mail campaigns. Furthermore, electronic transactions managed in a secure way enable the establishment of a better business climate between the stakeholders.

Both the construction enterprises and the construction material suppliers experience the changes that the electronic B2B solution brings to the workflow and the recruitment of new employees. One of the main barriers for the implementation of e-procurement is the conservative mindset of the employees on both sides. The traditional workflow processes make the introduction of new electronic solutions time consuming and costly. As a result, suppliers and construction enterprises are hiring people with IT skills to effectively use the e-procurement processes.

Yet the main impacts can be observed on the construction enterprises' side. Their procurement process has completely changed with the implementation of e-procurement: the elimination of the paper-based process has generated fewer administrative tasks, faster procurement processes and a higher security of transaction. Moreover, e-procurement has an impact on costs, mainly due to the implementation of e-auctions: on average, the provision costs have been lowered by an 8% as a result of this switch.

One of the construction enterprises using the E-Construction portal is the Greek enterprise J&P-AVAX. This enterprise started the implementation of the B2B system in March 2003 and uses the system mainly for request for quotation (RFQ), material sourcing and e-auctions. The use of the B2B platform has reduced the time required for material sourcing by a third when compared to the usual RFQ procedure. This extra time is now spent on better and more analytical order control and follow up systems. According to J&P-AVAX, the platform has also lowered procurement costs, especially when the e-auction process is used. However, no quantitative data are available at the moment.

Currently, E-Construction aims at raising the number of suppliers and buyers and creating a network abroad by connecting its e-marketplace to existing European construction e-marketplaces. This development strategy is expected to lead to more foreign suppliers and buyers, and hence a richer diversity of products and services on the one hand, and a larger buyers base on the other hand.

Lessons learned

Based on the development and implementation of the e-procurement portal, the developers (E-Construction) and its users have identified the following learning points:

- One of the main barriers for E-Construction is the conservative behaviour of the enterprises' employees to adopt new electronic solutions.
- In relation to the Olympic Games, for which E-Construction was originally designed, problems arose as the solution was not implemented until 2004. The result was that paper-based methods were still used during the construction boom generated by the Olympic Games. The optimal solution would have been to implement the e-procurement solutions prior to this boom thus providing the maximum savings in terms of cost and time for both suppliers and contractors
- Since building materials and other inputs to the sector are increasingly sourced internationally, a sector-specific e-procurement portal must be international to be really interesting to national procurers. In other words, the e-procurement portal needs to have international suppliers in its product catalogues.

References

Research for this case study was conducted by Anders Pennerup Gantzhorn, Ramboll Management, on behalf of e-Business W@tch. Sources and references used:

- *Interview with Key Accounts Manager Giannis Katsiaris, E-Construction SA, 2. June 2006*
- *Case review and interview with Key Accounts Manager Giannis Katsiaris, E-Construction SA, 16. June 2006*
- *Interview with George Gouloussis, Purchasing Administrator, J&P-AVAX SA, 27 June 2006*
  - *Websites:*
    - *E-Construction SA, www.b2bconstruct.gr*
    - *Perfect Commerce SA, www.perfect.com*

4.1.8 Summary of main points and conclusions

Many large construction enterprises are working towards strategic procurement and consolidation of the supplier base, using e-procurement in order to optimise prices and to secure compliance with quality standards, terms of delivery etc. In addition to the 2005 *e-Business W@tch* sector study on the CI, this year's study shows that change management is a key element of a successful implementation of e-procurement systems in a construction enterprise. The case study of *Skanska* supports this point. The change management process should be driven by strong and dedicated senior management, and focus should be on employee training.

As indicated in exhibit 4-2 (in Section 4.1.3) it is mostly large enterprises which use e-procurement systems. This may indicate that the business case for e-procurement implementation in large enterprises is now established. However, many construction SMEs do not utilise the opportunities provided by e-procurement. It is still difficult for construction SMEs to identify a solid business case for e-procurement due to the lack of ICT skills and due to the volume and investment requirements associated with custom-made e-procurement solutions. Because of these barriers, it is more likely that the short-term developments in the SME segment will be driven by suppliers' networks, involving building material providers and/or producers and the like.

Thus, for e-procurement to be interesting for European construction SMEs, it could be argued that e-procurement solutions need to be more affordable, easier to use, and web-based. Some of the data from the survey presented in Chapter 3 support this conclusion. For example, SMEs are spending less on ICT and have more often difficulties drawing funds for ICT investments compared to large enterprises (cf. Exhibit 3-4). Furthermore, only few SMEs employ ICT practitioners (compared to larger enterprises), and fewer SMEs send employees regularly to ICT training measures (cf. Exhibit 3-3). Thus, smaller companies normally do not have the same e-skills base as their larger counterparts; for e-procurement systems (and ICT systems in general) to be accepted by them, these systems will need to be more user-friendly and affordable.

As discussed is Section 4.1.4, the advantages of framework contracts and single sourcing in normal e-procurement situations may not be applicable to well-defined construction purchases conducted by large construction enterprises. Such cases may be better suited for an e-tendering process. The case study of *E-Vergabe* supports this finding. In these cases, an e-tendering procedure may yield better economies of scale than framework contracts.

The public sector is also a driver. The public e-procurement solutions are, however, currently focused on the initial steps of the procurement process i.e. notification of public tenders online and e-tendering, with the aim of increasing transparency in the public procurement process.

4.2 3D technology

4.2.1 Introduction

3D technologies (also called Building Information Modelling or BIM) are used in the CI as a tool to generate three-dimensional drawings, plans and construction outlines, and to improve communication among construction project stakeholders (Yeomans 2005, p. 21). This section will present the current use of 3D technology and subsequently analyse the potential benefits, barriers and business implications for implementation of 3D technology in the CI. It will be discussed how 3D technology can be used to optimise the preliminary stages of the construction process – the design and estimation phase and technological planning. Among other things, the ICT skills requirement for 3D technology are analysed and a special section on the development for interoperability standards is presented. The case study of the Lithuanian-based construction enterprise *Constructus* illustrates the use and benefits of 3D technology. Furthermore, this section looks into the current use, benefits, barriers and business implications of 3D technology in the CI.

It should be noted that the discussion on interoperability standards is also relevant for the sections of e-procurement and project webs (Sections 4.1 and 4.3, respectively).

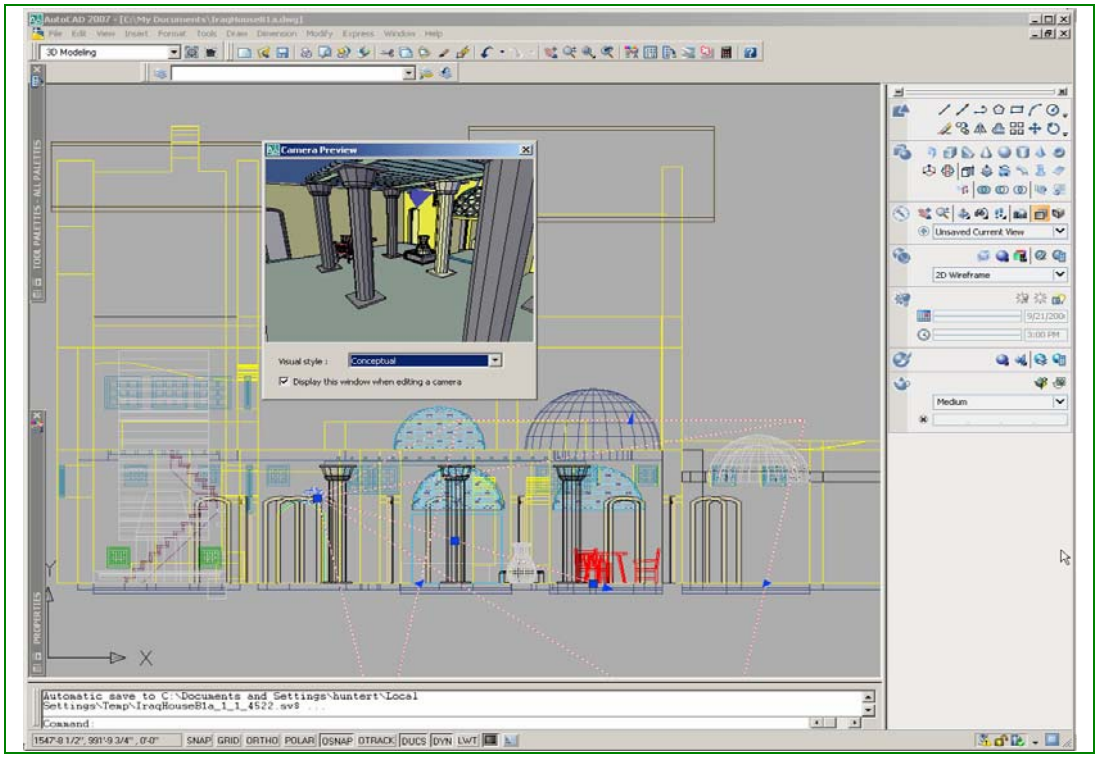
4.2.2 Definition of 3D technology

3D technology is part of a digital construction process, where all elements of a specific construction project are created and stored in a digital three-dimensional model. 3D technology can be used by the main stakeholders when planning, designing and constructing buildings and infrastructure. A 3D model can give a full overview of the building and generate an "as-built" database that can be handed over to other stakeholders in the construction process (Tredal & Johnsen 2005, p. 8).

A traditional paper-based or electronic 2-dimensional model cannot provide the stakeholders in a construction project with a fully fledged virtual model of a building with all the necessary data attached to the drawing before starting the actual execution of the project. 3D technology can provide faster quantity extraction, easier evaluation of construction methods and faster communication with the contractor or other stakeholders

(Terry 2005). Exhibit 4-10 illustrates an example of a user interface in a 3D technology solution for the CI.

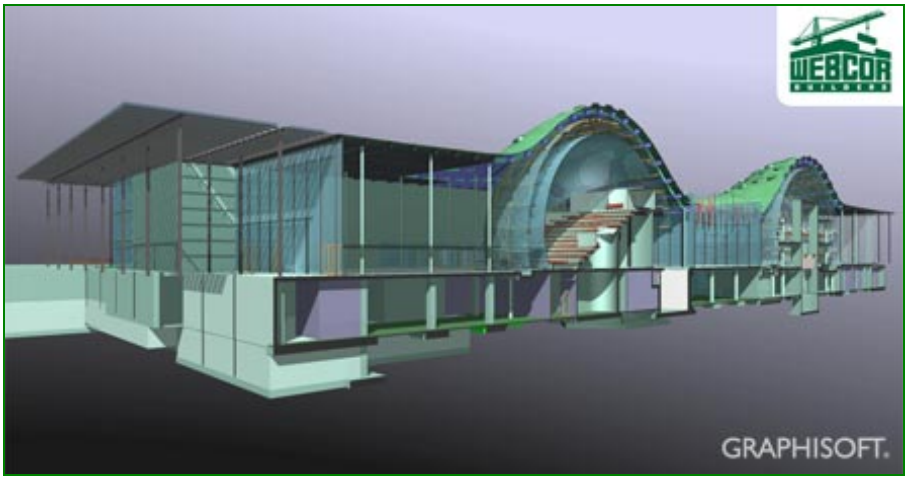
Exhibit 4-10: User interface in a 3D technology solution



Source: www.construcware.com, 12 April 2006

3D technology can provide stakeholders with an overview of the building's attributes and can identify weak points in the construction or irrational construction planning. Furthermore, some 3D technology software can extract information on the number of construction elements used in a specific project. The building objects can be pre-defined, but with flexibility in type and position to allow for change in construction design. Instead of data being static as in 2D models, data in a 3D model can be used in a parametric manner (Interview with Eric Bessone, March 2006) (Tredal & Johnsen 2005, p. 8). As illustrated in the *Constructus* case study described below, 3D technology can be used to simulate various construction phases and foresee potential obstacles. In addition to the illustration of the attributes of a construction project, a 3D technology solution can also be used to visualise the exterior and interior of a construction project. Exhibit 4-11 illustrates this kind of visualisation.

Exhibit 4-11: Visualisation using 3D technology



Source: Graphisoft, used by the California Academy of Sciences Project for Webcor Builders, Inc.

Some of the key issues in relation to the usage of 3D technology are illustrated by the following two business examples on the software providers Autodesk France and Micrograf.

Business example

Autodesk France – online solutions for the construction industry

Autodesk provides a selection of different software products to their customers such as AutoCAD, Architectural Desktop and Revit. The purpose of the software is to enable various stakeholders in the CI to exchange data and collaborate using a shared online platform.

The following key issues in relation to the online solutions were highlighted by Autodesk:

- *BIM or 3D technology can reduce risks and miscalculations, thus leading to cost reductions in construction projects;*
- *It is mainly the building/ construction owners who have started to see benefits from using and implementing 3D technology software in construction projects;*
- *Barriers to 3D technology uptake include a conservative culture and organisational behaviour and management approach;*
- *SMEs generally lack ICT capabilities, which poses barriers to the uptake of 3D technology;*
- *The issue of interoperability and standardisation is seen as another barrier. In France, governmental institutions are now pushing for more Industry Foundation Classes formats (IFC) when exchanging data. Autodesk sees IFC standards as a good way to share data. Owners and governmental institutions have begun to make demands on the use of more digitised data exchanges.*

Source: Interview with Eric Bessone, Sales Manager, Building Solutions Division, Autodesk France, March 2006 (summary)

Business example

Micrograf – a distributor of 3D technology

Micrograf is the distributor of Autodesk software in Portugal. In an interview with e-Business W@tch, Mr. Oliveria, Business Development Manager, highlighted:

- *Architects are using 3D technologies more than construction enterprises.*
- *There is huge impact and potential in using 3D technology as a tool for collaboration in the CI.*
- *Using 3D technology can help the industry and its stakeholders avoid errors and miscalculations, the two sources that contribute to additional costs to the construction project. Micrograf estimates that 40% of the total investment is wasted by errors due to poor communication, which can be reduced by using 3D technology.*

Source: Interview with Rui Oliveria, Business Development Manager, Micrograf, Portugal, March 2006 (summary)

4.2.3 Use of 3D technology in the construction industry

A commercial breakthrough is currently underway in countries where the use of ICT in the CI is already well developed. As an example, the Nordic region is at the forefront, but the technology is also gaining ground in other European regions.[45] As seen in the case study of *Constructus,* diffusion and penetration of 3D technology in Lithuania is limited to a small number of CI enterprises. This also seems to be the case in other Eastern European countries.

Based on data from the 2006 *e-Business W@tch* Survey (see Section 3.4.2), adoption of collaborative design processes and forecasting of demand are still rare in the CI and the 10 sectors studied this year by *e-Business W@tch*. Breaking the numbers down by size-band, "collaborative design processes" and "collaborative forecasting of demand" have been adopted by about 1 in 20 micro enterprises; whereas 29% of large enterprises use collaborative design processes and 32% collaborative forecasting of demands (see Exhibit 3-14).

According to a recent study, the use of 3D technology is not widely diffused and is mainly used on large projects, but the technology has the potential to enhance project collaboration and help prevent change in orders due to interference fits for most project sizes (CMAA 2005, p. 17). This study also showed that about half of the stakeholders surveyed did not use 3D technology, about 40% used it selectively, one in ten used it on most of their construction projects and only one in twenty used it on all their construction projects (CMAA 2005, p. 17). In fact, other industry experts argue that most design communication in the CI today is still done through 2D drawings or traditional text documents (Evans 2003). This finding is also confirmed by another recent study, where the issue of overcoming the 2D vs. 3D working culture was used to explain why construction enterprises are not undertaking more 3D work (Yeomans 2005, p. 79).

[45] Interview with Industry Sales Director Steen Læssøe, Bentley, February 2006

The uptake and use of 3D technology in the CI is also affected by the IT vendors producing the 3D technology software because the availability and usability is important for especially SMEs' purchasing decisions. Exhibit 4-12 lists some of the important 3D technology providers. There is a variety of 3D technology software providers located primarily in Europe and North America. Many of these software providers also produce 3D technology software for other industries than construction (e.g. for the computer games, automotive and aerospace industries).

The business example presented below further elaborates on the current implementation of 3D technologies in the CI:

Business example

Bentley – 3D modelling technology for the construction industry

Bentley is a global software provider in the area of 3D modelling and BIM. In an interview with e-Business W@tch, Mr. Læssøe highlighted:

- *The use of 3D technology in the CI is still limited but is expected to grow.*
- *The market for BIM solutions is growing and an increasing number of enterprises are starting to see the advantages of using these solutions.*
- *Lack of interoperability and standardisation is a barrier for the uptake of 3D technology.*
- *The main business impact is improvement of the design phase and risk/ cost reduction.*

Source: Interview with Steen Læssøe, Industry Sales Director, Bentley, February 2006

Exhibit 4-12: Non-exhaustive list of IT vendors of 3D technology software

Name	Country	Website
Autodesk	U.S.A.	www.autodesk.com
Bentley Systems	U.S.A.	www.bentley.com
BouwASP	The Netherlands	www.bouwasp.nl
Cycas	Germany	www.cycas.de
Cymap	United Kingdom	www.cymap.com
Graphisoft	Hungary	www.graphisoft.com
Leica Geosystems	Sweden	www.leica-geosystems.com
Nemetschek	Germany	www.nemetschek.de
PointLine	Switzerland	www.pointline.com
Scia	Belgium	www.scia-online.com
Star Informatic	Belgium	www.star.be
Tekla	Finland	www.tekla.com

Source: Desk research, Ramboll Management, March 2006

4.2.4 Potential benefits of 3D technology

The benefits from introducing 3D technology in the CI should be seen in the light of the losses resulting from design and construction errors and the lack of communication between stakeholders in the construction value chain. The losses generated by errors in the communication process between different stakeholders may amount to as much as 40% of the total investment of a construction project (Interview with Rui Oliveira, March 2006 and the NCC business example). In addition, the use of 3D technology for the construction of prototypes is expected to reduce waste and number of revisions (Yeomans 2005, p. 21). 3D technology enables architects, engineers and construction enterprises to make simulations of buildings in the project planning phase, and thus improvements can be introduced from the start of a construction project.

The following business example further highlights the potential benefits of 3D technology on time management and cost control. The business example highlights the learning point from the Scandinavian construction enterprise *NCC* in the construction of a university building:

Business example

3D technology at NCC Construction (Denmark)

NCC Construction used 3D technology on the construction of a 4m euros/4,000 m^2 university building project. The original schedule was planned with typical Computers and Information Technology (CPM)-based software. The problems were then analysed using 3D technology which revealed inefficient use of time and subsequent risks arising from this lack of time management. Problems such as unsynchronised schedules, uneven start-ups and durations, and many tasks in the same locations were highlighted using 3D technology. The construction schedule was streamlined, resulting in better time usage, more synchronised critical activities and a more feasible schedule. The benefits were:

- *A cut in project duration of 8 weeks*
- *A weekly reduction in overhead costs of 5,000 euros (management, electricity and heating of facilities)*
- *A 30% decrease in resources spent.*

Source: Graphisoft, 12 April 2006 (summary)

A construction project traditionally requires transfer of building models and construction design plans from the architect to the building engineering and construction enterprises. The document flow between architects and engineering/construction enterprises means that architects do not receive cost feedback from the engineering/construction enterprises until they have had the opportunity to review the forwarded plans. This process is time-consuming and has a high potential for errors. The architects often keep on designing and redesigning the building even if construction plans are under revision by engineering/ construction enterprises, resulting in the risk of rework in the case of cost-driven design changes promoted by the engineering/construction enterprises.

The above problem can be limited by using 3D technology. Design changes evaluated on the basis of their actual "costs of correction" (Cost-driven design) and construction changes can be implemented into the 3D model in real time, reducing the construction period and costs (Yeomans 2005, p. 32). Through the use of 3D technology, construction design and cost estimation can be seen as one ongoing parallel process.

In addition to the abovementioned benefits, a 3D model can gradually be upgraded during the design phases to include more data as the design progresses. This results in cost estimates of increasing accuracy. As seen in the Constructus case, 3D technology can be used to calculate the expenditure capacity of a construction project and create precise working plans.

Another important benefit of 3D technology concerns construction SMEs working as subcontractors. In traditional construction projects, subcontractors are often vulnerable to the effects of incomplete design documentation, schedule starts/stops and ex-post legal claims. The use of 3D technology creates a more predictable work environment. Studies conducted by IT providers have shown that the implementation of 3D technology can lead to a decrease in sub-contractor costs of 5%-20% (Graphisoft, www.graphisoft.com, April 2006).

The following business example of *Raiffeisen Real Estate* (Real estate developer), *Strabag* (Construction enterprise) and *4D Books* (Engineering services) from Hungary further sheds light on the benefits of 3D technology:

Business example

Raiffeisen/Strabag/4D Books

Raiffeisen Real Estate, a real estate developer in Hungary that works with construction enterprises, and Strabag Hungary, the Hungarian branch of a leading construction enterprise in Central and Eastern Europe, both work with 3D technology provided by 4D Books.

4D Books is a Hungarian-based enterprise providing engineering services to the Hungarian construction market. Created in 1992, the firm has provided 3D services since 1995. 4D Books employs 22 people in 2006 and had a turnover of 440,000 euros in 2005. "Virtual Construction", currently the main service provided by 4DBooks, deals with the creation of 3D models based on available paper-based and electronic documentation of a construction project. The 3D model developed for each construction project includes the architecture plans and statistics concerning the mechanical and electricity engineering (such as the protecting piping, the quantity and the budget of each material used for instance).

The cost of 4D Books services amounts to about 1.5% of the net cost of the construction project. The cost savings generated by "Virtual Construction" could reach 7- 8% of total construction cost.

Raiffeisen Real Estate's objective when implementing 4D Books' services was mainly to reduce management hours spent. The main objectives of Strabag were to study the technical feasibility of a project and find the errors and the exact quantities needed before the construction phase.

According to Raiffeisen Real Estate the main impact of 3D technology implementation was:

- *Improved communication between stakeholders through the 3D Model which generates up-to-date information*
- *Better transparency and traceability of data*

For Strabag the use of 3D technology had the following benefits:

- *Fewer people were needed for administrative tasks since all information was automatically gathered using the 3D model.*
- *3D technology enables optimisation of the subdivision of tasks and of the coordination of work.*

Sources: Interviews with Mr. Gábor Sziegl, managing director of 4D Books, April 2006, with Jozsef Takacs, Raiffeisen Real Estate, May 2006, and with Robert Varga, Strabag Hungary, June 2006

4.2.5 Barriers

Last year's *e-Business W@tch* sector study on the CI identified a number of barriers to the uptake of 3D technology in the CI. The barriers included cultural barriers towards new ICT possibilities and a lack of ICT capabilities, especially among construction SMEs. This year's study finds greater uptake and use of 3D technologies among architects, while other stakeholders such as engineers and contractors in the value chain are still not that familiar with 3D technologies (Yeomans 2005, p. 21) (Interview Steen Læssøe, February 2006)

The uptake of 3D technology may also be hampered by the lack of clearly communicated benefits of using 3D technology. Many construction enterprises are currently using 2D technology and have a long, proven track record with this technology. In addition, some construction enterprises cannot envision a clear business case for the adoption of 3D technology, i.e. the costs in the short term versus the long-term positive effects of a 3D technology investment.

The full benefits of advanced 3D technology solutions require interoperability between different internal systems in the organisation. The building material list generated on the basis of advanced 3D models can be integrated into the enterprises' Enterprise Resource Planning (ERP) system, and hence be fully integrated with procurement, logistics, and inventory systems. It is, however, important to notice that the findings from the survey presented in Section 3 indicated that only about 15% of the responding enterprises reported having ERP systems. Thus, the benefits of material list integration with ERP can currently only be reaped by a limited number of enterprises.

These features, however, require a data transfer standard. Such a data interchange standard could be the IFC standards. The main goal of this standard is to improve the exchange and share of information between different systems and software. Lately, IFC have been supported by national public services (Pro IT News 2006) (Medi@construct 2004). For example, the French public sector has begun to promote the IFC standard in building projects to avoid design and construction errors (Business example with Autodesk). Whether the implementation of IFC standards could act as a barrier to the

development of 3D technology is, however, still to be more closely investigated. Some studies argue that the use of international data standards such as the IFC will hamper the innovation of 3D technology and slow down the development of new software applications, because the standards will be outdated once they are finished, due to the long negotiation required.

The uptake of 3D technology may also be hampered by the lack of technical capacity, especially within the area of broadband internet. A broadband connection is necessary to effectively communicate 3D technology drawings and blueprints between stakeholders. As analysed in Section 3.1 about 6 in 10 enterprises have a broadband internet access. Looking at enterprise sizes, about 4 in 10 SMEs do not have the necessary internet capacity to operate 3D technology, meaning that their ICT system cannot handle the exchange of drawings and documents necessary to fully benefit from 3D technology.

This is, however, only a barrier if construction SMEs normally working as sub-contractors want to be able to work actively with the 3D model. If they, on the other hand, want to continue with the traditional workflow processes, the 3D technology drawings and blueprints can be transformed into traditional 2D drawings that can be easily communicated over via e-mail.

4.2.6 Business implications

The introduction of 3D technology affects the European CI value chain. The impact in EU ´Member States is furthermore affected by factors like public support/legislation and differences in industry structure.

The effect of 3D technology on construction stakeholders should be seen in connection with legislation initiatives in some EU Member States to promote the use of 3D technology. Some MS act as front runners in the promotion of 3D technology. E.g. Denmark has put in place a law that, as of January 1, 2007, imposes the use of 3D technology on all public construction projects. This law is expected to increase the uptake of 3D technology among Danish construction enterprises (and among some non-Danish construction enterprises operating in Denmark). There are indications that countries such as Norway and Sweden are to follow the Danish example of imposing the use of 3D technology in public construction projects. Another legislative implication can be found in France where the uptake of 3D technology has been hampered by French law prohibiting construction enterprises from doing the conceptualisation of a construction project in-house[46]. Thus, architects and engineering enterprises were the only driving forces of 3D technology uptake in France. These examples illustrate the amplitude of the impact of national law on the uptake of 3D technology.

Differences in the set-up of the CI between Member States also have an impact on the uptake and introduction of 3D technology. Some Member States, such as Denmark and France, have a divided industry where the stakeholders such as engineering and architects are part of individual enterprises which cooperate with each other in

[46] Law number 85-704 du 12 juillet 1985 relative à la maîtrise d'ouvrage publique et à ses rapports avec la maîtrise d'oeuvre privée" has been amended through Ordinance no. 2004-566 of 17. June 2004

construction projects. In other Member States, such as Sweden, architects and engineers are typically part of the same enterprise. This affects how the value chain works in the different countries. In countries where a construction enterprise is expected to encompass both engineering and architecture, construction SMEs will act more as sub-contractors to large construction enterprises, and thus use the 3D application chosen by the main contractor. This means that 3D technology solutions are currently limited to situations where a project's main contractor is responsible for most of the construction process including architecture and engineering (European Commission 2004, p. 11).

In connection with the discussion on e-standards and interoperability brought forward in Section 3.3 of this study, the following fact box will briefly provide information on the status of different interoperability initiatives:

Fact box

Status of work towards International Interoperability standards for the CI

Efforts are being made to create international interoperability standards within the CI.

The International Alliance for Interoperability (IAI) is the main organisation creating and distributing interoperability standards mainly within the CI. The IAI is an alliance of organizations, software companies, building product manufacturers, information publishers, owners, designers, and builders — in the CI and other related industries - whose goal is to develop a universal standard for information sharing and interoperability of intelligent digital building models developed towards all phases of the building life-cycle (planning, design, pre-construction, construction maintenance and alike). Since 1995, the IAI has developed and published a series of Industry Foundation Classes (IFCs). The current version of the IFCs has been approved by the International Standards Organization (ISO) as an international standard.

IFCs are recognized international standards that provide an organized structure for construction-related data. Use of IFCs, for example, would enable a construction material manufacturer to provide its product data in a format that can be inserted into a computer aided design program (CAD). This "intelligent" product carries data about its properties, such as dimensions, materials, strength, energy performance, fire rating, code compliance, applicability, cost, availability, and source. Appropriate property data about the window can then be exchanged with downstream applications such as cost estimating and energy analysis (www.building-connections.info, August 2006).

For further information on international interoperability standards visit:

- *International Alliance for Interoperability – www.iai-international.org*
- *European Committee for Standardization (CEN) – www.cenorm.be*

Exhibit 4-13: List of organisations working for standardisation and data exchange standards activities in the CI (Non-exhaustive)

Organisations	Planning	Design	Pre-construction	Construction	Tenant Improvements	Close-out	Ongoing operations
AISC	✓	✓	✓	✓			
ASHRAE	✓	✓				✓	✓
Autodesk	✓	✓	✓	✓	✓		
BLIS	✓	✓	✓				
FIATECH	✓	✓	✓	✓			
gbXML	✓	✓	✓	✓	✓	✓	✓
Graphisoft	✓	✓	✓	✓			✓
IAI	✓	✓	✓	✓	✓	✓	✓
IFMA	✓	(✓)	(✓)	(✓)		(✓)	
MIMOSA							✓
NavisWorks	✓	✓	✓	✓		✓	✓
NFRC		✓					
NIBS	✓	✓					✓
NIST		✓	✓	✓		✓	✓
OSCRE	✓	✓	(✓)	(✓)	(✓)		
PISCES	✓	✓				✓	✓
Primavera	(✓)	(✓)	(✓)	(✓)		(✓)	
Solibri	✓	✓	✓				
W3DC		✓					

Source: www.building-connections.info, August 2006

There are indications which point towards a possible change in the balance between the large and small construction enterprises in the value chain. The uptake of 3D technology solutions is mainly driven by architects and engineers and then introduced into large construction enterprises. The natural next step would be to promote 3D technology to smaller construction subcontractors (usually SMEs) but this may prove more difficult. Construction SMEs, operating as subcontractors or independent contractors, may have difficulties in meeting the ICT skills requirements needed to interact and fully benefit from the use of 3D technology. This means that, even if the architects / engineers and large construction enterprises have integrated 3D technology, the sector's SMEs might not be able to gain the same economic benefits of 3D technology implementation. Taking into account the limited ICT skills present in some construction SMEs (see exhibit 3-3), the economic incentive and motivation may not be present.

The following pages feature a case study on the use of 3D technology in the Lithuanian construction enterprise *Constructus*. This enterprise is the first Lithuanian construction enterprise to introduce 3D technology, and the case study supports the analysis of this section by highlighting the cost savings and the barriers to uptake of 3D technology in the CI. The second case study is that of the Norwegian construction project *Akershus University Hospital* where both 3D technology and IFC standards were used.

CASE STUDY: CONSTRUCTUS, LITHUANIA

Abstract

Constructus UAB is a large construction enterprise in Lithuania. It operates exclusively in the Lithuanian market and provides various construction-related services. In 2004, Constructus implemented a new e-business tool in its productivity processes called SAS Programinis Paketas[47] *based on 3D technology. This Lithuanian-made software allows construction project developers to integrate and coordinate the main preliminary stages of construction – design, estimation, and technological planning. Based on the 3D model, developers can speed up their work and save expenditures in developing, coordinating, and adjusting construction design.*

The software was used for the first time in the 2004-2005 PET Factory construction in the city of Klaipeda. The software allowed improvements in planning, management of production processes, and logistics.

Case study fact sheet

Full name of the enterprise:	*UAB Constructus*
Location (HQ / main branches):	*Vilnius, Lithuania*
Sector (main business activity):	*Construction related services*
Year of foundation:	*1994 (renamed in 2003)*
Number of employees:	*70 (2005)*
Turnover in last financial year:	*28.37 million euros in 2004*
Primary customers:	*Private real-estate developers, private enterprises, banks, municipalities*
Most significant market area:	*Designing and building industrial, commercial and residential estates*
Focus of case study:	*3D technology*
Key words:	*3D model including time management*

Background and objectives

UAB Constructus was founded in 2003 when the construction and project management enterprise Skanska decided to exit the Lithuanian market. The shares of the enterprise are now owned by a group of Lithuanian investors. The main activities of Constructus comprise commercial, residential, industrial and civil construction. The enterprise employs more than 70 people (2005), mostly project and construction managers, engineers and other construction specialists.

Constructus operates only in the Lithuanian market with local clients The Lithuanian construction market is facing rigid competition which has forced construction enterprises to look for ways to lower production costs. In 2004, Constructus decided to implement the

[47] SAS stands for Samatu Amortizuotas Sudarymas – a Lithuanian-built software package to calculate estimates and create design. It was developed by the enterprise called SES (statybu ekonomiai skaiciavimai), also responsible for a programme named SES2000 and SES2004 (new version) – which is used only to calculate costs. SES2000 is part of SAS software package.

e-business application SAS Software Package in its production processes. The main motive for investing in the software was to improve the enterprise's competitiveness in the local market. So far, Constructus is the only enterprise in Lithuania using such 3D software-based technology in construction. Constructus hopes that with the use of this e-business tool, their construction projects will benefit from:

- Improved **planning capacity**
- Ability to **anticipate and avoid mistakes** during the construction project cycle
- Better **control of the process** of construction while **improving interoperability**.

The above improvements can not be attributed to one single feature of the software, but is rather a result of the use of all the features of the programme. These features are listed in Exhibit 4-14 below:

Exhibit 4-14: SAS Software Package features and benefits for Constructus

SAS Software Features	Benefits for Constructus
3D model visualisation	Architects/engineers/clients can visualise the final product and use component modelling. Furthermore, they can follow stages of the production and modify the building design in real time
All-in-one data storage capacity	Efficiency and improved interoperability of having building plans/drawings/working plans in one place and in one format. Convenience for project managers, architects, suppliers and other stakeholders of construction.
Component modelling	Changing components in a building is easy and is reflected immediately in the final plans, drawings, prices and work schedules of the project manager.
Expenditure calculation	The new final price is calculated every time changes are made to the building; advantages of cost control of a project and the ability to modify costs/prices during component modelling stage and directly on a final 'invoice'.
Creation of precise working plans	Automatic production and updating of work schedules; any changes in the construction process will result in subsequent work schedules being updated immediately with appropriate new delivery times, supply orders, execution dates.
Comparing with alternatives (still being developed)	Ability to visualise and compare a number of whole building processes and final structures. Useful for comparing completely separate designs, different strategic decisions of building similar or different buildings.

Source: Constructus 2006

Most of the stakeholders of the construction process are expected to benefit from this e-business tool by improving their effectiveness and efficiency of work. However, it is argued by Constructus that, in the end, the building owner will benefit the most - through a lower total construction price achieved by using the 3D technology to secure faster planning and construction of building projects.

e-Business activities

Currently, the 3D model is not entirely finalised as parts of it are still being tested and modified. However, since 2002, other parts of the system have been regularly used in most of the Constructus assignments. In June 2004, the creation of a 3D model was initiated by a consortium comprised of UAB Constructus, UAB INRE and "Statybų

ekonominiai skaičiavimai (SES)“ – all local enterprises. The partners have contributed to this 3D model by bringing in their individual experiences with:

- the use of Bentley Systems software (INRE)
- the use of the SES 2000 (SES’s own product)
- the creation of a 3D model (Constructus)

The 3D model is based on a 3D model concept supplemented by a capacity to estimate the expenditure of construction, the ability to create/modify exceptionally precise work schedules, and the ability to compare structural building alternatives based on price and materials used (this type of 3D model is sometimes referred to as a “4D model” because of the inclusion of the “time” dimension).

Exhibit 4-15: 3D model used in Vilnius Municipality Building construction (2004)

Source: Constructus 2006

The 3D model part of the application was prepared by UAB INRE. In addition to providing traditional information database and visualisation use for architects and project managers (PMs), this part of the programme also allows for “component modelling”. This means that each separate part of the 3D model can be changed or modified. For example, the wall structure can be altered in size or material used, or it can be replaced with pillars. Such changes will immediately be reflected in the overall building plans, drawings, visualisations, safety descriptions and the final cost of production.

The 3D model has been used successfully for the Vilnius Municipality building construction which took place in 2002-2004. The real innovative features of the SAS application are:

- The expenditure calculation capacity of the model
- The ability to create precise working plans.

This allows the PM to explore different alternatives of different materials, construction types in the process of building and viewing expenditure changes in real time. This part of

the software was developed using an existing *SES 2000* cost estimation programme and connecting it to the existing database of raw materials, prices and quantities.

The 3D model has been used by Constructus since 2002. The improved 3D model was tested for the first time in a recent Constructus assignment – the 2004-2005 Klaipėda PET Factory construction (Klai-PET). In total, almost 145m euros were invested in the PET factory, of which more than 33m euros have been allocated to the construction and technology installation work performed by Constructus.

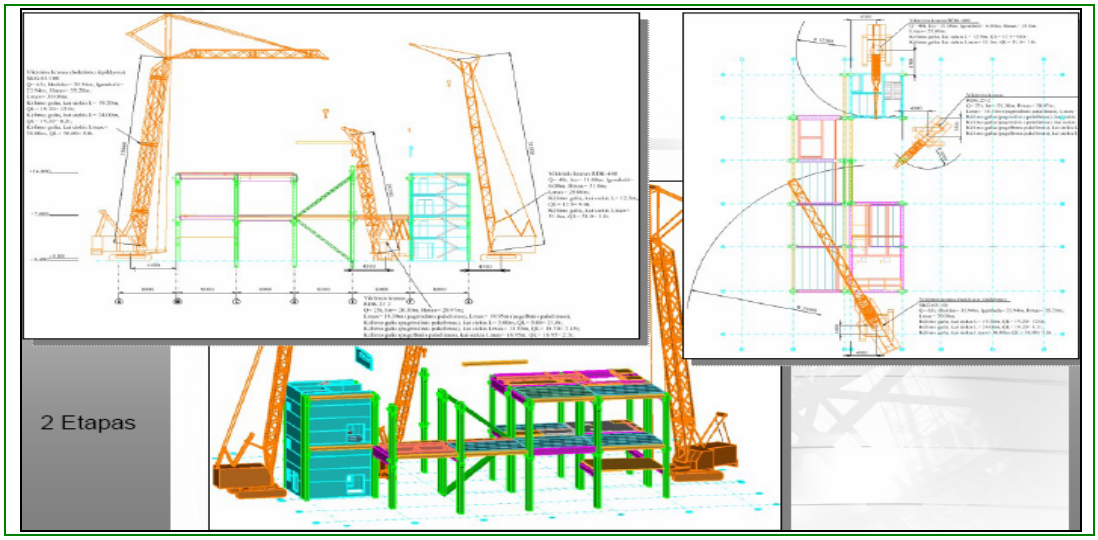
The use of 3D technology specifically involved on-site work foremen, material suppliers and subcontractors (more than 70 at times), construction workers (about 1000), post-construction building installation suppliers, the client himself and other stakeholders in the process.

Impact

The specific advantages can be attributed to the use of the 3D model during the Klai-PET factory construction. The advantages were:

- The 3D model was used to position the 500 ton capacity cranes in order to maximise their ability to lift up to 125 ton structural loads to a height of 14 metres. This process and its obstacles were simulated, which helped the engineers on the ground responsible for the execution.

Exhibit 4-16: Positioning of the crane in Klai-PET factory construction using 3D model



Source: Constructus 2006

- The 3D mappings and diagrams were handed over to the subcontractor AG Zimmer (Germany), who was in charge of the technical installation of the factory. It allowed the contractor to determine whether the proposed construction was suitable for the specific equipment to be placed inside.
- The 3D model visualisation was also an information source for the client who could suggest changes on-the-fly and see the effects of alterations immediately.

- The project team was able to use the model to create working schedules. The managing team decided to connect the 3D model to the Microsoft Office Project 2003 programme using Bentley Navigator software. It was useful in this project because there were four different physical work locations. These four work locations needed an individual specific flow of material and manpower. The integration of project management software in the 3D model facilitated the development of clear timetables for the demand of materials and manpower at each of the four separate work locations.
- In addition, the use of the 500 ton capacity crane brought down from Finland had to be planned very precisely because of high rental costs and the complexity of the assignment.
- According to Constructus, the initial working plan of 1,200 positions was increased to 3,500 positions using the 3D model after running a number of simulations. Overall, Constructus suggested that in this particular project the 3D model allowed most of the savings to be made in the building design phase, streamlining of materials supply and overall organisation of works. The avoidance of potential mistakes also served to reduce potential extra costs of the project. As a result, the PET factory was built at a relatively fast pace and within 18 months.

It is still too early to draw general conclusions on Constructus' 3D technology benefits as the new version of the SAS software package has only been tested in one assignment. However, based on this example and the experience of similar products abroad, Constructus predicts that use of the SAS software can save up to 40% of the time used to plan construction works and to estimate the final expenditure of the project. The 3D technology used by Constructus can also be used in connection with maintenance of finished construction projects. Constructus sees this as a major selling proposition towards future clients. Using 3D technology, Constructus would furthermore be able to maintain and renovate the building at lower cost than traditional building maintenance.

Lessons learned

The experiences gained from SAS in Constructus so far indicate advantages both in the planning and implementation phases of projects. Cost savings can be achieved especially in terms of time required to plan the assignments. It is also essential to note that the 3D model is not used by any competitor, which gives the enterprise a competitive advantage in the domestic construction market (at least in the short term). To retain this position, Constructus is planning to make SAS software an inherent part of its services, offered to clients at no extra cost. The enterprise believes, however, that the competitive advantage of such a tool will encourage other firms in the Lithuanian market to look for similar e-business solutions for improving efficiency of their construction processes. The developers have not noticed any major drawbacks of the 3D model yet.

References

Research for this case study was conducted by Simonas Vileikis, Ramboll Management Brussels, on behalf of e-Business W@tch. Sources and references used:

- *Written interview with Laura Kurselyte, March 2006*

- *Constructus enterprise brochures 2005 (Constructus, PET Factory construction)*
- *Presentation: Kompiuterinis statinio modeliavimas: architektūrinės, konstrukcinės ir technologinės dalies parengimas, statybos proceso ekonominis įvertinimas ir planavimas. Dr. Vladimiras Popovas, Saulius Mikalauskas, Darius Migilinskas. Vilnius November 1. 2005*
- *Websites:*
  - *Constructus,* www.constructus.lt
  - *Government of the Republic of Lithuania, www.lrvk.lt/main_en.php?id=en_aktualijos_su_video/p.php&n=122*
  - *EC DG Regio; Structural Funds in Lithuania http://europa.eu.int/comm/regional_policy/atlas/lithuania/factsheets/pdf/fact_lt_en.pdf*

CASE STUDY: AKERSHUS UNIVERSITY HOSPITAL, NORWAY

Abstract

The Danish architectural firm C.F. Møller has used 3D technology for the design and construction of the Akershus University Hospital in Oslo, Norway. With a budget of about 900m euros, 116.000 m^2 of new buildings, and 20.000 m^2 of renovation work the construction project is very large and 3D technology proved its value in decreasing the number of design and construction errors, decreasing construction time and optimising the flow of documents between stakeholders.

The main learning points were 1) The use of 3D models should be accompanied by information libraries if the knowledge sharing is to increase. Implementing information libraries could further enhance the effective project completion. 3) 3D technology, in the form implemented in the Akershus project, is robust enough to handle the entire design and construction process of even large and complicated projects and 3) The inclusion of HVAC building elements in the model (heating, ventilating and air-conditioning) made the building planning and execution easier.

Case study fact sheet

Full name of the enterprise:	*C.F. Møller Architects*
Location (HQ / main branches):	*Aarhus, Denmark / Copenhagen, London, Oslo*
Sector (main business activity):	*Architectural design, Hospital planning*
Year of foundation:	*1924*
Number of employees:	*261*
Turnover in last financial year:	*About 25.5m euros*
Primary customers:	*Building owners*
Most significant market area:	*Design of large buildings, e.g. hospitals*
Focus of case study:	*3D technology*
Key words:	*BIM modelling and IFC standards*

Background and objectives

Established in 1924, C.F. Møller Architects (CFMA) is an international Danish architectural firm specialised in the design of large construction projects within the office and hospital segment, having designed more than 30 hospitals and other health care related constructions, primarily in Scandinavia. The enterprise operates in more than 10 countries and employs 261 persons from 16 countries. Annual turnover is about 25.5m euros (2005).

In 2000, C.F. M.A. won the architectural and design contract for one of the largest new hospitals, the Akerhus University Hospital in Oslo, Norway. The client was the "Helseregion Øst Norge" (Health Care Region East, Norway). The Akerhus University Hospital is the largest in a series of new hospitals in Norway and will, when completed, be one of the most advanced hospitals in Europe. The construction work started in March 2004, and the new hospital will take over from the old one in October 2008. Thereafter demolition and renovation of the old hospital will take another 3 years before the project

is completed in 2011. The budget of the entire construction project amounts to about 900m euros and encompasses 116.000 m^2 of new buildings and 20.000 m^2 of renovation work. It includes 4.000 rooms for hospital functions and 1.500 rooms for communication and technical purposes, containing 60.000 articles of medical technical equipment, furniture and fixture.

e-Business activities

C.F. Møller Architects decided to work with 3D technology (also referred to as a Building Information Model (BIM)) for the design and construction of this project because they wanted to improve the control of the location and the quantity of applied building elements. This control of building elements should be carried out both during design and construction, and 3D technology was thought to be well suited for this purpose. In addition, the project owner found the use of 3D technology relevant and had already incorporated the costs of using 3D technology in the original construction budget. For this reason, no individual figures can be provided for the cost of using 3D technology.

Exhibit 4-17: 3D visualisation of the exterior of the Akershus University Hospital

Source: C.F. Møller Architects (2006)

During the design process, only a smaller part of the project (the Front/Entrance Building) was created as a full 3D model including interior fixing. This part of the project used all the features of the 3D model that could be used and also applied the Industry Federation Classes (IFC).[48] C.F. Møller Architects decided to use the software "Autodesk Architectural Desktop" as their BIM modelling tool. This software is widely implemented in

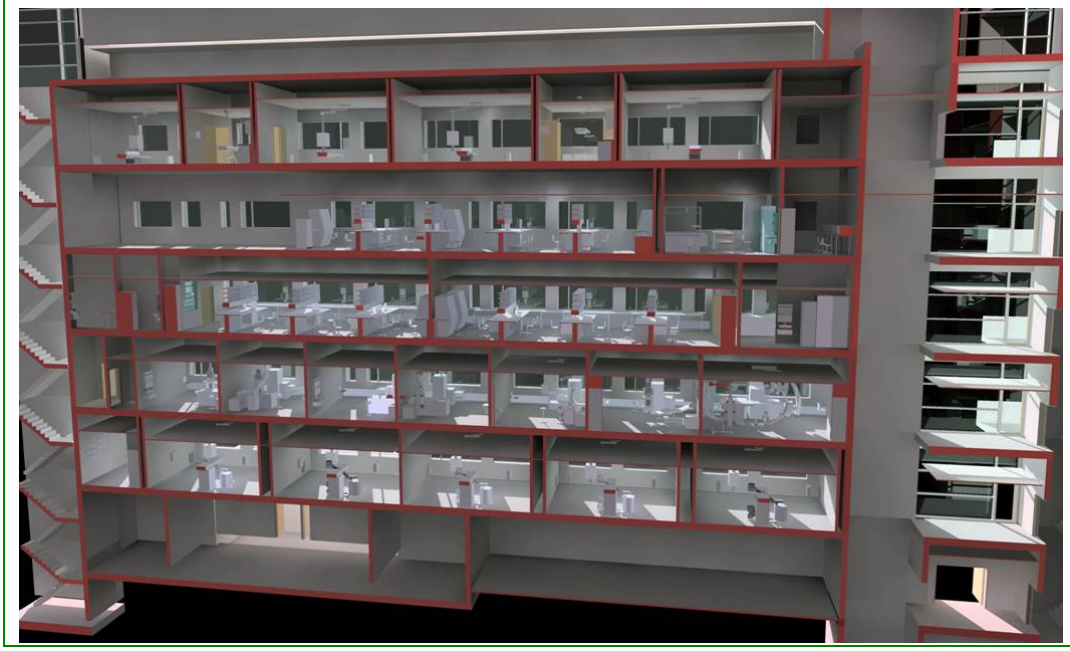
[48] The Industry Foundation Classes (IFC) is an object-oriented file format with a data model developed by the International Alliance for Interoperability (IAI) to facilitate interoperability in the building industry. For more information, visit: www.iai-international.org .

many architectural firms and engineering companies and was selected because it was viewed as the most cost-effective in the specific circumstances.

The Building Information Model differs from the traditional paper-based drawing process in so far as the files saved on the computer consist of virtual building objects and not lines of graphical objects. The computer-aided design (CAD) tool allows the architects to define data objects composed of building elements like walls, doors, rooms or windows. The entire physical environment which needs to be visualized is built up with those objects. All the objects are established in 3D and stored in a common central library. Subsequently, after they have been assessed in a quality assurance procedure, they are distributed to the project team. The intention is that all the information which is connected to the objects should be reused by all the actors in the value chain. The 3D model also includes information about national zoning regulations and laws.

3D technology does, however, not exclude traditional paper drawings: drawings can be extracted from specific views of the model available on separate files. Exhibit 4-18 below illustrates such a specific view of one of the hospital building in the Akershus University Hospital project.

Exhibit 4-18: 3D visualisation of the interior of the Akershus University Hospital



Source: C.F. Møller Architects (2006)

The use of a 3D model that used the Industry Federation Classes (IFC) meant that extra costs for training of key personnel among the project stakeholders were incurred. In addition, the use of IFC standards was estimated to result in slightly higher personnel costs in the early phases of the development of the 3D model.

As a special feature of the 3D model applied to the Akershus University Hospital project, the model included HVAC elements (heating, ventilating and air-conditioning). The subcontractors carrying out this work had access to the 3D model, and all building elements related to HVAC were created in the 3D model. The inclusion of these building

elements opened up new ways of working with production planning, and benefited the execution of the project.

Impact

The interoperability achieved through the use of the IFC standards enables all stakeholders to work on the same model, to monitor the development of each object by calculating building statistics, cost of maintenance, cost of heating/cooling and to visualize clash detection. Thus, quality assurance and communication within the project team is improved. The use of the IFC standards also has an impact on the efficiency of the construction project. The IFC standard makes it possible to export the building information model to an open and transparent format. This standard also respects national building codes and regulations. This means that compliance with regulation is secured for all changes to the 3D model.

In addition to the above benefits of a 3D model, its adaptability to construction changes has proven valuable. Due to organisational changes in the Norwegian national public health system and budget problems, the Akershus University Hospital was scaled down twice to about 75-80% of its originally planned size (in terms of square meters). This meant that the entire building project had to be redrafted. Since the 3D model is changeable and can perform real time simulation of any change to construction design, the architects and engineers could fairly easily make the necessary changes without large delays.

3D technology also has an impact on costs. The link between design and construction is improved through the use of BIM: the BIM contains all building information concerning a building element or a room. The contractor can generate his drawings directly from the updated BIM and thus the risk of mistakes is reduced. In addition, building part information can be streamlined directly to manufacturing machines. This process prevents errors occurring as a result of the use of non-updated plans or bad communication between different stakeholders, thus reducing or eliminating the extra costs associated with such errors.

The construction of the Front/entrance building, which is used as a test case for the use of BIM among all the actors has just been started, and will be finished in autumn 2007. Thus, no quantitative data concerning possible cost savings and productivity gains nor the experiences and conclusions of the actors (contractors) concerning BIM are available at this point.

Lessons learned

The use of BIM makes it possible to change the information flow of a construction project: usually, information is pushed from the consultants and clients to the contractors. But through the use of BIM, information can be pulled by all the stakeholders at any time.

During the project, the architects established libraries for building parts, equipment, fixture and furniture. This was done as an attempt to keep track of all the different elements and the information necessary to keep to a tight time schedule. Such libraries should be available at the start of the project and should preferably be accessible to the producers of building materials, in order to furnish them with all relevant and correct data.

The main lesson learned for the architects is that it is possible to complete a large project working with a BIM, and that this way of working provides enhanced control over all elements in a large project.

A specific learning point from this project is the value of including HVAC building elements into the 3D model. The inclusion of HVAC building elements made the building planning and execution easier.

The use of IFC standards for interoperability has proven valuable in increasing the knowledge sharing between the different stakeholders, to secure compliance with national building and zoning regulations and to minimise construction errors.

References

Research for this case study was conducted by Anders Pennerup Gantzhorn, Rambøll Management, on behalf of e-Business W@tch. Sources and references used:

- *Information provided by Architect Mr. Kjell Ivar Bakkmoen, C.F. Møller Architects, Norway, 28. June 2006*
- *Written interview with Architect Mr. Kjell Ivar Bakkmoen, C.F. Møller Architects, Norway, 8. July 2006*
- *Websites:*
  - *C.F. Møller Architects, www.cfmoller.com*
  - *Akershus University Hospital, www.nyeahus.no*

4.2.7 Summary of main points and conclusions

Based on the analysis and the case studies presented in the previous paragraphs of Section 4.2, the main findings and conclusions about the use of 3D technology by construction enterprises in Europe are summarised in the following:

- The benefits of 3D technology such as cost reduction, risk minimisation, more efficient communication between stakeholders and earlier error detection are well documented. They are illustrated in the case study on *Constructus*, as well as in the business examples of *NCC, Raiffeisen Real Estate, Strabag* and *4D Books*. A geographical difference in the promotion and uptake of 3D technology has been identified, however, with the Nordic region acting as frontrunners. Furthermore, this year's study confirms that the uptake of 3D technology is not so much hampered by barriers in the software itself as by barriers arising from the traditional workflow processes not adapted to ICT and the low level of ICT skills and capabilities, especially among construction SMEs.
- Another barrier to the uptake of 3D technology is the lack of a clear business case for the change from 2D to 3D technology, especially among engineering and construction enterprises. 2D technology is currently being used by many enterprises in the CI and they feel that their needs are sufficiently covered by this technology. For some stakeholders, the extra benefits arising from 3D technology (e.g. virtual construction, simulation of changes and the like) are not perceived as valuable or necessary.
- The benefits from using 3D technology are distributed throughout the value chain in CI, but the architects and contractors often carry the ICT system investments alone. In the short run, the sub-contractor and sometimes the building owner have little incentive to work with 3D technology, because it may take a long time to compensate for the potential cost burden. This, in conjunction with the lack of broadband connections among a large section of construction SMEs (cf. Exhibit 3.1) makes the business case, from their perspective, difficult to identify.

4.3 Project web

4.3.1 Introduction

Previous sector studies by *e-Business W@tch* on the CI suggested that the use of ICT for collaborative work processes can support project management and improve production in the CI (*e-Business W@tch* 2005a, p. 66). Furthermore, a US study showed that 30% of design and construction costs, excluding material costs, are wasted due to poor communication and inefficiencies within and between stakeholders in a construction project (Constructware 2005, p. 1). However, this year's e-Business Survey results presented in Chapter 3 show that only 1 in 10 CI enterprises in Europe reported sharing documents in collaborative work spaces. This could indicate "hidden" potential for construction enterprises in implementing project webs.

This section looks into how an ICT solution called “project web” can be used to improve the workflow processes in the CI. A project web is an application that can enable a better and more secure exchange of information and documents in a construction project (interview with Søren Bilsøe in February 2006). This section also discusses the diffusion of the project web in the CI, problems with standardisation, potential benefits (e.g. reduction in errors, improved management, instant access to revised documents and drawings), the challenge of traditional workflow process when using project webs and related barriers, such as the lack of standards, costs, and limited awareness.

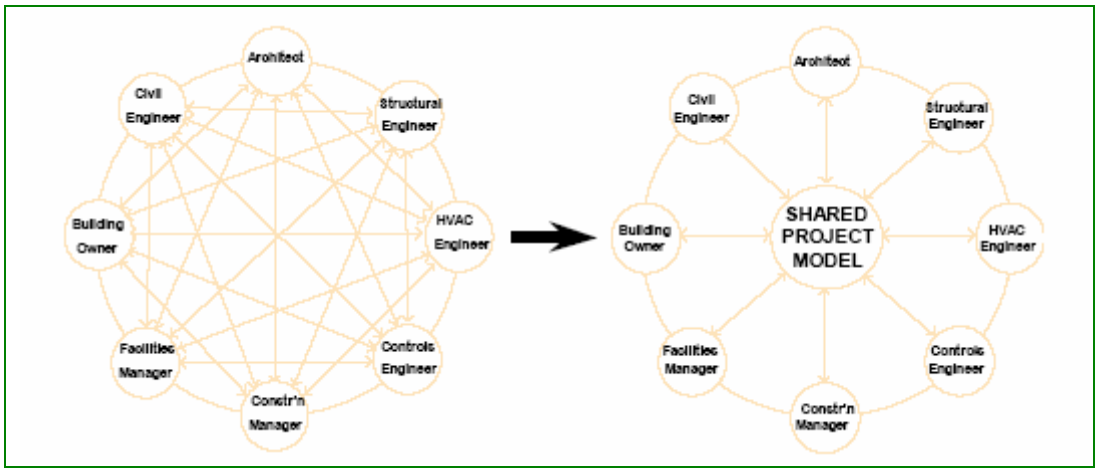
4.3.2 Definition of project web

Traditionally, cooperation in construction, as in any other industry, has been dealt with via paper-based methods, CD-ROM, disks, email or home-made proprietary systems (Constructware, www.constructware.com, April 2006). The main competitors to project webs are in fact traditional paper-based document handling along with e-mail and ERP systems (interview with Søren Bilsøe, February 2006). The 2006 e-Business Survey, however, shows that only about 1 in 10 responding enterprises in the CI said that they have an ERP system (see Exhibit 3-13). Thus, e-mail and traditional document handling is seen to be the main competitor to project webs.

The use of traditional document handling may result in slow and complicated workflow processes since there are many partners involved in a construction project. Furthermore, this can easily lead to misunderstandings between the various stakeholders especially regarding the expectations and assumptions of the client and the work provided by the construction enterprises (Interview with Jean-Yves Ramelli, March 2006).

One of the ideas behind the development of project web solutions is to enhance the element of virtual organisation in the CI. A project web is a tool to achieve a digital building process where all work-flow processes are gathered in a single online and digital platform that can be used by all the relevant users in a construction project. The idea is to establish an effective project management tool that gives all the project stakeholders easy access to the latest revised project information and documents via the online project web. The project web thus ensures information exchange between users in the project, e.g. one participant can easily transmit and exchange digital information to all other participants (Alexander et al. 1998, p. 2) (see exhibit 4-19). A “virtual” organisation, where documents and communication are electronic, may enable a “dialogue” between the stakeholders in a construction project and create integration in a very fragmented industry that is characterised by a large number of SMEs (Grassi 2006, p.1.).

Exhibit 4-19: Example on a generic project web solution



Source: Alexander et al., Information and Communication on Construction: Closing the Loop. In Construction Informatics Digital Library, 1998, p. 2

Exhibit 4-19 shows the exchange of information in a traditional construction project versus a view of the construction project using an online project web solution.

A traditional construction project includes a flow of physical documents to share information among stakeholders. Using a project web, the involved stakeholders can send and retrieve documents, drawings, construction plans and minutes from the project web server instead of having to send paper-based documents.

The information stored in the project web can be copied and read from the server by all users, who have been given a username and password, wherever and whenever needed. This means that a project web offers a wide variety of user access to the same material despite the differences in the users' own IT systems. Users can see all revised editions of the documents used in the construction project. The project web can follow a construction project from birth to delivery and the documents can also be viewed by the owner during the the operation and maintenance phase (Constructware 2005, p. 6).

Interviews conducted for this report indicate that the concept of project web is continuously being tailored to suit the specific needs of the enterprises in the CI.

Business example

Byggeweb A/S

Byggeweb A/S has market activities in all Nordic regions; including Norway, Sweden, Iceland, Finland and Denmark. Project web solutions are a growth area; they facilitate the exchange of information and documents among stakeholders in a construction project in a secure workspace. The project web platform is continuously being tailored to suit the specific needs of construction enterprises, taking into account comments and feed-back from several Nordic construction enterprises in a systematic manner.

According to Byggeweb A/S, the main rival solutions are paper-based document handling, e-mails, property-based systems, ERP systems and other specialised applications. A barrier for a further uptake of internet-based project web solutions is the relatively conservative nature and cultural barriers in general in the CI. Furthermore, there is a lack of a European-wide technical standard for interface between collaborative IT systems; it is common among project web suppliers to use different customised software, coding and programming. As regards SMEs, they normally do not have the financial resources to engage in project webs. In addition, as some SMEs work as sub-contractors, they are not accustomed to using the electronic features in the project web solutions and they lack the incentive to engage and finance participation in project webs.

Source: Interview with Søren Bilsøe, Sales Director, Byggeweb A/S, February 2006 (summary)

4.3.3 Use of project webs in the construction industry

The main stakeholders involved in the usage of project webs are the construction enterprises and clients. The architects, engineers, construction management, contractors, those in charge of operation and maintenance, the building management and the client/owner are all a part of the construction process and can potentially participate in a project web. The large number of participants may, however, complicate the communication and information sharing among the project stakeholders.

The value of a project web is that it promises to reduce errors by supporting project management. The uptake of project web solutions, however, is not very high. This year's survey shows that about 1 in 10 responding enterprises share documents in collaborative work spaces. Looking at enterprise sizes, however, about half of the large enterprises share documents in this way compared to only 8% of the micro-enterprises. Compared to the weighted all-sectors average, the CI is performing below average in this field (See Exhibit 3-14). This result can be explained by factors such as cultural barriers and the conservative nature of the CI (Interview with Søren Bilsøe, February 2006).

Architects and engineers tend to be the early adopters of project web solutions (B3Dkonsortiet 2006). At the (sub-) contractor level, and especially on the specific construction site, the use of project web has, however, not gained much support. In a Danish study, architects, engineers and contractors were asked about their usage of project webs. The study showed that it is mainly architects, engineers, contractors and clients who are involved in project webs, whereas other stakeholders are infrequently

mentioned. In addition, architects, engineers and contractors experience increasing demand for the further development of competencies in the area of project web (Inhouse Consulting 2006, p. 67) This trend is furthermore supported by an American study where the order of project web usage is the following; the construction project manager (96%), the administrative assistant (81%), the architect (79%), the construction manager (61%), the owner (60%), the engineer (55%) and finally the subcontractor (42%) are the most frequent users (Constructware 2001, p. 17).

Another finding of the desk research about project web solutions is the following list of IT vendors producing project web solutions:

Exhibit 4-20: Non-exhaustive list of IT vendors developing project web software

Name	Country	Website
4Projects	United Kingdom	www.4projects.com
BouwASP	The Netherlands	www.bouwasp.nl
BuildOnline	United Kingdom	www.buildonline.com
Byggeweb	Denmark	www.byggeweb.dk
Citadon	U.S.A.	www.citadon.com
Constructware	U.S.A.	www.constructware.com
Eudata	Belgium	www.eudata.be
Formi	France	www.formi.fr
KPN	The Netherlands	www.livelinked.nl
NVision	Luxemburg	www.iconstruct.lu
Procos	Belgium	www.procos.be
ProjektWeb	Denmark	www.ramboll.dk
Prosys	France	www.prosys.fr
Quadram	Luxemburg	www.quadram.lu
Scia	Belgium	www.scia.be
SwITch	Belgium	www.asbuilt.be
Van Meijel Projectservice BV	The Netherlands	www.edificium.com

Source: CSTC, Les Portails de Projects – Gestion collaborative électronique de documents dans les projects de construction, 2005.

As discussed in a report from the European Commission, exchange of information is not frequent in the CI and is hindered by the deficiency of shared information standards (European Commission 2004, p. 11). This can cause construction projects to exceed time limits and costs because of problems with communication and collaboration (CMAA 2004, p.11). Furthermore, Søren Bilsøe points to the problem that, due to the lack of a European-wide technical standard for the interface between collaborative IT systems, most producers of project web solutions use different customised software coding and programming (Interview with Søren Bilsøe, February 2006). This is also confirmed in a recent study which finds a: "*lack of software interoperability particularly between different types of systems, where it is not possible to transfer or use previous* data" (Yeomans 2005, p. 41). For a further elaboration on the issue of interoperability standards see Section 4.2.6.

Interviews support this point by highlighting that the different standards used by IT vendors may have the effect that enterprises have to use different project web solutions

from project to project. When no unified standard exists, some enterprises may be forced to spend resources on training and ICT to be able to handle different user interfaces and workflow processes in different types of project web software. This, in itself, may constitute a barrier to the uptake of project web solutions (Interview with Søren Bilsøe, February 2006).

4.3.4 Potential benefits of project webs

One of the main benefits of using project webs in the CI is the reduction of delays in communication. An American study showed that 40% of the questioned enterprises saw the project web as an eliminator of barriers such as delays in communication, workflow, and processing information and documentation. 94% of the questioned enterprises saw document management as a tool to reduce costs, with the main reduction stemming from man-hours used for creating, filing and searching for documents. The study also showed that enterprises gained a competitive advantage by using project webs, especially in the area of more effective communication and operational efficiency (Constructware 2001, p. 9, 13).

This is supported by another study on the UK CI, which showed that the main advantages from project webs are reduction of errors, improved possibility for audit, and reduction in building time (Martin 2003, p. 5-6). Another benefit from project webs is the reduction of errors arising from the use of different versions of key documents by stakeholders (Interview with Søren Bilsøe, February 2006). Project webs normally offer functionalities that enable users to retain their well-known workflow processes and access the needed documents, drawings and minutes online.

The following business example builds upon the benefits of project webs presented above and goes in greater detail with the possibility for auditing and log trail:

Business example

Prosys SA – a French project web provider

Prosys SA is one of the major project web providers in France. The use of project webs is not widespread in France at this stage, but for large projects (more than 100m euros) it can be economically feasible to use a project web.

The goal of the software supplier is to develop new affordable products (less than one euro per day per user) which can be adopted by the users according to their needs. This gives the possibility of selling software licenses, which allows the construction enterprise to use it for all their projects. According to Prosys, the use of project webs can enhance the transparency in the construction process and enables a continuous update of plans and schedules. The project web technology also enables the stakeholders to keep a watch on the log and audit trail in order to see who and when the stakeholders have seen revised documents.

Source: Interview with Emmanuel Netter, Head of Marketing, Prosys (summary)

Participation in a project web allows for fast access to the newest information and revised documents and drawings. For SMEs, there are also savings on printing costs. This can be seen e.g. in the best practice example conducted by the project web provider Citadon, where the Brazilian engineering enterprise Odebrecht saved over 5,000 US dollars per month in reduction of document dispatches and distribution and in printing costs (Citadon, www.citadon.com, March 2006).

4.3.5 Barriers

This section analyses the barriers to project web uptake in the CI. Three main barriers are identified on the basis of the survey results presented in Section 3.8.2 and the discussion in the previous paragraphs of Section 4.3.

Lack of standards. A barrier to the uptake of project webs in the European CI is that many of the present project webs cannot be integrated with other business administration software such as ERP systems. This increases the number of different ICT systems used in the enterprise and leads to increased ICT complexity, partly because employees have to be capable of using multiple ICT systems and partly because data exchange does not take place automatically. This complexity places a heavy burden on the staff (Yeomans 2005, p. 41). This lack of ICT systems' integration derives from the absence of industry standards within the area. Many different ICT systems (with different ICT formats and user interfaces) are used across enterprises. This further complicates the interaction between different enterprises. For construction enterprises participating in parallel construction projects, this may be problematic.

Lack of financial resources. Another barrier identified in this report relates to costs. In some cases, construction SMEs do not have the financial resources to engage in a project web (interview with Søren Bilsøe, February 2006). The survey results presented in Exhibits 3-4 and 3-7 support this argument by highlighting that SMEs use less of their total budget on ICT compared to large enterprises and that SMEs more often are forced to loan-finance their ICT investments compared to large enterprises. The one-off start-up costs for software and hardware can, for an SME, be quite considerable, and hence act as a barrier. This means that the large European construction enterprises drive the uptake of project web solutions.

Since large construction enterprises are primarily investing in project web solutions, the issue of who is to pay for the sub-contractor's participation in the project web arises. If it is a prerequisite for a project that stakeholders have or buy a specific project web solution, this may generate a barrier that hampers the access for SMEs to be subcontractors in large projects. Small sub-contractors rarely use the electronic features of the project web solutions, hence their incentives for engaging and partly financing the project web solutions are limited (Interview with Søren Bilsøe, February 2006). It can furthermore be argued that the use of project web solutions is closely connected to the direct benefits from using the solution. And because benefits for small sub-contractors seem to be limited, there are indications that the use of project web solutions is decreasing throughout the value chain i.e. larger construction enterprises working as project managers use project webs more than the smaller sub-contractors engaged in these projects (Martin 2003).

Limited awareness. Another barrier identified in the analysis concerns the diffusion and penetration of project web in the CI. Many construction SMEs are not aware of the content, requirements and benefits of project web solutions, and hence cannot assess the usefulness of such software. In general, ICT is not a primary focus point of many CI enterprises and this, in effect, hampers also the uptake of project web solutions.

4.3.6 Business implications

The business implications of implementing project webs in the European CI are that enterprises using project webs can achieve improvements in productivity through faster communication and fewer errors caused by versioning mistakes. The efficiency gains from faster workflow processes may thus save time and money. Furthermore, project web solutions can reduce building time and improve the maintenance and operation phase, because all documents, drawings and their revisions can easily be retrieved from the project web server.

The following business example is about the use of a project web solution in a construction project. This business example also illustrates some of the implications that project webs may have on the workflow processes and the efficiency of stakeholders involved in a construction project.

The broad introduction of project web solutions may widen the ICT gap between SMEs and large enterprises. Normally, the building owner, the engineering enterprises or the prime contractor selects a project web solution. This may have a negative effect on SMEs operating as sub contractors. If they want to be selected as sub-contractors on a specific project, they *must* implement the selected project web solution, even if this means implementing a new project web system, with possible new user-interfaces and ICT-skills requirements. If, in the next project, another prime contractor selects a different project web solution, the SMEs might be asked again to invest in new software.

Based on the survey presented in Section 3 it is argued that SMEs mainly finance ICT investments from their cash flow and, in addition, that SMEs have limited focus on ICT skills training (see Section 3.2). These factors could indicate that some SMEs would not be able to support a continuous change of project web solutions. **Overall**, the implementation and use of project webs are not expected to greatly impact the dynamics and structure of the European CI. It is more likely that their use will reinforce current trends towards cost reduction in the construction process.

Business example

Bouygues Construction (France)

Bouygues Construction is a French construction enterprise with a turnover of 5.5bn euros in 2004 and has 38,500 employees in 60 different countries. Bouygues first adopted project web solutions in 2000 and in 2002 They decided to use project web solutions systematically for all big construction projects exceeding 50 different stakeholders. At present (2006), Bouygues is using project web solutions on 20-25% of their projects.

Bouygues implemented a project web solution for the construction of the Home Office Building in England. The Home Office project started in 2001 and ended in January 2005. Three buildings (75 000m2) were delivered for 3,400 employees and 255m euros in total have been invested in the project. A clause of the contract stipulated that all the project stakeholders should use the project web solution implemented by Bouygues. In June 2003, 237 different stakeholders were using the project web; 18 gigabytes of data were shared (13,400 online documents). At the end of the project 50 gigabytes of data were online. Bouygues chose software provided by Brigsnet. The costs of the project web solution can be divided in three parts: 1) A monthly fee 100-200 euros; 2) maintenance and consulting equivalent to 3 fulltime employees; 3) internal training costs amounting to approx. 600-2000 euros.

Based on the project webs, engineers and architects can conduct projects from France in e.g. Tahiti, which would not be possible with traditional papers and mails. The use of project web generated a 25% saving on cost for paper and mail but the main impacts from project web implementation seem to be not quantitatively but rather qualitatively measurable through improved project execution.

Bouygues expects project web solutions to remain simple and maybe even simpler to use in the future. The challenge is how to combine 3D technology and project webs. There is a lack of standards concerning 3D technology and stakeholders still work on 2D plans. The challenge for Bouygues is therefore to implement a graphic charter (like IFC standards) so a 3D plan with notification on each object can be realised and shared on a project web. This can, according to Bouygues, lead to 20 to 30% savings during the conception phase.

Source: Interviews with Mr. Eric Juin, Bouygues Construction, 28 March 2006 and 20 April 2006; Annual Report 2005, Bouygues Construction

The following case study features the French construction enterprise Spie *SCGPM* which successfully uses project webs in their construction projects. The case illustrates the benefits and barriers to project web usage in the CI.

CASE STUDY: SPIE SCGPM, FRANCE

Abstract

Spie SCGPM, the regional branch of the fourth-largest French construction enterprise, Spie Batignolles, is at the forefront of the implementation of project web solutions in the CI. The mother enterprise, Spie Batignolles, had a global group turnover of 805m euros in 2004 and 60 offices in 5 European countries. The regional branch, Spie SCGPM, covers the Paris area and employs around 500 people. In 2000, Spie SCGPM introduced project web solutions into its construction projects and has, as of spring 2006, used project web solutions in 10 different construction projects. The enterprise adopted the software called Projecteo provided by Prosys SA, and this solution has generated a positive impact on the work organisation of the enterprise as well as on the workflow process of construction projects.

The main advantages of the use of this project web solution within Spie SCGPM have been improved response time and communication among stakeholders in the construction project and a greater efficiency in construction planning and building.

Case study fact sheet

Full name of the enterprise:	*Spie SCGPM*
Location (HQ / main branches):	*France*
Sector (main business activity):	*Construction*
Year of foundation:	*1950 (SCGPM) (merged with Spie Batignolles in 1984 and became Spie SCGPM)*
Number of employees:	*About 500 people*
Turnover in last financial year:	*160 m euros*
Primary customers:	*Public and private contractors*
Most significant market area:	*Construction projects*
Focus of case study:	*Use of Project Web Solutions*
Key words:	*Construction planning, project webs*

Background and objectives

Spie Batignolles, the mother enterprise of Spie SCGPM, is the fourth largest French construction firm. With branches in Germany, England, Spain, Portugal and Switzerland, Spie Batignolles had a turnover of 945m euros in 2005 (35% in classic construction, 20% within maintenance, 20% within specialised construction (such as underground or technological construction projects), and 25% through partnerships in real estate projects (www.spiebatignolles.fr, June 2004) and currently employs more than 5,000 people. Spie SCGPM acts as a regional branch of Spie Batignolles in the geographical area of Paris (Ile de France). Spie SCGPM works primarily within the four business segments of office, residential buildings, commercial centres, hostelry and non-residential buildings (hospitals, schools and equipment).

The enterprise is organised into two main activity branches: **Concertance** (Complete building projects) and **Présance** (Rehabilitation, renovation and maintenance). This division is intended to secure higher efficiency within the four main business segments.

Spie SCGPM executes projects for public clients such as the French Ministry of Culture and Communication, the General Direction of the Civil Aviation (DGAC) or the Hospital Saint Camille in Paris. Private clients include Hines (client of the Meudon Campus project below mentioned), BNP Paribas, France Telecom and Renault (www.spiebatignolles.fr, May 2005). The turnover of Spie SCGPM amounted to 160m euros in 2005. The main competitors to Spie SCGPM are Bouygues (France), Vinci (France) and Eiffage (France).

Since the activities of Spie SCGPM are only in the Paris area, this means that Spie SCGPM only competes with enterprises also operating in the area. According to Spie SCGPM the enterprise holds a market share of 15% - 20% within the greater Paris area (Interview with David Barbin, Engineer, Spie SCGPM, March 2006). This competitive position is obtained through close and long-lasting customer relationships. Moreover, Spie SCGPM creates a competitive advantage by utilising synergies found in the relatively small and flexible size of the enterprise.

e-business activities

Since the year 2000, Spie SCGPM has adopted project web solutions as this was a requirement in public tenders. Furthermore, contractors wanted to be more involved in the ongoing planning and execution of the construction projects. Spie SCGPM has experience with project web solutions from 10 recent construction projects and currently uses project web solutions for 3 different projects as illustrated in Exhibit 3-10:

Exhibit 4-21: Current construction projects using project web solutions

Construction project	Project description	Construction period
Antony Parc II	42m euros, 29,000 m^2 offices	May 2005 - April 2007
Montreuil Arborial	35,000 m^2 offices for the French Ministry of Agriculture	May 2005 - May 2007
Meudon Campus	95m euros, 6 buildings, 45 000 m^2 offices	April 2004 - December 2006

Spie SCGPM uses the software Projecteo LT provided by Prosys (though no exclusivity clause with the provider has been signed) as their Project Web solution. This choice is based on the following criteria:

- The project web vendor should be a French enterprise preferably situated in the greater Paris area.
- The project web solution should be cost-efficient with no or low implementation cost and no requirements for high-tech hardware.
- The system software should have a high degree of usability and provide easy communication between the users and not add to the costs.

As the use of a project web solution was imposed by the client and represents an extra cost for Spie SCGPM, the low price of the solution was a decisive criterion for Spie in choosing the provider.

The main function of the Projecteo LT project web software is to host all data of a construction project and to enable the diffusion of documents to selected stakeholders in

the construction project. An interface is provided and the project web is divided in 4 main parts:

- A personalised welcome page
- A list of all members taking part in the project
- Files and data sharing
- Forum for communication with other stakeholders.

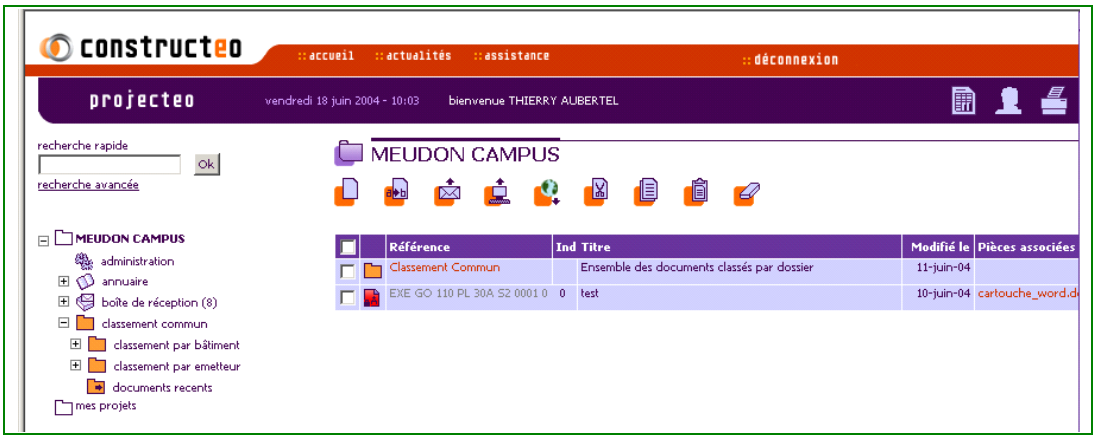
As the provider Prosys SA works closely with Microsoft in the development of software, Projecteo is based on a Microsoft NET 2.0/SQL Server 2005 platform. The interoperability of the system is built around standards like SOAP (Simple Object Access Protocol), Web services, XML and XHTML. Moreover, the tool for visualisation in Projecteo enables the users to open and annotate more than 200 different formats, including formats such as CAO (AutoCAD, Microstation) and Office (Word, Excel, Powerpoint). The feature for document handling is a main issue in terms of document security. Every time a document is uploaded into the project web solution, all the relevant stakeholders in the construction project are informed via e-mail and have instant access to these documents. Each user is responsible for the distribution of the documents and the security of each document uploaded.

Spie SCGPM's Meudon Campus works as an example of project-by-project implementation of project web solutions. Here, the project web solution was not in operation during the first study phase of the elaboration of the Meudon Campus project (also called the commercial study period). In May 2004, when the project went into the operational phase, a project web solution was introduced. In the beginning of 2004, a meeting with the project web software provider, Prosys SA, was conducted with the purpose to establish the content and set-up of the project web operation.

Then a one-day training session for Spie SCGPM's administrator was conducted prior to launch of the project web solution, and Prosys SA and Spie SCGPM organised two additional training sessions of 2 hours to present the main aspects of the software and the procedures to all the stakeholders of the Meudon Campus project.

Almost all the stakeholders in the construction process, with the exception of some sub-contractors, use the system – including the contractor, construction firms, sub-contractors, the engineering enterprise and the client. In the case of Meudon Campus, all project data is shared via the project web including blueprints, plans, photos, memos and syntheses. Only financial data is deemed too sensitive to be placed on the project web platform. Each stakeholder/user has a personal access code, and needs a PC with internet to use the project web solution. To upload data, the user has to first create a folder by filling out a card with a code from the paper-version of the document. Then the user can upload the different documents to this folder. Finally, the user has to notify the upload to the persons that are going to access the file. Each stakeholder/user will receive an e-mail and can access the documents immediately. The documents that have been uploaded cannot be modified: the user must create a new folder if he wants to add or over-write existing documents. The user-interface for document handling is illustrated below.

Exhibit 4-22: The Projecteo LT project web solution user interface (The Meudon Project)



In the Meudon Campus project, costs of using the project web solution can be divided in two main elements: implementation costs and operational costs. Implementation costs at project level amount to approx. 5,000 euros including meeting activities and training (not including software purchase and/or licensing). Operational costs are around 50 euros per month per user. By implementing project web solutions into more projects, Spie SCGPM plans to decrease the cost per user. This goal is, however, still to have room for upgrades, further development of the features and user-interfaces of the software.

Impact

Initially, Spie SCGPM did not expect any specific impact from the introduction of project web, but after a few years this perception changed, and the enterprise has come to realise the potential of project webs. At the moment, the use of project webs cannot be used as a sales argument in contract negotiations by Spie SCGPM because project webs do not seem to be diffused throughout the CI and among the customers (Interview with David Barbin, Engineer, Spie SCGPM, March 2006). However, Spie SCGPM expects the value-adding potential of project webs to increase over the next years as customers become more and more aware of the possible financial and managerial advantages of using ICT and, in particular, project web solutions. At the moment, the impact generated within the enterprise is most clearly seen in terms of efficiency gains on work-flow processes.

The use of project webs has an impact on the work-flow process by improving the communication capabilities within Spie SCGPM. This impact is mainly seen in the speed at which information flows in and around the project organisation in the construction projects. The use of e-mails as main communication channel and the use of common standards for graphic charts, financial numbers and construction design have greatly improved the information flows among project team members, and the quality of the shared information has also improved. In addition, the accessibility of information has increased due to the standardised process of document categorisation.

Pre-project web work-flow process

A construction plan is circulated to all relevant personnel in the project team via traditional mail and each member reviews the plan for mistakes, miscalculations and the like. The drawback of the traditional work process is low response time due to slow work processes, lack of a warning system for delay in communication, etc. Moreover, the traditional pre-project work-flow process is hampered in its effectiveness and efficiency by the lack of a versioning control system. Several versions of the same document may circulate between stakeholders, a circumstance which can lead to design and construction mistakes.

Post-project web work-flow process

When a sub-contracting firm in the construction project uploads a specific document online on the Prosys project web, relevant project team members receive an instant e-mail with a notification of this new document. If, for example, an engineer in the project team finds a mistake in the measures, he/she can immediately contact the document owner (in this case the construction sub-contractor) and notify him/her of the mistake in the document.

The sub-contractor will not send out a revised document but can only cancel the old and flawed document and then upload the new and revised document. In this way, the project web reduces the mistakes arising from versioning issues.

Another impact of the use of project web is the increased possibility of changing sub-contractor during the construction process. Traditionally, Spie SCGPM found it difficult to shift sub-contractors during the construction process because highly relevant information regarding the specific construction process was embedded with the sub-contractor. By enforcing the use of a project web solution, Spie SCGPM has access to more information and can, with greater ease, involve a new sub-contractor during the construction process.

Lessons learned

Spie SCGPM is satisfied with the positive impact of the project web so far. However, according to Spie SCGPM, a difficult task in the implementation of project web solutions has been to define the criteria of classification of the platform. These criteria depend on the requirements of each project and consequently shift from project to project. This makes it difficult to make a generic project web platform to be used in different types of construction projects.

On the other hand, the presentation of Projecteo software and the short training of the users have been the most successful point of the implementation. It has enabled the stakeholders to understand the project web and has induced a positive attitude towards the concept before using it. Based on this, Spie SCGPM expects to use project webs more and more in the future and hopes to implement the system on all the enterprise's construction projects irrespectively of project size.

The integration of systems like AutoCAD-based software into the project web would be relevant for Spie SCGPM. It represents a future benefit related to the evolution of project webs, as the visualisation tool for plans in project web are not precise enough today. This

integration should, however, be done with software that does not require specific hardware to be installed.

References

Research for this case study was conducted by Anders Pennerup Gantzhorn, Ramboll Management, on behalf of e-Business W@tch. Sources and references used:

- *Interview with Principal Engineer David Barbin, Spie SCGPM, 14. March 2006*
- *Interview and case review with Principal Engineer David Barbin, Spie SCGPM, 17. March 2006*
  - *Websites:*
    - *Spie SCGPM,* www.spiebatignolles.fr
    - *Prosys SA, Inc.,* www.prosys.com

4.3.7 Summary of main points and conclusions

Based on the survey findings presented in Chapter 3, the analysis and the case study on *SPIE* presented in the previous paragraphs in Section 4.3, the main findings and conclusions about the use of project webs by construction enterprises in Europe are summarised as follows:

- The uptake of project web solutions is hampered by different and often complex software solutions based on different user interfaces and ICT standard.
- Project webs are mainly used by large European construction enterprises and the user interfaces are characterised by the complex nature of the projects they are designed to address. This means that the software solution is often not dimensioned to suit the requirements of construction SMEs. In addition, the usage and the benefits from using project webs are not evenly distributed among stakeholders in the value chain. This means that the economic incentives for implementing project web solutions are not apparent for all stakeholders, in particular construction SMEs.
- Complex user interfaces require ICT competencies that European construction SMEs do not possess. Hence, more focus could be placed on creating simpler and more cost-efficient project webs that would be easy for construction SMEs to implement. By having both standardised “off-the-shelf” project web solutions for construction SMEs and customised complex solutions for the large construction enterprises, the uptake of project webs could increase. Project webs have to be simple and have a relatively intuitive structure; otherwise there is a risk that the application will not be used. In addition, due to a widespread lack of ICT skills, the industry seems to be experiencing a decrease in the use of project webs in the supply chain.

- Among industry experts there is still “open” debate as to whether project web solutions should adapt to existing workflow processes or whether implementation should lead to the abolishment of old workflow process. The reason for changing the workflow process to fit the new electronic workflow process of a project web solution should be to fully gain the benefits of online document handling and sharing. Otherwise, the traditional workflow processes may hamper utilisation of the features of the project web solutions, making them less effective and efficient.
- Due to the lack of integration possibilities between project web solutions and already existing ICT systems (like ERP systems), some construction enterprises do not implement project webs. This trend is mostly visible among European construction SMEs and stems from the lack of a European-wide industry standard for project webs. The uptake of project web solutions could be supported by a focus on creating an industry-wide European standard concerning the integration of collaborative systems with other business-related applications.

5 Conclusions

The CI is, compared to the nine other sectors studied by *e-Business W@tch* in 2006, one of the industries with the lowest uptake of ICT. For many of the indicators, figures for the CI are ranked at or near the bottom of the ten surveyed sectors. However, survey results and case studies also presented in this report show that CI enterprises are not far behind their counterparts in other sectors studied this year on certain indicators such as e-procurement, e-standards and ICT-enabled product or process innovation.

Based on the survey findings presented in Chapter 3, the three ICT trends and the case studies discussed in Chapter 4, this chapter identifies possible impacts and implications for CI enterprises and the industry as a whole. The final section identifies some policy implications also arising from this analysis.

5.1 Business impact

5.1.1 Implications for enterprises

Perceived overall significance of e-business

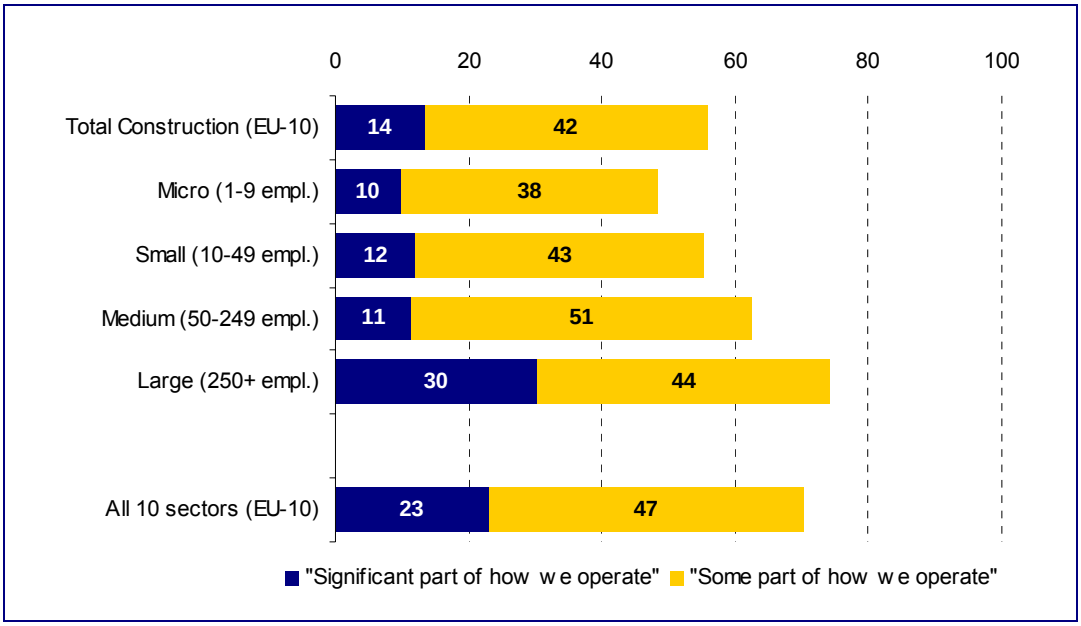
The use of ICT and e-business is not yet generalised in the CI as shown by this year's survey findings in Chapter 3. This is also the case for the three ICT trends analysed in Chapter 4 of this study. E-procurement, 3D technology and project webs are all at the stage where innovative frontrunners are in the process of developing and implementing these solutions. Large enterprises and public clients are mainly driving the uptake of these technologies, but the further development and uptake are dependent on a more wide adaptation of these technologies by small and medium-sized enterprises. An indicator of the speed of adaptation is the overall perceived significance of ICT and e-business among enterprises.

Exhibit 5-1 below presents data from the 2006 *e-Business W@tch* Survey on the perceived overall importance of e-business. About 1 in 6 construction enterprises responded that e-business is a "*significant part*" of the way they operate, while about 4 in 10 said that e-business plays "*some part*" in how they operate. Compared to the weighted all-sectors average, the CI is below in both the two abovementioned groups. In addition, more than 4 in 10 construction enterprises did not find any importance of e-business to the way they operate. It is worth noting, however, that about a third of large enterprises found that e-business is a significant part of the way they operate and another half said that they find it playing some part in how they operate. It is, therefore, clear that e-business plays a greater role for the large than for the micro and small enterprises in this sector.

One reason for this could be the large number of SMEs with limited ICT experience and, therefore, a limited perception of the impact and importance of ICT on their business. Another reason that may explain these findings can be that the service provided by construction enterprises is delivered mostly on-site and customised to individual client

needs. This may mean that especially SMEs often cannot see the connection between their business and the opportunities brought on by ICT.

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



Base (100%): Companies using computers (excl. "don't know"). N (for sector, EU-10) = 744

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)

In relation to the perceived impact of e-business presented above, the survey also asked respondents about the perceived influence of ICT on their business. The positive ICT influence is mainly to be found within areas such as business process efficiency, internal workflow processes and customer service.

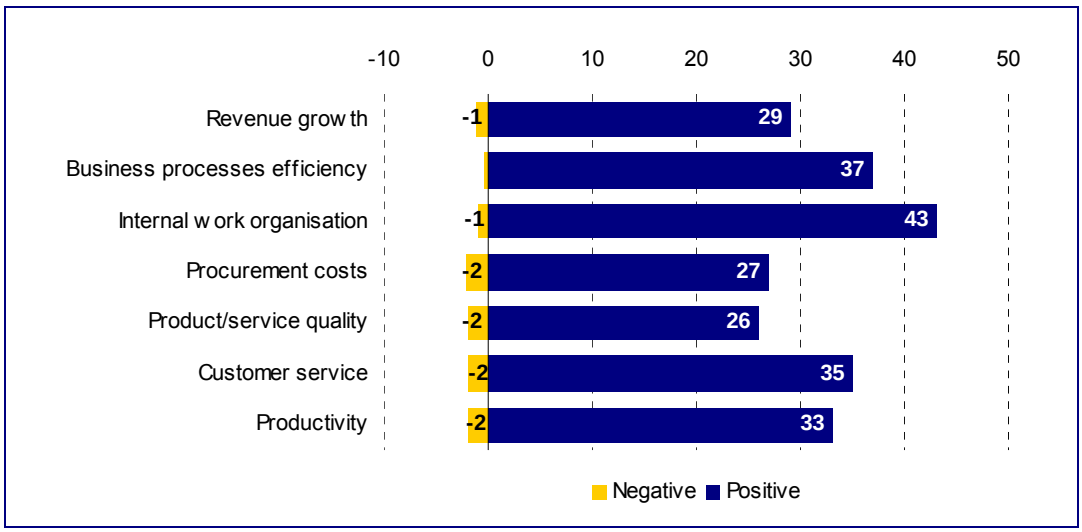
Of the factors defined in Exhibit 5-2, influence on procurement costs and product/service quality were rated the least significant. This is an interesting finding because, as argued in Section 4.1, the main benefits of e-procurement is a decrease in procurement cost through consolidation of the supplier base and the introduction of framework contracts. In addition, it was illustrated in Section 4.2 of this report that the main benefits from 3D technology and project web are a minimisation of errors in construction and an increase in the delivered quality of product/service. These findings could indicate that the main benefits of some of the ICT trends presented in Section 4 are among the benefits which enterprises find less interesting or significant to their business.

The findings presented in Exhibit 5-2 indirectly support the findings shown on Exhibit 3-27 in Section 3.8, according to which CI enterprises cannot identify the benefits of ICT, but still find this technology complicated, expensive and not compatible. These factors may make it difficult for enterprises to justify investments in ICT when they find it expensive and often without perceived positive impact.

According to the 2006 e-Business Survey results, about 4 in 10 construction enterprises perceive a positive ICT impact on their internal workflow processes (see Exhibit 5-2). However, as shown in Exhibit 3-13 in Section 3.4.1, only a limited number of CI enterprises actually have ERP or document management systems installed. In addition, as presented in Section 3.4.2, only a limited number of enterprises have implemented collaborative design processes, forecasting of demand systems or share documents in collaborative work spaces (see Exhibit 3-14).

The discussion in Section 4.3 highlighted that the current traditional workflow processes in CI may constitute a barrier to the uptake of project webs and 3D technologies. These two technologies actually have the potential to improve internal workflow processes. It could, thus, be argued that construction enterprises may be more ready to implement project webs and 3D technologies than implied by the above mentioned survey findings. This might be the case because CI firms currently perceive the value of these systems to be higher than that of e-procurement, for example (see Exhibit 5-2).

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



Base (100%): Companies using computers. N (for sector, EU-10) = 754

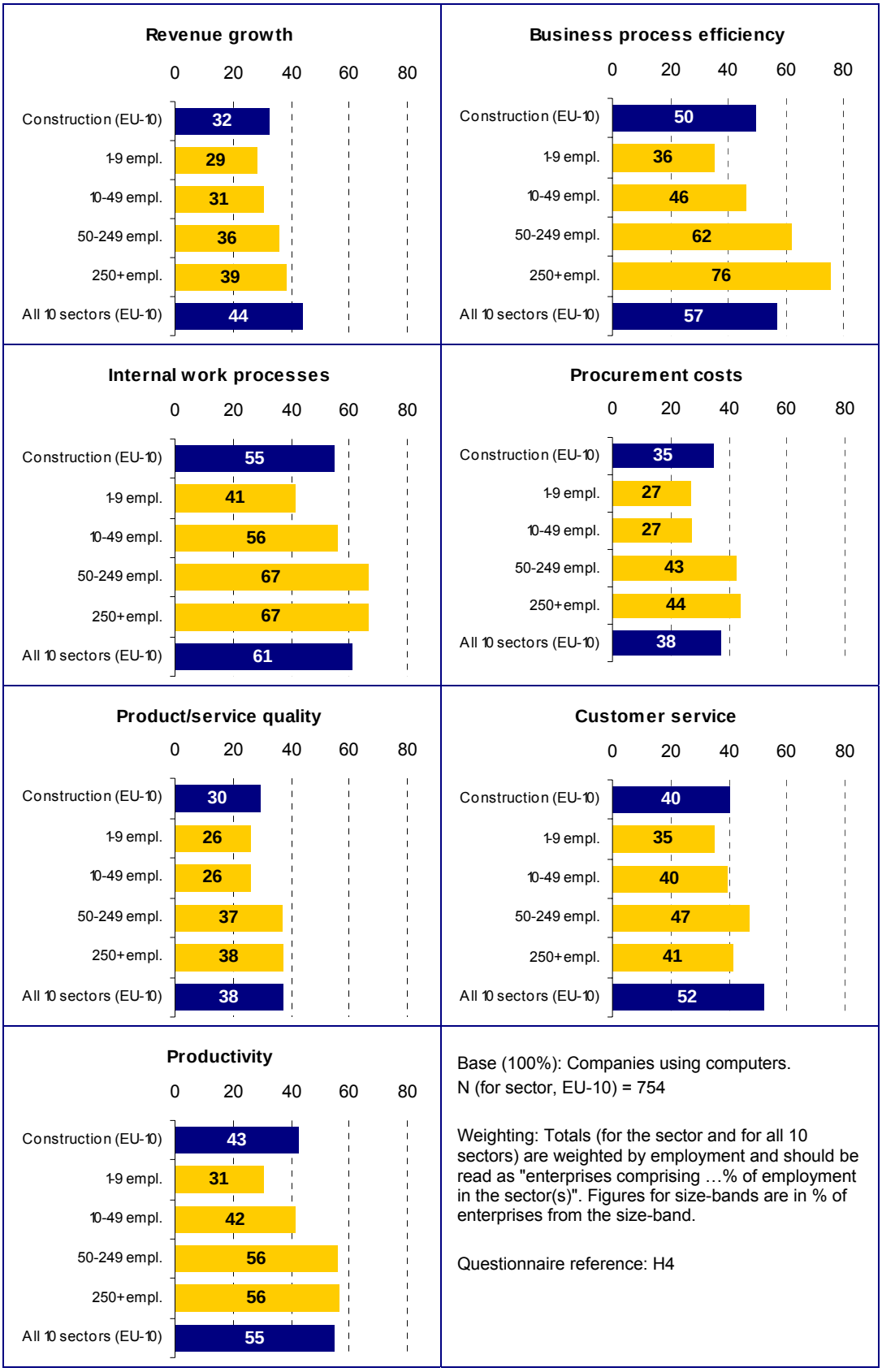
Weighting: in % of firms. Questionnaire reference: H4

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

Impact on specific business areas

Exhibit 5-3 presents the survey findings concerning the perceptions of CI enterprises about the positive effect of ICT on different business areas. Areas such as business process efficiency, internal work processes and productivity are, according to the survey, found by most enterprises in this sector to be positively affected by ICT. In the other end of the spectrum are areas such as revenue growth and product/service quality which are deemed to be least affected by ICT. These findings are in line with the findings from Exhibit 5-2 and further support the argument put forward above that enterprises, currently, see the role of ICT to be more about internal process optimisation than in areas such as procurement, marketing and quality.

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



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

Compared to the other nine sectors studied this year by the *e-Business W@tch*, the CI lags behind in perceived positive influence of ICT on all the studied business areas. Lack of ICT skills among this sector's SMEs and subsequent lack of possibilities to optimise the use of ICT could explain some of the observed differences.

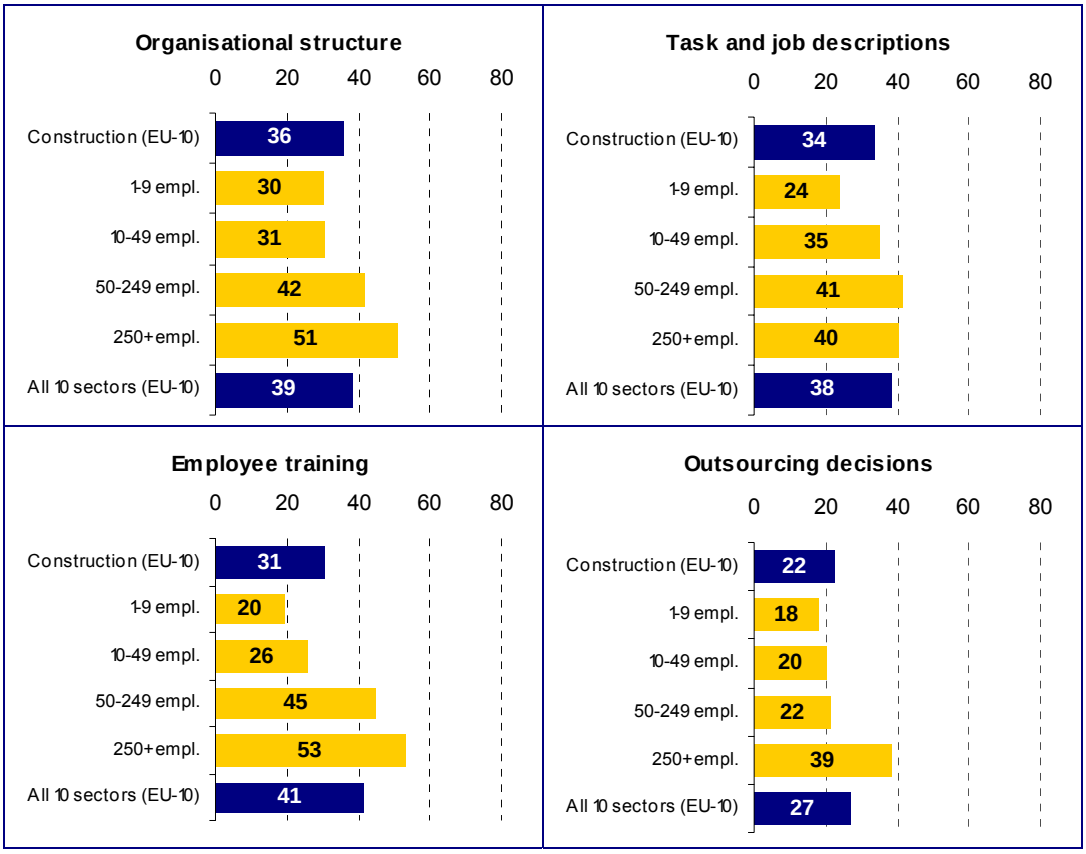
Across the nine specific business areas shown in Exhibit 5-3, micro-enterprises in general claim fewer positive impacts of ICT than large enterprises. A clear pattern appears, in which micro-enterprise cannot see the positive influence of ICT on their business to the same extent as large enterprises. This observation practically confirms the argument brought forward in Section 4.3, that especially SMEs in this sector have difficulties in identifying the benefits of introducing ICT systems such as e-procurement, 3D technology and project webs into their business.

Impact on organisation

In both the CI and in the other 9 benchmarked sectors, around a third of the enterprises perceive ICT as having a positive influence on "*organisational structure*" and "*task and job descriptions*" (see Exhibit 5-4). The impact of ICT on outsourcing has been limited in the CI and the data indicates that only about 1 in 5 enterprises experience a positive effect from ICT on their outsourcing decisions. In addition, only about 1 in 3 said that they see a positive impact from ICT on employee training. The impact on the organisation from the implementation of ICT can, based on the survey results presented in Exhibit 5-4, be argued to be somewhat limited.

Looking into different sizes of enterprises, a relationship exists between enterprise size and perceived importance, indicating that ICT is more important to this sector's large enterprises than to the plethora of micro-firms and SMEs in CI. The same relationship is observed as regards the influence of ICT on employee training. At an aggregate level, the CI lags behind the weighted all-sectors average, which confirms a possible lack of awareness of the ICT potential. This may in turn explain the lacking focus of this sector's companies on investments related to employee training in this area.

Exhibit 5-4: Perceived important influence of ICT on…:



Base (100%): Companies using computers. N (for sector, EU-10) = 754

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

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

ICT impact on competitiveness and productivity[49]

Public e-tendering has helped increase transparency in the procurement market for construction contracts, giving easier access to tender notices for both large and small construction enterprises. This increased access to tender information is expected to slightly improve the competitiveness of construction SMEs because they will spend fewer resources on business intelligence in the search for available tenders.

e-Procurement as a tool to support strategic procurement is a development which is already reported to offer savings for large enterprises (see Section 4.1 and the case study about *Skanska*). The survey findings presented in Section 4.1, however, illustrated the rather limited used of e-procurement (Exhibit 4-2), that most of the materials procured online were raw materials and mixed products (Exhibit 4-4) and that most of the suppliers

[49] For more information on the impact that ICT may have on enterprises' competitiveness and 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')."

of e-procurement were mainly regional or national (Exhibit 4-5). In addition, SMEs more seldom use e-procurement compared to medium-sized and large enterprises.

Based on these findings, it is argued that large construction enterprises, with buyer-driven e-procurement systems, are expected to improve their competitive situation vis-à-vis smaller enterprises. This change in competitiveness is rooted in the large volume of raw material and intermediate products that large construction enterprises are able to purchase. This high volume allows for more favourable contracts with raw and intermediate material suppliers which lead to lower unit costs compared to construction SMEs with more limited procurement volumes.

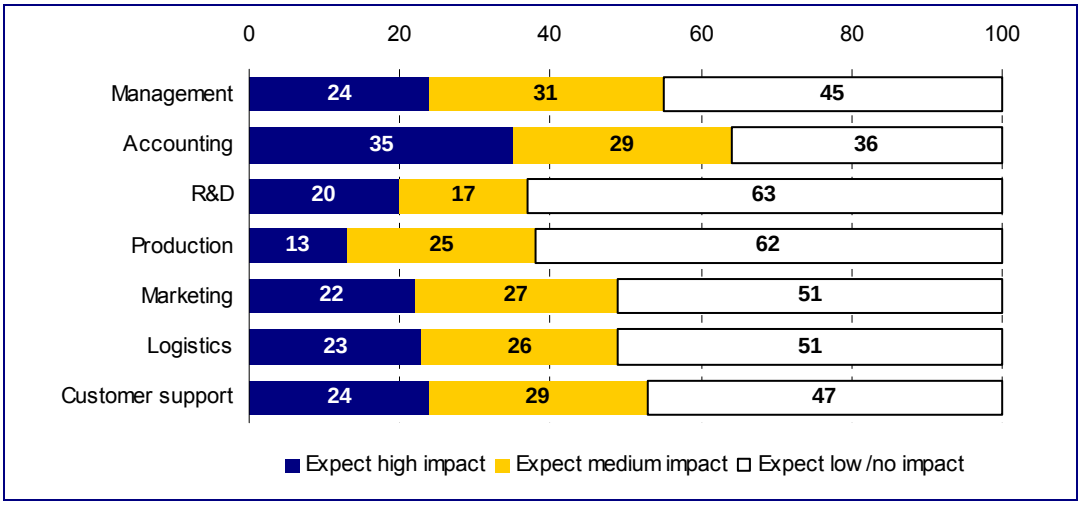
The case studies and business examples presented in Section 4.3 illustrate that the use of project web solutions is expected to increase productivity through more efficient communication between construction project stakeholders. However, the effect of this trend is not expected to greatly affect the overall competitive situation in the CI. Cases presented in this study indicate that project webs are not used as an external sales argument in connection with clients, but more often as an internal project-related optimisation tool. The survey data support this argument by pointing out that the construction enterprises see ICT and e-business more as a tool to optimise internal processes than as an external, customer-oriented tool (see Exhibit 5-3).

Expected ICT impact in the future

As illustrated in Exhibit 5-6 below, CI enterprises anticipate that ICT will have the highest impact on management, accounting and customer support, while they expect ICT to have less future impact on production.

Indeed, by using ICT, the supply and value chain can be optimised due to better information sharing and interlinking with suppliers. As discussed in Chapter 4, however, the main benefits of 3D technology and project webs are envisaged on the production process, where both systems have the potential to increase productivity. It is, therefore, interesting that, according to the survey results, construction enterprises do not perceive ICT as having high impact on production compared to other aspects of their business. This might indicate that the benefits of these technologies have not been successfully communicated to potential customers in the CI.

Exhibit 5-5: Anticipated future impact of ICT



Base (100%): Companies using computers. N (for sector, EU-10) = 754

Weighting: by employment, i.e. figures should be read as "enterprises comprising…% of employment in the sector". Questionnaire reference: H8

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

At the same time, ICT is not expected to have any considerable impact on research and development in CI enterprises. Interestingly, the same more or less perception has been identified across most of the sectors studied this year –with the expected exception of ICT-related industries. This seems surprising, because combining ICT and R&D can create a competitive advantage. In CI, for example, 3D technology (discussed in Section 4.2) can lead to both product and process innovation through simulation of individual components in the project and through complete construction simulation.

Concluding assessment

Exhibit 5-5 below shows the identified impact of ICT and e-business on the CI. The implications are divided into implications for large and small enterprises. The scores are not to be understood as 'exact' results of a quantitative computation, based on some model; they are tentative, reflecting the opinion which the study team has formed, on the basis of the survey findings of the analysed in Section 3 and 4.1 along with expert interviews, the case studies presented in Section 4.1-4.3 and the literature review. Based on this, the concluding assessment presented in Exhibit 5-5 should be regarded as a vehicle for debate.

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

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

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

The main expected business impacts of the ICT and e-business trends for **large enterprises** are:

- Survey findings show that e-procurement and collaborative work spaces are not yet implemented to a high extent in the CI. However, the discussion in Sections 4.1 and 4.3 indicates that the use of e-procurement and project webs seems to affect the organisational structure and the workflow processes in enterprises already working with such technologies. As was illustrated by case studies presented in these sections, CI enterprises have to change the traditional work processes to accommodate elements such as online information sharing, just-in-time communication and electronic approval of documents like drawings and construction blueprints.
- This year's survey results indicate a limited uptake of e-procurement systems in the CI, but also a rather high activity in online procurement. Based on this trend, it is important to state that the future implementation of e-procurement may change the overall approach to procurement among large construction enterprises. For some years now, large enterprises have focused on strategic procurement, more precisely on buyer-driven procurement systems based on an ICT platform. In order to succeed with strategic procurement in the CI, enterprises need to implement support functions such as help desks and hotlines in addition to standard operating procedures. The purchaser (often site and line managers on the physical construction site) should be supported by a centralised procurement department to handle large scale, framework-based procurement across different construction projects.
- The increased use of e-procurement among large enterprises will increase the requirements for ICT skills among employees, especially among site and line managers in CI. As shown in Chapter 3, construction enterprises in general, do not

focus much either on hiring ICT practitioners or on regular ICT training of their employees. Improved ICT skills, however, are necessary to take advantage of new ICT technologies, such as project web solutions and 3D technology.

- So far, 3D technology is only in use in selected projects, but experience indicates that it does have an impact on this industry's process innovation. Especially within the activities of proposal writing, construction design, engineering and physical construction, 3D technology may have profound impact on workflow processes.

The three selected technologies discussed in this study appear to have limited impact on small and medium-sized construction enterprises, mainly because of their low uptake. Nevertheless, some effect has been noted and the main identified impacts for **small and medium-sized enterprises** include:

- The introduction of a project web requires a change from traditional mail-based communication among stakeholders to communication over a centralised project web system. To reap all the benefits of project webs, stakeholders need to invest time in document description and handling, as well as in establishing new operating processes for document handling and sharing. Survey findings presented in Chapter 3 show that about 4 in 10 construction SMEs do not have a broadband connection to the internet. Such a connection, however, is seen as a prerequisite for implementation of project webs and its lack may impact this sector's SMEs negatively and decrease their competitiveness in the long run.
- Concerning the ICT skills and capabilities among construction SMEs, the introduction of e-procurement, 3D technology and project webs will require ICT skills within several areas, such as handling of 3-dimensional drawings and blueprints and electronic document handling. This means that the construction SMEs will have to continuously, but probably not dramatically, upgrade ICT competences to support the introduction of e-procurement, 3D technology or project webs.

5.1.2 Implications for industry structure

This section assesses the implications of ICT and e-business adoption on the structure of the CI. As with the 2005 *e-Business W@tch s*ector study on the CI, a 'five-forces-model', developed by Michael E. Porter (1980), will by applied to discuss and assess e-business implications on the industry's structure.

Background information:

Michael E. Porter's Five-Forces Model

The 'Five Competitive Forces' model was developed by Michael E. Porter in his book "Competitive Strategy: Techniques for Analysing Industries and Competitors" in 1980. Since then, it has become an important tool for analysing industrial structure, competition and strategic options of players. Porter's model is based on the insight that a corporate strategy should meet the opportunities and threats in the 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. Porter's model helps to identify the main driving forces in an industry. Based on the information derived from the Five Forces Analysis, enterprises 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 Bishop William Lawrence University Professor at Harvard Business School.

Even though industry experts and stakeholders are currently debating the effect and impact of ICT on the development of the industry, the key drivers of competition are to a high extent not to be found in ICT and developments in e-business. The expected increase in rivalry in the European market due to cross-country enterprise consolidation has limited origin in ICT related issues. The main driving forces and the major areas where ICT and e-business will have an impact in the future are illustrated below. The impacts illustrated graphically below are based upon the survey presented in Section 3 along with the analysis conducted in Section 4 and 5. In addition expert interviews with academia and industry stakeholder have created the foundation for the following analysis. The following section after Exhibit 5-7 elaborates on the findings of the Five Forces analysis.

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

Competitive forces		General importance in the sector (currently) *low < > high*	Impact 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)			

***** "New entrants" in the sense of new enterprises being founded. “New entrants” in the sense of enterprises from a different geographic area entering the European market are considered under "rivalry in the market".

Source: *e-Business W@tch* (2006), developed from Michael E. Porter

Threat of new entrants

There are different opinions about the impact of the EU enlargement on the CI. For some, the accession of new Member States is perceived as having an important impact on this industry. Others argue that this factor will not greatly change the competitive situation of the European CI as a whole, but there may be, in some regions, an increase in new entrants to the industry.

In any case, the introduction of ICT in enterprises is not expected to greatly affect the possibilities for new entrants into the CI. The implementation of e-procurement, 3D and project web technologies, for example, is mainly driven by the companies’ internal need to reduce mistakes in the construction process and increase efficiency in procurement and communication. New entrants to the CI must have or acquire general ICT skills within communication, accounting, document management, and process optimisation in order to compete. These skills are, however, available in the marketplace from professional education agencies and the like.

As regards the three technology trends discussed in this sector report, it can be said that 3D technology requires more specialised ICT skills in terms of engineering and design skills. Such requirements, however, are not expected to be a barrier to potential new entrants because these skills are available in the market place in the form of educated personnel or can be acquired through training courses offered by professional institutions.

Substitution of products / services

The CI is not greatly affected by the issues of client substitution to other products and services because there are no real alternatives to construction products/services. Currently, there are no feasible alternatives for building owners when constructing buildings and the like. Building owners can, however, choose to substitute between different types of building materials. Due to architectural trends, some building materials are more in fashion at certain times but it is argued that only a limited amount of building materials need highly specialised know-how to install. In general, most types of building materials can be applied by most enterprises.

Bargaining power of suppliers

e-Procurement systems are gradually becoming more widely diffused, especially among large construction enterprises. This development may decrease the bargaining power of suppliers because buyers would then tend to engage in a limited number of framework contracts. The possible limitation of the supplier base may increase competition among suppliers of "off–the-shelf" construction products and raw materials, leading to decreased bargaining power of suppliers. The case study of *Skanska* presented in Section 4.1 is an example of the shift in bargaining power that can arise from the implementation of e-procurement. In this case study, Skanska was able to negotiate more favourable framework contracts with suppliers that resulted in lower procurement costs.

In some cases, such as design-protected materials, patented work processes or similar, however, the construction enterprise is dependent on specialised supplies. This would put some suppliers in a more favourable position whereas suppliers with standardised goods would be more vulnerable towards an opening of the market and the increased transparency resulting thereof.

Bargaining power of customers

The bargaining power of the construction clients (customers) is already considered to be high due to high competition in many EU Member States. The competitive situation is affected by a rather stagnating market for the last few years which, until recently, have given greater supply than demand. This has meant that the bargaining power of customers have been fairly high. The use of e-tendering by public and private clients may further increase the bargaining power of the customers because a large number of potential tenderers will have the ability to tender (due to greater information transparency). An increased number of economic operators tendering for construction contracts would lead to a decrease in prises and an increase in the bargaining power of the clients / building owners.

As discussed in Chapter 4, some large construction enterprises focus on ICT-enabled optimisation of internal workflow processes. In an effort to counteract the increased external pressure, these companies aim at identifying potential cost savings that could partly offset this external pressure on profitability.

Rivalry in the market

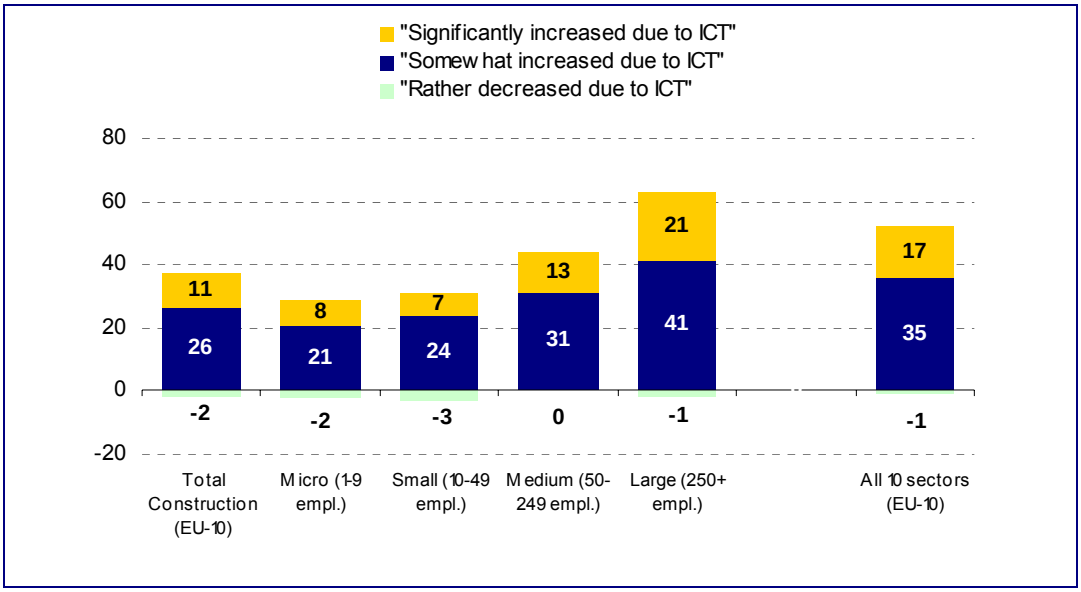
As described in Section 2.2, one trend in the CI is consolidation among building material suppliers, engineers and construction enterprises. Rivalry in the construction market is already considered high and the use of e-procurement is expected to add to this development

Among complete construction enterprises, competitive rivalry is expected to be impacted by the continuous consolidation among large enterprises. The uptake of ICT is, however, not expected to impact this process, which is rather driven by volume and profitability issues. This assessment is supported by survey results presented in Exhibit 5-8, which indicate that about 1 in 10 enterprises finds competition to have significantly increased

due to ICT, while about 1 in 4 enterprises argued that competition has somewhat increased. Compared to the weighted all-sectors average, the CI does not consider the impact of ICT on competitiveness to be as large. This observation is in line with findings that CI enterprises, in general, do not perceive ICT to have as much influence on their business as on average in the 10 sectors studied (see Exhibit 5-3). However, the situation is different for the medium-sized and large construction companies; here, 45-60% of all firms said that they have experienced at least some increase in competition due to ICT. Among large firms, in particular, more than 20% said that ICT has led to a significant increase in competition. Thus, the effect of ICT on competition might be more pronounced for larger firms than for small ones in the CI.

Among building installation enterprises, the impact of ICT on competitiveness is even smaller. Less than 1 in 10 found competition to have significantly increased due to ICT. The rather limited perception of ICT impact on competitiveness may be attributed to the low general uptake of ICT solutions by companies in this sub-sector, in connection with internal focus of the ICT systems implemented in the CI.

Exhibit 5-8: Perceived impact of ICT on competition in the industry



Base (100%): Companies using computers. N (for sector, EU-10) = 754

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: H6

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

5.2 Policy implications

The CI is undergoing significant changes due to internationalisation, increased competitive pressure, consolidation and the resulting continuous requirements for higher productivity and efficiency (see Section 2.2.2).

The survey illustrated that the CI has limited focus on ICT skills development and employment of ICT practitioners, and has a lower uptake of advanced ICT solutions such as ERP, collaborative work spaces, and procurement systems, compared to the weighted all-sector average. In this context, policies to promote ICT and e-business in the CI are justified as one among different initiatives that may improve the uptake and use of ICT. Due to the high turnover and number of jobs in the European CI, any improvements to the competitiveness and effectiveness of European construction enterprises will have a positive impact on other industries and may also have an impact on the European economy as a whole.

Based on the analyses of this sector study n the CI, Exhibit 5-9 below illustrates the possible implications arising from increased e-business activity in the CI.

Exhibit 5-9: Policy implications arising from e-business activity in the CI

Policy issues		Possible initiators	Policy leverage *low < > high*
1	Improve ICT skills	European Commission National Governments Regional Governments Industry federations Business support networks	
2	Raise awareness of ICT benefits and potentials	European Commission National Governments Regional Governments Industry federations Business support networks	
3	Facilitate the process of interoperability	European Commission National Governments Industry federations Business support networks	
Maximum: 3 points (or)			

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

Improve ICT skills

The survey results presented in Section 3.2 showed that construction enterprises have limited focus on ICT skills development. Furthermore, ICT skills' development was identified as a challenge, especially for SMEs, in the three areas of ICT use discussed in Chapter 4, perhaps most importantly in the transition to 3D technology. Large enterprises (acting as prime contractor/business partner) and clients from the public sector are important drivers in this development, in the sense that they formulate new requirements for ICT use in SMEs, but also by providing information about new ICT. In most countries

in the European Union, ICT skills are already a part of existing business training and education programmes. Thus, any new initiatives aiming at ICT skills development should be coordinated and promoted locally to ensure commitment from local stakeholders and the customisation of content to country specificities.

As was discussed in the 2006 *e-Business W@tch* Workshop on the CI sector study, the European e-Skills Forum[50], established by the European Commission and the CEN Workshop Agreement (CWA)[51] could be appropriate fora to discuss the issue of ICT skills development in the CI. A product of such discussion could be an **assessment of required skills** for enterprises in the CI. The required skills can be provided at a general level, such as public education, or it can be about more specific ICT skills which could be provided by vocational and higher education institutions or professional educational programme vendors (private operators). In connection with this identification of ICT skills requirements, the terminology of the e-Skills Forum concerning ICT practitioner skills, ICT user skills and e-business skills should be applied (see European e-Skills Forum 2004, p. 6). It is important, however, to bear in mind that any public initiative to support and improve ICT skills among enterprises should not interfere with private markets for training and education, thereby possibly creating market imbalances.

In addition, it is recommended that **industry and trade associations play a more active role** in the identification of the abovementioned ICT skill requirements. Knowledge from enterprises could be filtered through industry and trade associations to the e-Skills Forum and the CEN to support work toward identification of possible ICT skills gaps and the solution to such issues.

Raise awareness of ICT benefits/ potentials and e-business policies

The analysis in this sector study has shown that raising awareness about ICT and e-business is important. The survey illustrated that fewer enterprises in the CI found ICT important for their business compared to the weighted all-sectors average.

Based on these findings, it appears that there is still need for policy to focus on raising awareness among CI enterprises on the potential benefits and risks of ICT. Furthermore, the public sector can play a more active role as promoter of ICT. Through its role as an important client, the **public sector can play a central role** in encouraging the use of e-construction and at the same time save money in its own administrative procedures. Examples of an active role in this field include requirements for using e-tendering, e-signatures and 3D technology in public construction works.

In addition, analysis in this report and discussion at the 2006 *e-Business W@tch* Workshop on the CI suggest that the European Commission and national authorities could promote the uptake of ICT in the CI by encouraging the identification of **best case examples** from enterprises already using ICT with success. Although construction enterprises are already aware of the basic benefits and requirements of ICT, real case examples of successful ICT implementation by their peers would be a good way of

[50] For more information on the e-Skills Forum, see http://communities.trainingvillage.gr/esf

[51] For more information on CEN Workshop Agreement (CWA) www.cenorm.be

promoting further uptake in this industry. CI associations also have a role to play in this respect, by facilitating peer-to-peer demonstrations of implemented ICT solutions.

Facilitate the process of interoperability

Setting standards and promoting interoperability is the third important policy implication identified based on the analysis of this sector study. The 2006 e-Business Survey findings indicated that a limited number of construction enterprises use e-standards. Results presented in Section 3.3 also suggest that there is no immediate migration trend in CI towards more advanced e-standards such as XML. In addition, according to responses presented in Section 3.8, incompatibility of software is one of the main barriers for ICT uptake in the CI. Furthermore, within each of the three technologies presented in Chapter 4, there are a number of issues related to standardisation. Thus, a **common e-standard** would be desirable.

The European Commission is supporting the work on ICT standards and interoperability, including the interoperability of networks, which is performed by the European Committee for Standardisation (CEN - www.cen.eu, June 2006). This sector study could provide the basis for a discussion on three issues which are of particular relevance for the CI:

- flexibility and upgrade of e-standards,
- market-dominating standards adopted by large IT providers, and
- the introduction of e-signatures.

The work towards common standards has promising benefits for the uptake of ICT in the CI but it would also be relevant for analysing the potential benefits of introducing **standard transfer protocols** instead of e-standards. Proponents of the introduction of a standard transfer protocol as opposed to a general e-standard argue that general standards take too long to be agreed upon, will be outdated when introduced, and that these solutions are hard to be implemented in upgrades by IT providers. It is also argued that a standard transfer protocol is a more flexible solution that leaves room for frequent technology and content upgrading. This discussion, however, is an open debate and policy makers – notably at the European level – could invest in analysing the benefits and drawbacks of these two approaches.

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Eric Bessone, Sales Manager, Building Solutions Division, Autodesk France, March 2006

Farzin Saber, Professional Relations Manager, IBX, March 2006

Jean-Yves Ramelli, French Ministry of Equipment, March 2006

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Steen Læssøe, Industry Sales Director, Bentley, February 2006

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.[52] 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.[53] This should be considered when comparing figures over the

[52] 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.

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

years, as figures either represent a percentage of "all companies" (as in 2002 and 2003) or a percentage of "companies using computers" (as in 2005 and 2006). Differences are minimal, though, when figures have been weighted by employment.

The 10 sectors which were selected for the 2006 survey are extremely heterogeneous in terms of their size. Construction and tourism are by far the largest with about 1.5 million enterprises in each of the EU-25.[54] 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.

[54] 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*.[55]

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

[55] 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.[56]

- 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.

[56] 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[57] (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.

[57] 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%**

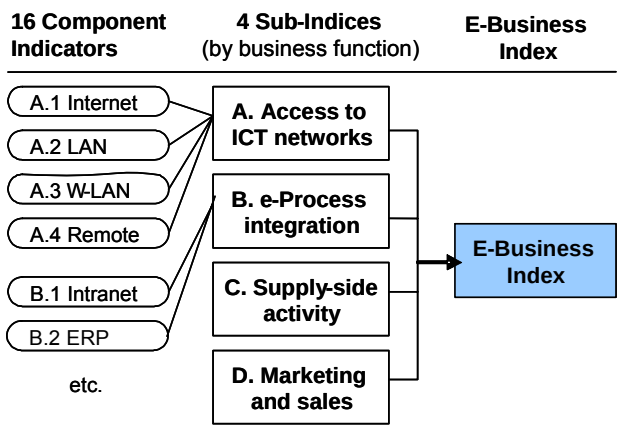
confidence intervals at α=.90

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: Expanded Tables – Data by Country

General remarks on country data break-downs

The studies of *e-Business W@tch* have a sectoral perspective and focus, within sectors, on small and medium-sized enterprises; the analysis of geographic differences is not in the foreground. This decision on the study focus recognises that the e-business activities of a company are mainly determined by its business activity, the configuration of its value system and its size, rather than by the location of a firm.

For several reasons, country data on e-business adoption must be taken with a pinch of salt. They can reflect, at least to some extent, the structure of the economy rather than the overall e-maturity of firms. In Italy, for example, sectors dominated by small firms are much more prevalent than in other countries. Since large firms are more advanced in electronic business, aggregated data may point at a lower level of e-business activity in Italy. In contrast to Italy, the relative performance of French and Dutch companies is significantly better if the emphasis is on larger firms. These benchmarking results suggest that the digital divide between small and large firms could be quite pronounced in these countries.

It should also be considered that the average size of the companies interviewed in a sector can differ by country, depending on industry structure and the available business directories used for sampling. It cannot be excluded that some directories may have a bias towards smaller / larger firms. Although this effect is counteracted by weighting the answers (according to the representation of various company sizes in the population), it cannot be excluded that structural differences in the sample have an impact on results. Ideally, comparisons between different countries should only be made within the same size-band of firms, rather than on the aggregate level. However, at least within a given sector, the number of observations available does not allow a break-down by country *and* size-band.

Exhibit A2-1: Internet access and remote access to enterprise network

	Companies with internet access		Companies with broadband internet access		Share of employees with internet access		Remote access to enterprise network	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**95**	**90**	**72**	**64**	**n.a.**	**47**	**25**	**13**
Micro (1-9 empl.)		89		60	n.a.	48		10
Small (10-49 empl.)		99		73	n.a.	28		23
Medium (50-249 empl.)		99		86	n.a.	38		40
Large (250+ empl.)		98		87	n.a.	42		56
NACE 45.2 (Comp. con.)	97	93	80	71	n.a.	55	31	13
NACE 45.3 (Installation)	92	89	65	61	n.a.	43	20	12
Belgium	98	97	87	91	n.a.	50	26	10
Czech Republic	100	100	64	65	n.a.	66	37	27
Denmark	100	100	82	71	n.a.	56	47	10
Germany	98	95	62	44	n.a.	47	21	14
Greece	100	100	54	43	n.a.	71	25	20
Spain*	90	77	78	65	n.a.	42	24	4
France	86	74	80	67	n.a.	31	27	16
Ireland	100	100	52	27	n.a.	36	25	6
Italy	97	95	60	49	n.a.	21	8	1
Latvia	96	95	71	67	n.a.	56	13	13
Lithuania	99	98	79	77	n.a.	46	18	14
Luxembourg	96	96	78	71	n.a.	33	28	21
Hungary	93	88	68	63	n.a.	66	32	24
Netherlands	96	100	83	92	n.a.	65	46	22
Austria	100	98	69	53	n.a.	40	43	16
Poland	96	94	70	59	n.a.	66	19	17
Slovenia	97	92	66	53	n.a.	53	26	21
Slovakia	97	93	86	83	n.a.	60	44	19
Finland	100	100	83	82	n.a.	73	42	12
United Kingdom	96	93	61	59	n.a.	55	17	7
Bulgaria	91	82	50	42	n.a.	44	11	24
Norway	98	97	87	91	n.a.	50	26	10
All 10 sectors (EU-10)	**95**	**93**	**76**	**69**	**n.a.**	**43**	**35**	**16**
Micro (1-9 empl.)		89		62		51		12
Small (10-49 empl.)		98		75		29		22
Medium (50-249 empl.)		99		83		33		43
Large (250+ empl.)		99		84		44		60
Base (100%)	firms using computers		firms using computers		firms with internet access		firms using computers	
N (for sector, EU-10)	754		754		715		754	
Questionnaire reference	A1		A3		A2		A5	
* Data only indicative due to low number of observations (N ~ 25-50).								

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

Exhibit A2-2: Demand for ICT skills and skills development

	Companies employing ICT practitioners		Regular ICT training of employees		Companies with hard-to-fill vacancies for ICT jobs in 2005		Companies using e-learning	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**22**	**14**	**18**	**12**	**2**	**1**	**12**	**8**
Micro (1-9 empl.)		14		10		1		9
Small (10-49 empl.)		19		18		0		7
Medium (50-249 empl.)		28		28		2		14
Large (250+ empl.)		52		32		6		30
NACE 45.2 (Comp. con.)	24	14	16	7	2	0	14	9
NACE 45.3 (Installation)	20	14	19	15	1	2	11	7
Belgium	22	10	19	7	4	0	13	4
Czech Republic	15	4	29	12	0	0	25	12
Denmark	40	27	25	13	4	0	26	18
Germany	11	5	15	11	2	0	3	5
Greece	54	44	26	17	8	5	15	12
Spain*	23	10	16	13	0	0	19	16
France	16	4	14	4	0	0	7	1
Ireland	13	1	11	4	2	0	11	5
Italy	25	24	18	13	0	0	10	11
Latvia	41	25	23	12	8	3	18	15
Lithuania	42	30	13	8	4	4	25	24
Luxembourg	27	21	20	13	0	0	7	7
Hungary	17	8	7	2	0	0	8	4
Netherland	37	8	23	5	6	1	11	11
Austria	31	7	29	10	5	0	15	7
Poland	34	29	26	18	5	11	11	6
Slovenia	8	4	20	15	1	0	28	30
Slovakia	26	14	33	16	4	2	16	17
Finland	28	9	18	5	0	0	20	12
United Kingdom	25	16	19	9	5	0	17	9
Bulgarian	15	4	20	14	6	2	26	25
Norway	48	41	25	8	1	0	31	21
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Micro (1-9 empl.)		12		9		2		12
Small (10-49 empl.)		15		16		0		11
Medium (50-249 empl.)		29		28		2		19
Large (250+ empl.)		59		41		6		35
Base (100%)	firms using computers		firms using computers		firms using computers		firms using computers	
N (for sector, EU-10)	754		754		754		754	
Questionnaire reference	B1		B4		B2		B5	
* Data only indicative due to low number of observations (N ~ 25-50).								

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

Exhibit A2-3: Companies receiving orders from customers online

	Accept orders from customers online		Receive up to 25% of orders online		Receive more than 25% of orders online		Use specific ICT solutions for e-selling	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**13**	**11**	**84**	**88**	**16**	**12**	**8**	**5**
Micro (1-9 empl.)		12		90		11		4
Small (10-49 empl.)		11		87		13		6
Medium (50-249 empl.)		14		83		17		8
Large (250+ empl.)		13		78		22		16
NACE 45.2 (Comp. con.)	13	9	75	75	25	26	9	4
NACE 45.3 (Installation)	12	12	93	93	7	7	7	5
Belgium	9	6	91	99	9	1	6	0
Czech Republic	25	27	62	83	38	17	7	4
Denmark	19	17	96	100	4	0	9	5
Germany	11	12	84	61	16	39	4	6
Greece	5	5	76	96	24	4	10	12
Spain*	10	6	79	99	21	1	10	10
France	7	8	100	100	0	0	10	5
Ireland	7	8	100	100	0	0	6	7
Italy	7	11	100	100	0	0	1	0
Latvia	7	12	79	80	21	20	5	5
Lithuania	19	15	81	91	19	9	3	4
Luxembourg	6	9	100	100	0	0	8	2
Hungary	16	17	65	47	35	53	6	5
Netherland	11	6	72	28	28	72	6	1
Austria	15	13	100	100	0	0	17	4
Poland	18	23	100	100	0	0	9	12
Slovenia	12	5	82	96	18	4	9	4
Slovakia	21	32	75	71	25	29	8	13
Finland	28	29	87	87	13	13	17	5
United Kingdom	20	9	80	94	20	6	13	0
Bulgaria	27	16	68	45	32	55	17	10
Norway	20	23	86	79	14	21	16	15
All 10 sectors (EU-10)	**35**	**25**	**73**	**75**	**27**	**25**	**18**	**9**
Micro (1-9 empl.)		23		79		21		6
Small (10-49 empl.)		26		76		24		12
Medium (50-249 empl.)		29		75		25		16
Large (250+ empl.)		26		74		26		27
Base (100%)	firms using computers		firms accepting orders online		firms accepting orders online		firms using computers	
N (for sector, EU-10)	754		123		123		754	
Questionnaire reference	F4		F6a+b+c		F6d+e		F10	
* Data only indicative due to low number of observations (N ~ 25-50).								

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

Exhibit A2-4: Companies ordering supply goods online

	Place orders online		Place up to 25% of orders online		Place more than 25% of orders online		Use specific ICT solutions for e-sourcing	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Construction (EU-10)	**53**	**51**	**74**	**72**	**26**	**28**	**12**	**6**
Micro (1-9 empl.)		51		72		28		4
Small (10-49 empl.)		54		76		24		10
Medium (50-249 empl.)		57		80		20		17
Large (250+ empl.)		58		69		31		26
NACE 45.2 (Comp. con.)	49	37	76	83	23	17	14	7
NACE 45.3 (Installation)	57	58	73	69	27	31	9	6
Belgium	48	45	75	59	25	41	12	7
Czech Republic	56	54	67	77	33	23	7	4
Denmark	87	77	57	58	43	42	10	12
Germany	63	68	73	76	27	24	5	6
Greece	43	38	81	81	19	19	15	10
Spain*	37	21	81	92	19	8	12	10
France	53	47	87	83	13	17	12	2
Ireland	45	41	80	89	20	11	11	8
Italy	51	53	72	74	28	26	7	1
Latvia	52	52	82	76	18	24	9	11
Lithuania	49	32	76	71	24	29	8	12
Luxembourg	53	55	92	87	8	13	4	0
Hungary	42	46	86	80	14	20	7	7
Netherland	59	54	72	63	28	37	12	1
Austria	68	62	62	59	38	41	27	12
Poland	68	71	55	42	45	58	8	6
Slovenia	36	37	81	78	19	22	4	5
Slovakia	34	31	81	66	19	34	15	12
Finland	73	55	67	78	33	22	26	7
United Kingdom	58	64	77	76	23	24	24	9
Bulgaria	40	38	69	69	31	31	13	10
Norway	74	69	49	47	51	53	16	16
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
Base (100%)	firms using computers		firms placing orders online		firms placing orders online		firms using computers	
N (for sector, EU-10)	754		401		401		754	
Questionnaire reference	E1		E3a+E3b+E3c		E3d+E3e		E7	
* Data only indicative due to low number of observations (N ~ 25-50).								

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

Annex III: Glossary of Technical Terms

Term	Definition[58]
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.

[58] 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[58]
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.[59] 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.

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

Term	Definition[58]
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[58]
VoIP	Voice over Internet Protocol (IP). The use of telephony services over internet networks, by means of digitised voice transfer technology.
VPN	Virtual Private Network. A way to use a public telecommunication infrastructure, such as the internet, to provide remote offices or individual users with secure access to their organisation's network.
WAN	Wide Area Network. A network allowing the interconnection and intercommunication of a group of computers over a long distance.
WAP	Wireless Application Protocol. A communication protocol for delivering data over mobile telephone systems, allowing cellular phone sets and other mobile hand-set systems to access WWW pages and other wireless services.
Website	A related collection of World Wide Web files that includes a beginning file called a home page.
Wi-Fi	Wireless fidelity. A popular term for a high-frequency wireless local area network (W-LAN). Wi-Fi technology is rapidly gaining acceptance as an alternative or complementary infrastructure to a wired LAN.
W-LAN	Wireless Local Area Network. An implementation of a LAN with no physical wires, using wireless transmitters and receivers. It allows a mobile user to connect to a LAN or WAN through a wireless (radio) connection. A standard, IEEE 802.11, specifies the technologies for wireless LANs.
WWW	World Wide Web. The collection of pages in HTML format which reside on web-servers. Although WWW and the internet are different, the terms are increasingly becoming interchangeably used.
XML	Extensible Mark-up Language. A standard to describe the contents of a page or file. XML is a way to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere.

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