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ICT and e-Business Impact in the **Furniture Industry**

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ICT and e-Business Impact in the Furniture Industry

A Sectoral e-Business Watch study by

Databank

Final Report

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This report was prepared by Databank on behalf of the European Commission, Enterprise & Industry Directorate General, in the context of the "Sectoral e-Business Watch" programme. The Sectoral e-Business Watch is implemented by empirica GmbH in cooperation with Altran Group, Databank Consulting, DIW Berlin, IDC EMEA, Ipsos, GOPA-Cartermill and Rambøll Management based on a service contract with the European Commission.

About the Sectoral e-Business Watch and this report

The European Commission, Enterprise & Industry Directorate General, launched the Sectoral e-Business Watch (SeBW) to study and assess the impact of ICT on enterprises, industries and the economy in general across different sectors of the economy in the enlarged European Union, EEA and Accession countries. SeBW continues the successful work of the *e-Business W@tch* which, since January 2002, 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 SeBW website (www.europa.eu.int/comm/enterprise/ict/policy/watch/index.htm, www.ebusiness-watch.org).

This document is a final report of a Sector Impact Study, focusing on electronic business in the furniture industry. The study describes how companies use ICT for conducting business, and, above all, assesses implications thereof for firms and for the industry as a whole. The elaborations are based on an international survey of enterprises on their ICT use, econometric analyses, expert interviews and case studies.

Disclaimer

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Executive Summary

Key findings

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

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

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

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

About this study

This is the final report of the Sectoral e-Business Watch study on the furniture industry. The study informs on how companies use ICT for managing their business processes, internally and in exchanges with suppliers and customers. It identifies related opportunities, possible barriers for ICT adoption and digital integration and assesses the impact of ICT deployment for firms and for the industry as a whole. Possible implications for policy actions are indicated.

Findings presented are based on literature, expert interviews, case studies and the results of an international survey of enterprises on their ICT usage conducted by the SeBW in August/September 2007.

The study addresses, in particular, policy makers (in the fields of innovation and ICT-related policies and in sectoral policy) and representatives of the furniture industry (notably firm managers, decision-makers in marketing, procurement, ICT and e-solutions, and human resources managers).

For the purpose of the study, the furniture sector is defined as those business activities described by NACE Rev. 2 in Chapter 31, namely 31.01, 31.02 and 31.09. These correspond to: manufacture of office and shop furniture, kitchen furniture and other furniture.

Main trends in the industry and e-business issues

The EU-27 furniture industry is an economically important sector, providing employment to 1.4 million people and generating a turnover of 118 billion Euros in 2004. In most of the European countries, furniture represents between 2 and 4% of the production value of the overall manufacturing sector.

The sector is dominated by small and medium sized enterprises. This is both a point of strength of the EU industry, as these companies are generally more flexible and quick in adapting to market changes, and a point of weakness, as they are more likely to lack investment capability.

A quickly changing and highly competitive environment is putting increasing pressure on EU furniture manufacturers. Product innovation and reduced lead times are the key success factors for businesses to respond to such challenges and to remain competitive. A closer link with both intermediary and final customers is also a clue to keep the pace with market changes and provide adequate customer service. Horizontal and preliminary to these

factors is the capability of furniture manufacturers to rely on properly skilled human resources.

Furniture firms need to pursue innovation strategies based on creativity, quality and differentiation of products, as well as improved customer service. Investments are made in the areas of design and creation, automation of production processes, advertising and communication.

Furniture companies are "e-ready"

The quality of furniture companies' basic ICT infrastructure is fairly good, notably among SMEs. For example, the share of small firms (with 10-49 employees) that have broadband internet connections is around 40%.

The diffusion of Wireless LAN (W-LAN) technology is also high: close to 60% of employees work in companies that use a W-LAN. Also, the share of companies that enable remote access to their computer network is about 50%. With regard to ICT and e-business skills, the vast majority of companies do not suffer from a shortage of ICT practitioners. A good share of furniture companies is equipped to introduce more advanced forms of e-business, a major question addressed in this study is the reason why this is not occurring.

CAD and 3D modelling: efficiency and customer-driven production and innovation

CAD and 3D tools are playing an increasingly important role in furniture companies of all sizes and product lines. The analysis carried out for the present report provides insights on how design tools can be exploited for the purpose of customer-driven production and innovation, allowing a cost and timely-effective way to meet customers' needs. Moreover, design tools can be used to enhance the customer experience at the point of sale, providing virtual visualisation of product options and, ultimately, leading to customer-driven production and innovation.

A further goal would be to increase the efficiency of the design process and foster overall integration with manufacturing and marketing & sales activities. These tools may act as stepping-stones to a wider integration of the product information flow throughout the overall companies' operations. Results from the CATI Manufacturing Survey 2007, however, indicate that the integration of design with manufacturing and marketing & sales has not occurred on a large scale.

"Green" design and production as a way to gain competitive advantage

Issues concerning sustainability and "green" design are becoming a very important part of the furniture design and production process. This general trend is driven by national and EC regulation and is fostered by customers' awareness. In order to effectively respond to environmental challenges, a comprehensive approach is required. Environmental issues need to be taken into account from the product concept and design phase onwards, through procurement, production and post-sales, until de-manufacturing. The analysis carried out in this report indicates that innovative companies have started to adopt environment-friendly strategies, based on ICT tools for the life cycle assessment of furniture products. It is worth noting that these companies succeed in converting the burden of additional costs (due to compliance to strict regulation) into a competitive advantage: the possibility to base communication and marketing on "green" issues that are particularly appealing with the high-end segments of the market.

Flexibility needed to address complexity of production and reduce lead times

The furniture industry faces new business complexities. Product demands span a broad range, from commoditized to highly customized products. Customer demand is continuously changing, while competition from low-cost countries is increasing. To keep pace with the customers' demand, manufacturers are offering expanded product lines and custom options. The wide variety of dimensions, colours, finishes, fabrics and product options -leaving aside the value of the stock, efficiencies in storage and logistics - are placing increased demands on information systems to provide the functionality and flexibility required to address

all the business requirements. On top of this, are the demands by customers for reduced delivery times.

The EU furniture industry has made large investments in production and modern manufacturing techniques. Insights from literature and interviews for this report indicate that flexibility of operations and manufacturing process efficiency has been achieved not so much from investment in high-tech robotics and integrated automation, but more relying on skilled workforce and general purpose manufacturing equipment. The furniture industry handcrafting background emerges in the model of ICT and e-business adoption in this sector: mainly system automation for production, but little business management or system integration in the company or with business partners.

In order to sustain competitiveness at an international level, however, the European industry needs to further advance in efficiency and integration of business processes, such as procurement, production planning, warehousing, inventory control. The realisation of extensive cost reductions and time savings, by integrating all aspects of the supply chain, can be supported by the implementation of proper ICT and e-business solutions, such as SCM. This process is strictly dependant upon the effective implementation of internal business processes management systems, such as ERP. However, adoption and usage of SCM and ERP are still limited to larger firms while smaller players face relevant constraints and barriers, such as cost and complexity of technologies. It also appears from the analysis that the identification of priority areas for focused investments is possibly the suggested path for companies embracing e-business.

e-Marketing and sales

A main feature of the furniture industry is the number and diversity of business players along the value chain, including handicraft companies and professionals. The diversity of ICT systems in place and of competences is a major hurdle to integration.

In particular, e-business integration is still lacking between manufacturers and independent distributors, due to the characteristics of furniture distribution networks and the complexity of industrial categorisation and coding. e-Marketing and e-sales activities towards final customers are still limited in this sector, and are aimed at providing technical and commercial information rather than actual e-commerce functions.

Furniture manufacturers and retailers may benefit from improved interoperability and standardisation both for integration of business processes and for the development of B2B and B2C commerce activities. The report highlights interesting examples of web-based e-communication and e-cataloguing initiatives supporting selling activities.

Case studies and the CATI Manufacturing Survey 2007 confirm Web catalogues as the most used web-based application. Web catalogues are seen as a kind of customer service and are hardly ever integrated with ordering and production/distribution systems.

ICT as an enabler of process innovation

It was a consistent finding in e-Business Watch sector studies that ICT play a crucial role in particular to support process innovation, in manufacturing as well as in service industries. This can be confirmed for the furniture sector: enterprises representing about 47% of sector employment said that they had launched new (or improved) products in 2006/07. About 44% of those said that their product innovations had been directly related to or enabled by ICT. ICT play a crucial role to support process innovation across all size classes.

Impacts of ICT adoption

An econometric analysis was conducted, based on the e-Business Survey 2007 for the furniture industry. It allows identifying ICT impacts on selected business dimensions in the furniture industry. It stems from the survey data that ICT-driven innovation process in this industry is linked to the share of employees with university degree and of ICT practitioners and is favoured by the existence of long-standing and electronically-organised relations with business partners. Conversely, the overall impact of ICT on the furniture industry structure is limited.

Finally, ICT and make-or-buy decisions are related, although it is not possible to establish the direction of this link

A varied picture from case studies

Case studies presented in this report illustrate the adoption of ICT and e-business solutions in a few enterprises that were selected as they deal with relevant topics. Case studies lustrate the adoption of ICT and e-business solutions investigated through the survey and match some of the hypotheses presented in Chapter 4. Experiences come from different countries and include firms of different size. Examples can be found in the areas of integration of design activities (Danona and RobinWood), supply chain integration (Micuna, Profim, Home Base and Scavolini), outsourcing (Stokke), the usage of the web for communication with customers (Quatuor, Webmobili) and e-sales (IWOfurn).

Policy implications

Policy measures for the furniture industry should address the issues interoperability and standardisation, the creation of a favourable environment for innovation and the improvement of skills.

Policy measures in the area of **standardisation** should now aim at fostering faster and wider implementation of standards both at sector and at cross-sector level, in particular as concerns the integration with distribution, and the target of SMEs. This would ultimately bring relevant advantages to the whole furniture manufacturing industry in terms of efficiency and responsiveness to the market. One of the most important issues in the area of standardisation is the need for a shared classification and standardisation scheme of products coding of data

Policy measures should aim at creating a **favourable environment for innovation.** This should include the support to the effective availability of broadband across all European countries in order to overcome situation of e-exclusions. Findings of the report indicate that the innovation activities of furniture firms are linked to the availability of ICT skilled resources and of personnel with university degrees. It is also well known that design and creativity are points of strength of the European furniture industry. Efforts should be made at a European and national level to encourage synergies between design and supporting technology in order to favour cross fertilisation between these two fields.

ICT and e-business are rapidly changing the way business is conducted in this industry. Innovative applications require changes in organisation and working procedures. **Skill upgrading and training of personnel** are important to assure the successful implementation of new applications; however SMEs may have difficulties to exploit opportunities related to the introduction of new technologies due to the lack of the necessary skills. Policy may have a role in promoting entrepreneurial and managerial understanding of e-business applications, in providing information about e-business and support to decision-making and in encouraging the improvement of skills related to the reorganisation of working processes and procedures and the implementation of innovative technologies.

1 Introduction

1.1 About this report

Purpose, sources and addressees

This is the final report of the Sectoral e-Business Watch study on the furniture industry[1]. The study analyses diffusion and usage of ICT among companies in the furniture sector. It illustrates the extent and the way ICT is applied in core business processes, both internally and with business partners. It provides examples (case studies) of real life applications of ICT and e- business in furniture companies; it identifies opportunities, possible barriers for ICT adoption and digital integration and assesses the impact of ICT deployment for firms and for the industry as a whole; it indicates possible implications for policy actions.

The analysis is based on statistics from Eurostat (SBS) and UEA UEA (European Furniture Manufacturers Federation), literature, case studies and the results of an international survey of enterprises on their ICT usage conducted by the SeBW in August/September 2007[2]. Several interviews were carried out, both for developing case studies and for discussing the results with the sector experts who are part of the Advisory Board.[3]

The study addresses, in particular, policy makers (in the fields of innovation and ICT-related policies and in sectoral policy) and representatives of the furniture industry (notably firm managers, decision-makers in marketing, procurement, ICT and e-solutions, and human resources managers), suppliers of ICT solutions and consultancy forms specialised in manufacturing, as well European and national furniture industry associations.

Study structure

The study is structured into **six main sections**. Chapter 1 explains the background and context *why* this study has been conducted: it introduces the Sectoral e-Business Watch (SebW) programme of the European Commission, a conceptual framework for the analysis of e-business, and the specific methodology used for this study. Chapter 2 provides some general information and key figures about the furniture industry in Europe. Chapter 3 describes the current state-of-play in e-business in this industry, focusing on specific ICT-related issues that were found to be particularly relevant to this sector. Chapter 4 assesses the impact of the developments described in chapter 3 on innovation, market structure, and value chain characteristics. Chapter 5 presents company case studies. These have been selected as practical examples and evidence for the issues discussed in chapters 3 and 4. Chapter 6, finally, summarises the key findings and draws conclusions on policy implications that could arise from the observed developments.

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1 For the purpose of the study, the furniture industry is defined as those business activities described by NACE Rev. 2 in Chapter 31, namely 31.01, 31-02 and 31.09. See also section 2.1 of this report.

2 Detailed information about the survey is available in Annex 1.

3 For a complete list of Advisory Board Members see http://www.ebusiness-watch.org/advisory/2007_08.htm.

Combining exploratory, descriptive and explanatory approaches

The study approach is exploratory, descriptive and explanatory, thus applying a broad and sound methodological basis: A **qualitative case study approach** (chapter 5) is combined with a descriptive presentation of **quantitative survey data** (chapter 3) and an **economic analysis** of ICT adoption and its impacts (chapter 4). This threefold approach is meant to produce an in-depth understanding of current e-business issues in the industry (the "practitioner's view") as well as the state of the art of e-business practice (the “empiricist’s view”), while also *assessing* the economic effects of this practice, for instance on firm productivity and innovation (the "economist's perspective"). While the results from these different approaches are presented like self-sustained pieces of research in separate chapters, they are intertwined and cross-referenced.

1.2 About the Sectoral e-Business Watch

Mission and objectives

The "Sectoral e-Business Watch" (SeBW) explores the adoption, implication and impact of electronic business practices in different sectors across the European economy. It represents the continued effort of the European Commission, DG Enterprise and Industry to support policy in the fields of ICT and e-business, which started with "*e-Business W@tch"* in late 2001.

In ICT-related fields, DG Enterprise and Industry has a twofold mission: "*to enhance the competitiveness of the ICT sector, and to facilitate the efficient uptake of ICT for European enterprises in general*." The services of the SeBW are expected to contribute to these goals. This mission can be broken down into the following main objectives:

- to assess the impact of ICT and e-business on enterprises, industries or sectors and the economy in general;
- to highlight barriers for ICT uptake, i.e. issues that are hindering a faster and/or more effective use of ICT by enterprises in Europe;
- to identify and discuss policy challenges stemming from the observed developments, notably at the European level;
- to engage in dialogue with stakeholders from industry and policy institutions, providing a forum for debating relevant issues.

By delivering evidence on ICT uptake and impact, SeBW is supporting informed policy decision-making, in particular in the fields of innovation, competition, industrial and structural policy.

Policy context

The original *e-Business W@tch* programme was rooted in the **eEurope Action Plans** of 2002 and 2005. The goal of eEurope 2005 was "*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".[4]

The **i2010 policy**[5], 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). This Communication anticipates "*a new era of e-business solutions*", based on integrated ICT systems and tools, which will lead to an increase 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).

"ICT are an important tool …"

"More efforts are needed to improve business processes in European enterprises if the Lisbon targets of competitiveness are to be realised. European companies, under the pressure of their main international competitors, need to find new opportunities to reduce costs and improve performance, internally and in relation to trading partners. ICT are an important tool to increase companies' competitiveness, but their adoption is not enough; they have to be fully integrated into business processes."

Source: European Commission (2005): Information Society Benchmarking Report

In February 2005, the European Commission proposed a **new start for the Lisbon Strategy**. While it recommended changes in the governance structures, i.e. the way objectives are to be addressed, the overall focus on growth and jobs remained the same. Some of the policy areas of the renewed Lisbon objectives address ICT-related issues. Central Policy Area No. 6 deals with facilitating ICT uptake across the European economy. Policy-makers in this area will require thorough analysis of ICT uptake based on accurate and detailed information on the most recent developments. Such evidence-based analysis is also needed when targeting individual sectors to fully exploit the technological advantages, in alignment with Central Policy Area No. 7 "Contributing to a strong European industrial base". Furthermore, Guideline No. 9, addressed to Member States, encouraging the widespread use of ICT,[6] can be effectively addressed only if actions are based on understanding of the potential for and probable effectiveness of interventions.

In 2005, taking globalisation and intense international competition into consideration, the European Commission launched a **new industrial policy**[7] with the aim to create better

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

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

[6] "Working Together for Growth and Jobs: a New Start for the Lisbon Strategy", Communication, COM (2005) 24, Brussels, 02.02.2005 http://europa.eu.int/growthandjobs/pdf/COM2005_024_en.pdf .

[7] "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.

framework conditions for manufacturing industries in the coming years. Some of the policy strands described have direct links to ICT usage, recognising the importance of ICT for innovation, competitiveness and growth.

The new EU industrial policy aimed at complementing work at Member State level to support a strong and dynamic industrial base. It included seven new initiatives - on competitiveness, energy and the environment, on intellectual property rights, on better regulation, on industrial research and innovation, on market access, on skills, and on managing structural change – aimed at supporting a wide range of industry sectors. The approach underlying the new industrial policy is based on the screening of 27 individual sectors of manufacturing industry and construction, the furniture sector included. This industrial policy is an important step in the delivery of the Commission's Lisbon "Partnership for Growth and Jobs. In May 2007 the "Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries"[8] has been issued by the European Commission. The study provides a comprehensive overview of the competitive scenario of these fashion-related industries; it also provides indications and recommendations on how to enhance the competitive position of the enlarged European industry. The study team has thoroughly analysed this document and has built upon its relevant findings and conclusions in particular for developing the industry scenario and the recommendations for policy implications.

The SeBW is one of the policy instruments used by DG Enterprise and Industry to support the implementation of the industrial policy and related programmes. Its activities are complementary to other related policy programmes in the field of ICT, such as:

- 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.9

In parallel to the work of the SeBW, the "**Sectoral Innovation Watch**" (see www.europe-innova.org) analyses innovation performance and challenges across different EU sectors from an economic perspective. Studies cover, inter alia, the following sectors: chemical, automotive, aerospace, food, ICT, textiles, machinery and equipment.

Scope of the programme

Since 2001, the SeBW and its predecessor "e-Business W@tch" have published e-business studies on about **25 sectors**[10] of the European economy, annual comprehensive synthesis reports about the state-of-play in e-business in the European Union, statistical pocketbooks and studies on specific ICT issues. All publications can be

[8] Available at http://ec.europa.eu/enterprise/furniture/index_en.htm.

[9] 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.

[10] see overview at www.ebusiness-watch.org/studies/on_sectors.htm.

downloaded from the programme's website at www.ebusiness-watch.org. In 2007/08, the focus is on the following sectors and specific topics:

No.	Sector / topic in focus	NACE Rev. 1.1	Reference to earlier studies by SeBW
1	Chemical, rubber and plastics	24, 25	2004, 2003
2	Steel	27.1-3, 27.51+52	--
3	Furniture	36.12-14	--
4	Retail	52	2004, 2003
5	Transport and logistics services	60, 63 (parts thereof)	--
6	Banking	65.1	2003
7	RFID adoption and implications	(several sectors)	--
8	Intellectual property rights for ICT-producing SMEs	30.01+02, 32.1-3, 33.2+3; 64.2; 72 (parts thereof)	--
9	Impact of ICT and e-business on energy use		--
10	Economic impact and drivers of ICT adoption		--

The SeBW presents a **'wide-angle' perspective** on the adoption and use of ICT in the sectors studied. Studies assess how ICT is having an influence on business processes, notably by enabling electronic data exchanges between a company and its customers, suppliers, service providers and business partners. The underlying conceptual framework is explained in more detail in the following section. In addition, the studies also provide **background information** on the respective sectors, including a briefing on current trends.

1.3 ICT and e-business – key terms and concepts

A definition of ICT

This study examines the use of information and communication technology (ICT) in European businesses. ICT is an umbrella term that encompasses a wide array of systems, devices and services used for data processing (the information side of ICT) as well as telecommunications equipment and services for data transmission and communication (the communication side). The European Information Technology Observatory (2007) structures the ICT market into four segments with an estimated total market value of about € 670 billion in 2007 (Exhibit 1.3-1).

In its widest sense, 'e-business' refers to the application of these technologies in business processes, including primary functions (such as production, inbound and outbound logistics or sales), and support functions (such as administration, controlling, procurement and human resources management). Companies in all sectors use ICT, but they do so in different ways. This calls for a **sectoral approach** in studies of ICT usage and impact. The following section introduces a wider framework for the discussion of e-business developments that will be used in the following analysis of the furniture industry.

Exhibit 1.3-1: The EU ICT market according to EITO (2007)

Market segment	Products / services included (examples)	Market value for EU (2007) (EITO estimate)
ICT equipment	Computer hardware, end-user communications equipment (such as mobile phones), office equipment (such as copiers) and data communications and network equipment (such as switching and routing equipment, cellular mobile infrastructure)	€159 billion
Software products	System and application software	€76 billion
IT services	Consulting, implementation and operations management	€140 billion
Carrier services	Fixed voice telephone and data services, mobile telephone services, cable TV	€293 billion

Source: EITO 2007

Gaining momentum after a phase of disappointment

When the bust phase of the previous economic cycle – commonly referred to as the 'new economy' – started in 2001, the former internet hype was suddenly replaced by a widespread disappointment with e-business strategies. Companies adopted a more reserved and sceptical attitude towards investing in ICT. Nevertheless, ICT has proved to be the key technology of the past decade (OECD 2004, p. 8), and the **evolutionary development** of e-business has certainly not come to an end. The maturity of ICT-based data exchanges between businesses and their suppliers and customers, fostered by progress in the definition and acceptance of standards, has substantially increased across sectors and regions over the past five years. In parallel, **recent trends** such as 'Web 2.0' and social networking are widely discussed in terms of their business implications and it is widely recognised that 'e'-elements have become an essential component of modern business exchanges. In short, e-business has regained momentum as a topic for enterprise strategy both for large multinationals and SMEs.

> *"Measurement of e-business is of particular interest to policy makers because of the potential productivity impacts of ICT use on business functions. However, the ongoing challenges in this measurement field are significant and include problems associated with measuring a subject which is both complex and changing rapidly."*
>
> *OECD (2005): ICT use by businesses. Revised OECD model survey, p. 17*

Companies use ICT in their business processes mainly for **three purposes**: to reduce costs, to better serve the customer, and to support growth (e.g. by increasing their market reach). In essence, all e-business projects in companies explicitly or implicitly address one or several of these objectives. In almost every case, introducing e-business can be regarded as an ICT-enabled process innovation. Understanding one's business processes and having a clear vision of how they could be improved (be it to save costs or to improve service quality) are therefore critical requirements for firms to effectively use ICT.

The increasing **competitive pressure** on companies, many of which operate in a global economy, has been a strong driver for ICT adoption. Firms are constantly searching for opportunities to cut costs and ICT holds great promise in this respect as it increases the **efficiency of a firm's business processes**, both internally and between trading partners in the value chain.

While cutting costs continues to motivate e-business activity, innovative firms have discovered and begun to exploit the potential of ICT for delivering against key business objectives. They have integrated ICT into their production processes and **quality management** and, most recently, in **marketing** and **customer services**. These last sectors are widely considered key to improve competitiveness in the current phase of development of European economies. Competing in mature markets, such as furniture, requires not only optimised cost structures, maximal efficiency, and products or services of excellent quality but also the ability to communicate effectively and cooperate with business partners and potential customers. Case studies presented in Chapter 5 demonstrate that efficient communication with intermediate and final is a key success factor in this industry.

A definition of e-business

As part of this maturing process, electronic business has progressed from a specific to a very broad topic. A central element is certainly the use of ICT to accomplish **business transactions**, i.e. exchanges between a company and its suppliers or customers. These can be other companies ('B2B' – business-to-business), consumers ('B2C' – business-to-consumers), or governments ('B2G' – business-to-government). In the broad sense, transactions include commercial as well as other exchanges such as sending tax return forms to the tax authorities.

Glossary

Definitions by standardisation groups (ISO, ebXML)

The term 'business transaction' is a key concept underlying the development of e-standards for B2B exchanges. Therefore, definitions have been developed by standards communities to underpin their practical work. Examples include:

- ***Business**: "a series of processes, each having a clearly understood purpose, involving more than one party, realized through the exchange of information and directed towards some mutually agreed upon goal, extending over a period of time" [ISO/IEC 14662:2004]*
- ***Business transaction**: "a predefined set of activities and/or processes of parties which is initiated by a party to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved parties even though some of the recognition may be implicit" [ISO/IEC 14662:2004]*
- ***e-Business transaction**: "a logical unit of business conducted by two or more parties that generates a computable success or failure state" [ebXML Glossary]*

If transactions are conducted electronically ('**e-transactions**'), they constitute e-commerce. Transactions can be broken down into **different phases** and related

business processes, each of which can be relevant for e-commerce (see Exhibit 1.3-2). The pre-sale (or pre-purchase) phase includes the presentation of (or request for) information on the offer, and negotiations over the price. The sale / purchase phase covers the ordering, invoicing, payment and delivery processes. Finally, the after sale / purchase phase covers all processes after the product or service has been delivered to the buyer, such as after sales customer services (e.g. repair, updates).

Exhibit 1.3-2: Process components of transactions

Pre-sale / pre-purchase phase	Sale / purchase phase	After sale / after-purchase phase
■ Request for offer/proposal	■ Placing an order	■ Customer service
■ Offer delivery	■ Invoicing	■ Guarantee management
■ Information about offer	■ Payment	■ Credit administration
■ Negotiations	■ Delivery	■ Handling returns

Practically each step in a transaction can either be pursued electronically (online) or non-electronically (offline), and all combinations of electronic and non-electronic implementation are possible. It is therefore difficult to decide which components actually have to be conducted online in order to call a transaction (as a whole) 'electronic'.

In 2000, the OECD proposed broad and narrow definitions of electronic commerce, both of which remain valid and useful today[11]. While the narrow definition focuses on 'internet transactions' alone, the broad definition defines e-commerce as "*the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over* ***computer-mediated networks***. *The goods and services are ordered over those networks, but the payment and the ultimate delivery of the goods or service may be conducted on- or offline"* (OECD, 2001). The addendum regarding payment and delivery illustrates the difficulty mentioned above to specify which of the processes along the transaction phases constitute e-commerce (see Exhibit 1.2-2). The OECD definition excludes the pre-sale / pre- purchase phase and focuses instead on the ordering process. The SeBW follows the OECD position on this issue,[12] while fully recognising the importance of the internet during the pre-purchase phase for the initiation of business.

Using the OECD definition, e-commerce is a key component of **e-business** but not the only one. A wider focus oriented on business processes has been widely recognised. This vision of e-commerce also covers the digitisation of **internal business processes** (the internal processing of documents related to transactions) as well as **cooperative** or **collaborative processes** between companies that are not necessarily transaction-focused (for example industrial engineers collaborating on a design in an online environment). The OECD WPIIS[13] proposes a definition of e-business as "*automated business processes (both intra-and inter-firm) over computer mediated networks*" (OECD, 2004, p. 6). In addition, the OECD proposed that e-business processes should integrate tasks and extend beyond a stand-alone or individual application. 'Automation' refers here to the substitution of formerly manual processes. This can be achieved by replacing the paper-based processing of documents by electronic exchanges (machine-to-machine)

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

[12] The respective survey questions ask companies whether they "place / accept online orders".

[13] Working Party on Indicators for the Information Society.

but it requires the agreement between the participants on electronic **standards** and processes for data exchange. The latter definition of e-business and automation hereby described have been adopted and used in the present report about the furniture industry.

Glossary

Definition of key terms for this study

- ***e-Transactions****: commercial exchanges between a company and its suppliers or customers which are conducted electronically. Participants can be other companies ('B2B' – business-to-business), consumers ('B2C'), or governments ('B2G'). This includes processes during the pre-sale or pre-purchase phase, the sale or purchase phase, and the after-sale / purchase phase.*
- ***e-Commerce****: the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. (OECD)*
- ***e-Business****: automated business processes (both intra- and inter-firm) over computer mediated networks. (OECD)*
- ***e-Interactions****: covers the full range of e-transactions as well as collaborative business processes,. such as collaborative online design processes which are not directly transaction focused.*

e-Business and a company's value chains

In some contexts, the term c-commerce (collaborative commerce) is used. Although this concept was mostly abandoned when the 'new economy' bubble burst in 2001, it had the merit of pointing towards the role of ICT in co-operations between enterprises and the increasing digital integration of supply chains. These developments go beyond simple point-to-point exchanges between two companies.

Despite dating back 20 years to the pre-e-business era, Michael Porter's framework of the company value chain and value system between companies[14] remains useful to understand the relevance of e-business in this context. A **value chain** logically presents the main functional areas ('value activities') of a company and differentiates between primary and support activities. However, these are "*not a collection of independent activities but a system of interdependent activities*", which are "*related by linkages within the value chain*".[15] These linkages can lead to competitive advantage through optimisation and coordination. This is where ICT can have a major impact, in the key role of **optimising linkages** and increasing the efficiency of processes.

The **value system** expands this concept by extending its scale beyond the single company. The firm's value chain is linked to the value chains of (upstream) suppliers and (downstream) buyers; the resulting larger set of processes is referred to as the value system. All e-commerce and therefore electronic transactions occur within this value system.

[14] Porter, Michael E. (1985). Competitive Advantage. New York: Free Press. Page references in quotations refer to the Free Press Export Edition 2004.

[15] Ibid., p. 48.

Key dimensions of Porter's framework (notably inbound and outbound logistics, operations, and the value system) are reflected in the **Supply Chain Management** (SCM) concept. Here, the focus is on optimising the procurement-production-delivery processes, not only between a company and its direct suppliers and customers, but also aiming at a full vertical integration of the entire supply chain (Tier 1, Tier 2, Tier n suppliers). In this concept, each basic supply chain is a chain of sourcing, production, and delivery processes with the respective process interfaces within and between companies.[16] Analysing the digital integration of supply chains in various industries has been an important theme in most sector studies by the SeBW. The analysis of the digital integration of supply chains is of utmost relevance in the furniture industry, as illustrated in Chapter 3.2 of this report.

1.4 Study methodology

The methodological framework of the SeBW builds upon the methodology established for the previous implementation of the e-Business W@tch. However, the methodology has been adapted to the new focus of activity, supporting the progress from monitoring "e-readiness" and "e-activity" to the evidence-based analysis of "e-impact".

Data and information sources

The Sectoral e-Business Watch approach is based on a mix of data collection instruments, including the use of existing sources (e.g. the Eurostat Community Survey on ICT usage in enterprises) as well as primary research (notably the SeBW Survey and case studies). The main sources of information used for this study are:

- **SeBW Survey on Manufacturing** (2007): The furniture industry was covered as one of three sectors in the SeBW Survey on manufacturing industries, besides the chemical and the steel industries. About 760 interviews have been conducted (in seven European countries and the USA) with companies from the furniture sector. Detailed information about the survey methodology is provided in Annex 1.
- **Eurostat Community survey on ICT usage in enterprises** (2006): Results of the Eurostat survey are used as a complementary source for the analysis of ICT adoption in companies from the sector.
- **Case studies**: 10 case studies on e-business adoption in companies from the furniture sector have been conducted specifically for this study. The selection was made with a view to achieve a balanced mix of cases in terms of countries, business activities, and company size-bands. Cases include best practices, innovative e-business approaches, as well as typical examples of e-business activity (state-of-the-art) in the sector.
- **In-depth interviews:** In addition to the interviews conducted with firm representatives as part of the case study work, in-depth interviews with industry and e-business experts, notably with members of the Advisory Board, were conducted.
- **Information from industry federations:** Annual reports and position papers of industry federations were a further source: UEA (the European furniture

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

manufacturer's federation) and Federlegno Arredo (The Italian Industry Association).

Data analysis

For data analysis, descriptive and analytical statistical methods are used.

Descriptive statistics: The discussion of the Eurostat survey results in Chapter 3 is mostly based on descriptive cross-tabular presentation of simple frequencies (typically percentages of enterprises with a certain activity). This constitutes the first and most basic step in data presentation.

Analytical statistical methods: Descriptive presentation and discussion of survey results, including the use of compound indicators derived from simple frequencies, is useful as a first step; however, it is very limited in its power to explain ICT impact. Analysis of appropriate data sets using **advanced statistical methods** is therefore required to gain robust and meaningful evidence on ICT effects.

Analytical statistical methods: Descriptive presentation and discussion of survey results, including the use of compound indicators derived from simple frequencies, is useful as a first step; however, it is very limited in its power to explain ICT impact. Analysis of appropriate data sets using **advanced statistical methods** is therefore required to gain robust and meaningful evidence on ICT effects.

The analysis of ICT impact (see Chapter 4) does not only require data on ICT adoption, but also background information such as structural data and economic indicators on firm performance, innovation activity and growth. The analysis focuses on the following areas (data sources in brackets): innovation, market structure, value chain composition. For each dimension, hypotheses were specified on (i) how they influence ICT adoption and (ii) what are the impacts of ICT on these areas.

Validation of results

The study was conducted in consultation with an Advisory Board that was specifically implemented to critically accompany the study from the start. Members of the Advisory Board for this study were:

- Ms Maria José Nunyez, AIDIMA (Associacion de Investigacion y Desarrollo en la Industria del Mueble y Afines), Spain;
- Mr Bart De Turck, UEA (Union Européenne de l'ameublement), Belgium;
- Mr Frederik Lauwaert, EFIC (European Furniture Industries' Confederation), Belgium;
- Mr Mino Politi, Webmobili, Italy.

For each Advisory Board, in addition to informal exchanges with the respective study teams during the research phase (e.g. via telephone, e-mail and in bilateral meetings), two meetings were organised. The first meeting took place on 9 May 2007 in Milan during the inception phase. At this meeting, the study exposé and research plan was discussed. Bilateral consultation meetings with the Advisory Board members took place with the objective to discuss and validate the findings of this interim report in July and September 2007. A second meeting was organised in February 2008, with the aim to discuss and validate the results of the interim report. The results of the final report have been validated trough bilateral contacts and meetings.

2 Context and Background

2.1 Sector definition – scope of the study

For the purpose of the study, the furniture industry is defined as those business activities described by NACE Rev. 2 Chapter 31, namely 31.01, 31.02 and 31.09. The NACE Rev. 2 Groups and their correspondence in NACE Rev. 1.1 are shown in the table below. The names of business activities refer to NACE Rev. 2.

Exhibit 2.1-1: Business activities covered by the furniture industry (NACE Rev. 2 and 1.1)[17]

NACE Rev. 2	NACE Rev. 1.1 (Proxy)	Business activity:
31	**Dn 36.1**	**Manufacture of furniture**
31.01	36.12	Manufacture of office and shop furniture
31.02	36.13	Manufacture of kitchen furniture
31.09	36.14	Manufacture of other furniture

The analysis focuses on comparable sub-sectors as for structure, process automation and uptake of ICT. This excludes the manufacture of mattresses, which used to be 36.15 in NACE Rev. 1.1 and has now become 31.03 in NACE Rev. 2. It should be noted that t the global Eurostat figures for this sector include car and plane seats.

The manufacture of chairs and seats, which used to be distinct as 36.11 in NACE Rev. 1.1, is included in 31.01, 31.02 and 31.09.

The EU furniture industry is an assembling industry which employs various raw materials including wooden boards, metal, leather and glass. There is actually a close interdependence between the furniture industry and its supplying industries; distribution is mostly carried out by specialised independent retailers.

Furniture has traditionally been a labour-intensive industry that includes both small local craft firms and large manufacturers. Small enterprises often act as sub-contractors –often highly specialised in specific tasks- for larger firms (producing components, semi-finished products or finishing and assembling furniture).

The structure of this industry has deeply changed with the advent of “flat-pack” and ready-to-assemble furniture that allowed mass production. Traditional manufacturers have retained important niche market segments primarily for high-end, expensive and design-led products, which are mostly purchased locally, while mass-produced large-volume products are sold locally and for export.

[17] NACE Revision 2 is a four-digit classification of business activities. It is a revision of the “General Industrial Classification of Economic Activities within the European Communities”, known by the acronym NACE and originally published by Eurostat in 1970. NACE Rev. 2 will replace the currently used Rev. 1.1 on 1 January 2008.

2.2 Industry background

Turnover, number of firms and employment

The EU-27 furniture industry is an economically important sector, providing employment to 1.4 million people and generating a turnover of 118 billion Euros in 2004. In most of the European countries, furniture represents between 2 and 4% of the production value of the overall manufacturing sector.

Exhibit 2.2-2: Furniture industry structural profile, EU 27 in 2004

	Number of firms	Employment	Value added	Turnover (million euros)
Furniture	143.8	1,381,500	35,467	117,860

Source: UEA, *Eurostat (SBS)* 2006

The breakdown between small, medium-sized and large enterprises varies in the different countries. In Germany, a majority of the enterprises employed more than 20 employees. The average number of persons employed in a German firm was 78. In Italy, where there were 35,800 enterprises employing 211,000 persons, the average number in one enterprise was 6. In France the average number of persons in one enterprise was 11. Italy had the largest share of employment (15.1% out of the total EU-27 employment), followed by Poland and Germany with 12% and 11.9% respectively. Estonia is the country where the furniture industry accounts for the highest share of non-financial business economy. In the period 1999-2003, the former EU15 furniture industry has continuously lost jobs. This trend is due both to the delocalisation of production activities in low labour cost countries and to the increasing automation of production processes.

Exhibit 2.2-3: Share in EU27 employment in furniture manufacturing of the top five Member States, 2004

Rank	Country	Share in EU-27 employment in furniture manufacturing
1	Italy	15.1
2	Poland	12.0
3	Germany	11.9
4	Spain	10.3
5	UK	9.1

Source: *Eurostat (SBS)*

Exhibit 2.2-4: Employment specialisation ratio in furniture manufacturing (EU27=100), 2004

Rank	Country	Furniture manufacturing employment in national industrial employment
1	Estonia	268.2
2	Lithuania	231.3
3	Romania	230.1
4	Slovenia	206.5
5	Poland	201.1

Source: *Eurostat (SBS)*

Production costs and productivity

On the EU level, purchases of materials and of services account on average for about 64% of the production value (respectively 49% for materials for manufacturing and 15% for services for manufacturing, development of products, distribution). Out of the cost for material, the highest incidence is for woods and panels, followed by components, i.e. semi-finished products, which account for about 17%.

In 2004, apparent labour productivity [18] was 25,700 euros per person employed in the EU 27 furniture manufacturing sector, well below the industrial average (40,900 euros).[19]

Average personnel costs per employee were also relatively low, at 20.600 euros.

The gross operating rates provide information on the ratio of the gross operating surplus to turnover, which was 8.3% for the manufacture of furniture in 2004. This is 2.7% below the EU-27's average for the non-financial sectors (i.e. manufacturing and other services).

Exhibit 2.2-5: Productivity and profitability in furniture manufacturing, 2004

	Apparent labour productivity (1,000 Euros)	Average personnel cost (1,000 Euros)	Gross operating rate (%)
Furniture	25.7	20.6	8.3
Office and shop furniture	n.a.	28.0	8.2
Kitchen furniture	35.0	26.0	10.6
Other furniture	20.5	16.0	10.1

Source: *Eurostat (SBS)*

Investments

On average, in the furniture industry investments represented 4% of the production value or 10% of the value added in 2004. Investments are higher in the office furniture industry than in the rest of the furniture industry. In general, investments are made in the following areas:

- **Automation of production processes**. About half of the total investments are for new machinery, in order to automate production processes, through the introduction, e.g., of Computer Assisted Manufacturing (CAM) solutions and Computerised Numerical Control (CNC) machines. Important investments are made in this area by the medium-sized and large enterprises to optimise production to create synergy between different lines or sites of production and to reach economies of scale.
- **Design and creation** of new models made within the enterprise or by external designers and experts, changes in appearance, in the use of materials (combination of different types of materials), in ergonomy, in ecology (recyclable furniture).

[18] Value added per person employed.

[19] Source Eurostat (SBS).

- **Advertising and communication**. This includes the development of a brand image, detailed catalogues for retailers and consumers, investment in the internet technology, advertising on media, participation in fairs, training of sales personnel.
- Creation and/or management of efficient **distribution** channels.

EU furniture industry production by country

Germany was the largest furniture producer in the EU in 2003[20], accounting for about one quarter of total EU15 production, followed by Italy. Poland is the largest producer among the New Member States, with a total production of 3,500 million euros.

Exhibit 2.2-6: EU-25[21] furniture industry production value by country, 2003

Country	Production value (million euros)
Germany	19,800
Italy	19,456
France	9,224
Spain	8,492
UK	8,328
Poland	3,500
Netherlands	2,581
Denmark	2,541
Belgium	2,376
Austria	2,203
Sweden	2,113
Czech Republic	1,558
Portugal	1,260
Finland	1,135
Greece	828
Slovenia	752
Slovakia	733
Ireland	435
Hungary	382
Lithuania	328
Estonia	301
Latria	150
Cyprus	107
Malta	75

Source: *UEA, 2006*

In 2005, Germany was the largest furniture market in terms of sales value in Europe, followed by UK and Italy. According to a survey carried out by Eurostat in 2006[22], expenditure on furniture accounts for 2.5% of total private household consumption expenditure (PHCE) in Europe.

[20] 2004 data about production are not available.

[21] No data are available for Luxembourg.

[22] Eurostat, Statistics in Focus, "Furniture – comparative price levels in 33 European countries", 2007.

International trade

In the period 2002-2005, the imports of furniture from extra EU 25 have been steadily growing, recording more than 11 billion euros in 2005. In that year, the trade deficit was about 1 billion euros. China is, by far, the main extra EU supplier, with more than 4 billion euros in 2005. The USA are the main outlet market for the European furniture production.

Exhibit 2.2-7: EU-25 furniture industry external trade, 2002-2005

Million euros	2002	2003	2004	2005
Imports	7,494	8,245	9.935	11.376
Exports	10,244	9,621	9.923	10.227
Balance	2,750	1,376	-12	-1.149

Source: *Eurostat 2007*

Exhibit 2.2-8: Top ten EU suppliers of furniture products 2002-2005

Extra-EU25 Countries	2004	2005	% share of imports	% growth 2002-2005
China	3,163	4,283	37.7	145.9
Indonesia	838	841	7.4	9.9
Romania	748	821	7.2	46.3
Vietnam	462	520	4.6	104.1
Switzerland	469	495	4.4	11.3
USA	392	464	4.1	-7.0
Turkey	430	444	3.9	43.7
Malaysia	339	373	3.3	17.5
South Africa	428	343	3.0	15.6
Brasil	428	309	2.7	35

Source: *Eurostat 2007*

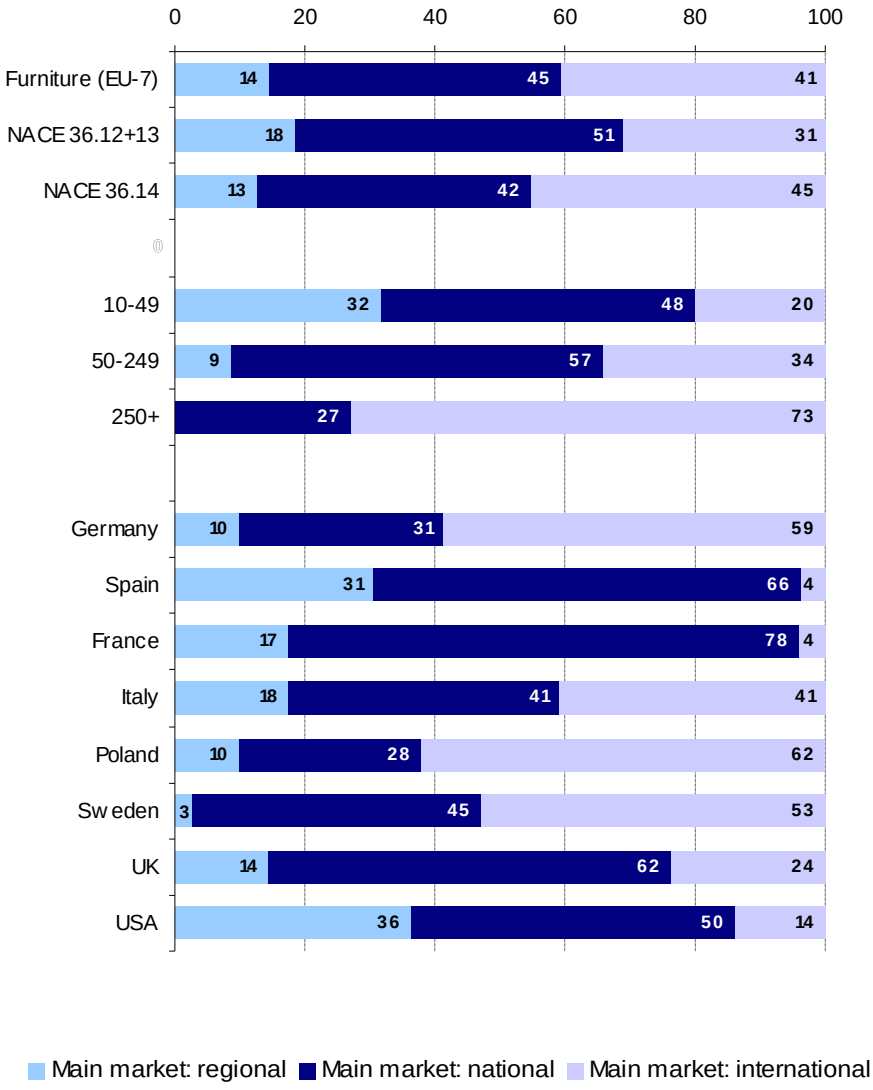
Exhibit 2.2-9: Top ten EU markets, 2002-2005

Extra-EU25	2004	2005	% share of exports	% growth 2002-2005
USA	2,481	2,333	22.8	-22.7
Switzerland	1,563	1,629	15.9	4.9
Russia	812	952	9.3	47.4
Norway	818	915	8.9	25.6
Japan	497	476	4.7	-2.6
Canada	240	278	2.7	7.2
UA Emirates	202	242	2.4	35.7
Croatia	228	227	2.2	9.8
Romania	160	207	2.0	98.4
Turkey	137	183	1.8	78.8

Source: *Eurostat 2007*

The following exhibits, based on the results of the SeBW Survey on manufacturing (2007), illustrate the attitude of furniture firms to internationalisation, both in terms of market (exhibit 2.10) and organisation of production (exhibit 2.11).

Exhibit 2.2-10: Percentage of firms and most significant market area (2007)



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

Base (100%) = all companies excl. those saying "don't know". N (Furniture, EU-7 and USA) = 758.

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

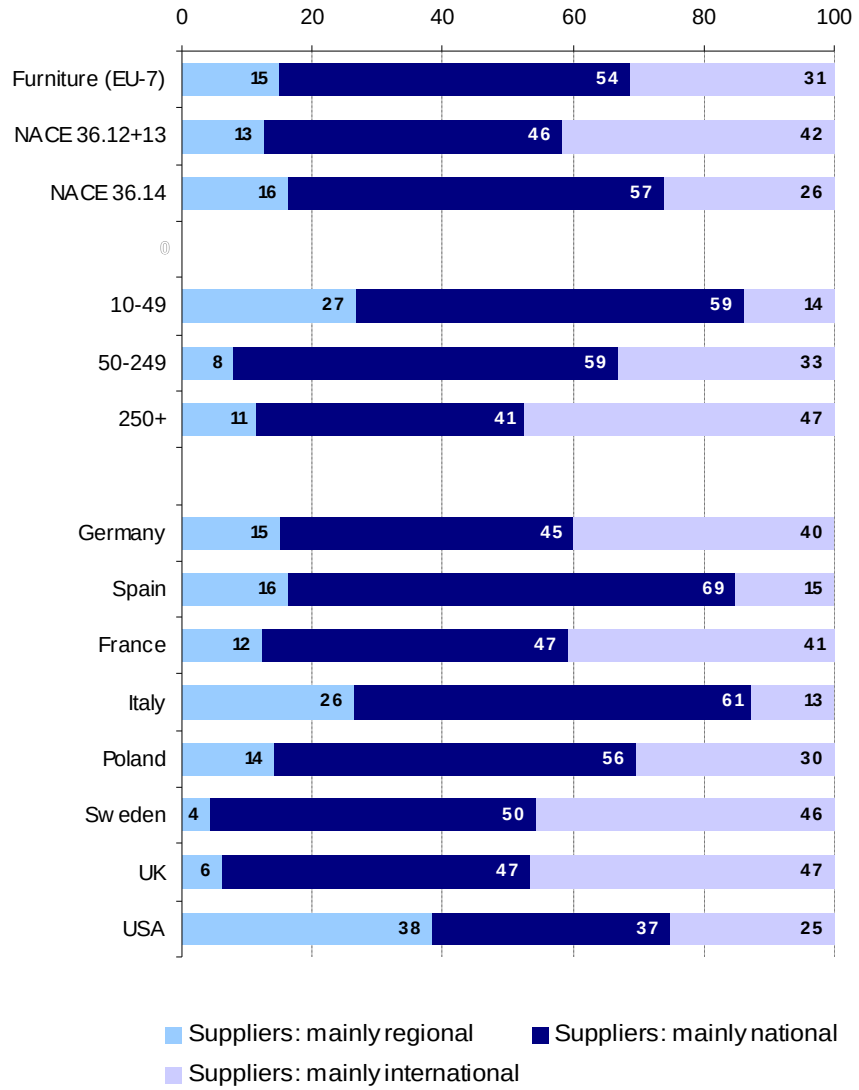
Questionnaire reference: G4a, G4b, G4c

Source: e-Business Survey 2007 by the SeBW

The results indicate the market areas addressed by European firms vary remarkably by country, size class and sub-sectors. In the furniture industry, companies representing 41% of total employment operate mainly at an international level and companies representing 45% of total employment operate mainly at a national level. Overall the degree of internationalisation is lower in comparison with the other manufacturing sector as both in the Chemicals and in the Steel sector over 50% of companies operate mainly at an international level. However, considering the type and nature of the products, these data indicate that internalisation of markets is taking place especially in the "other furniture" sub-sector. Medium and large companies operate mostly on a national and an

international scale. Only 9% of medium-sized companies have their main market in the region where they are based and practically none of the large companies interviewed. The regional scale of small companies (32% operate mainly at a regional level) is possibly related to their activity as sub-contractors of larger groups. The situation by country reflects the international competitive positioning. Germany, Italy and Sweden (with Ikea) are leaders on the main international markets; the international attitude of Poland -62% of companies based in this country mainly operate on the international market- is explained by the high share of subcontracting activity. Spanish and French companies are more focused on the domestic market (only 4% of companies are active on an international level).

Exhibit 2.2-11: Percentage of firms which procure mainly from regional, national or international supplier base (2007)



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

Base (100%) = all companies excl. those saying "don't know". N (Furniture, EU-7 and USA) = 750.

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

Questionnaire reference: G5a, G5b, G5c

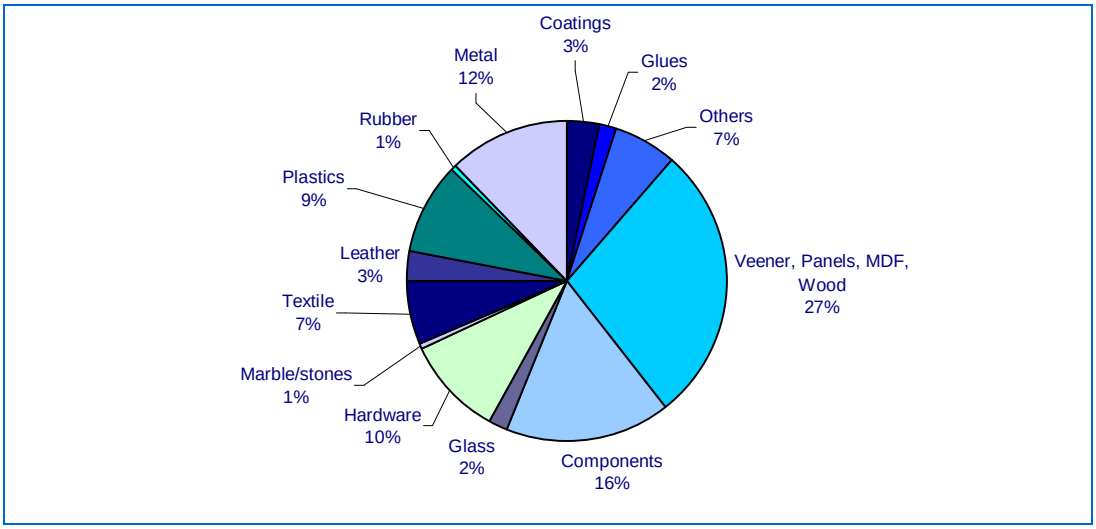
Source: e-Business Survey 2007 by the SeBW

Exhibit 2.11 illustrates the geographical scale of procurement in the furniture manufacturing industry. Again, it is the breakdown by country that provides the most interesting insights. While Germany, Sweden, France and UK have expanded abroad the range of suppliers, Italy and Spain rely mostly on the domestic side.

EU furniture industry: main sub-sectors

The furniture manufacturers are often specialised in one type of furniture and the various types of furniture are made with different materials, as shown in the following exhibit. Wood and wood-related[23] products are the most important type of material used in this industry.

Exhibit 2.2-12: Types of materials used in the furniture manufacturing materials



Source: *UEA 2006*

The largest sub-sector of EU furniture production is the upholstered furniture industry (16% of production value or 13.1 billion Euros in 2003[24]), followed by the kitchen furniture sector (13% or 10.6 billion Euros) and the office furniture sector (10% or 8.9 billion euros).

Office furniture accounts for about 10% of the total industry production and for a higher share of the total value added. Firms operating in these market segments are, generally speaking, more advanced as for the usage and exploitation of production technologies and ICT for business process automation. They operate at an international level more often than their counterparts from the other industry sub-sectors.

Home office furniture consumption has been rapidly growing in recent years. During the late 1990's there has been across Europe a rapid expansion of flexible, remote and tele-work practices, coupled with PC penetration in the home. This has created growth opportunities for home office furniture. This is also leading to an unprecedented convergence between traditional office furniture markets and the suppliers of domestic household furniture.

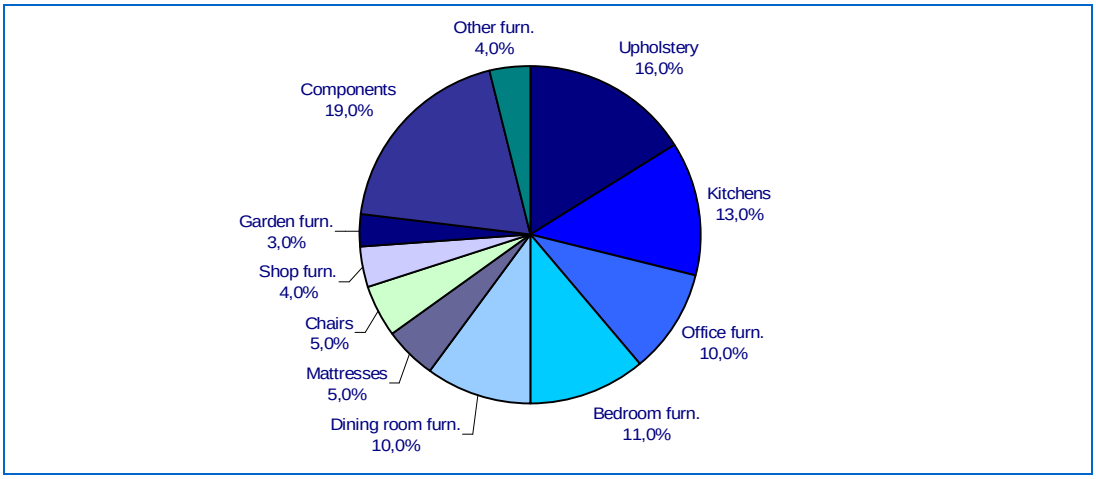
[23] MDF is an acronym for Medium Density Fiberboard, also known as particleboard. A manufactured material made essentially of glue and sawdust, the material has a weight and strength similar to real wood but there are many differences.

[24] 2004 data about types of furniture are not available.

The **kitchen** furniture industry is also quite advanced from a technological point of view, however this industry is highly fragmented, product differentiation per country is high (different standard measures of modules, e.g.), therefore it remains mostly a national industry.

The **upholstered furniture** industry is generally less advanced in technological and organisation terms and the average size of operating firms is smaller than in the other sub-sectors.

Exhibit 2-13: Types of furniture produced in EU, 2003 (in % of production value)



Source: *UEA 2006*

An important distinction in the furniture industry is made between domestic furniture, which is produced for the home and sold through retail outlets, and **contract furniture.** The latter addresses commercial and corporate markets. The most important difference between domestic and contract furniture markets is in the distribution channels utilised to bring the products to market. The contract furniture sector is also more recipient toward e-business applications, including e-procurement.

The distribution structure

The production of furniture and the distribution of furniture are usually carried out by separate firms. Even if some manufacturers have their own distribution network –this is an increasing trend especially among large manufacturers- or directly sell to the consumers, the large majority of them sells their products to retailers (specialised in furniture or not) who reach the final consumers.

It is estimated that there are about 100,000 outlets distributing furniture in the European Union and employing almost 600,000 persons[25].

The total furniture retail market is estimated at 100 billion euros. This amount represents 3.5% of the total consumption of households[26].

[25] Source UEA 2006.

[26] Source UEA 2006.

Distribution of furniture is more concentrated (especially in the Northern part of Europe) than the furniture industry. While retailing in France, Germany and the UK mainly consists of large multi-store outlets, in Italy most furniture is sold in small independent outlets.

With the exception of the Swedish company Ikea and some German and French groups, distribution of furniture is hardly ever carried out on a European scale. Distributors who are making a part of their turnover in other countries than their own are scarce.

Stocks are limited and costs related to stock management are often borne by the furniture manufacturers. Competition in the retailing business is strong and takes three forms: direct between specialised retailers, indirect from other distribution channels and induced because of other services and goods.

Exhibit 2.2-14: EU breakdown of furniture stores, 2006 (% of sales) (EU-25)

Type of furniture store	% of sales
Small and medium-sized independent furniture retailers	27
Large scale furniture retailing	20
Direct sales	7
Do It Yourself retail stores	5
Departments stores (i.e. non-specialised)	4
Supermarkets (i.e. non-specialised)	3
Mail-order sales	4
Retailers affiliate to buying groups[27]	30
Total	**100**

Source: *UEA 2006*

Specialists are emerging, department stores are keeping their position, and independent retailers continue to decline. Retailers increase their demand towards manufacturers to provide more direct support in terms of service, display, discounts and even home delivery, without allowing them extra margin, driving manufacturers to take cost out of the distribution chain.

The internet has added another dimension in distribution; manufacturers have to maintain consistent pricing and control at retail level.

Overall, the distribution of furniture within the **contract sector** is dominated by direct supply to end-users. However, depending on the end-user, the distribution channel may change. For example, the tourism and leisure industry is more likely to use architects, interior designers, contract furnishers and hotel buying groups. In addition, the healthcare and education sectors both tend to use central buying groups and increasingly rely on e-procurement and auctions.

[27] Retailers that join together in order to negotiate lower prices when purchasing goods and services.

2.3 Trends and challenges

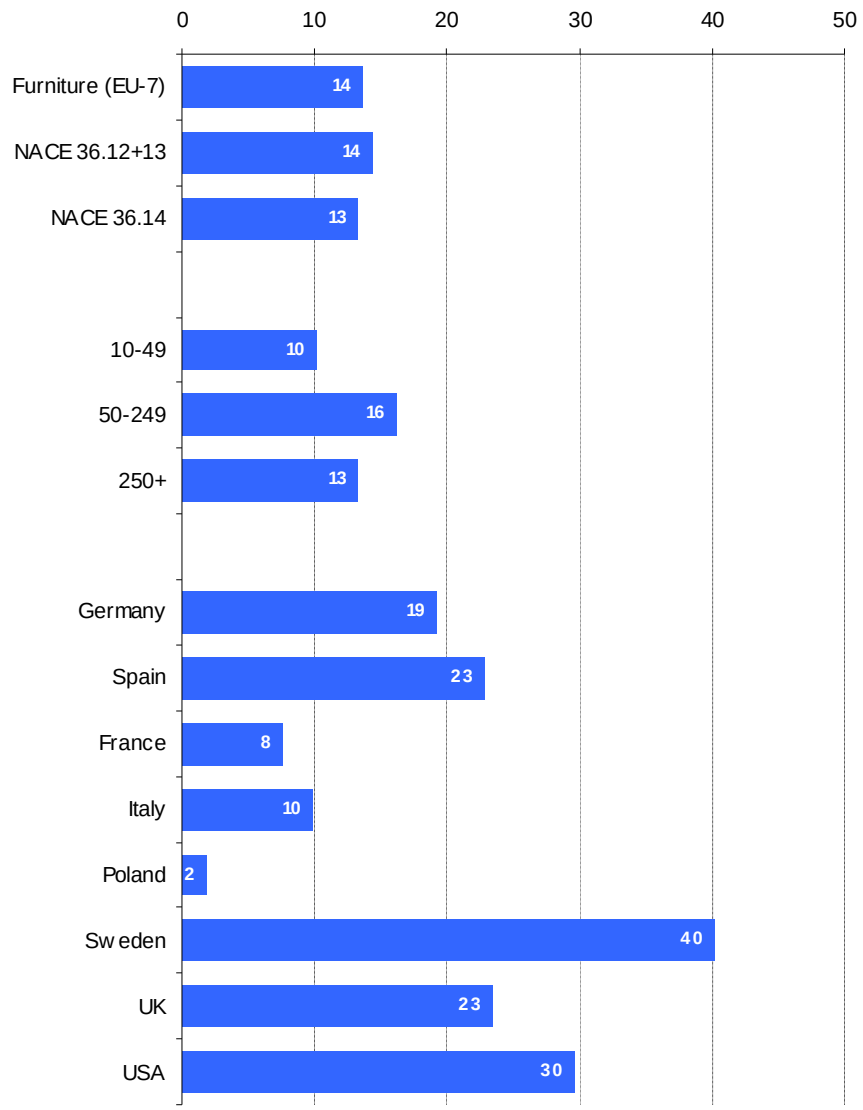
Industry trends

There is a concentration process in the furniture industry. Furniture manufacturers are investing for expanding their activities either by extension of existing plants or creation of new plants or purchases of existing enterprises. In general, the average size of the firms is increasing. Differences in market positioning and strategy remain across the main producing countries. In Germany, for instance, the largest enterprises have invested in Polish enterprises, where labour costs are lower than in Germany. In Italy, strong co-operation exists between small entrepreneurs in the area of, for example, design, marketing, production. Moreover, small enterprises often act as sub-contractors for larger firms (they produce components, semi-finished products or finish or assemble furniture). This results in great flexibility.

In the SeBW Survey on manufacturing, firms were asked whether they had outsourced any business activity in the past twelve months. Exhibit 2-15, illustrates the results. The propensity to outsource business activities is quite low: companies representing only 14% of the sector employment have outsourced business activities. Overall, there are no significant differences across sub-sectors and size classes. The breakdown by country, instead, is quite varied. Sweden, likely under the Ikea's effect, shows the highest attitude to outsourcing. In Poland, outsourcing is hardly ever practiced, as this country is home to many third parties companies.

Furniture manufacturers are increasingly **investing in automation and ICT,** in order to standardise their production, especially in the kitchen and office furniture industry. This requires large amounts of capital that may be more easily collected by large firms than by smaller ones. Nonetheless, there are often difficulties in implementing the most ambitious projects of advanced manufacturing because of the problems arising when very complex technologies require organisation changes and are to be managed by knowledge workers.

Exhibit 2.2-15: Firms having outsourced business activities in the past 12 months in % (2007)



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

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

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

Questionnaire reference: G22

Source: e-Business Survey 2007 by the SeBW

Challenges

The broad range of offer and the increasing customisation of product lines, which are characteristic of the manufacturing of furniture, translate into operational and technological challenges that must be addressed, these include:

- **Increased product complexity**: changing market conditions dictate increased product line options, finishes, and rapidly changing fabric styles. Coordination across all departments is required to optimise the existing product lines and implement changes and new product lines as required.

- **Reduced lead times**: competitive pressures have forced the overall order fulfilment lead times to be reduced. The actual production lead times are a small part of this overall lead time and relatively constant, forcing attention to other upstream and downstream areas of the business for reductions and efficiencies (see section 3.2 Supply Chain Management).
- **Sales automation:** increased access to technology within the customer base has put pressure on furniture manufacturers to provide automated tools to configure and price products, as well as provide visualisation of the products with dynamic graphics and layout utilities. The ability to deliver and support this type of automation requires specialised applications and skill sets that may not be currently available within the organisation.
- **Access to business information**: manufacturers face the challenge of long lead times for raw materials and short lead times for finished products. In order to effectively address this, access to current and historical business information to drive forecasting and material planning is critical
- **Technology Integration:** technology improvements throughout the supply chain have placed an increased demand on the availability and access to business information and to enhanced integration across multiple platforms. Legislation and environmental concerns

The main environmental EU Directives which directly affect the furniture industry are industrial emissions – Integrated Pollution Prevention and Control (IPPC, currently being revised[28]), Volatile Organic Compounds (VOC[29]), and waste (Packaging and Packaging Waste[30]). EMAS[31] schemes are already used in the sector and wooden furniture industry is being considered for a Community eco-label[32].

The impact of such regulation on the European furniture industry is relevant in terms of costs, arising because the more environmentally friendly solvents and varnishes are less effective and more expensive, and add to production time. This clearly poses a challenge towards those imported products that are not subject to the same controls. However, environmental-friendly and green design products are becoming part of the marketing strategy of EU furniture manufactures as a response to an increasing consumers' request for the responsible usage of materials, combining social needs and responsibility.

Adaptation to changing demand

Demand for furniture is influenced by a number of factors, including the economic climate, demographic changes, international trends and consumer lifestyles. This industry is particularly sensitive to the overall economic performance. People tend to spend money on furniture when they move or redecorate their homes. This is also true for the contract furniture market, where economic confidence is reflected in refurbishment and new building projects in hotels, public buildings, retail shops and commercial property. If

[28] http://ec.europa.eu/environment/ippc/ippc_review_process.htm

[29] http://ec.europa.eu/environment/air/stationary.htm#3

[30] http://ec.europa.eu/environment/waste/index.htm

[31] The Eco-Management and Audit Scheme (EMAS) is the EU voluntary instrument which acknowledges organisations that improve their environmental performance on a continuous basis.

[32] http://ec.europa.eu/environment/ecolabel/index_en.htm.

the economy is performing well, this is usually reflected in the housing and construction sectors, which has a positive effect in the furniture sector.

Demographic changes, including declining birth rates and growth in the middle age and older population bands, affect types of housing and furniture required. Smaller families, later marriages and single person households, combined with working from home trends and more frequent eating out, are presenting challenges and opportunities for furniture manufacturers.

Consumer awareness of furniture design and interest in home decoration and improvement are also important driving forces for this industry. In European countries, the strong general interest in DIY and home improvement, as well as in environmental issues, has produced a more informed and aware furniture consumer. The role of e-business in supporting furniture firms to address changing demand mainly relies in the possibility to provide additional information channels to intermediaries and consumers (see e.g. the case studies about IWOfurn and Webmobili in Section 5). e-Business also provides means for direct communication with customers for product development and productions, such as tools for the visualisation of products at the point of sale (see case study about Danona in Section 5.1).

Innovation

Furniture being a mature industry, innovation is crucial to sustain market growth. Innovation in the production processes in the furniture industry can be sub-divided in two types:

- *Innovation that is required by competitiveness and the reduction of costs*. This includes automation of business processes, integration with business partners, the use of Computer Aided Design or Manufacturing (CAD-CAM) and the introduction of new materials that are more resistant or cheaper than previous ones. Use of the internet and development of e-business are also important means to reach and provide services to new market segments.
- *Market led innovation*. The European furniture industry is today a mature sector where companies find it difficult to sustain a significant level of growth. This means that they have to pursue innovation strategies based on creativity, quality and differentiation of products. The concept of differentiation includes not only the quality/price logic, but is more and more associated with other attributes such as design, style and utilitarian functions. This means an innovation guided by the market and the consumers. Design and the change of forms are the most important paths for product innovation. Use of new materials may be asked by the consumers (fabrics for upholstered furniture, recyclable materials, etc.) or environmental concerns of the consumers (safety, health, etc.) may lead to changes in the production processes (for instance use of coating without solvents, etc.).

Section 3.6 provides the results about innovation in the furniture sector as highlighted by the CATI Manufacturing Survey 2007.

The market seen by the interviewees

The perception of market characteristics, as expressed by the interviewed companies is illustrated in the following tables, based on the SeBW Survey on manufacturing (2007).

The firms' perception is that rivalry in the market is increasing: nearly 70% of companies agree on this statement, with only minor differences across size bands and countries. Among the other factors that impact on competition, fluctuations of the demand and technological changes are the most important; furniture firms, nearly unanimously, think that the demand is not predictable. Companies active in the "other furniture" sector are the most concerned about the threaten of new entrants, possibly because this is the sub-sector where international competition is harder. The issue of quick obsolescence of products and services is not particularly critical, with the exception of companies based in Italy. A possible explanation for this exception is that these companies are active in the higher marker segments where continuous innovation is required.

Perceptions expressed by the interviewees about the market characteristics are in line with the considerations made above in this section about the main trends and challenges: furniture firms operate in a highly competitive, quickly changing and hardly predictable context and seem to have limited knowledge on how to control their competitive environment. It is an open question and a possible suggestion for policy recommendations, whether ICT and e-business may have a role in supporting firms in . managing and exploit their knowledge for enhancing their competitive positioning.

Exhibit 2.2-16: Furniture market characteristics

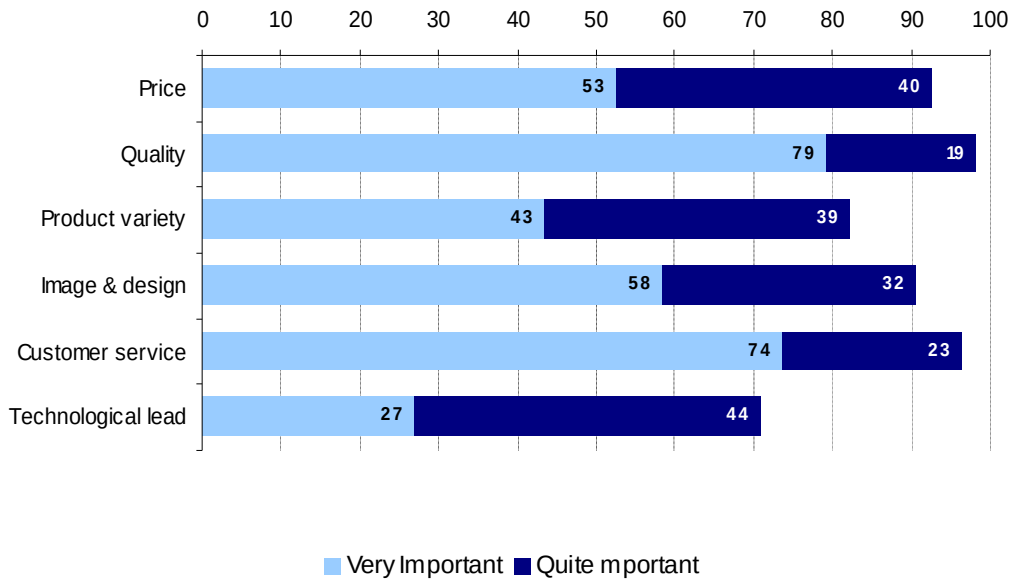
	Companies which agree that their…					
	competitors' actions are not predictable		**market position is threatened by new entrants**		**production technologies change rapidly**	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**45**	**52**	**39**	**46**	**52**	**55**
NACE 36.12+13	49	54	29	34	52	62
NACE 36.14	43	52	44	51	52	53
Furniture – by size (EU-7)						
Small (10-49 empl.)		54		48		56
Medium (50-249 empl.)		44		40		54
Large (250+ empl.)		(34)*		(36)*		(40)*
Furniture – by country						
Germany	49	59	31	33	34	43
Spain	51	51	54	58	58	59
France	31	46	76	62	34	48
Italy	54	59	61	59	57	62
Poland	37	46	21	22	61	63
Sweden	(29)*	(32)*	(37)*	(40)*	(42)*	(55)*
UK	48	46	26	34	60	41
USA	32	40	29	41	38	42
Other sectors (EU-7)						
Chemicals	44	48	38	49	40	41
Steel	24	41	31	36	40	37
Base (100%)	all firms		all firms		all firms	
N (2007, EU-7+USA)	761		761		761	
Questionnaire reference	G8a-a		G8a-b		G8a-c	

Exhibit 2.2-16 (continued)

	Companies which agree that their…					
	products and services become quickly obsolete in their market		market demand is not predictable		rivalry in the market is increasing	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	30	36	54	63	68	69
NACE 36.12+13	29	36	47	57	70	64
NACE 36.14	31	36	58	65	67	71
Furniture by size (EU-7)						
Small (10-49 empl.)		38		65		68
Medium (50-249 empl.)		29		55		72
Large (250+ empl.)		(26)*		(44)*		(66)*
Furniture – by country						
Germany	31	26	69	71	80	67
Spain	31	33	52	59	77	76
France	23	29	42	56	86	80
Italy	53	58	66	71	65	65
Poland	17	23	50	57	64	79
Sweden	(27)*	(26)*	(39)*	(46)*	(74)*	(56)*
UK	27	21	39	53	49	50
USA	25	18	41	53	65	54
Other sectors (EU-7)						
Chemicals	24	25	42	54	71	72
Steel	12	17	51	54	69	65
Base (100%)	all firms		all firms		all firms	
N (2007, EU-7+USA)	761		761		761	
Questionnaire reference	G8a-d		G8a-e		G8a-f	
The survey was conducted in seven EU Member States (Germany, France, Italy, Spain, Poland, Sweden, United Kingdom) and in the USA.						

Source: e-Business Survey 2007 by the SeBW

Exhibit 2.2-17: Percentage of firms which say that following characteristics are quite or very important for competition(2007)



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

Base (100%) = all companies excl. those saying "don't know". N (Furniture, EU-7 and USA) = 750.

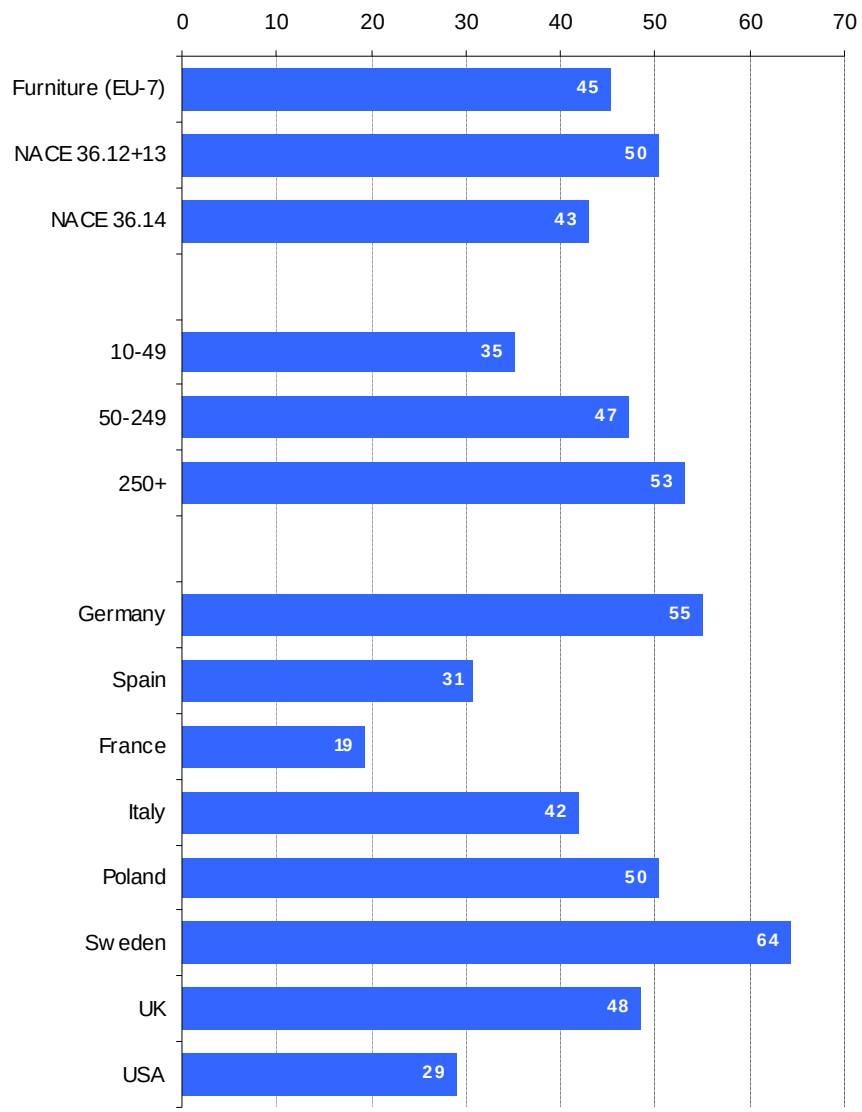
Figures for total sector. Questionnaire reference: G8b

Source: e-Business Survey 2007 by the SeBW

Quality of products and customer service are the most important requirements to face competition. These considerations are consistent with other results form the SeBW survey and from case studies, indicating that furniture firms are quite active in product and process innovation and in customer service initiatives, especially at the point of sale. Interestingly, image and design are considered more important than technology lead. Furniture firms seem still more concerned about aesthetic concepts rather than about the skilled use of technical tools. This finding may lead to the conclusion that effort should be done in order to better exploit synergies between these fields (see Section 6).

Finally, the interviewees were asked to indicate how they perceive the importance of ICT for competition.

Exhibit 2.2-18: Percentage of firms saying that ICT has an influence on competition in their sector (2007)



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

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

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

Questionnaire reference: F4

Source: e-Business Surveys 2007 by the SeBW

It appears that less than half the companies think that ICT has a relevant influence on competition in this sector. The share slightly increases among large firms and in some countries, but overall, this picture highlights the fact that ICT and e-business are not a priority. Issues related to global competition, changing demand, product and process innovation are definitely more direct concerns than ICT and e-business adoption. This perception is fully in line with the overall findings of this study, for which furniture firms generally adopt a very selective and pragmatic approach. ICT and e-business are hardly ever the core of business strategy in this sector, more often they represent the tactical mean to address specific needs in process management.

3 Deployment of ICT and e-business applications

The main objective of this chapter is to provide a up-to-date description of the state-of-play in e-business in this sector and to outline major developments in the framework conditions for ICT usage. This broad picture of sectoral e-business activity is the basis for a more analytical assessment on drivers and impacts of ICT adoption presented in Chapter 4. The presentation of the empirical evidence has been structured into the following main themes:

- **Access to ICT networks & endowment with basic infrastructure:** Section 3.1 looks at companies' access to ICT networks and their endowment with basic infrastructure. The objective is to assess the sector's overall "e-readiness", i.e. the basis for doing business electronically.
- **ICT and e-business for design and modelling of new products and integration with manufacturing and marketing & sales.** Furniture manufacturers face many challenges when designing and modelling new products, these include the difficulty in exchanging the information with the shop floor as well the supply and sales chain. Advanced 3D modelling tools have demonstrated tremendous potential for improving the efficiency of generating product information needed for the production of furniture pieces. Now the key is not only to increase the efficiency of the generation process, but to link this information with the product data workflow through the development and manufacturing process. The study provides an overview of the main applications for integrating design and production. The CATI Manufacturing Survey 2007 assesses the level of uptake and the impacts of these applications. The study provides examples of innovative companies, such as those implementing green[33] design of environmentally and ecologically friendly materials and processes.
- **ICT for value chain integration and process efficiency** (Section 3.3). The EU furniture industry is an assembling industry, firms' activity is generally organised around a network of third parties and business partners, suppliers of raw materials are often very concentrated and the incidence of material and service cost on production value is quite high. Even slight improvements of efficiency in the supply chain management produce significant cost savings. Therefore improving the efficiency of production and supply chain processes is a key objective. However, the potential for improvement is not the same for all players involved and the degree of exploitation of the potential advantages may vary remarkably across sub-sectors, size and country. This section analyses how ICT are used to improve business processes in the value networks of the furniture industry sector.
- **ICT potential for sales and customer service** (section 3.5). This section presents evidence that marketing and customer service is becoming a major focus of e-business activity even in traditional manufacturing sectors, notably in the context of global competition. The European furniture sector is witnessing an increasing complexity and concentration of distribution. As many of the business customers operate through central purchasing organisations at the EU level, small furniture producers risk to be excluded due to their insufficient supplying capacity. As

[33] Including design for waste prevention in the first place and design for better materials management facilitates the handling of products at the end of their service life.

regards e-business applications in marketing and sales, attention has been given to those solutions that can enhance customer service at the point of sale, such as tools to configure and price products, as well as provide visualisation of the products with dynamic graphics and layout utilities.

- Finally, the chapter investigates the role of **ICT for product and process innovation**.

3.1 Basic access to ICT networks and skills

This section looks at companies' access to ICT networks and their endowment with basic infrastructure in 2007. The objective is to assess the sector's overall "e-readiness", i.e. to what extent the basic ICT infrastructure for doing business electronically is in place.

Internet access – the deployment of broadband

Practically all companies (99%) from the furniture sector with at least 10 employees are connected to the **internet** (see Exhibit 3.1-1), similarly to the other manufacturing sectors analysed, chemical and steel.

The share of employees with **internet access** is an indicator for the "informatisation" of work and production processes in manufacturing. In the furniture sector where traditional, manual work is still important, fewer workers need ICT to perform their tasks, only 24% of firms corresponding to 26% of employment in the sector reported that their employees have access to the internet, . In other sectors, notably in chemical by contrast, ICT are increasingly used to manage and control production processes (36% of firms accoounting for 45% of employment).

This degree of informatisation in work processes does not change significantly with firm size. In larger firms, the share of employees with internet access is relatively low (25%) as the organisation of activities does not require the usage of ICT by employees in charge of most of production operations; in medium firms, in contrast, the blurring boundaries among different companies functions account for the slightly higher (29%) usage of the internet among the workforce.

The quality of companies' internet access is fairly good, notably among SMEs. The share of small firms (with 10-49 employees) that say they are connected with **broadband**[34] was 37%in 2007. Broadband adoption in the furniture sector is in line with the other manufacturing sectors (40% and 41% for chemicals and steel respectively).

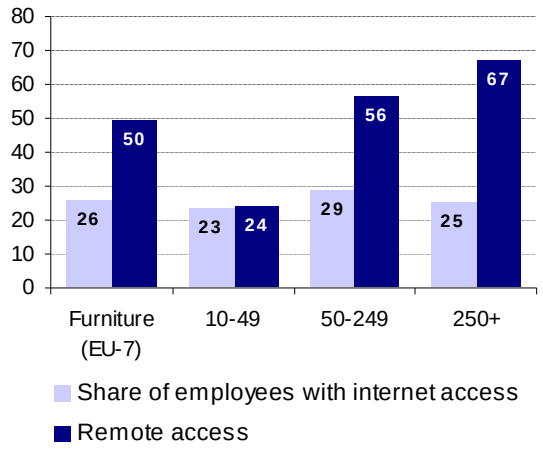
[34] Broadband has been defined in this study as internet connection with a bandwidth of at least 2 Mbit/s.

Exhibit 3.1-1: Internet access (2007)

	Companies with internet access		Average share of employees with internet access in firms		Companies with internet access >2 Mbit/s	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**100**	**99**	**26**	**24**	**46**	**39**
NACE 36.12+13	100	100	33	29	44	46
NACE 36.14	99	99	23	22	47	36
Furniture – USA	**99**	**98**	**33**	**46**	**71**	**67**
Furniture – by size (EU-7)						
Small (10-49 empl.)		99		23		37
Medium (50-249 empl.)		100		29		42
Large (250+ empl.)		100		25		54
Other sectors (EU-7)						
Chemical	100	99	45	36	46	40
Steel	100	100	30	24	34	41
Base (100%)	all		A1 = 1, excl. DK		A1 = 1, excl. DK	
N (Furniture, 2007, EU-7+USA)	761		749		586	
Questionnaire reference	A1		A2		A3c	
The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.						

Source: e-Business Surveys 2007 by the SeBW

Exhibit 3.1-2: Internet access and remote access to the company network(2007)



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

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

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

Source: e-Business Survey 2007 by the SeBW

Another good indicator for "e-readiness" is the share of companies that enable **remote access** to their computer network. This means that employees can access data from a company's network remotely, e.g. when working from home or travelling. In the furniture

sector, remote access is available to about 50% of the sector's employees. Diffusion of remote access is only 24% in firms with 10-49 employees but raises up to 56% in firms with 50-249 employees and to 67% in firms with 250 or more employees. The practice of remote access to company network is probably related to the diffusion of PDAs, mobile phones, laptops and other portable devices, in combination with developments in Wi-Fi technology, especially among the sales force, which is usually numerous and widely distributed over the territory. Currently, these systems are mostly used by large enterprises. However, companies of any size can take advantage from this kind of applications as they increase flexibility and shorten supply chain processes.

Use of internal networks

The use of ICT to connect computers internally to a company network (Local Area Networks – **LAN**) is quite diffused, even for small firms, 67% of which use this technology (see Exhibit 3.1-3). The diffusion of **Wireless LAN** (W-LAN) technology has surged in recent years across all the sector analysed in the e-Business Watch. Currently, almost half (47%) of employees in the furniture sector work in companies that operate a W-LAN. In large firms, the adoption rate has reached 66%. The increasing importance of wireless technologies and internal mobility in this industry is driven by the type of organisation of activities: cooperative projects for the development of products, sales people accessing data off the internet or from the corporate database for commercial purposes, usage of wireless devices for trade shows and fairs, where inherent mobility and easy setup are strong assets.

Exhibit 3.1-3: Internal networks used (2007)

	LAN		W-LAN		Website		Intranet	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**84**	**71**	**47**	**30**	**87**	**79**	**45**	**31**
NACE 36.12+13	84	72	54	34	94	88	50	32
NACE 36.14	84	70	44	28	83	75	43	30
Furniture – USA	**91**	**83**	**68**	**47**	**87**	**91**	**45**	**46**
Furniture – by size (EU-7)								
Small (10-49 empl.)		67		25		76		26
Medium (50-249 empl.)		89		52		92		51
Large (250+ empl.)		100		66		93		63
Other sectors (EU-7)								
Chemical	95	82	58	38	89	84	69	43
Steel	94	78	49	30	90	79	71	36
Base (100%)	all		all		all		All	
N (Furniture, 2007, EU-7+USA)	761		761		761		761	
Questionnaire reference	A4a		A4b		A4c		A4d	
The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.								

Source: e-Business Surveys 2007 by the SeBW

ICT skills requirements

Nearly 20% of firms employ ICT specialists; only 9% reported that they experienced difficulties in recruiting qualified resources in this area. There are no differences across

size classes. The findings indicate that the shortage in ICT skills is not an issue in this sector. Interestingly, 64% of firms –and 61% of small companies- have made ICT investments in the past 12 months.

Exhibit 3.1-4: ICT skills requirements and investments (2007)

	Employ ICT practitioners		Have experienced difficulties in finding qualified practitioners		Say that e-business has a significant impact on skills requirements		Have made ICT investments in past 12 months	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**33**	**18**	**7**	**9**	**53**	**39**	**75**	**64**
NACE 36.12+13	26	19	4	6	54	37	80	74
NACE 36.14	36	17	8	10	53	40	72	60
Furniture – USA	**11**	**16**	**48**	**7**	**29**	**31**	**46**	**48**
Furniture – by size (EU-7)								
Small (10-49 empl.)		13		12		35		61
Medium (50-249 empl.)		39		4		53		77
Large (250+ empl.)		49		7		75		87
Other sectors (EU-7)								
Chemical	45	22	21	15	40	36	83	72
Steel	52	24	20	5	36	28	85	70
Base (100%)	All		E1=1		All		All	
N (Furniture, 2007, EU-7+USA)	761		152		761		761	
Questionnaire reference	E1		E3		E5		E9	
The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.								

Source: e-Business Surveys 2007 by the SeBW

3.2 Integrating new product design with manufacturing, marketing and sales

3.2.1 Introduction to product design issues

In the furniture industry, design of new products is a complex process that involves a synthesis of elements related to comfort, aesthetics and resistance. Furniture manufacturers face many challenges when designing and modelling new products, these include the difficulty in exchanging and sharing information with the shop floor, as well as with business partners, along the supply and sales chain. In addition, issues concerning sustainability and green design are becoming a very important part of the furniture design and production process. This is due both to regulation and to the need for a more responsible usage of materials, combining social needs and responsibility with a creative interpretation of contemporary aesthetic concepts and the skilled use of production methods.

The use of integrated, ICT-supported furniture design procedures can be a real competitive advantage in this sector, where most designers have an aesthetic rather than a technical background.

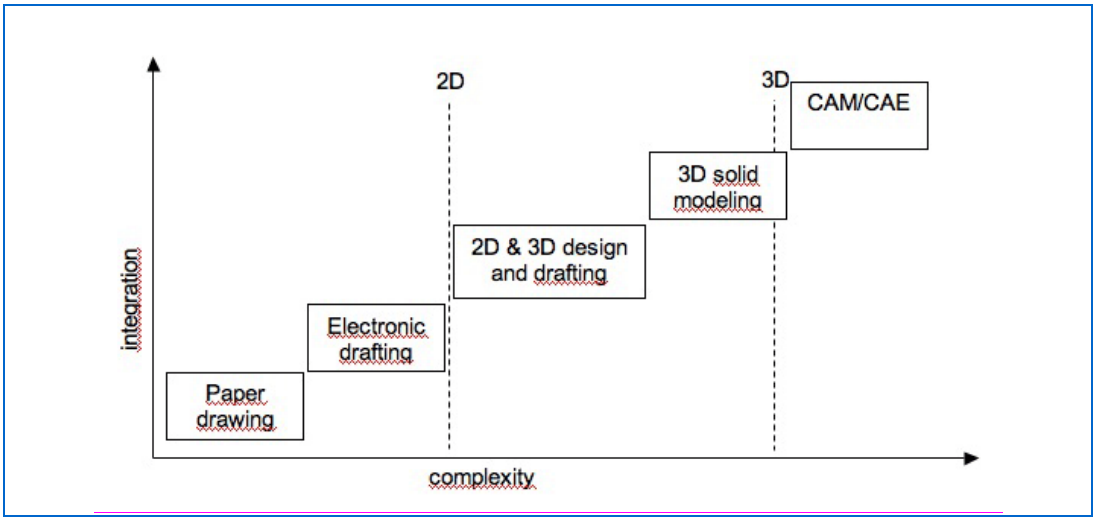
Different levels of integration can be achieved through design and production. Computer-aided Design (CAD) and Computer-aided Manufacture (CAM) are two of the most commonly used computer-based tools in use in this industry. Increasingly, CAD/CAM has come to mean not only graphic-based information, but also includes the integration and management of text and numeric-based information at an enterprise-wide level. In the field of design, computer-aided engineering (CAE) is increasingly important. CAE are computer systems that analyze engineering designs. Most CAD systems have a CAE component, but there are also independent CAE systems that can analyze designs produced by various CAD systems. CAE systems are able to simulate a design under a variety of conditions to see if it actually works. The evolution of software applications in the field of design and engineering has led to complex green design production systems, including eco-design[35] tools.

3.2.2 ICT-enabled integration of design and production

CAD in the furniture industry

A CAD system is a combination of hardware and software that creates and stores drawings, which can be viewed, printed, or updated as required. CAD systems have evolved from the days of their introduction; the graph below illustrates the evolution process from the 1970s onwards. From being able to merely develop flat two-dimensional drawings, CAD systems can now create dynamic and mathematically enriched three-dimensional (3D) models.

Exhibit 3.2-1:: Evolution of ICT tools for design and modelling



These systems enable companies to produce cost-effective and precise illustrations of physical systems, and are increasingly being adopted in the furniture industry[36].

Industrial designers utilise 3D software and CAD programmes to move from concept to production. Product characteristics specified by the industrial designer may include the

[35] Ecodesign means the systematic integration of environmental aspects into product design with the aim to improve the environmental performance of a product throughout its whole life cycle.

[36] Data about diffusion and usage of CAD applications will be presented in the Final Report on the Furniture Industry and will be based on the results of the CATI Manufacturing Survey 2007.

overall shape of the object, the location of details with respect to one another, colours, texture and aspects concerning the use of the product ergonomics. Additionally, the industrial designer may specify aspects concerning the production process, choice of materials and the way the product is presented to the consumer at the point of sale. Using 3D software and CAD programmes is also possible to give the final consumer a clear and appealing idea of how the furniture will appear on the premises, increasing his willingness to buy.

The introduction of 3D modelling tools, combined with parametrics and product database, can dramatically increase the efficiency in the product development process. Software tools may also improve the speed and accuracy in which product data is generated and communicated within the company, thus supporting the automation and integration of production processes. Moreover, ICT-based tools for design can integrate technical and engineering issues (including eco-design issues) that would be otherwise incorporated at a later stage in the design-engineering process.

However, the usage of 3D among smaller companies is still constrained by relevant barriers, including concerns about productivity. Being a more complex solution, 3D modelling, at least in the initial phase does not allow producing the required documentation for production as quickly as using 2D CAD methods. Other important considerations are the cost of the hardware and software, training costs and time requirements, and compatibility with current computer systems. The diffusion of such systems within smaller companies is related to the possibility to speed up the initial generation of product information through the use of 3D modelling tools, eliminating redundancy of information entry through better electronic data management and exchange, and reducing errors induced by the necessity of 'interpreting' 2D documentation.

Business example:

The use and implementation of CAD in the Swedish furniture industry

An example of CAD adoption by the furniture industry is given by a recent study conducted in Sweden. The study shows that more than half of all product-developing companies in the Swedish furniture industry are using CAD today, and an increasing number of companies are implementing it. The furniture industry has come rather far in the use of CAD, but it could be better at implementing the systems in a proper manner. This could be related to companies often not planning their implementation; accordingly, they do not examine issues like organisational needs and goals, what the tool might be used for, and the resources required. The study found that the following factors are involved in successful implementation: management support, realistic budgeting, selection of system and effective, company-specific training. Most CAD users are satisfied with their system and think that it fulfils their needs. Many of the difficulties referred to by respondents can be related to the implementation phase and could be avoided. In general, the furniture industry considers that CAD improves their product development work.

Source: "The use and implementation of CAD in the Swedish furniture industry", by Hagström Lina, Ritzen Sofia, Johansson Joachim; Forest Products Journal 2006, vol. 56, n. 1

The expected impacts of the introduction of these systems are increased agility in responding to customer demands for design changes, time to produce the necessary engineering information is more predictable, cost and quality control are more reliable and manageable.

Exhibit 3.2-2 and 3.2-3, from the CATI Manufacturing Survey 2007, confirm the high percentage of firms using CAD systems, with an average of 72% of firms; the access of employees to CAD systems varies according to company size, from 50% in small enterprises to 93% in large factories. The difference among NACE 36.12+13 and NACE 36.14 data is evident and is considered to be due to the different business orientation of the enterprises: NACE 36.12+13 – kitchen and office furniture - are more business-to business and contract-oriented, with the need to integrate a higher number of parts and design varieties in the production system, while NACE 36.14 companies are more customer-oriented. This difference will resurface also in the survey results concerning supply chain management systems.

Exhibit 3.2-2 Adoption of e-business software packages in the furniture industries – Part 1 (2007)

	PLM		CAD		2D modelling		3D modelling	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of empl.	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**9**	**5**	**72**	**55**	**48**	**30**	**51**	**37**
NACE 36.12+13	10	5	85	73	58	41	65	48
NACE 36.14	8	5	66	49	43	25	45	32
Furniture – USA	**11**	**6**	**68**	**60**	**37**	**34**	**26**	**31**
Furniture by size (EU-7)								
Small (10-49 empl.)		4		50		25		32
Medium (50-249 empl.)		7		79		47		56
Large (250+ empl.)		15		93		78		70
Other sectors (EU-7)								
Chemical	16	6	63	41	31	23	31	25
Steel	16	7	83	54	64	30	66	34
Base (100%)	all		all		all		all	
N (Furniture, 2007, EU-7+USA)	761		761		761		761	
Questionnaire reference	A7e		A10a		A10b		A10c	

PLM = Product Lifecycle Management; CAD = Computer Aided design
The survey of 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Source: e-Business Surveys 2007 by the SeBW

CAE in the furniture industry

Traditionally, designers and structural engineers, when confronted with a complex design task, tend to differ in the methods and tools they employ. Engineers attempt to divide a problem into parts and to make predictions for each, analysing the different parts separately, considering them as a system consisting of a set of well-defined parts. This is often done by use of Computer Aided Engineering (CAE) software. The designer, in contrast, attempts to grasp the problem in its entirety, viewing matters of structure, function and form as pertaining to the entire system. This difference in perspective could lead to much confusion in discussions between members of the two professions. An

innovative use of CAE software for facilitating communication enables professionals to handle both perspectives at the same time. CAE tools can also be used for testing the feasibility of various ideas and concepts prior to prototyping and production.

In other industries, such as airplane, automobile, mechanical and construction industry, sketching in connection with design often leads to a variety of potential designs that are analysed in terms of such aspects as deformation behaviour and strength, usually by means of computer programmes based on Finite Element Method (FEM). The results of such analyses can be visualised in terms of virtual two- and three-dimensional models. In the furniture industry, however, designing aids of this sort are used to only a limited extent, due to the structural mechanical characteristics of materials, parts and joints. In the case of wood, for example, the characteristics of the material are different in different directions. The modelling of glued joints is also an issue.

Although CAE systems in which geometric modelling, construction and manufacturing functions are integrated have been developed and are widely used in large-scale production, the designing of furniture traditionally takes the use of prototypes as a starting point when attempting to create new designs. The combining of IT tools for geometric modelling with the use of FEM analysis and visualisation would enable new furniture designing methods to be developed that would also facilitate collaboration with experts in the engineering sciences and in aesthetics in the designing of furniture. This way, work concerning matters of form, structure, strength and choice of materials could be integrated into a single process.

CAD-CAM and CAE integration

Computer Aided Manufacturing (CAM) systems assist in automating a manufacturing unit and include tools, such as real-time control and robotics. Most CAM systems use CAD drawings to produce the machine code required to manufacture the physical components depicted in the illustrations. Such systems are referred to as CAD/CAM systems and are very popular in the manufacturing industry. When integrated with CAE, they become CAD/CAM/CAE systems.

In the furniture industry, CAD/CAM software is also used in the manufacturing of wooden parts and bespoke, individual pieces, or for the mass production of items like cabinets or other decorated furniture, and often requires little knowledge of engineering or computing: together with sophisticated programmes aimed to large-scale production, there is software aimed at skilled artisans rather than engineers that allows woodworkers to import, scale, position and machine 2D and 3D decorations and textures onto their designs, in order to manufacture more distinctive and attractive products.

Developments in CAD/CAM have led to the creation of tools such as CNC machine control, parametric design, automated production documentation, 3D modelling, and advanced rendering. Computer-aided industrial design (CAID) is a subset of computer-aided design (CAD) that includes software that directly helps in product development.

Within CAID programmes designers have the freedom of creativity, but typically follow a simple design methodology that involves creating sketches, generating curves directly from the sketch and generating surfaces directly from the curves. The end result is a 3D model that projects the main design intent the designer had in mind. The model can then be saved to send it to a rapid prototyping machine to create the real-life model.

CAID helps the designer to focus on the technical part of the design methodology rather than taking care of sketching and modelling -- then contributing to the selection of a better

product proposal in less time. Later, when the requisites and parameters of the product have been defined by means of CAID software, the designer can import the result of his work into a CAD programme (typically a Solid Modeller) for adjustments prior to production and generation of blueprints and manufacturing processes.

The adoption of CAD, CAE and other ICT-based design systems leads to the production of a vast amount of files related to products and procedures: hence, the introduction of document management and knowledge management systems is paramount to an efficient use of integrated design (see Scavolini case study).

However, the CATI Manufacturing Survey 2007 data concerning CAE and CAM (see Exhibit 3.2-3) do not appear consistent with the CAD adoption percentage and the peculiarities of furniture manufacturing: this could be due to the high cost of CAM machine tools, not always affordable by micro and small enterprises that often rely on handcrafting; however, as the expert advisory board pointed out, part of the production is based on numeric control machine tools, that are not always considered by the companies as part of a CAM system.

More sophisticated systems, such as Product Lifecycle Management (Exhibit 3.2-2), seem to be limited to a small percentage of large enterprises – a finding confirmed in other manufacturing sectors such as chemical and steel production.

Exhibit 3.2-3: Adoption of e-business software packages in the Furniture industries – Part 2 (2007)

	CAE		CAM	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of empl.
Furniture (EU-7)	**11**	**8**	**26**	**20**
NACE 36.12+13	17	11	33	24
NACE 36.14	8	6	23	18
Furniture – USA	**21**	**22**	**26**	**17**
Furniture – by size (EU-7)				
Small (10-49 empl.)		7		17
Medium (50-249 empl.)		7		28
Large (250+ empl.)		16		35
Other sectors (EU-7)				
Chemical	18	8	31	16
Steel	21	9	30	15
Base (100%)	all		All	
N (Furniture, 2007, EU-7+USA)	761		761	
Questionnaire reference	A10d		A11a	

CAE: Computer Assisted Enfigineering; CAM = Computer Assisted Manufacturing
The survey of 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Source: e-Business Surveys 2007 by the SeBW

CAD-CAM integration increases the overall value chain efficiency

The use of ICT-enabled tools in the design process has strongly improved the efficiency of the engineering process in the furniture industry, and the introduction of CAD/CAM systems has often acted as a stepping-stone to a wider integration of the product information flow through the production process. However, even if many furniture companies have implemented CAD or CAM or both at some level (see Exhibit 3.2-3), there is a need for further information on how their current tools might be improved or

what other tools are available to enhance their impact. This kind of information is especially important for micro and small enterprises, where CAD/CAM is often the only kind of ICT-enabled tool being implemented in the production process.

Consolidation of information pertaining to CAD/CAM practices both from within and outside of the furniture industry could be used to provide both base level information on computer-based tools and recommendations for future directions.

Untapped potential for 3D modelling

Advanced 3D modelling tools have demonstrated tremendous potential for improving the efficiency of generating product information needed for the production of furniture pieces. This is a significant enabling tool in the case of outsourcing of design and production, an important trend nowadays in furniture manufacturing. The availability of consistent design and production data through all the workflow, independently from the location of the process itself, is fundamental for an efficient outsourcing procedure. The potential of e-business in this area is not the same for all players, though a deeper knowledge of these systems could enable small industries to get more sub-furniture orders.

The data from the CATI Manufacturing Survey 2007 show that the evolution from 2D to 3D modelling seems to be in progress, with a sizeable penetration of ICT-enabled systems both in small and large companies. Another interesting trend to be followed in the future is the application of concurrent engineering techniques to the implementation of green production in the furniture industry: concurrent engineering is a grouping of concepts and techniques aimed at reducing product cycle time, improving quality, and lowering cost. Computer technologies can be introduced into all facets of the design and manufacturing operation, allowing more efficient sourcing and use of raw materials, elimination of toxic substances and design for de-manufacturing, recycling and disposal of the furniture pieces.

3.2.3 Eco-design and sustainability in the furniture industry

Issues concerning sustainability and green design are becoming a very important part of the furniture design and production process. Even in a "traditional" sector such as furniture manufacturing, eco-sustainable manufacturing based on new products, new materials, energy efficiency and integrated design could be developed into a competitive advantage for European companies. Designing for sustainability is a process that goes beyond the designer's drawing block. It comprises aspects of design, procurement, manufacturing and product usage – a challenge to be addressed by all levels of an organisation. The goal is to design products in such a way that de-manufacturing and disposal of components are conceived since the very beginning of the design phase.

Methods and tools for assessing environmental sustainability

An accepted method for making environmental assessments is life-cycle assessment (LCA), a rather common tool in the manufacturing industry nowadays, although often said to be too complex and time-consuming. LCA is normally used by experts, and the results are seldom utilised in everyday product development work. There are also other approaches to assisting the designer, such as qualitative environmental assessment tools and Design for Environment (DfE) guidelines. These kinds of tools are very important for raising the product designer's awareness, but they also have limitations as far as actual

implementation is concerned. Life-cycle based environmental tools for product designers are based on CAD, PDM (Product Data Management) and LCA support tools, and give to the product designer an indication of the reason for and magnitude of environmental impact. The objective of these tools is to make product designers aware of how choice of material influences the environment, and how they, in their design work, might create more environmentally friendly products.

Actually, the best way to reduce pollution is to prevent it in the first place. Some furniture companies (such as Evertaut, whose activities are illustrated in the following business example) have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts, and are using this feature as a marketing plus, as consumers are increasingly opting for furniture solutions that combine quality, functionality and sustainable production values.

Business example:

Evertaut and the FISP programme

Evertaut, a small manufacturing company (12 employees) based in Blackburn (UK) that offers bespoke seating solutions to the theatre, office, and education sectors, joined the FISP (Furniture Industry Sustainability Programme) of FIRA[37] International.

FISP membership requires the compliance with two core commitments, environmental policy and legal compliance, and the implementation of at least five of: environmental management systems; waste, energy, packaging and transport management, procurement policies including environmental and social issues, sustainable timber purchasing, air emissions and end-of-life procedures. Furthermore, companies must comply with at least two of six social and economic commitments: nuisance management, community relations, education and training, employment, charity work and competitiveness.

The environmental policy applies to all of Evertaut's activities, including import of raw materials and components wood machining, assembly of timber frames and components, surface coating, upholstery and delivery of products to customer.

Evertaut is implementing an environmental management system; the waste produced is in small amounts and not of the hazardous type. Energy consumption in the factory is closely monitored, such as the volumes of packaging used; pallets are recycled and cardboard reused whenever possible. The company has a procurement policy within its quality system and this includes environmental and social issues. All timber and wood based product suppliers are asked to provide policy statements. Most suppliers are EU based, although the company is aware of some products coming indirectly from the Far East. Recyclable products are purchased wherever feasible. The company has identified its main emissions to air as VOCs from use of solvents. These emissions are monitored for health and safety reasons and for local authority requirements. Any furniture returned to the factory for reasons such as damage is reworked or remanufactured wherever practicable. However, less than 1% of product is returned. The

[37] FIRA is an association for research in the furniture industry. Information available at www.fira.co.uk/

company also offers a CAD layout service, enabling the clients to visualise the items in situ before committing to an order.

Source: FIRA/FISP case study; Evertaut website (http://www.evertaut.co.uk/)

"Green" movements in architecture and interior design, together with accompanying innovations in technology, have changed the way in which architects and clients select furniture. Many producers are now basing most of their communication on the environmental characteristics of their products: an example is provided in the following business example.

Business example:

Green marketing in office furniture

The American Steelcase, one of the world main producers of office furniture, is strongly basing its communication on green issues, touting the environmental benefits of its chairs and workstations in everything from print ads to product literature.

The Steelcase manufacturing facility in Sarrebourg, France, achieved in 1998 the ISO 14001 certification from the International Standards Organisation, and today recycles 80% of its waste.

Last year, Steelcase created product environmental profiles for each of its major furniture lines that tell customers how much recycled content is in each product, what certifications it has achieved and other environmental information. Independent groups have certified that its products don't harm indoor air quality and are made of recyclable materials.

Steelcase also develops and teaches programmes for design professionals on topics such as designing for the environment, recycling and materials choice. Also, the company sponsors pro-environment speakers as well as green events held by the U.S. Green Building Council and other groups.

The company has adopted Cradle-to-Cradle product certification that requires using environmentally safe and healthy materials designing for material reutilisation such as recycling or composting, conserving energy and using renewable energy, embedding water stewardship practices, and instituting strategies for social responsibility.

Source: Company press releases (http://www.steelcase.com)

In the furniture industry, the depletion of hardwood forests and chemicals contained in paints and glues are among the main issues related to sustainability. Sustainable site development, waste management, water conservation, energy efficiency, materials selection (including packaging), VOC reduction, transport management and sustainable procurement are among the main parameters of sustainable furniture production, and should be considered when looking at the full spectrum of life-cycle impacts of a product, if not an entire product line or company, and identifying opportunities for improvement at each stage, rigorously and systematically.

Business example:

Hermann Miller integrates environment into product design

In 2002, the American furniture company Hermann Miller integrated design for environment (DfE) as a core business strategy, implementing a three-part "protocol for sustainability" focused on infusing environmental attributes into all of its new products and, eventually, into all of its existing ones. The idea began with customers' growing questions about the environmental attributes of products.

Hermann Miller's DfE strategy is based on three components: an environmental rating tool for new products; a materials database that prioritizes existing environmentally friendly materials and spurs the development of new ones; disassembly guidelines and related training procedures.

The sustainability protocol was designed to integrate with the existing product development process. Each product evaluated by the system is rated in three different areas: disassembly, material chemistry, and recyclability. In each of those areas, designers use the tool to assign a series of credits related to various design factors. If a product can be completely disassembled down to its individual components, it gets a "credit" of 100%. A component that cannot be disassembled easily, such as a glued assembly, receives a 0% rating.

Similar ratings are given for "material chemistry", the human health and environmental factors associated with each product component. Every material contained in product is rated on a green/yellow/red colour scheme and assigned a corresponding credit, which is weighted based upon the amount of that material in the product. The third rating is given to each material based upon its recyclability, along with the material's recycled or renewable content.

Finally, the three scores are compiled and the product is given an overall score. The database that drives much of the tool is based on product information provided by suppliers. The overall goal is to continually improve each product's score by finding better alternatives to problematic components, such as less-toxic dyes or reduced-VOC particleboard.

Herman Miller is using the sustainability tool to assess all new launch products (roughly 10 a year) as well as existing products as they are updated and relaunched.

Source: The Green Business Letter, April 2002

Proactive measures to eliminate waste or toxic substances have the added benefit of pre-empting future legislation and minimizing potential liabilities in environment, health and safety. Pollution prevention can be achieved in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through effective pollution prevention policies.

In the furniture industry, different measures can be taken according to the main type of materials used: wood, metal or plastic. The "greening" of the production process extends to the whole supply chain, down to waste management and recycling.

Business example:

Recycling at Raymour & Flanigan Furniture

The US company Raymour & Flanigan Furniture is on track to recycle 15.2 million pounds of waste this year. "Furniture ships from our manufacturers in cardboard, plastic and Styrofoam packaging," Michael Goldberg, Executive Vice President, explained to Environmental Leader website. "Considering we sell on average 8,000 pieces of furniture each day, we generate a lot of recyclable material."

Raymour & Flanigan has renovated a 41,000 square foot recycling centre on their main campus to handle the material. What used to be sent to landfills is now sent to the Recycling Centre in Liverpool New York for handling and processing. The recycled materials are used by other manufacturers to create new consumer products.

Starting with a reduction process known as heat extrusion, technicians at Raymour & Flanigan take clean bulk Styrofoam and send it through a special processing unit which reduces it to 10 percent of its original size to make an end product called an "ingot" weighing approximately 50 pound. Ingots are shipped to manufacturers instead of area landfills.

The company's goal for 2007 is to recycle 700,000 pounds of Styrofoam, 13.2 million pounds of cardboard, and 1.3 million pounds of plastic.

The recycling centres process all cardboard and Styrofoam generated from the company's entire market area in the US Northeast. All plastics are recycled at respective Customer Service Centers and bales of plastics are then consolidated at the main recycling facility.

Source: Environmental Leader, August 2007 (http://www.environmentalleader.com)

To cope with the "green issue", an increasing number of companies are adopting environmental management systems (EMS) and certifying them by international standards. ISO 14001 is becoming the dominant international standard for assessing environmental management processes and in EU many firms are also registering their EMS according to the Eco-Management and Audit Scheme (EMAS). Although the SeBW did not carry out a specific and systematic analysis about the adoption of environmental management systems and related certification in EU, examples have been found in many European countries. These examples range from large companies, such as the Italian group Scavolini – analysed as a case study in Section 5.7 – to medium sized ones (to quote an example the Spanish company Geromobel[38]) also including handcraft companies (see the example of the Spanish company Almazán Mueble Artesano[39].

The environmental aspect of packaging material recycling is taken into consideration in order to offer to the consumers an environmental-friendly image, part of a wider communication strategy. When adopting this approach, the role of e-business is mainly in supporting the concurrent engineering process, with a comprehensive approach that follows the global environmental impact of the product. Environmental issues need to be taken into account from the product concept and design phase onwards, through

[38] See http://www.geromobel.com/index.html.

[39] See http://www.almazan-mueble-arte.com/empresa/index.php.

procurement, production and post-sales, until de-manufacturing. The analysis carried out indicates that innovative companies have started to adopt environment-friendly strategies, based on ICT tools for the life cycle assessment of furniture products. It is worth noting that these companies succeed in converting the burden of additional costs (due to compliance to strict regulation) into a competitive advantage: the possibility to base communication and marketing on "green" issues that are particularly appealing with the high-end segments of the market.

3.3 Supply Chain Management

In the furniture industry, the supply chain is complex and involves a number of separate activities that are increasingly organised in integrated production networks. The following table (Exhibit 3.3-1) illustrates activities and players in the industry value chain.

Exhibit 3.3-1 Activities and players in the furniture value chain

Activities	Players in the furniture sector value chain
Materials supply	External suppliers (wood, other material, chemical products)
Machinery supply and development	External suppliers coupled with internal development
Support services	External suppliers, quality control carried out internally
Design	Both internally and relying on external suppliers and professionals
Manufacturing	Both internal and outsourced to sub-contractors, especially for parts and components
Assembling	Both internally and outsourced to sub-contractors
Logistics and transports	Generally outsourced to specialised service providers
Marketing	Internally and in cooperation with retailers
Buying of finished products or RTA (Ready to assemble))	Specialised buyers
Retailing	Various typologies of retailers, direct sales
After sales services	Internally, outsourced to external suppliers, coupled with retailers
Recycling	Internally, outsourced to specialised external suppliers, coupled with retailers
Legend:	
predominant internal activities	partially outsourced activities / predominant external activities

Source: Databank elaboration 2007

Suppliers of raw materials are often very concentrated which leaves little bargaining power for the furniture industry itself. Due to the incidence of material and service cost on production value (see section 2.2), even slight improvements produce significant cost savings.

e-Business tools for Supply Chain Management (SCM) can help companies to coordinate and manage their third-party relationships, for instance with sub-contractors and business partners. Moreover, SCM systems can help furniture companies to match supply and demand through integrated and collaborative tools in a process that includes suppliers, manufacturers, wholesalers, retailers and eventually consumers.

3.3.1 The potential benefits of SCM systems

Current managerial interest in SCM highlights how manufacturing companies are implementing a process of rationalisation that cuts across workplaces, enterprises and entire industries. Like earlier innovations in management practice, such as just-in-time, total quality management and business process reengineering, SCM systems promote a continued focus on the need to reduce inventory levels and eliminate waste in operational processes, maximise quality at source, and develop closer, long-term relationships with business partners. However, what distinguishes SCM from these earlier concepts is that unlike the traditional focus on improvements in internal processes efficiency, SCM seeks to improve competitive performance through the closer integration of external enterprise relations.

Available SCM solutions cover demand planning, inventory planning and control, warehousing management and procurement. They may also include field sales forecasting and, eventually, Customer Relationship Management (CRM).

Supply Chain Planning applications enable companies to develop forecasts by creating a collaborative environment for multiple individuals, groups and partners. These systems help enterprises by developing schedules that maximize the utilisation of plants, equipment and inventory, to reduce cycle times and improve profits. Supply Chain Planning applications also support make-to-order (MTO), make-to-stock (MTS) or just-in-time (JIT) inventory needs with extensive analysis and simulation capabilities, giving to the company the visibility needed to support collaborative programmes such as vendor managed inventory (VMI) and continuous replenishment programmes (CRP).

Inventory control management applications provide the inventory and warehouse management capabilities needed to manage and view materials and products across multi-company, multi-division, or multi-site environments. All inventory-related transactions, including lot details and movement history, are recorded in order to track, analyze, and optimize operations. Inventory control also allows the management of materials, intermediate goods and finished goods on the basis of defined characteristics (such as shelf-life, best-before dates, moisture content).

Warehouse management solutions respond to warehouse distribution challenges, such as customer compliance initiatives, increased inventory and order volumes, and multiple distribution channels, that can drive process manufacturers to move beyond their standard enterprise inventory control functions. Further on along the fulfilling process, logistics management applications help in the planning and costing of freight for inbound deliveries from suppliers, outbound shipments to customers and transfer orders to other warehouses or distribution centres, including routing & rating, load planning, costing and invoicing.

Procurement costs can be reduced through several functionalities included in SCM: procurement activities are streamlined to increase efficiency and resources utilisation. Contract and order management modules may be used to create, maintain and evaluate contracts and orders. Flexible pricing conditions, in conjunction with contract and order management, are used to handle the price variation of raw material effectively. Prices and purchasing activities can be monitored and traced efficiently throughout the fluctuating market conditions.

SCM is an all-embracing concept that, if properly implemented, delivers improvements in speed, quality, flexibility and cost.

3.3.2 SCM in the furniture industry

A complex industry value chain

As highlighted in section 2.3, today's furniture manufacturers face new business complexities. Product demands span a broad range, from commoditized to highly customized products. Customer demand is continuously changing, while competition from low-cost countries is increasing. Creating brand differentiation and keeping market share depend more than ever on understanding customer needs and providing customer service and sales effectiveness. To keep pace with the customers' demand manufacturers are offering expanded product lines and custom options. The wide variety of dimensions, colours, finishes, fabrics and product options - leaving aside the value of the stock, efficiencies in storage and logistics - are placing increased demands on information systems to provide the functionality and flexibility required to address all the business requirements. On top of this come the demands by customers for reduced delivery times. In addition, in some market segments such as contract furnishings, custom orders are the norm. The result is a low volume production environment with very complex product development, scheduling, and production needs. This sort of low volume production environment is also very common in high-tech industries such as defence or medical instrumentation. The difference is that there is considerably more price sensitivity in the furniture industry and little tolerance for missing production deadlines.

Flexibility and process efficiency are key success factors

These trends are accompanied by pressure of maintaining margins and profitability. Vital to success is, therefore, the ability to control costs and optimize processes. As a result, many furniture companies are focusing on improving supply chain management, on streamlining operations and optimizing their ability to adapt to a changing business environment.

However, at the same time, supply chain improvement efforts are constrained, especially among smaller players, by a fragmented and disparate ICT infrastructure, poorly integrated solutions, including legacy systems, manufacturing execution systems, and an assortment of custom applications. Not only does this mean high integration costs, but more importantly, it means impaired visibility into supply chain processes.

SCM and internal process automation

A major technological issue is that SCM applications rely upon the kind of information that is stored in ERP software or in other applications used for internal processes. Theoretically, SCM applications could be fed with data from legacy systems (for many small companies this means Excel spreadsheets spread across the company) but this inevitably would impact on the quality of the outputs. SCM applications benefit from having a single major source for information, ideally ERP. It can be concluded, therefore, that the successful implementation of supply chain integration can hardly be achieved unless internal process integration has been previously and effectively achieved.

The two areas, intra-enterprise integration (mainly represented by ERP) and inter-enterprise integration (mainly represented by SCM) are strongly intertwined and have very similar features.

The CATI Manufacturing Survey 2007 provides a detailed picture of how and to which degree these solutions are adopted in the sector and especially among SMEs.

The high percentage of micro and small enterprises composing the European furniture industry could be the reason of the relatively low penetration of e-business software packages shown in Exhibit 3.3-2: just about 21% of firms use enterprise resource planning systems (a percentage that grows to 71% in large companies), a percentage that decreases to 10% when supply chain management and document management systems are involved.

Exhibit 3.3-2: Adoption of e-business software packages in the Furniture industries - Part 3 (2007)

	ERP		SCM		DMS	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**39**	**21**	**15**	**10**	**25**	**19**
NACE 36.12+13	38	19	16	8	31	21
NACE 36.14	40	22	15	11	22	19
Furniture – USA	**20**	**16**	**24**	**18**	**21**	**28**
Furniture by size (EU-7)						
Small (10-49 empl.)		16		9		18
Medium (50-249 empl.)		41		15		22
Large (250+ empl.)		71		23		38
Other sectors (EU-7)						
Chemical	68	38	39	17	38	22
Steel	59	33	27	14	27	20
Base (100%)	all		all		All	
N (Furniture, 2007, EU-7+USA)	761		761		761	
Questionnaire reference	A7a		A7b		A7d	

ERP = Enterprise Resource Planning; SCM = Supply Chain Management;
DMS = Document Management Systems
The survey of 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Source: e-Business Surveys 2007 by the SeBW

Insights from literature and interviews carried out for the present analysis indicate that CAD/CAM tools are increasingly popular, a finding confirmed by the industry survey data (see exhibits 3.2-2 and 3.2-3). In this industry one of the greatest challenges is to find ways in which they can be successfully integrated in a cost-effective manner in such an environment. The skilled workforce and general purpose manufacturing equipment employed in the industry means the shop floor is usually quite flexible to changes in production requirements. What is typically less responsive is the product design and manufacturing information needed for production. An important goal is to find ways of making the enterprise more capable of responding to increasing demands for more timely and accurate generation of the information needed for production of new furniture pieces.

An outstanding example in this industry is represented by the well-known Ikea group; although primarily a retailer, it has developed a distinctive competence in the overall supply chain management.

Business example: Ikea

Ikea structure

Ikea's structure is designed to optimise the efficiency of the design and supply processes. It is organised in four distinct parts that operate as a type of internal market. Ikea of Sweden (IOS) has the headquarters function. It is split into 12 Business Areas aligned to products (e.g. sofas, dining furniture, beds etc.). Under IOS, the Retail Division controls all the stores, the Distribution Centres are likewise grouped under distribution and the Trading Areas deliver the purchasing and supplier support functions.

The Business Area Manager commissions a product using an integrated project team that includes a designer (either freelance or from one of Ikea's two design schools in Sweden), a technician and a product developer. The marketing decision maker in the Business Area (called 'Istra')) will then set up a competitive tender to decide the country of production. The trading areas compete to win the contract to supply that product or product range, either globally or regionally, in a tender process. Once the Istra gives the go-ahead, the Business Area is responsible for the product. The product supply manager takes on responsibility for a first-buy test run of the product. If this is a success the supply planner will then be responsible for ensuring continuous supply.

Ikea lead times

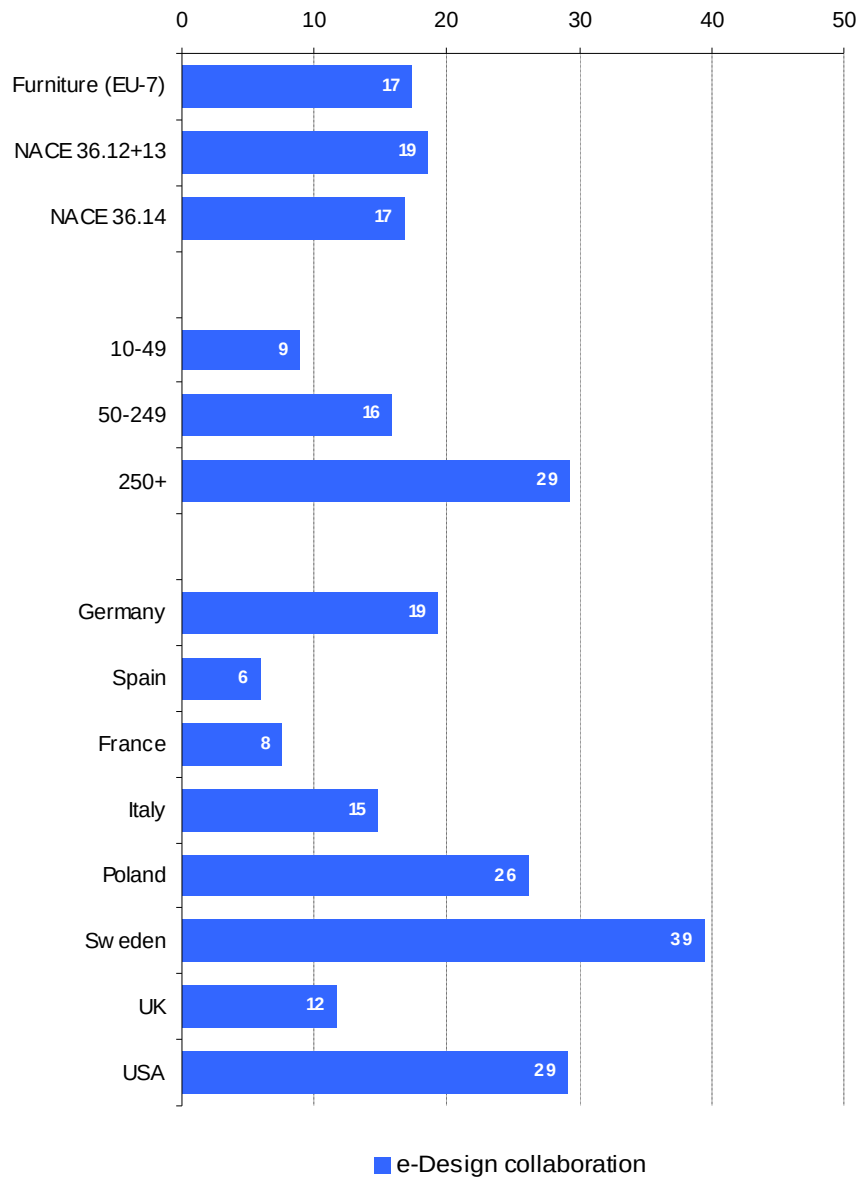
Great emphasis is put on the ordering and distribution methods. Ikea's suppliers are categorised according to the lead time that they work on. Ikea's policy is to try to shorten lead times gradually, helping suppliers to develop business processes in such a way to progress to the required performance. Once a supplier is able to achieve this they explore the possibilities of cutting the distribution link out of the chain so that retail stores deal directly with factories (Vendor Managed Inventory or VMI) perhaps with goods bypassing the distribution centres altogether and going direct to retail stores. All links in the chain work together to shorten the cycle time and cut out logistical costs so that products reach the customer at the lowest possible price. The progression up the ladder is gradual and reached by agreement with suppliers. The goal of maximising speed has to be balanced against the dependability of supply and the maintenance of high percentage availability of the product in the stores. A distinctive feature of Ikea logistics policy is cooperation. Manufacturers acknowledge that margins earned with Ikea can be lower than with other customers but the received support and the nature of the relationship outweigh this disadvantage. From a supplier's perspective a solid relationship with Ikea gives his operation a critical mass and the development of expertise and 'best practice' that can be put to good use in winning business from other customers.

Source: http://ffinto.org/furniture_supply_chain/bestpractice.htm

What is striking about Ikea's business model is the analysis in minute detail of each and every stage in the value chain to the final customer and the holistic approach adopted. It is irrelevant whether the materials are in Ikea's ownership or in the hands of their suppliers and sub-suppliers at any particular stage. All the links along the value chain share the goal of minimising lead time cut logistical costs and reach the customer at the lowest possible price.

Furthermore, Exhibit 3.3-4 highlights the leading position of Sweden in the e-design development: 39% of Swedish firms adopt ICT-enabled systems in order to collaborate with business partners in the design of new products or services. This percentage, more than double of the European average of 17%, can be ascribed to the role of IKEA in developing an outsourced network of design and manufacturing partners in Sweden and all over the world. These data, however, should be considered as only indicative due to the small number of observations.

Exhibit 3.3-3: Percentage of firms collaborating with business partners in the design of new products or services (2007)



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

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

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

Questionnaire reference: B10

Source: e-Business Survey 2007 by the SeBW

The importance of supply chain integration

Integration along the supply chain is a key issue among furniture companies in order to speed up and achieve instant visibility into orders, shipments, and inventory across the supply chain, as well as improving the tracking of processes from design to manufacturing. Reducing lead times is crucial to improving competitiveness of the EU industry as not only this would enhance reputation but would be a service that many extra-EU manufacturers would find difficult to match.

While supply chain processes are increasingly complex and involve a diversity of partners, manufacturers need to address these issues without the need to use expensive solutions or release sensitive information in external databases whenever activities are outsourced. As SCM systems are used to manage numerous and different tasks, this requires inputs from various applications, and to share data with external partners' information systems. As a result, firms clearly need to address a broad range of organisational and technical challenges when introducing SCM.

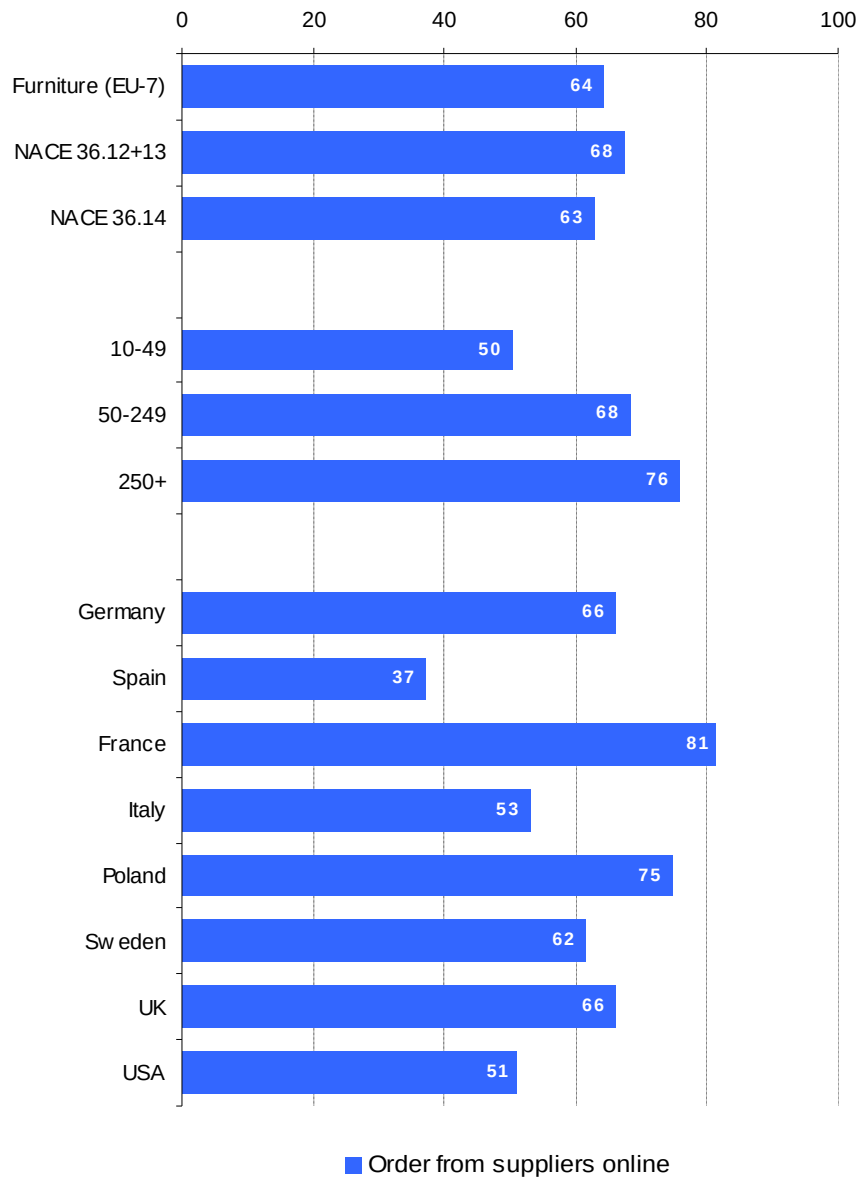
Inter-enterprise integration, represented by SCM, is strongly related with and dependent upon the effective implementation of **intra-enterprise integration** (mainly represented by ERP). They represent complementary approaches for addressing the same strategic challenges. SCM, however, provides the opportunity to expand the advantages of optimisation and integration to the entire supply chain through the creation of a collaborative, networked environment.

Desk research for this study indicates that the full digital integration of data exchange with customers and suppliers is still limited to larger firms. The CATI Manufacturing Survey 2007 illustrates to which degree these systems are actually diffused in this industry, which are the main barriers to adoption – especially for smaller players – and which are the recorded impacts.

There are indications that the **limited degree of computerisation** and related **know-how**, **cultural differences**, and the **diversity of technological equipment** are still **relevant barriers to integration**.

In contrast with the relatively low penetration of "internal management" ICT-enabled tools such as ERP, SCM and DMS, European furniture companies appear to be quite active on the Web side: Exhibit 3.3-4 highlights how 64% of furniture manufacturers use the Internet or other computer-mediated systems to order goods and services, a percentage rising to 76% in the case of large companies but quite high (50%) also for SMEs. It should be noted, though, that the survey question did not specify whether e-mail exchange was to be included – and probably many of these exchanges are simply "conventional orders" transmitted via e-mail, mainly in SMEs.

Exhibit 3.3-4: Percentage of firms ordering goods or services on the internet or via other computer-mediated networks (2007)



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

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

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

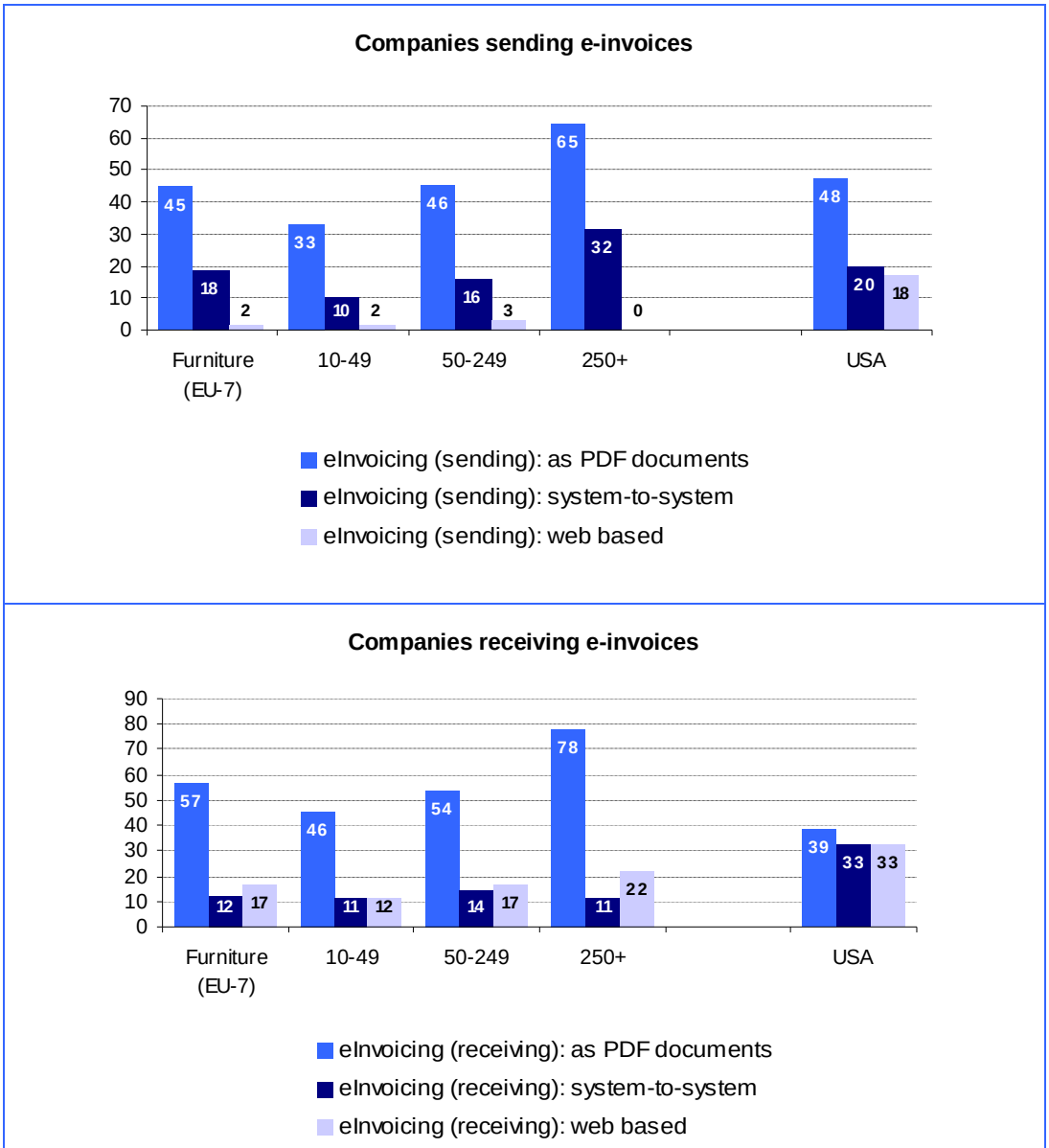
Questionnaire reference: B1

Source: e-Business Survey 2007 by the SeBW

The survey results concerning e-invoicing (Exhibit 3.3-5) confirm how the "keep it simple" approach works also when ICT is involved: the exchange of PDF documents is a simple way of communicating and is widely adopted even in SMEs, while system-to-system exchanges are limited to medium-large enterprises. The e-invoicing practices seem to work easier upwards (the percentage of companies sending e-invoices is higher than the

percentage of companies receiving e-invoices); this could highlight a discontinuity in the supply chain management methods.

Exhibit 3.3-5: Percentage of companies sending / receiving e-invoices in 2007 (different methods)



The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.
Base (100%) = all companies. N (Furniture, EU-7 and USA) = 761.
Weighting: Figures for sector totals and countries are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms. Questionnaire reference: B5, B6

Source: e-Business Survey 2007 by the SeBW

The penetration of Material Requirements Planning (MRP) systems and Manufacturing Resources Planning (MRP II), as shown in Exhibit 3.3-6, is relatively low in the European furniture industry. These production-oriented ICT systems determine the amount of material needed may bring relevant gains in process efficiency. The difference between the adoption in large and small companies is huge (42% versus 9%) and shows a wide "cultural gap" that should be filled in order to enable SMEs to a more effective competition

in the market. The gap is remarkable also in comparison with the other manufacturing sectors

Exhibit 3.3-6: Adoption of e-business software packages in the Furniture industries – Part 3 (2007)

	Material Requirements Planning systems		Manufacturing Resources Planning systems	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**23**	**12**	**16**	**7**
NACE 36.12+13	30	13	20	9
NACE 36.14	19	12	14	6
Furniture – USA	**18**	**12**	**10**	**3**
Furniture – by size (EU-7)				
Small (10-49 empl.)		9		5
Medium (50-249 empl.)		25		12
Large (250+ empl.)		42		33
Other sectors (EU-7)				
Chemical	49	20	31	11
Steel	49	16	20	8
Base (100%)	all		All	
N (Furniture, 2007, EU-7+USA)	761		761	
Questionnaire reference	A11b		A11c	

MRP = Material Requirements Planning
The survey of 2007 was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.

Source: e-Business Surveys 2007 by the SeBW

3.4 e-Business for sales and distribution

3.4.1 Introduction to sales and distribution issues

In the furniture industry, the sales and distribution channels are mainly independent from production, although in the past years, the share of direct sales through proprietary networks has increased. Usually distribution is carried out on a national scale, apart from some high-end design furniture firms and contract furniture producers, and of course Ikea, that is a one-of-its-kind organisation.

European furniture distribution channels include independent furniture retailers, buying groups, large-scale specialist distribution, non-specialist department stores, and building trade, mail order, DIY (Do It Yourself) . Exhibit 3.4-1 illustrates the role and the importance of the main distribution players in the various industry sub-sectors [40].

[40] The breakdown of sales by type of store is presented in Exhibit 2-12.

Exhibit 3.4-1- – Players and sectors in furniture distribution and sales

	General	Kitchen	Office	Upholstered	Flat-pack	Contract
Small –medium Independent retailers	■■	■■	■	■■		
Large-scale specialised retailers	■■	■■	■■	■■	■	
Non-specialist department stores	■■			■	■	
Direct sales	■■	■■	■	■■	■	■■
Mail order	■				■	
DIY	■	■			■■	
Buying groups	■		■■			■■
Maximum importance: 2 points ■■						

Source: Databank

As previously stated in section 2.3 of this report, the European furniture sector is witnessing an increasing complexity and concentration of distribution. Moreover, the "design furniture" manufacturers are steering towards a distribution model based on flagship stores that should provide more tailored services to the customers: such services often include 3D simulations and virtual reality tools to give the client a clearer idea of how the furniture will look in his/her home.

The characteristics of furniture distribution networks, coupled to the huge variety of items present in the average furniture shop, make the realisation of e-business systems a hefty task. The main issues are connected to standardisation of information and systems, to the huge variety of legacy systems adopted by the different manufacturers and distribution networks, and to the final user/customer experience.

3.4.2 e-Business applications in marketing & sales

Distribution in the furniture industry is structured in a complex way and extranets and internet-enabled supply-chain automation solutions aim at optimising the relationships between manufacturers and dealers. Order management and logistics are two of the areas where e-business proves to be particularly beneficial to the furniture industry.

Successful furniture wholesale distribution depends on three key factors: offering the products customers need, keeping tight control of margins and making sales and fulfilment processes as fast, efficient and customer-focused as possible. Furniture distributors face increasing competition throughout the value chain, as retailers develop direct B2B sales and manufacturers sell direct to customers.

ICT solutions for marketing and sales in the furniture sector are maturing rapidly. More and more large retailers are deploying sophisticated data models to manage their major assets of inventory and debtors. With strong competition occurring at all levels of the marketplace, retailers are using brand differentiation to secure market share. For ICT, this requires stronger customer relationship management and a focus on the customer experience of the brand. Creating brand differentiation depends on customer service and

sales effectiveness, and market leadership and growth depend on understanding customers' needs and providing the products and services to meet them.

The marketing and sales software products developed for the furniture industry are designed to address all aspects of the trading operation, from the shop floor right through to the executive's desktop. They enable the retailer to manage and control an extended network of geographically dispersed outlets from a central position, without creating dependence on a heavy-weight network infrastructure.

The in-store systems are 'network enhanced' and may draw on remote data sources if network services are available, but continue to operate using local data sources if network services are not available.

The product range and pricing strategy can be set up and maintained by country, region, area, brand and store profile from the central head office. New suppliers and products can be added to the range and others phased out. Merchandisers can update the latest supplier prices and special deals. Marketing specialists are able to review their price and margin strategy against the competition and build special promotions. All the data that is generated from these activities is picked up by the store software and drives behaviour accordingly.

The following business example shows how the distribution network can be successfully integrated in the overall company ERP (Enterprise Resource Planning) system.

Business example:

Document management implemented at Hanssem

Korean furniture distributor Hanssem Co., Ltd. required an enterprise resource planning (ERP) system and large-capacity storage to collaborate with its 500-plus partners and outlets. Hanssem implemented an SAP R/3 ERP system and HP StorageWorks solution, which improved efficiency, order processing and overall corporate competitiveness.

The new system allowed the IT staff to efficiently manage data and orders from the partners and dealers network, reducing anomalies in orders: the percentage of "abnormal" orders declined from 80% to 15% thanks to the adoption of the new data management system.

Source: HP case study published on HP website (http://www.hp.com)

The business example about Hanssem highlights the possible impacts of ICT on customer performance, through cost saving and better customer service. However, the CATI Manufacturing Survey data show that this kind of document management systems are not widely adopted in the European furniture industry.

The need for this kind of ICT-enabled solutions is made more stringent by globalisation and international trade that deeply influence the European furniture industry. Managing purchase orders, suppliers and logistics service providers who may be located in different areas is a major challenge both for manufacturers and for distributors. Many different manufacturing, transportation, financial service, and logistics companies can be involved in any furniture that is sourced overseas. e-Business solutions and networks could be of great help, mostly for the small furniture producers who risk to be excluded by central purchasing organisations due to their insufficient supplying capacity.

Evidence from literature and case studies indicate that advanced e-business integration between manufacturers and independent distributors is scarce in this industry. Strategic investments of smaller EU furniture manufacturers focus on production planning, stock turn improvement and reduction of out of stocks, not so much on integrating with their distribution network. There are however examples of integration of information systems regarding the management of orders and invoices. These findings have been confirmed by the CATI Manufacturing Survey 2007.

ICT for customer service at the point of sale

Parallel to the integration of the above described tools in the enterprise management systems, there is a need for software tools that enhance the customer experience at the point-of-sale.

Increased access to technology within the customer base has put pressure on furniture manufacturers to provide automated tools to configure and price products, as well as provide visualisation of the products with dynamic graphics and layout utilities. Such tools can profit from 3D modelling and virtual reality solutions: the possibility to offer state-of-the art systems of rendering and virtual reality, able to show the client how the selected furniture should appear in his home, is an important asset in furniture sales.

Virtual reality is a computer simulation that uses 3D graphics and devices to provide an interactive user experience and can offer indirect but realistic visual experiences (both on-line and in-store) for evaluating furniture and see whether it matches other items or decoration. 3D desktop virtual reality has become an affordable system, and the furniture industry could benefit from virtual reality features to understand market needs and wants, and provide a satisfying shopping experience.

Furniture retailers have to carry a wide selection of items to meet customer expectations, but the dimensions and characteristics of the product and the value of inventories can limit the number of products actually available. Virtual reality systems can bring product information to clients and sales people quickly and easily, offer realistic product trials and generate orders that can be linked to warehouse management software or on-demand production systems.

Virtual reality systems can also be linked to virtual prototyping for product development, and can be used as a market research system for understanding consumer preferences and behaviours (for example in a website).

The ability to deliver and support this type of automation, though, requires specialized applications and skill sets that may not be currently available within any organisation.

An interesting example of integration between the client at point of sale and the production process is presented in the Danona (E) case study presented in section 5.1 where made-to measure furniture is designed together with the client via a 3D CAD/visualisation system, and the relevant production data are sent directly to the mill.

A similar approach is followed in a B2B context by the subject of another case study, the Austrian company Robinwood (section 5.6). Robinwood implemented an e-distribution platform that allows planning, calculating and ordering customer-tailored furniture with arbitrary design.

3.4.3 e-Commerce in the furniture industry

Business to consumers

Major challenges that European furniture manufacturers face in implementing e-commerce initiatives include: initial costs for ITC infrastructure and solutions (this poses particular difficulties due to the large number of SMEs that dominate the EU marketplace); resistance to innovation, both internal and external to the organisation; lack of technically-skilled human resources; identification of an addressable end market for the online selling of furniture.

Selling furniture on the Web isn't always easy: B2C activities are not very developed in the furniture retail sector. Big market players are reluctant to sale online, due to a strategy based on local stores and price differentiation. Independent retailers often hesitate to develop communication web-sites and online catalogues, and remain stuck to traditional business. This underdeveloped e-market can also be explained by the fact that purchasing a piece of furniture implies a long and complex process, due to high cost and aesthetic function of products: in highly "emotional" purchases such as furniture (home furniture) the personal and first-hand experience of the customer is paramount. Thus, furniture websites are mainly devoted to provide information, tools and a general feel of the company's offer. Moreover, the information extracted by the web sessions of clients can also be very valuable to manufacturers, in order to evaluate what are the preferred items, finishes and combinations.

The risks of understating the complex procedures involved in the setup of a furniture e-commerce venture are clearly addressed in the following business example.

Business example: USA

A "negative" example: the case of the former furniture.com portal

In January 2000, furniture.com executives promised Web shoppers 24-hour browsing and six- to eight-week delivery times on everything from table lamps to 10-piece bedroom ensembles.

Convincing customers to buy furniture online was the easy part. The company reported $22 million in net revenues for nine months ending September 2000--more than twice the total 1999 net revenues--and attracted 1 million users a month.

But with the increase in usage came a dramatic jump in customer dissatisfaction. Customer complaints leapt from one in 1999 to 149 in 2000, steep even by dotcom standards. The leading complaint: delivery problems, followed by product quality and bill disputes.

The company failed to factor in the logistics and costs involved in shipping such a bulky commodity cross-country and had no way to track orders.

Furniture.com also created a cancellation policy no furniture company could afford. Customers could cancel orders right until delivery day. With six-week waits turning into six-month delays, a third of all orders were cancelled. Local logistics companies had warehouses of unwanted furniture. Storage costs that surpassed the already astronomical shipping costs Furniture.com footed for customers.

The online retailer, which launched in January 1998, closed its doors on Nov. 6, 2000 and filed for bankruptcy on Nov. 20. In 2001, a group of former employees founded a new company and purchased the Furniture.com website and name. The website is now up and working, and has learned from past mistakes.

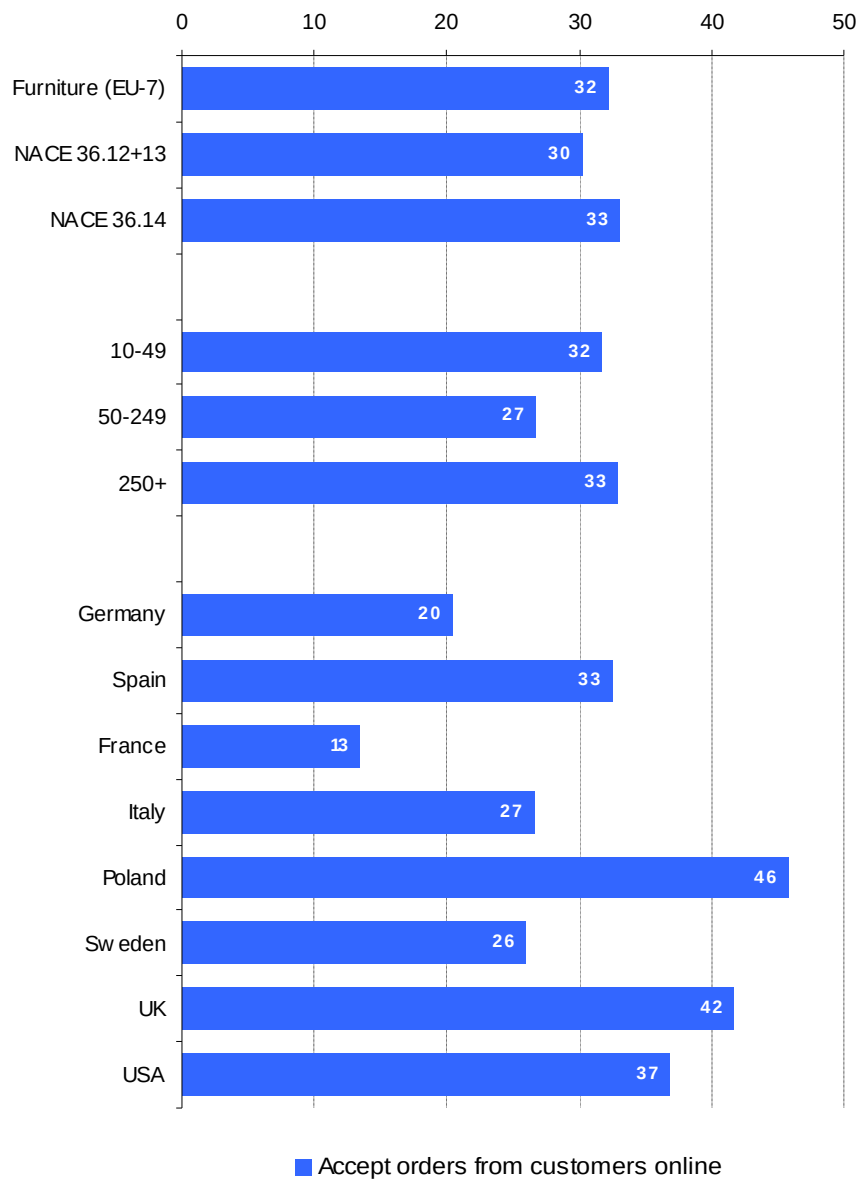
Source: CIO.com, May 2001 (http://www.cio.com); furniture.com website (http://www.furniture.com).

A remarkable example of successful furniture e-commerce is given instead in the Quatuor case study (section 5.5): Quatuor decided to develop e-business activities while sticking to its core activities and values, based on high quality service and advice, which led to develop non-fully integrated solution requiring (but also allowing) human intervention at many stages in the purchase process. This strategy has proved to be successful: it offered good visibility to the store and helped to attract more distant, diversified and numerous clients.

The Webmobili case study (section 5.8) shows instead the implementation of an Internet-based search engine providing consumers with a comprehensive point of information about the national offer of medium-high range furniture and related items. All the information has been standardised and presented in a way easily accessible to the public. This way it's possible to give visibility to Italian design furniture, which mainly consists of small-medium sized manufacturers and independent retailers.

The trend shown by business examples and case studies is confirmed by the CATI Manufacturing Survey: the survey results illustrated in Exhibit 3.4-2 show an interesting share of companies addressing their customers via the internet, although EU companies slightly lag behind their US counterparts.. The overall percentage is 32%, with a slightly higher value for B2C – oriented NACE 6.14 manufacturers (while we'll see that kitchen and office furniture manufacturers rely more on e-catalogues). . The high percentage of companies form Poland that can receive orders on line is likely to be related to the large share of firms acting as third parts producers (therefore linked to larger and more advanced manufactures) in this country. Unfortunately, the absence of previous surveys does not allow a comparison with older data.

Exhibit 3.4-2: Percentage of firms where customers can order goods or services on the internet or via other computer-mediated networks (2007)



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

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

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

Questionnaire reference: B3

Source: e-Business Survey 2007 by the SeBW

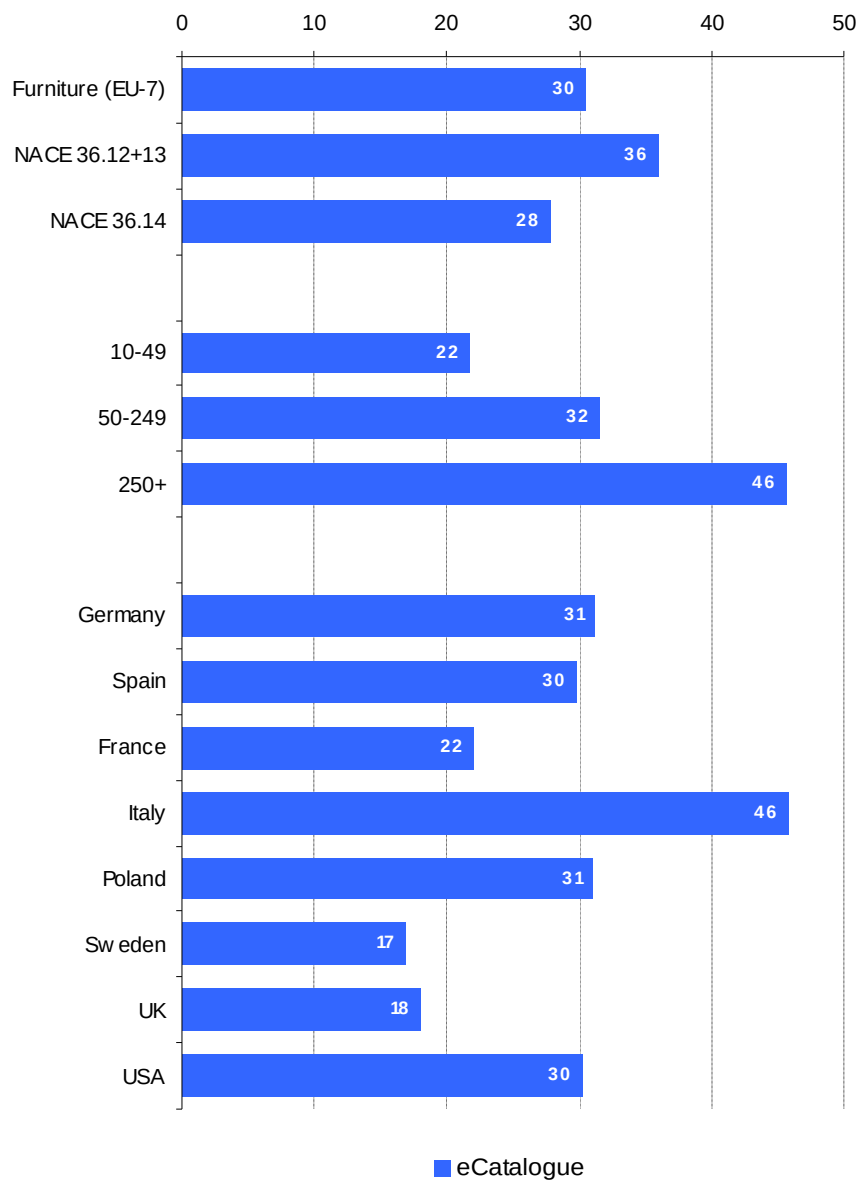
Selling furniture depends on the product style, quality, appearance and price. Catalogues are considered as the most important marketing tool and the most usual way of communication in this sector. In this sense, the information quality and the way of presentation is a key factor when elaborating them.

On the other hand, there is a high number of errors when ordering the products, which may represent high losses for the company (between 3-7% of the company income).

These errors are due to the high number of variations that can suffer a product, that is, different dimensions, fabrics, materials, finishing, etc.

In this sense, traditional catalogues are incomplete. In addition to their high commercial price and the high number of references included, these are not able to show all the variations of every model: shape, colours, accessories, materials, etc.

Exhibit 3.4-3: Percentage of firms having an electronic catalogue describing their products or services based on a certain industry standard for e-catalogues (2007)



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

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

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

Questionnaire reference: C2

Source: e-Business Surveys 2007 by the SeBW

Exhibit 3.4-3 shows a relatively high adoption of e-catalogues in the furniture industry. This trend, more evident in large companies, is also due to the requests of interior designers, who need product information easy to store (compared with paper catalogues) and quicker to update.

Another driver is the complexity of the catalogue, higher in the kitchen and office furniture sector, that significantly shows higher e-catalogue adoption percentages (36% vs 30% average adoption): e-catalogues are easier to update for the manufacturer and more searchable by the customer. Besides, this sector strongly addresses the contract market that needs quick and flexible selection and ordering systems.

The significantly higher percentage of e-catalogue adopters in Italy can be ascribed to the presence of a network set up by the Italian furniture manufacturers association and described in the Webmobili Case Study. Moreover, Italian companies are particularly dedicated to high-end design furniture, and their offer is addressed to interior designers and architects who have a high level of familiarity with computers and prefer e-catalogues to paper.

Standardisation of data, an important issue in e-business, is a very sensitive concern in the furniture industry, due to the huge variety of items, materials and finishes available on the market. At a European level, this subject has been addressed, among the others, by the SMART-fm[41] initiative, illustrated in the following business example and, presently, by the INNOVAFUN[42] .

Business example:

A Smart way of doing business

Until now the e-commerce potential has been underexploited due to disparate technologies - from design systems to catalogue management tools - that hinder business-to-business interoperability.

The solution is the creation of international standards, and perhaps more importantly if they are to be implemented, proving and demonstrating their benefits to furniture manufacturers, retailers and software engineers. With that goal in mind the SMART-fm project will release a tutorial and pilot demonstrator in Europe aimed at convincing the European furniture sector, comparatively the largest worldwide in terms of employment, of the value of standardisation.

"The problem of introducing a standard has generally been the complacency of software designers toward implementation," explains project manager María José Núñez at AIDIMA in Spain. "We have therefore tackled the issue from a transparent approach. Rather than trying to impose standardisation, we are trying to convince the sector of the benefits through demonstrations and easy-to-use software."

The standards-based software being developed by SMART-fm, under the umbrella of the funStep interest group, is aimed at allowing B2B interoperability at all stages of the furniture production life-cycle from the

41 See http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/60707.

42 http://standards.eu-innova.org/Files/Publication/EUR_Standards_INNOVAFUN.pdf.

importation of raw wood to the sale of the finished product. It also promises to allow software designers to bring programmes to market within two months, while making it cheaper, easier and faster to upgrade software in the future.

Standardisation also reduces errors. Compared to current methods of communication between companies, i.e. faxes and e-mails, a standardised automatic system would cut errors by "at least 90 per cent," Núñez says, with "all actors being certain that the information they are sending and receiving is correct." That translates to further cost and time savings.

Many furniture manufacturers and retailers are starting to be convinced, and as the project manager notes, they are beginning to put pressure on their software suppliers to move toward standardisation. "There has been great interest in our dissemination activities," Núñez says, indicating that standardisation in the worldwide furniture sector, with its potential implementation by "thousands" of companies, is an achievable goal.

Source: CORDIS website (http://cordis.europa.eu)

The scenario is different for office furniture, and other highly standardised furniture sectors: in this case, the success of specialized furniture e-commerce sites will depend mainly on the ability to deliver a combination of information and advice in a format that makes the customer comfortable.

Business to Business

B2B furniture transactions (direct sales of contract furniture to companies through e-commerce, and/or subcontracting of various production/distribution activities) are also a promising trend. The use of web standards such as XML language help customers to better manage the acquisition of furniture products and services, providing access to efficient trading mechanisms and commerce processes: content management services, global supplier directories, sourcing tools, B2B auctions and reverse auctions, electronic payment and streamlined transaction services.

Another interesting example of how the internet can be successfully exploited to improve contacts between furniture industries is the IWOfurn platform (described in a case study in section 5.2), a B2B portal dedicated to the European furniture industry. Through the IWOfurn platform, registered companies have the possibility to present themselves through a detailed company profile, upload brochures, presentations and catalogues, contact users and manage mailing-lists within the community. IWOfurn is a relatively young initiative (the service has been running since 2006) but it is attracting a day-by-day higher number of furniture operators.

At the moment, there are quite few examples of industry-specific e-marketplaces where suppliers and buyers can trade and exchange goods and services. However, initiatives in the field of e-procurement of raw and semi-finished materials are likely to develop in the coming years as manufacturers increasingly realise that there are significant benefits to be achieved in terms of cost reduction and increased efficiency.

Interoperability and standardisation

One of the main technical challenges towards integration between manufacturing and distribution is the standardisation of both data and information systems, also related to

the variety of legacy systems adopted by the different manufacturers and distribution networks. The setup of international standards is paramount for a wider adoption of e-business in the furniture industry.

In the e-Business Watch Manufacturing Survey 2007, the companies were asked whether they use particular ICT standards. Overall, the adoption of standards is very limited: most of the interviewed companies indicate they do not adopt any kind of standard. This can be partly attributed to a lack of awareness about this technical aspect of the survey respondents, as the standards are "hidden", i.e. integrated into the software. However, it is clear that this industry is far from adopting standards on a large. Most firms adopting standards are still relying on proprietary standards, as underlined by the results illustrated in exhibit 3.4-4: a policy even more adopted by large industries that can impose their standards on suppliers and distribution networks (and often even have their own distribution networks). While 18% of firms (61% of large firms) adopt proprietary standards, only 8% of companies adopt EDI-based standards, and 9% use XML-based standards. This percentage, however, is somehow contradicted by the relatively large amount of companies adopting e-catalogues (as XML is the election standard for web catalogues). This discrepancy could be due either to the adoption of other e-catalogue typologies, or, again, to a lack of awareness. Results form the SeBW survey (see Exhibit 3.3-5) indicate that electronic exchanges with suppliers (more concentrated and linked with long-standing relationships) are relatively more advanced, while interoperability with the downstream part of the value chain is by far more limited.

Exhibit 3.4-4-: Firms using technical standards (2007)

	EDI- based standards		**XML- based standards**		**Proprietary standards**	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Furniture (EU-7)	**21**	**8**	**16**	**9**	**34**	**18**
NACE 36.12+13	21	7	16	9	30	16
NACE 36.14	20	9	15	9	37	19
Furniture – USA	**29**	**18**	**12**	**14**	**26**	**22**
Furniture – by size (EU-7)						
Small (10-49 empl.)		6		6		16
Medium (50-249 empl.)		17		21		25
Large (250+ empl.)		42		18		61
Other sectors (EU-7)						
Chemical	38	15	16	11	31	18
Steel	34	12	22	10	22	14
Base (100%)	all		all		all	
N (Furniture, 2007, EU-7+USA)	761		761		761	
Questionnaire reference	C1a		C1b		C1c	
The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.						

Source: e-Business Surveys 2007 by the SeBW

Currently, the number of business partners and of the systems in place are so high that the automation processes is practiced only with very few players, as it poses relevant technological challenges related to product coding, not to mention the economic justification of the necessary investments. This situation is common to other

manufacturing sectors where most players are SMEs and both manufacturers and distributors are fragmented[43]. In other sectors, such as food[44] it has been the role of distribution -in general more advanced and concentrated than manufacturers- to drive the whole sector to the adoption of standards for interoperability on a large scale. The situation of the furniture sector is somehow in between and varies remarkably across different countries.

3.5 ICT as an enabler of innovation

The growing diffusion of ICT in all areas of business is a major enabler of technological change, innovation and thus –ultimately– economic development. ICT-driven innovation activity is central to the subsequent effects of ICT economic impact (see also Chapter 4).

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

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

A process innovation, on the other hand, can be viewed as an outward shift of an existing supply function which generally aims at lowering variable costs in the various companies' operations. In this sector process innovation may include the automation of existing processes, the streamlining of both operations and information flows and it is often related to the organisation of production. In recent years much effort –and related debate- has been carried out around the concept of mass customisation. Mass customisation is commonly referred to as the ability to produce customised products at a price which is normally associated to standard products. Research in the field is on-going[45]; however it appears that this strategy may bring relevant competitive advantages to the implementing organisations. The usage of 3D or other applications at the point of sales is, e.g., an interesting application which may support this strategy.

To get some evidence on the role of ICT for innovation, the Sectoral e-Business Watch asked companies from the sectors studied in 2007 whether they had "launched any new or substantially improved products or services" during the 12 months prior to the interview, and if they had introduced "new or significantly improved internal processes" in the same period of time. As these questions were not further specified, it is not possible to make any distinction about the type of innovation that was actually carried out. This lack of distinction may raise the concern that the question has been intended differently

[43] See e-Business W@tch Sector Study on the Furniture Industry (2006), see www.ebusiness-watch.org ('resources').

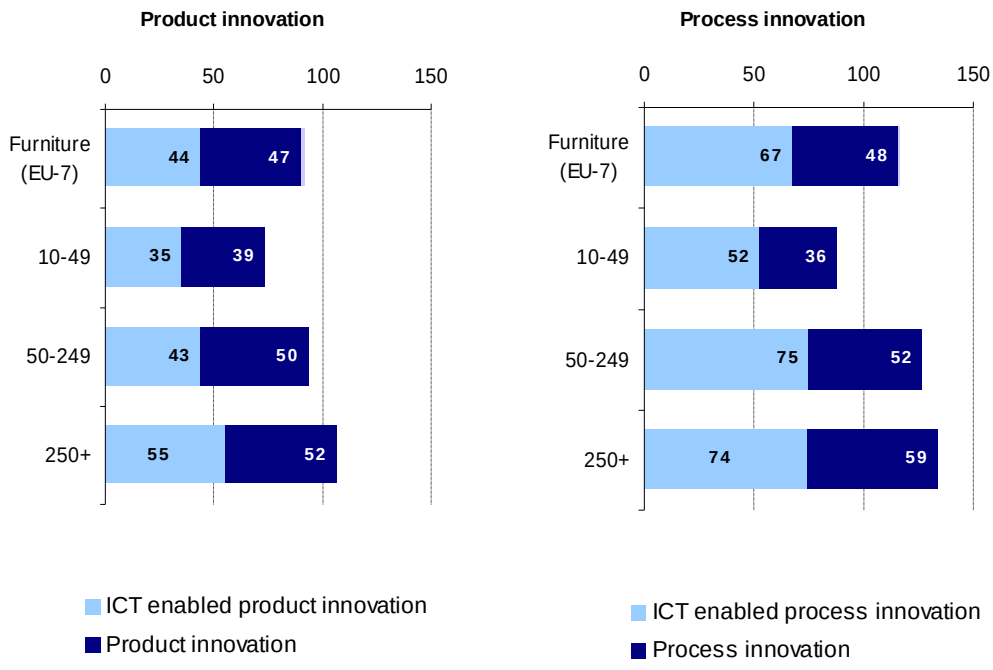
[44] See e-Business W@tch Sector Study on the Food Industry (2006), see www.ebusiness-watch.org ('resources'.

[45] See, among the others European Commission, Enterprise and Industry Directorate-General Study on the competitiveness, economic situation and location of production, in the textiles and clothing, footwear, leather and furniture industries; 2007

by the interviewed companies[46]. The analysis carried out in the next sections refers, therefore, to innovation in a broad and generic sense.

Enterprises representing about 47% of sector employment said that they had launched new (or improved) products in 2006/07. About 44% of those said that their product innovations had been directly related to or enabled by ICT (see Exhibit 3.5-1). This high share indicates the increasingly important role of ICT for product planning and manufacturing processes, in particular in medium and large enterprises.

Exhibit 3.5-1: Companies having introduced product / process innovation in % (2007)



The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.
Base (100%) = all companies. N (Furniture, EU-7) = 761.
Weighting: Figures for sector totals are weighted by employment ("firms representing x% of employment in the sector / country"), figures for size-bands in % of firms.
Questionnaire reference: D1, D2, D3, D4

Source: e-Business Survey 2007 by the SeBW

It was a consistent finding in e-Business Watch sector studies that ICT play a **crucial role** to support process innovation, in manufacturing as well as in service industries. This can be confirmed for the furniture industries: out of all companies that said they had introduced new or significantly improved processes, nearly 70% (by their share of employment) said that the new processes are enabled by ICT. Even the share of small companies is quite high, as about 50% of companies reported that their process innovation(s) were ICT-enabled.

[46] If product innovation is intended in a broad sense (including e.g. the introduction of new fabrics or colours) the empirical knowledge of this sector suggests that nearly all the players could be expected to have introduced innovations in the past 12 months. On the other hand, if radical process innovation is meant, very few players can state to have introduced innovation in the past 12 months. Percentages around 50% rather indicate a varied perception of the concept of innovation.

In a **cross-sectoral comparison**, the share of ICT-enabled process innovation is broadly in line with findings for other manufacturing sectors. Exhibit 3.5-2 shows that results for various sectors studied by e-Business Watch over the past 3 years are fairly consistent.

Exhibit 3.5-2: Cross-sectoral comparison: percentage of product / process innovations that are ICT-enabled

Sector	Product innovation: % ICT-linked		Process innovation: % ICT-linked		Year of survey*
Manufacturing					
Chemical, rubber, plastics	36%	~ ~	73%	~ ~ ~	2007
Food	15%	~	62%	~ ~ ~	2006
Pulp and paper	34%	~ ~	59%	~ ~ ~	2006
ICT manufacturing	54%	~ ~ ~	70%	~ ~ ~	2006
Steel	48%	~ ~	64%	~ ~ ~	2007
Furniture	44%	~ ~	67%	~ ~ ~	2007
Automotive	21%	~	86%	~ ~ ~ ~	2005
Pharmaceutical	18%	~	72%	~ ~ ~	2005
Machinery & equipment	25%	~	66%	~ ~ ~	2005
Publishing	65%	~ ~ ~	83%	~ ~ ~ ~	2005
Retail and services					
Retail	70%	~ ~ ~	81%	~ ~ ~ ~	2007
Transport and logistics	76%	~ ~ ~ ~	75%	~ ~ ~	2007
Telecommunications	86%	~ ~ ~ ~	92%	~ ~ ~ ~	2006

* Surveys of 2005 and 2006 include micro-firms with up to 9 employees

Data weighted by employment. Reading example: "Out of those companies in the food industry which said they had introduced new or significantly improved internal processes in the past 12 months, 62% said that at least some of these process innovations were enabled by ICT."

Source: e-Business Surveys 2005, 2006 and 2007 by the SeBW

The role of ICT for process innovation was found to be most important in the publishing and automotive industries. Differences are more pronounced for product innovation, obviously depending on the nature of the goods and services produced. Notably in service industries such as telecommunications and transport and logistics, ICT are essential for the development of new products/services. In the furniture industry, instead, product innovation appears to be closely linked to variables, especially those related to aesthetics, that can be fully addressed by other means than ICT.

3.6 Summary of ICT and e-business adoption

The analysis of e-business topics and adoption presented in the previous sections of chapter 3 brings about the following key findings and conclusions:

Access to ICT networks & endowment with basic infrastructure

The **quality of companies' internet access is fairly good** in the furniture sector, notably among SMEs. The share of small firms (with 10-49 employees) that say they are connected with broadband is 37% in 2007. Broadband adoption in the furniture sector is in line with the other manufacturing sectors. **Wireless LAN on the rise**: close to 50% of employees work in companies that operate a W-LAN and even 25% of small firms do. The share of companies that enable **remote access** to their computer network is about 50%. With regard to ICT and e-business skills, the vast majority of companies do not suffer from a shortage of ICT practitioners.

The share of **employees with internet access is quite low** in this sector, around one employee out of four, as the organisation of activities does not require the usage of ICT by employees in charge of most of production operations;

Size-related technological gap: rates of adoption of ICT and e-business clearly relate to scale of operations but not so remarkably as in other manufacturing sectors. Case studies provide interesting examples of innovative micro and small firms that adopted innovative solutions. Differences are more relevant among countries, although data at country level are less statistically significant.

Overall, the results form the SeBW Survey indicate that this sector is fairly well equipped in terms of basic ICT infrastructure and a good share of furniture companies is equipped to introduce more advanced forms of e-business. A major question addressed in this study is the reason why this is not occurring (see section 6.1) .

ICT and e-business for design and modelling

There is evidence that **CAD and modelling tools** are playing an increasingly important role in furniture companies of all sizes and product lines. These tools may potentially act as stepping-stones to a wider integration of the product information flow through the production process. However, this has not happened yet on a large scale: overall the CAD/CAM integration is still limited

Issues concerning **sustainability and green design** are becoming a very important part of the furniture design and production process. In response to this trend, the application of concurrent engineering techniques may improve the implementation of green production in the furniture industry.

More sophisticated systems, such as Product Lifecycle Management, seem to be limited to a small percentage of large enterprises – a finding confirmed in other manufacturing sectors such as chemical and steel production

ICT for value chain integration and process efficiency

Reduction of **lead times** and optimisation of **stocks** are key success factors for furniture manufacturers. **SCM systems** and the integration of business processes they bring about are by far the most important applications in this area. Potential benefits of SCM are

evident; however adoption and usage are still limited to larger firms while smaller players face relevant constraints and barriers. Supply chain integration is strictly dependant upon the effective implementation of internal business processes management systems - such as **ERP** - as well as the introduction of **organisational changes.**

The furniture industry handcrafting background emerges in the model of ICT and e-business adoption in this sector: mainly system automation for production, but little business management or system integration in the company or with business partners. Due to the strong "hand-working" component of the sector, integrated automation is not perceived as a must. Furniture manufacturers, mainly SMEs, should be made more sensitive to the possible advantages of business integration as a competitive advantage, as the present approach could be sustainable only for high-end, handcrafted furniture but not for mass production. To effectively compete with low labour cost countries (that can supply to the lack of business integration with low-cost personnel), European companies should be aware of the benefits of integrated systems for production management.

The business partners appear to play an important role as drivers to a first adoption of web-based exchanges, albeit at a simple level such as e-mail exchange of invoices.

ICT for marketing and sales

Advanced **e-business integration between manufacturers and independent distributors** is scarce in this industry due to the characteristics of furniture distribution networks. Smaller EU furniture manufacturers focus on production planning, stock turn improvement and reduction of out of stocks, not so much on integrating with their distribution network. e-Marketing and e-sales activities towards final customers are still limited in this sector and are aimed at providing technical and commercial information rather than actual e-commerce functions. Industry associations are active in promoting members' activities through the internet. The **lack of system integration** observed in the internal processes influences the management of all downstream operations

Case studies and the CATI Manufacturing Survey 2007 confirm **Web catalogues** as the most used web-based application. Web catalogues are seen as a kind of customer service and are not always integrated with ordering and production/distribution systems

A major issue that would increase the efficient use of ICT and e-business in the furniture industry is addressing the need for **standardisation**. Furniture manufacturers (and retailers) may benefit of improved interoperability and standardisation both for integration of business processes and for the development of B2C and B2C commerce activities. The **implementation of standards** is a controversial point: the general industry trend towards standardization does not apply to a sector where the retention of business partners is high and proprietary standards seem to work well.

ICT for innovation

There has been a significant innovation activity in the furniture industry in the past 12 months. Survey results indicate the increasingly important role of ICT for product planning and manufacturing processes, in particular in medium and large enterprises. ICT play a **crucial role** to support process innovation across all size classes. Firms representing 44% of employment in the sector have introduced ICT enabled product innovation and 67% have introduced process innovation. Even among small firms, the share of companies relying on ICT for their innovation process is quite significant (35% and 52% of firms for product and process innovation respectively).

4 Drivers and impacts of ICT adoption

4.1 Conceptual framework: the structure – conduct – performance paradigm

Adding an analytical perspective

Chapter 3 presented a descriptive assessment of the state-of-play of ICT and e-business use in the furniture industry. It focused on the diffusion of ICT-based applications and on how they are used by companies, both for internal processes and for exchanges with other organisations or consumers. This Chapter adds a more **analytical perspective** on the **impacts of ICT** adoption in the furniture industry, based on an econometric analysis. The section is organised as follows. First, it outlines a conceptual framework to assess the economic drivers and impacts of the ICT adoption. Second, it includes three sections with econometric analysis on of the relationship between ICT and three business dimensions, i.e. innovation, market structure and value chain. In the analysis, data from the e-Business Survey 2007 are used. The chapter concludes with a summary of the main results.

The standard "structure – conduct – performance" paradigm

The conceptual framework of this section is a common analytical way for all sector studies included in the Sectoral e-Business Watch project. Therefore references on the specific sectoral outcomes like retailing are based on this joint concept to make it comparable with other sectoral reports and to make them comparable in the cross-section report as well.

Economic literature suggests that the ongoing diffusion of ICT and e-business technologies and services among firms in the economy at large is a striking example of the possible dynamics of technological change and economic development (see, for example Breshnahan and Trajtenberg, 1995, Helpman, 1998a and 1998b). The adoption and diffusion of new technologies can be spurred by many different drivers and can have far-reaching consequences. Virtually all economic spheres can be affected by technologically induced changes, including innovation dynamics, productivity and growth, the development of market structures, firm performance, and the composition of the demand for labour.

As a conceptual framework for the analysis of the interplay between these characteristics, ICT diffusion and innovation, an extended **Structure – Conduct – Performance (SCP)** paradigm is adopted.[47] Developed by Mason (1939) and Bain (1951), the paradigm states that firm and industry performance is determined by the conduct of buyers and sellers, which is a function of the market structure.

The term **structure** is used here meaning "industry structure" which includes but goes beyond market structure characteristics of the original concept. The primary features of an industry's structure are related to market structure in the conventional sense: the

[47] Following the discussion with Advisory Board members, the SCP paradigm was chosen over other alternatives because it constitutes a comprehensive framework that allows to capture and study the interdependencies between sector characteristics and firms' behaviour.

number and size of supplying firms as well as the number and preferences of customers and their size in case of businesses. An important aspect of market structure dynamics is the level of ease of market entry. Further industry structure characteristics are related to products, production and production factors: the degree of product differentiation, the degree of vertical integration of production, i.e. value chain characteristic, the technologies available to the firms, the firms' cost structure (i.e. the relative importance of costs for items such as production facilities, energy, personnel), and finally the workforce composition and the demand for labour, most importantly with regard to knowledge and skills. All these characteristics determine the level of competition in the industry.

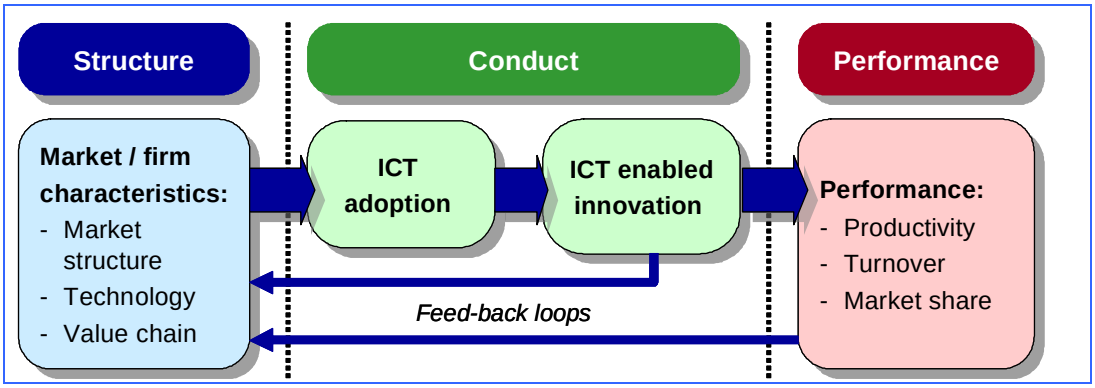
These industry structure components influence a firm's **conduct**. The conduct aspects most important here are production strategies, particularly with regard to inter-firm collaboration, as well as investments in ICT and in ICT-enabled innovation.

Finally, a firm's **performance** is assumed to be the outcome of its conduct. Successful innovations improve firm performance by, for example, reducing production cost, increasing productivity, improving product quality or enabling it to enter new markets. This may eventually lead to increased sales, turnover and market shares.

Extending the SCM paradigm: feedback effects

In contrast to the standard SCP paradigm, the flow of causality is in fact not one-directional (Fauchart and Keilbach, 2002 and Nepelski, 2003). As an example of feedback between performance and industry structure, successful and innovative companies are more likely to grow and increase their market share at the expense of less progressive firms, which transforms the market structure. There may also be feedbacks between conduct and industry structure: for example, depending on the innovation type – i.e. product or process innovation, ICT-enabled or not –, innovations influence the choice of products manufactured and a firm's cost structure. Innovations may also change the incentives to perform activities in-house versus outsourcing them and, consequently, may influence the demand for labour and its composition. It may also further shape the relationships with suppliers and customers, for example with regard to collaboration intensity. Thus, in the following discussion it is assumed that firm performance may have a feedback effect on both firm conduct and industry structure, and conduct may have a feedback on structure. This conceptualisation allows for an enhanced economic approach that studies the drivers and impacts of ICT and ICT-enabled innovations at the firm and sector level. Exhibit 4.1-1 illustrates the SCP paradigm together with the causality relationships of the elements studied in this sector report.

Exhibit 4.1-1: Conceptual framework for the analysis of e-business impacts



Source: DIW/empirica

The extended SCP paradigm defines the two dimensions of the forthcoming analysis. First, the extended SCP paradigm identifies market structure and firm characteristics that drive the diffusion of ICT and the process of turning ICT use into marketable products and production processes, i.e. ICT-enabled innovations. Second, the paradigm seeks to identify the feedback effects of firms' innovative activity on these characteristics and firm performance.

Applying the SCM paradigm to an analysis of ICT drivers and impacts

The SCM paradigm allows identifying firm and industry dimensions that can be considered as relevant for the diffusion of ICT and its impact on these dimensions. Consequently, the following elements of market and firm structure were identified as ICT drivers: market rivalry, supplier-buyer relations and workforce composition. The impact of ICT adoption and ICT enabled innovation is studied through productivity and employment as proxies for firm performance. This construct enables the understanding of not only uni-directional causal relationships but recognises the presence of firm performance impacting upon the drivers of ICT adoption.

The following analysis is based on a set of hypotheses which focus on the critical role of ICT for innovation. The hypotheses allow for an economic approach to study the impacts of ICT at the firm level for the following business dimensions: **innovation dynamics** (Section 4.2), **market structure** (Section 4.3), and **value chain characteristics** (Section 4.4). The hypotheses are tested on the basis of data from the e-Business Manufacturing Survey 2007.

In contrast to the other sectors studied in the Sectoral e-Business Watch 2007/2008, appropriate secondary sectoral data from the EU KLEMS database are not available for the furniture sector. These data are essential for an econometric analysis of impacts related to productivity and employment. Consequently, an analysis of the dimensions of productivity and employment that would complete the conceptual framework cannot be provided in the furniture industry report.

In sections 4.2 - 4.4, regression analysis is used. For methodological reasons one should be **cautious with drawing conclusions about "drivers" and "impacts" of ICT**; it is more reasonable to refer to "links" between ICT adoption and other variables. Firstly, regression analysis is a technique used for modelling and analysing data, assuming that one variable is dependent upon another single independent variable (simple regression) or several independent variables (multiple regression). Although regression can be used to analyse causal relationships, one must be cautious in drawing conclusions regarding causality, because there is typically a broad range of potential non-causal explanations of links between variables. In statistics, this is referred to as "confounding", i.e. a confounding variable is associated with both the assumed cause (independent variable) and the assumed outcome (dependent variable). Secondly, the estimation results do not allow for conclusions about the direction of causality, mainly because the dependent and the independent variables are reported for the same time period.

4.2 ICT and innovation

Introduction to ICT and innovation in the furniture industry

The role of ICT as an enabler of innovation has been analysed in Section 3.5. The main findings of this analysis is that there has been a significant innovation activity in the furniture industry in the past 12 months. Firms representing 44% of employment in the sector have introduced ICT enabled product innovation and 67% have introduced process innovation. Even among small firms, the share of companies relying on ICT for their innovation process is quite significant (35% and 52% of firms for product and process innovation respectively).

In a cross-sectoral comparison, the share of ICT-enabled process innovation in the furniture industry is broadly in line with findings for other manufacturing sectors (see Exhibit 3-5.2).

The purpose of this section is to go further in investigating the ICT-related innovation activity. It focuses on two questions. First, what are the characteristics of firms that introduce ICT-enabled innovations? In terms of the extended SCM paradigm, this question is related to the effects of industry structure on firm conduct. Second, how do ICT-enabled innovations affect firm performance and organisational change? This question is related to the effects of firm conduct on performance and industry structure.

4.2.1 Links between skills, e-collaboration and ICT-enabled innovation

Internal capacity: ICT skills positively linked with ICT-enabled innovation

Knowledge stock and skills found a firm's absorptive capacity to successfully adopt new technologies (Cohen and Levinthal, 1989). Thus, in order to develop marketable products or feasible production processes based on ICT, a firm needs to build up its knowledge stock and expertise, i.e. assets complementary to the technology applied. The most obvious example of investments in such complementary assets include investments in education and training that accompany ICT investments. In other words, firms that combine high levels of ICT on the one hand and high levels of knowledge and worker skills on the other may be more active in ICT innovation.

The case study about the Danona company (section 5-1) illustrates that the company has strongly innovated design and customer service by upgrading the technical competences of the sales team. Sales agents were trained in order to present the application (for design at the point of sale) to the main outlets retailing with the goal to detect whether any adjustment was needed. Similarly, Profim (section 5.4) and Scavolini (section 5.7) largely invested on training employees and workers to ensure the effective usage of the newly adopted applications. In contrast, one of the conclusions of the Stokke case study (Section 5.9) is that more training of sourcing partners would have been needed to ensure a quicker and more effective uptake the important innovation introduced in their logistic processes.

The following hypothesis was formulated to test the assumed importance of investments in complementary assets:

Hypothesis I.1: Furniture firms characterised by a higher share of employees with a university degree are more likely to conduct ICT-enabled innovations than firms with a lower share.

The hypothesis is tested on the basis of the following data from the e-Business Survey 2007:

- Question D2: "Have any of these product or service innovations been directly related to or enabled by information or communication technology?" (asked to companies having introduced new products / services)
- Question D4: "Have any of these process innovations been directly related to or enabled by information or communication technology?" (asked to companies having introduced new processes)

As regards questions D2 and D4, the ICT related innovation were not further specified. In the furniture sector, product innovation may range from the manufacturing of new models (including using different materials or colours) and in that case practically all manufacturers are innovative to making new products by changing productions systems, in which case very few manufacturers are innovative. For this reason, it is not possible to detect which kind of innovation business had in mind when answering to the survey question. The results provide anyway interesting insights about the link between the usage and ICT and the innovation activity.

The main explanatory variable is the share of employees with a university degree. To additionally account for the effect of internal capacity on innovation, a variable controlling for the presence of ICT practitioners was added. This should control for the effect of ICT-specific skills on a company's innovative potential. The variables are based on the following survey questions:

- Question G11: "Please estimate the percentage share of employees with a college or university degree in your company."
- Question E1: "Does your company currently employ ICT practitioners?"

Exhibit 4.2-1 reports the results of the regression.[48] An analysis of the results leads to the following conclusion.

High education and ICT skills drive ICT-enabled innovation: increases in the share of employees with a university degree positively affect the likelihood of conducting ICT-enabled innovations. Similarly, and to a larger extent, employing IT practitioners significantly increases a firm's propensity to use ICT to develop new products and services. This finding provides evidence that the success of the ICT-driven innovative process is linked to the availability and quality of complementary assets, i.e. ICT-related knowledge and skills. Not surprisingly, these results illustrate that human resources who are familiar with ICT can better exploit the ICT technologies in a creative manner. In this sector, in particular, innovation is often linked to the usage of ICT for design that requires adequate skills for full exploitation. In terms of implications, these findings may suggest the conclusion (presented in Section 6.3) that efforts should be made to encourage synergies between design and supporting technologies in this sector.

[48] Coefficient estimates indicate how changes of dependent variables influence the dependent variable. The estimation results do not allow for conclusions about the direction of causality, mainly because the dependent and the independent variables are reported for the same time period.

Exhibit 4.2-1: Effect of employee skills on ICT-enabled innovation activity

Independent variable [a]	Coefficient	Standard Error
% of employees with college or university degree (G11)	0.014***	0.004
IT practitioners (E1)	1.075***	0.143
Less than 249 employees (Z2b)	-0.256	0.320
Firm founded before 1998 (G2)	-0.195	0.136
Model diagnostics		
N = 637		
R-squared = 0.123		
Note: Probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998) a Codes in brackets refer to questions in e-Business Survey 2007. Dependent variables: D2 and D4 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

Inter-firm collaboration enhances ICT-enabled innovation

There are indications that ICT has a direct impact on process innovation in companies by facilitating links between different companies (Lee, 2000). ICT-enabled inter-organisational systems integration and collaboration may enhance the innovation capabilities of companies by providing opportunities for shared learning, transfer of technical knowledge and exchange of information.

The most obvious benefit of information exchange and integration with the help of ICT is the optimisation of the value chain. Other, less obvious consequences for firms' innovativeness can be found in tacit and knowledge-based processes. There ICT allows creating communication infrastructures facilitating production networks of knowledge workers or enables business partners to align the incentives of multiple players by creating joint business units or facilitating the work of teams on the same tasks (McAfee, 2006).

The use of electronic networks may lead to a higher probability of firms collaborating in innovative activities and it may increase the amount of collaborative relations they have (European Commission, 2004). In other words, it can be said that the use of ICT applications supporting information exchange and inter-firm collaboration constitutes necessary input for ICT-enabled innovative output, i.e. re-engineered processes, new products or distribution channels.

The e-Business survey 2007 included a few questions about inter-firm collaboration (see Section 3-3 Supply Chain Management). Overall, the level of inter-firm collaboration in this industry is quite low. Collaboration in the design of new products or services, e.g., is carried out electronically only by companies representing 17% of total employment (see Exhibit 3-3.3). Even large firms do not adopt e-collaboration on a large scale.

A few case studies, however, illustrate the importance of networking in this sector. The company Home Base (see section 5-10) implemented a Windows™-based ICT solution that allows to efficiently manage the information flows with customers, suppliers (700 contractors), warehouses and logistic contractors. The case studies IWOfurn and Webmobili (sections 5-2 and 5-8) illustrate that the establishment of an electronic

platform that brings together all the relevant players has been crucial for strengthening the market position of the participating companies.

Thus, the following hypothesis can be formulated to test the assumed importance of collaborative applications for innovative output:

Hypothesis I.2: Furniture firms that use ICT applications to exchange information or collaborate with business partners are more likely to introduce ICT enabled innovations than firms in the same sector that do not use such applications.

The hypothesis is tested on the basis of data from the e-Business Survey 2007. Again, the analysis focuses only on ICT-enabled innovations (see questions D2 and D4 in previous section). Independent variables control for the use of the following:

- Question A7: "Does your company use a Supply Chain Management system?"
- Question B9: "Does your company share information on inventory levels or production plans electronically with business partners?"
- Question B10: "Does your company use software applications other than e-mail to collaborate with business partners in the design of new products or services?"

Exhibit 4.2-2 reports the results of the regression. An analysis of the results leads to the following conclusions:

e-Collaboration increases innovative output: The use of applications and practices supporting the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations. Out of the three technologies, the use of SCM applications has the strongest effect on the firm's propensity to introduce ICT-enabled innovations. This may be due to the high importance of SCM for value generation.

Firm age a disadvantage: Firm age has negative implications for conducting ICT-enabled innovations. Within the group of firms that practice e-collaboration, firms founded before 1998 are less likely to introduce ICT enabled-innovations than firms founded 1998 onwards.

Exhibit 4.2-2: Effect of electronic collaboration with business partners on ICT-enabled innovation activity

Independent variable[a]	Coefficient	Standard Error
Use of SCM (A7)	0.635***	0.146
Share information (B9)	0.494***	0.189
Applications to collaborate (B10)	0.580***	0.150
Less than 249 employees (Z2b)	-0.331	0.274
Firm founded before 1998 (G2)	-0.223*	0.125
Model diagnostics		
N = 697		
R-squared = 0.090		
Note: Probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998). [a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variables: D2 and D4 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

The finding that ICT-enabled innovation is linked to the existence of long-standing and electronically-organised relationships with business partners is particularly relevant for this sector. Long-standing business relationships are typical of this industry, as the various activities are often organised around established networks of partners. On the other hand, the adoption of ICT and e-business supporting supply chain and internal processes automation is still limited. It may be concluded that a wider spread of these applications, could be very helpful for the competitiveness of the sector, not only –as it is commonly observed- in terms of efficiency but also for the innovation activity that it is likely to induce and support.

4.2.2 Links between ICT innovation, firm performance and organisational change

ICT-enabled innovation positively linked with firm performance

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

These somewhat ambiguous results of the impact of ICT on corporate performance can be explained if one drops the assumption that there is a direct link between ICT investments and corporate performance. The key to understanding the impacts of ICT on performance is to view ICT as an enabler of innovation (Koellinger 2006), which is the view taken in this section.

This view was confirmed in a study by Clayton and Waldron (2003) on e-commerce adoption and business impact in several industries. They found that businesses maintaining higher levels of sales of new and improved products, as a proportion of their turnover, achieve above sector average rates of sales growth. This means that these firms increase their market share due to ICT-enabled product innovation. The effect is present in both manufacturing and service sectors.

A few case studies conducted for this report confirm that ICT-enabled innovation can positively impact on firm's performance. By introducing ICT-enabled innovation in logistic operations, Stokke and Profim (sections 5.4 and 5.9) significantly reduced delivery times, a key competitive factor in this industry, as described in section 2-3.

Interestingly, services provided to business partners, or associated companies, via web platforms (RobinWood, IWOfurn, Webmobili, presented in sections 5-2, 5-6 and 5-8) seem a very suitable mean for ensuring relevant impacts on firm's performance. These cases also confirm the importance of enhancing SME participation in digital value chains.

In order to find out whether there is a positive impact of ICT-enabled innovations on firm's performance in the analysed sector, the following hypothesis is formulated:

Hypothesis I.3: ICT-enabled innovations are positively correlated with a firm's turnover.

The hypothesis is tested on the basis of data from the e-Business Survey 2007. Question G9 was: "Has the turnover of your company increased, decreased or stayed roughly the same when comparing the last financial year with the year before?" For questions D2 and D4 about innovation see the section related to Hypothesis I.1 above. Exhibit 4.2-3 reports the results of the regression. An analysis of the results leads to the following conclusion:

ICT-enabled output positively related with turnover increase: Firms with a higher incidence of ICT-enabled innovation activity are more likely to report a turnover increase, i.e. to have experienced sales growth. Although turnover increase was used as a dependant variable, this should not be read as a simple formula for success like "the more ICT-enabled innovation, the more turnover a firm will have". There are possible confounding factors such as growth of a company in general. A positive relationship might also have been obtained by exchanging the dependent and independent variables, in the sense that firms experiencing turnover growth are more likely to innovate with ICT. In any case, the results indicate that the dynamics of business growth and innovativeness are strongly linked, possibly reinforcing each other.

Exhibit 4.2-3: Effect of ICT-enabled innovation activity on turnover increase

Independent variable[a]	**Coefficient**	**Standard Error**
ICT enabled innovation (D2, D4)	0.303***	0.110
Less than 249 employees (Z2b)	0.003	0.279
Firm founded before 1998 (G2)	-0.117	0.120
Model diagnostics		
N = 697		
R-squared = 0.093		
Note: Probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998). [a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variable: G9 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

ICT diffusion drives organisational change

ICT diffusion may impact on a company's organisation, i.e. the structure of and the relationships between departments within an enterprise. Organisational changes may relate to a rearrangement of functions, workflows and importance of departments and employees working in them. Outsourcing also implies organisational changes; this subject is however dealt with in the section about value chains below.

ICT transformed the process of replicating business innovations across organisations (Brynjolfsson et al., 2006). Traditionally, deploying business innovation on a larger scale took time and required considerable involvement of resources and employees. Today, ICT allows companies to embed business innovations and then implement them across the organisation at a much smaller cost than before without compromising on quality. Every location or unit implements and follows all steps of the new process in a way specified in the software design.

The copy-exactly strategy is particularly beneficial if the initial understanding of the process is low, the lifecycle is short and the process is difficult to improve (Terwiesch and Xu, 2004). This is true for manufacturing industries with rapidly changing production

technologies and intensive technological competition. In such industries the speed of adoption of new production processes plays a decisive role for remaining at the cutting edge. On the other hand, tools, such as e-mail, knowledge management systems, wikis or instant messaging, considerably improve the process of innovation in knowledge-intensive and service-oriented sectors with informal, unstructured and spontaneous type of work, such as banking (McAfee, 2006).

Some of the case studies conducted for this report, confirm that ICT implementation requires organisational changes (see section 5-1 and 5-3 about Danona and Micuna and 5-9 about Stokke) and that these changes sometimes require to win people's resistance (Profim, section 5-4)...

ICT may facilitate firms' innovativeness by propagating innovations that are less structured than business processes. To analyse the importance of ICT for organisational change in the sector at stake, the following hypothesis is formulated:

Hypothesis I.4: ICT use is positively correlated with organisational changes.

The hypothesis is tested on the basis of the following data from the e-Business Survey 2007:

- Questions D5a-d: "During the past 12 months, has your company introduced major changes in its corporate strategy / management techniques / organisational structure / marketing concepts?" [49]

In order to account for various effects of different ICT components on organisations, explanatory variables include:

- *Infrastructure endowment index* that comprises of hardware components used by a firm and includes the share of employees with an internet access at their workplace, internet connection capacity and the use of LAN, Intranet and Extranet.
- *Software endowment index* that comprises of software applications used by a firm. The index includes the following applications: a software application to manage the placing or receipt of orders, ERM, SCM, CRM and the use of the internet to buy and sell goods.
- *ICT human capital variable* that controls for the presence of ICT practitioners.

In addition, the regression includes dummy variables controlling for the percentage of employees with a higher university degree, firm size, age and country of origin. To analyse the relationship between ICT-enabled innovation and the use of electronic data and information exchange between business partners, an ordered logit regression was run.[50] Exhibit 4.2-4 reports the results of the regression. An analysis of the results leads to the following conclusions:

[49] For each positive answer a firm scores one point. Consequently, the dependent variable takes a value between "0", if a company did not carry out any of the listed changes, and "4" if it undertook all of them.

[50] Similar to probit/logit regressions, ordered logit model is used when the dependent variable is ordinal. In contrast, however, to probit/logit an ordered logit model can be applied if the dependent variable has more than two levels.

ICT hardware endowment, measured in terms of network infrastructure usage and internet access, increases weakly the likelihood of introducing organisational changes.

Software use drives organisational changes: The intensity of ICT applications use is one of the major drivers of organisational changes. This together with the previous result indicates that ICT soft- and hardware have different implications for companies' conduct and performance. Whereas hardware is a necessary condition for an efficient ICT use, it is not a sufficient condition for business transformation. It is rather innovative software that enables firms to rearrange their operations, functions and workflows, i.e. find innovative ways of doing business.

Employees' skills important: The likelihood of a firm to introduce organisational changes increases with the share of employees with a higher university degree.

Exhibit 4.2-4: ICT use and organizational change

Independent variable[a]	**Coefficient**	**Standard Error**
Infrastructure index (A2, A3, A4)	0.012***	0.004
Software index (A6, A7, B1, B3)	0.221***	0.069
IT practitioners (E1)	0.191	0.233
% of employees with higher university degree (G11)	0.018***	0.007
Less than 249 employees (G2)	-0.467	0.495
Firm founded before 1998 (Z2b)	-0.326	0.221
Model diagnostics		
Number of observations = 485		
R-squared = 0.061		
Note: Ordered probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998).		
[a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variable: D5		
Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

This result has important implications, illustrated in section 6.3. The improvement of e-business skills related to the re-organisation of working processes and procedures is fundamental for the deployment and the exploitation of innovative ICT solutions.

4.2.3 Overview of results on ICT and innovation

The analysis about drivers and impacts of ICT-enabled innovation in the furniture industry highlights some interesting findings:

Hypothesis I.1 *"Furniture firms characterised by a higher share of employees with a university degree are more likely to conduct ICT-enabled innovations than firms with a lower share"* **is confirmed**. The ICT-driven innovative process is linked to the share of employees with university degree and of ICT practitioners .

Hypothesis I.2 *"Furniture firms that use ICT applications to exchange information or collaborate with business partners are more likely to introduce ICT enabled innovations than firms in the same sector that do not use such applications"* **is confirmed**. The use of applications and practices supporting the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations.

Hypothesis I.3 ***"****ICT-enabled innovations are positively correlated with a firm's turnover"* **is confirmed**. Firms with a higher incidence of ICT-enabled innovation activity are more likely to report a turnover increase, i.e. to have experienced sales growth.

Hypothesis I.4 *"ICT use is positively correlated with organisational changes"* **is confirmed**. However ICT hardware endowment, increases weakly the likelihood of introducing organisational changes, while software use drives organisational changes. Innovative software applications enable firms to rearrange their operations, functions and workflows, i.e. find innovative ways of doing business. The likelihood of a firm to introduce organisational changes increases with the share of employees with a higher university degree.

4.3 ICT and market structure

Introduction to ICT and market structure in the furniture industry

This section analyses ICT diffusion with respect to market structure. It focuses on two questions. First, does the structure of product markets and, in particular, the competition affect the pace of ICT adoption, i.e. firm conduct? Second, how does firm conduct with respect to the technology adoption affect corporate performance in terms of the firm's market position?

The e-Business Survey 2007 included a set of questions about the companies' perception of competition. Findings presented in section 2-3 indicate that furniture firms operate in a highly competitive, quickly changing and hardly predictable context and have limited knowledge on how to control their competitive environment (see Exhibit 2-16).

The survey also investigated the perceived impact of ICT on competition. According to the results of the SeBW survey (Exhibit 2-18), less than half the companies think that ICT has a relevant influence on competition in this sector. The share slightly increases among large firms and in some countries, but overall, this picture highlights the fact that

4.3.1 Market structure and ICT diffusion

The effect of market competition on the adoption of ICT was investigated through the econometric analysis and the following hypothesis was formulated:

Hypothesis M.1: Increasing rivalry in the market is a driver for the adoption of ICT.

The hypothesis is tested on the basis of the following data from the e-Business Survey 2007:

- Question G8a: "Please describe the type of competition in your main market. Do you agree that rivalry in the market is increasing?" (Independent variable.)
- Index on ICT endowment, based on several variables on ICT usage, including: the use of LAN, WLAN, WWW, Intranet, Extranet, ERP, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners. (Dependent variable.)

Exhibit 4.3-1 reports the results of the regression. An analysis of the results leads to the following conclusions:

Importance of increasing market rivalry for ICT usage is not confirmed. The hypothesised relevance of increasing market competition for the intensity of ICT adoption was not confirmed. In other words: furniture firms that do not experience increasing competition may nevertheless invest strongly in ICT, and firms that do experience increasing competition may not invest in ICT.

Firm size has a strong influence: Firms with less than 250 employees that perceive increasing market rivalry have a significantly lower ICT endowment than firms with 250 or more employees perceiving market rivalry

Not surprisingly, the findings of the econometric analysis confirm that ICT and e-business are not a priority in response to competition. This can be explained by two main reasons: on the one hand, there is strong competitive pressure (even in terms of survival), for which furniture firms are more focused on other concerns – such as market fluctuations, slowly growing and unstable demand, and fierce international competition from low cost countries. Moreover, there is a lack of "pull" potential from distribution chains and business partners. This scenario should normally spur the use of ICT but, conversely, is also diverting resources to other goals.

Exhibit 4.3-1: Market rivalry and the intensity of ICT use

Independent variable[a]	Coefficient	Standard Error
Increasing rivalry (G8a)	0.276	0.284
Less than 249 employees (G2)	-2.046***	0.708
Firm founded before 1998 (Z2b)	-0.451	0.319
Model diagnostics		
N = 697		
R-squared = 0.058		
Note: OLS regression. [a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variables (index): A2, A3, A4, A6, A7, B1 and B3 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

4.3.2 ICT impact on market structure

Historically, distance to market and transportation cost limited the number of customers a firm could reach. At the beginning of the internet era, a common believe was that ICT and e-commerce were to eliminate the limitations of location and enable firms to expand regardless of geographical locations (Cairncross 1997).

One example of how ICT allows firms to expand their operations and change the structure of existing markets, or create new ones, are entries of internet start-ups. Amazon or eBay are already icons of e-commerce that changed the landscape of the retailing industry. Though of a smaller magnitude, these effects hold for traditional shops as well.

ICT offers existing firms possibilities to expand their market reach, which consequently leads to market structure changes as well. This can be illustrated by the way ICT enables companies to cross boundaries of their markets and industries. An example for blurring lines between sectors and a possible thread for retailing comes from manufacturing firms

like Dell. This firm uses ICT to surpass the whole retailing sector and to sell their goods directly to customers instead of depending on a network of retailers. As illustrated in chapter 2 and in section 3.5, these changes have taken place to a limited extent also in the furniture sector, where most commercial activities are still carried out in a traditional way, with limited networking support. In this section, in order to assess the relationship between ICT and the changes of market structure, the following hypothesis is formulated:

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

The hypothesis is tested on the basis of the following data from the e-Business Survey 2007:

- Question G7: "Has the share of your company in this market increased, decreased, or stayed roughly the same over the past 12 months?" (Dependent variable.)
- The explanatory variable controlling for a firm's ICT endowment level is an index composed of answers to the questions regarding the internet connection type, the use of LAN, WLAN, WWW, Intranet, Extranet, ERP, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners.

Exhibit 4.3-2 reports the results of the regression. An analysis of the results leads to the following conclusions:

ICT effect on market share is not confirmed: The hypothesis that ICT endowment enables firms to extend their market share was not confirmed. This means that furniture firms that are well-endowed with ICT may nevertheless not be able to increase their market share, and firms with a small level of ICT use may nevertheless be able to increase their market share. This result confirms the empirical observation that the usage and exploitation of ICT for gaining competitive advantages in the furniture sector is quite limited, for the reasons described in section 4.3.1.

With regard to this specific question a doubt may raise that there have been inconsistencies in the understanding of the concept of "market share". First, this question lacked the definition of *which*[51] market, the question referred to; a generic definition may have led to different understanding of this issue and of subsequent answers. Second, this is a very fragmented industry, therefore –even in case the concept were clear- medium and small firms may not be in a position to estimate the actual market share.

The case studies conducted for this report indicate that there might be exceptions. An example of successful furniture e-commerce is given in the Quatuor case study (section 5-5). This success is directly linked to Quatuor's website. Firstly designed to be a communication and online catalogue, the website became progressively an e-shop. An indirect effect of ICT adoption on market share is also witnessed in the Webmobili case study (section 5-8) as well as in other initiatives aimed at e-cataloguing.

[51] The concept of market share is not univocal as *market* could be defined in different ways: it may refer to the geographical coverage (domestic, regional, international), different sub-sectors or market channels and a firm may record different performances over the different *markets.*

Exhibit 4.3-2: The intensity of ICT use and change in the market share

Independent variable[a]	Coefficient	Standard Error
ICT endowment (A2, A3, A4, A6, A7, B1, B3)	0.023	0.228
Firm founded before 1998 (Z2b)	-0.237	0.190
Less than 249 employees (G2)	-0.010	0.430
Model diagnostics		
N = 659		
R-squared = 0.017		
Note: Ordered probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998). [a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variable: G7 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

4.3.3 Overview of results on ICT and market structure

Summarising the results of the econometric testing of hypotheses on ICT and market structure, the two hypotheses were not confirmed

Hypothesis M.1: "*Increasing rivalry in the market is a driver for the adoption of ICT", **is not confirmed.*** The analysis indicates that no clear links can be detected between ICT diffusion and increasing rivalry in the market.

Hypothesis M.2: "*ICT endowment is positively correlated with a change of market share"* **is not confirmed.**

4.4 ICT and the sector value chain

This section analyses ICT diffusion with respect to the furniture industry's value chain. It focuses on the question whether ICT use affects the firms' decisions regarding 'make or buy', i.e. outsourcing decisions. This question is related to the effects of firm conduct on industry structure.

ICT diffusion and outsourcing

In light of the transaction cost theory, decreasing costs of search, evaluation and monitoring of suppliers should lead to a shift away from firms and toward markets as a form of organising economic activity (Coase 1937, and Williamson, 1985). Consequently, the expectations regarding the potential of ICT as technologies introducing innovative ways of doing business, re-shaping firm boundaries and changing the constellations of value chains were enormous (see, for example, Johnston et al., 1988, Johnston et al., 1988a, Milgrom et al., 1990, Fulk et al., 1995). The availability of powerful and cheap ICT was said to increase the attractiveness of markets (Malone et al., 1987 and Lucking-Reiley et al., 2001). The authors of the move to the market paradigm argued that companies would reduce their dependency on hierarchy and outsource business activities.

In the e-Business Survey 2007, firms were asked whether they had, in the past twelve months, outsourced any business activity. The propensity to outsource business activities is quite low: companies representing only 14% of the sector employment have outsourced business activities. The case studies conducted for this report, include two examples of outsourcing, both regard logistic operations (Micuna and Stokke, sections 5.3 and 5.9). To test whether ICT leads to more outsourcing in the analysed sector, the following hypothesis is formulated:

Hypothesis V.1: ICT endowment is positively correlated with outsourcing.

The hypothesis was tested with the following data from the e-Business Survey 2007:

- Question G22: "Has your company outsourced any business activities in the past 12 months which were previously conducted in-house?" (Dependent variable.)
- Index on ICT endowment, composed of answers to the questions regarding the internet connection type, the use of LAN, WLAN, WWW, Intranet, Extranet, ERP, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners.

Exhibit 4.4-1 reports the results of the regression. An analysis of the results leads to the following conclusion:

Intense ICT use is positively related to the outsourcing of business activities. The more advanced a company is in terms of ICT use, the more likely it is to have outsourced some business activities in the last twelve months. This provides support to the hypothesis that ICT and make-or-buy decisions are interrelated, although it is not possible to establish the direction of this link

In other words, it is not possible to say whether the intense usage of ICT drives outsourcing or the necessity to outsource activities is a driver to the adoption of ICT. The empirical evidence from case studies suggests that the strategic decision to outsource activities is more likely to drive the adoption of the necessary ICT technologies, rather than the other way round. The case study about Stokke (section 5.10) is a good example of such a circumstance. Stokke decided to organise warehouse operations in one outsourced location. Following this strategic decision, the company implemented an e-business solution that aimed at supporting the outsourced activities. This conclusion is also supported by the general finding (section 6.1) for which, in this industry, firms tend to adopt a selective approach to ICT, adopting -if and only- those solutions that suit specific and actual needs and requirements.

Exhibit 4.4-1: The intensity of ICT use and outsourcing

Independent variable[a]	**Coefficient**	**Standard Error**
ICT endowment (A2, A3, A4, A6, A7, B1, B3)	0.048***	0.018
Less than 249 employees (G2)	-0.086	0.346
Firm founded before 1998 (Z2b)	0.052	0.152
Model diagnostics		
N = 651		
R-squared = 0.050		
Note: Probit estimates. Reference groups: firms with >250 employees (reference group for firms with <249 employees), firms founded after 1998 (for firms founded before 1998). [a] Codes in brackets refer to questions in e-Business Survey 2007. Dependent variable: G22 Significance levels: * 90%, ** 95%, *** 99%. Coefficients with no asterisk indicate no relationship.		

Source: Sectoral e-Business Watch, DIW Berlin (2008)

Overview of results on ICT and outsourcing

Summarising the results of the econometric testing of hypotheses on ICT and outsourcing, the analysis pointed the following main findings:

Hypothesis V.1: "*ICT endowment is positively correlated with outsourcing,* ***is confirmed*****.** ICT and make-or-buy decisions are related, although it is not possible to establish the direction of this link.

4.5 Summary of impact analysis

The analysis in chapter 4 follows the logic of an extended "structure – conduct – performance" concept. This concept assumes that an industry's structure determines the conduct of the firms in the industry, and the firms' conduct determines their performance. There are feedback effects: both firms' conduct and their performance may impact on the industry's structure. Findings for chapter 4 show that ICT and e-business have considerable impacts on the furniture industry, although they do not change the market structure.

The analysis in this chapter was conducted along the following types of impacts: innovation, market structure, and value chains. The following conclusions were drawn from an econometric analysis, the e-Business Survey 2007, case studies conducted for this report and literature evaluation:

- **Innovation**: In the furniture industry, ICT impact appears to be significant both for product innovation and, most importantly, for process innovation. Many case studies conducted for this report confirm that ICT can be considered as an enabler of innovation and positively impact on firm performance. The ICT-driven innovative process is linked to the share of employees with university degree and of ICT practitioners. The use of applications and practices that support the electronic exchange of information between companies positively affects the likelihood of conducting ICT-enabled innovations. As regards impacts, the analysis found that ICT software is the most important driver of organisational changes.
- **Market structure**: In the furniture industry, the effect of ICT on market structure is not proved. The hypothesised relevance of increasing market competition for the intensity of ICT adoption was not confirmed. Similarly, there is no evidence that ICT endowment is positively correlated with a change of market share. Examples from case studies indicate that there might be –obviously- exception to this rule. However, the overall impact of ICT on the furniture industry structure is limited.
- **Value chains**: As regards outsourcing, the econometric analysis found that ICT intensity indeed increases the propensity to outsource business activities. ICT and make-or-buy decisions are related, although it is not possible to establish the direction of this link.

5 Case studies

Introduction and overview

The case studies summarised in Exhibit 5.1 – together with analysis of secondary literature, business examples and survey results – build the basis for conclusions and policy implications presented in chapter 6 of this report.

Exhibit 5-1: Case studies and business examples presented in this report

No.	Case title	Country	Case focus
1	e-Sales and e-Communication at Danona	Spain	**e-Sales and e-communication:** The case study describes the process for designing and implementing a software application that allows the design of furniture at the point of sale with the aim to enhance customer service.
2	IWOfurn, **I**ntegrated **Wo**rld of **Furn**iture	Germany	**e-Marketing, e-sales and e-communication:** IWOfurn is a B2B web portal for the European furniture Industry. It operates as a marketing and communication service and as an e-commerce platform aimed at connecting manufacturers and retailers.
3	Micuna, automation of logistics	Spain	**Supply Chain Management, RFID:** The case describes the migration process from manual warehouse procedures to their fully computerised management, with renewal of the information and communications systems between the production plant and the warehouse.
4	Benefits of ICT and e-business at Profim	Poland	**ERP, CRM, e-communication with customers:** An integrated ERP system encompassing all areas of business. Significant impacts achieved on company production, logistics and relations with clients leading to shorter delivery times, lower costs, less overstocking and improved customer service.
5	e-Communication and e-sales at Quatuor	Belgium	**e-Communication and e-sales:** A web site for communication and e-sales, keeping good quality services and personalised contact with clients as key success factors
6	RobinWood.at: web platform and a B2B channel	Austria	**On-line platform, e-distribution, and e-communication:** An online planning, ordering and calculation web platform for small joineries and furniture studios as new B2B Channel at Schmidhuber, Austria
7	Scavolini, intranet for internal document management	Italy	**e-Invoicing:** Intranet application for internal document management with the aim to improve information flows, rationalise document management activities and increase productivity
8	Webmobili, the furniture search engine	Italy	**e-Marketing and e-communication:** A search engine that provides consumers with a comprehensive point of information about the national available offer of medium-high range furniture and related items
9	e-Business and B2b integration to sourced warehouse at Stokke	Norway	**ERP – Enterprise Resource Planning, e-Sales, ICT and e-business impacts on work processes:** The case study focuses on the implementation of e-business solutions in the area of warehouse and outbound logistics
10	e-Communication with suppliers and distributors at Home Base	Denmark	**e-Communication with suppliers and distributors, AutoCAD, ERP:** The case study shows how an ICT system facilitates a business model organised around efficient information flow within the whole operation from the design process and customer orders to production and delivery.

Case studies have been selected as they deal with the topics analysed in chapters 3 of this report and illustrate the adoption of ICT and e-business solutions investigated through the e-Business Watch survey. Experiences come from different countries and include firms of different size.

Danona and RobinWood provide interesting examples of **integration of design activities** with production and sales. They are particularly interesting as both are examples of customer-driven integration.

The complex issue of **supply chain integration** is illustrated by the examples of Micuna, Profim, Home Base and Scavolini. Stokke is about an outsourcing strategy in the area of warehouse and logistics.

Finally, there are a few examples of the usage of the web for **communication and marketing** purposes (Quatuor, Webmobili) as well as of actual e-sales (Quatuor and IWOfurn).

Case studies also match some of the hypotheses described in Chapter 4 as they provide examples of how ICT can impact on companies' performances. The RobinWood case study, e.g., highlights the usage of ICT for increasing the customer base and improving the relationships with intermediate and final customers. In the Quatuor case study, there are indications of the importance of skills and innovation on company's performance. Another example is Scavolini, where productivity of internal processes was induced by the introduction of ICT based process innovation. In Micuna, the positive effects of ICT on the company's supply chain performance are illustrated.

5.1 e-Sales and e-Communication at Danona, Spain

Abstract

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

Case study fact sheet

■ *Full name of the company:*	*Danona Sociedad Cooperativa*
■ *Location (HQ / main branches):*	*Azpeitia (Guipúzcoa), Spain*
■ *Main business activity:*	*Production of household furniture*
■ *Year of foundation:*	*1962*
■ *Number of employees:*	*250*
■ *Turnover in last financial year:*	*38,000,000 euros*
■ *Primary customers:*	*Furniture retail chains, purchase group, independent sales outlets*
■ *Most significant geographic market:*	*Spain, France, Russia and Australia*
■ *Main e-business applications studied:*	*e-Sales, e-Communication with customers*

5.1.1 Background and objectives

Danona Sociedad Cooperativa is a company dedicated to the manufacture and marketing of household furniture located in Spain. It is currently a member of Mondragón Corporación Cooperativa

The idea for the project described hereby arose from the interest Danona showed in 2001-2002 in the possibilities offered by 3D Computer Assisted Design at points of sale for furniture, above all regarding the presentation of products to the end customer. The company has always sought to maintain an innovative approach in such dealings, and its aim here was to gain an advantage over its competitors.

Danona had been working with the firm Sofland, an ICT service provider, for some time, receiving advice on ICT technology matters and R&D. Sofland was the one that prompted this interest.

The project was launched in 2003 and the initial outputs were available in the same year. In view of the success of these first results, the project has been prolonged up to the present, with a series of improvements made over the course of these years.

The project's main goals are as follows:

- To improve customer service (points of sale), providing the option of an easier and quicker choice of the products put on sale
- To reinforce the positioning of the Danona product at the point of sale
- To achieve differentiation as regards competitors
- To facilitate the work of Danona sales representatives.

5.1.2 e-Business activity

Project description

The project involves developing a software application for the design of made-to-measure furniture according to the different parts that make up each product, with the option of choosing different colours and other product features such as materials.

This would mean that both the company's sales representatives, when presenting the catalogue to the points of sale, and the actual retail outlets themselves, would have a tool to facilitate their work and improve the way in which products are presented.

Product launch: preliminary version

The process for launching the product was straightforward. This was helped by the free-flowing contact between Danona and Sofland, as technology adviser and provider.

An initial timeframe was established during which Sofland set about preparing a first version of the software application to be implemented in 2002. It was a simple version, but it already allowed to create models and it proved to be very useful. This version had the following functions:

- 3D display allowing for models of products to be created according to the different parts involved.
- Colour choice option.
- Pre-selection was made of a series of settings/decors in which the product could be positioned and seen.

It should be noted that this first version allowed for modelling in only one Danona product line.

In 2002, Danona's sales representatives began to present the application to the main outlets retailing its products with a view to analysing whether any adjustments needed to be made to the hardware at these points of sale. It should be stressed that these outlets were extremely diversified in terms of computer types and models, which meant that it was vital to opt for a simple software tool. Specifically, it was designed using an Access Database, which did not interfere with existing IT systems in the outlets. Accordingly, all a retail outlet needed to do to operate with this software tool was to copy a file onto its computer.

Throughout 2002 all Danona product lines were included as well as those of its subsidiary Leroa, in this new software application. It should be stressed that adding a new product line, with an average of 500 references, involved three weeks of work.

Between 2002 and 2005, regular meetings were held between the heads of the Sales and Product Design Departments at Danona and Sofland, the purpose being to regularly monitor the project's development and correct any problems that appeared in its implementation, mainly at the points of sale. The sales reps played a key role in this monitoring process, being the ones in direct contact with customers.

The meetings led to a series of four-monthly upgrades of the first version, incorporating new features and the ironing out of any errors that had been detected. The set-up phase demonstrated the importance of involving end users for the successful development of the initiative.

New 2005 version

As a result of the work undertaken over the 2002-2005 period, the decision was taken to launch a new version of the software at the end of 2005, which would include new features. The following were the main improvements:

- Allowing different product lines to be combined when creating models.
- Increasing the range of settings, in order to achieve a better view of the product in the place where it was to be located.
- Including the option of designing modules, in other words, being able to cut the parts to build a customised piece of furniture.
- Option of exporting the models created to other virtual reality software formats in order to broaden the available solutions.
- Option of preparing orders and submitting them to the company's ERP, albeit solely on an internal basis, that is, by the sales reps.

Likewise, work proceeded on incorporating new items in the catalogue to the software application. This new version is the one currently in use, but work is under way in 2007 on an upgrade, which will add new features to those already existing.

Project costs

From the start of the project (2002) through to the present, the costs have amounted to around 120,000 euros. This figure includes the different versions made since the launch, as well as the work involved in extending the application to include Danona's various catalogues from 2002 to the present.

Personnel involved

The first phase of the project involved the following departments at Danona:

- Sales Department
- Product Design Department

In addition, the launching of the project and the process of upgrading, adjusting and improving it have involved the 15 sales reps at Danona.

Technology used

The technology used consists of:

- Customised programming, with C++ programming language
- Open GL 3D object viewer
- Access Databases

5.1.3 Impact

The project's main impacts have been:

- Reinforcement of the Danona product's market positioning at the point of sales, by providing a powerful tool for presenting and "creating" products
- Enhancement of the Danona brand image through enhanced differentiation of products and services
- Better service provided to customer points of sale
- Reduction in the time sales reps spend presenting catalogues
- Generation of know-how on the way of presenting catalogues

5.1.4 Lessons learned

The main lessons learned are:

- The simplicity of the software application chosen has been vital to the project's success. This has meant that its implementation and use have not required a major effort either for the company or for its point of sale customers.
- The choice of a customised programme, tailored to meet the company's needs and requirements, was important for the project's success.
- The relationship between the client company and the technology provider is of key importance, as the long standing relationship allowed building trust.
- The hands-on involvement of Danona sales reps right from the project's very onset has been very important, relaying suggestions and problems detected in the software application to those responsible for the project.

This case study is interesting as it provides an example of the potential of 3D technologies not only for product development but also for improving the overall efficiency in generating product information needed for the manufacturing of furniture pieces. 3D CAD systems have a quite good penetration in the furniture industry: according to the CATI Manufacturing Survey 2007, 37% of European furniture manufacturers (a percentage that grows to 70% when large firms such as Danona are considered) have implemented this kind of technology. The recorded impacts, such as reduction of lead times, better customer service and enhanced know-how are in line with the hypothesis about ICT-enabled innovation presented in section 4.1. The reinforcement of product image is also a key impact.

5.1.5 References

Research for this case study was conducted by DBK, S.A. C/Juan Bravo, 3. Edificio C. 28034 Madrid, on behalf of the Sectoral e-Business Watch. Sources and references:

- Telephone interview with Javier Arellano, Sales Director at Danona (13 September 2007).
- Telephone interview with Yon Fernández (Sofland) (17 September 2007).
- Websites:
  - Danona, http://www.danona.com
  - Sofland: www.softlanddigital.com (last access September 2007))
  - Mondragón Corporación Cooperativa: www.mcc.es
  - Technology Institute for Furniture, Wood, Packaging and Related Items (AIDIMA), http://www.aidima.es

5.2 IWOfurn, Integrated World of Furniture, Germany

Abstract

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

Case study fact sheet

■ *Full name of the company:*	*IWOfurn Service GmbH*
■ *Location (HQ / main branches):*	*Weil im Schönbuch, Germany*
■ *Main business activity:*	*Consulting, marketing, collection of technical requirements from companies of the furniture sector, management of the IWOfurn B2B portal*
■ *Year of foundation:*	*1.6.2007*
■ *Number of employees:*	*15*
■ *Turnover in last financial year:*	*Not available yet. Former 1eEurope GmbH*
■ *Primary customers:*	*Manufacturers and retailers in the furniture sector*
■ *Most significant geographic market:*	*Europe*
■ *Main e-business applications studied:*	*e-Marketing, e-Sales, e-Communication with Customers*

5.2.1 Background and objectives

Background

IWOfurn is resulting from a project initiative of FENA, the European Federation of Furniture Retailers, a non-profit organisation of furniture retail, the members of which are represented by the national trade organisations from Germany, Austria, France, the Netherlands, Belgium, Italy, Spain, Portugal and Switzerland. The technical and organisational planning for IWOfurn was initiated by FENA with the primary aim to enable the European furniture operators to electronically exchange data and information. The portal has been developing into a complex and scalable solution and the commercial development of the platform services was taken over by FENAnet Service GmbH in 2006, which turned into IWOfurn Service GmbH on June 1st 2007.

About IWOfurn Service GmbH

The main activity of IWOfurn Service GmbH is to supply consultancy to the operators of the furniture industry in Germany and in Europe. The company is responsible for technological and marketing management of the IWOfurn platform. Besides that, IWOfurn Service GmbH also organises steering committees at a European level, with the aim to collaborate with national industrial and retail representatives and associations, and in order to discuss their market and technological requirements. Two major consortia have been set up by IWOfurn Service GmbH: the IWOfurn user group, which brings together retailers and manufacturers, meeting twice a year to discuss technologies and market requirements and the ad hoc groups dedicated to specific technological issues. Within IWOfurn there is also a partner acquisition team mainly addressing retailers with the aim to motivate their business partners as e.g. suppliers towards the use of the IWOfurn platform and electronic information exchange in general.

Objectives

The fundamental role of e-business in the furniture sector was the driving force for the implementation of the IWOfurn B2B platform (www.IWOfurn.com).

Exhibit 5.2-1: IWOfurn B2B platform sreenshot

Source: ***www.IWOfurn.com***

The furniture retail market includes a huge variety of products, from furniture to accessories of any kind. This characteristic of the furniture market offered an opportunity to look for technological solutions able to cover all product categories and to reduce the redundancy of data management with the ultimate goal to improve the quality of information, standardise product catalogues to make them easily accessible to all user groups, increase business exchanges among partners and finally increase the competitive positioning of both big groups and SMEs, the latter representing a considerable share of the furniture market in Europe. A high level of expectations regarding the ability of integration of different user groups and technology under the light

of cost effective support and maintenance were the foundations for a successful realisation of the portal.

5.2.2 e-Business activity

Timing of the activity

The solution has been operational since the end of 2005 and is being constantly developed to offer additional services to its registered members. At the beginning the system offered only basic functions, such as company and catalogues presentation; a large number of functionalities have been added to implement the business workflows up to its current version including an ordering system (the B2B shop). Future plans aim to integrate the solution with additional services, such as logistics and financial services, as well as specific marketing and event services, in order to give the companies a possibility to enlarge their sales channels and markets throughout Europe.

Cost of the activity

Since its start-up in 2003, 3,000 man days were spent for the development and implementation of the solution with a 2.5 million euros investment, including both the purchasing of the technological infrastructure and the development of the content. The system requires constant maintenance in terms of both technological and editorial issues. The technological maintenance is carried out by 1eEurope Deutschland GmbH (the shareholders of which are the same of IWOfurn Service GmbH); the technological maintenance as well as any investment in new technological infrastructures are directly paid by IWOfurn. IWOfurn is responsible for the updating of the standard web contents, while in case of data contents (i.e. structured data like catalogues), IWOfurn offers its members/users the possibility to maintain their data by themselves, by either using an Integration Toolkit IWOfurn offers for free, or by service providers they choose.

e-Business to efficiently manage workflows

IWOfurn connects companies, information and workflows efficiently. Data can either be exchanged without redundancies on the internet portal or between integrated systems such as ERP solutions and retailing software packages.

Through the IWOfurn platform, registered companies have the possibility to present themselves through a detailed company profile, upload brochures, presentations and catalogues, contact IWOfurn users and manage mailing-lists within the community.

All users have the possibility to select companies by company type, company name, country, state of registration and then easily access their presentation/company profiles. The system furthermore indicates if the selected company is IWOfurn certified for specific workflow functionalities (catalogue exchange or exchange of transactions e.g. orders or invoices). Additional functionalities of the portal (for example, catalogues browsing, mailing functionalities, e-commerce operations) are accessible only through registration.

Four services provide all necessary modules to handle retailers' requests to furniture suppliers:

- Catalogue exchange with the retailers including downloads in their retail software. Retailers with local software solutions can download the catalogues and place orders through their system, or smaller retailers using online services can be supplied with the B2B shop;
- B2B shop, a product information and ordering system mainly addressed to small retailers;
- EDI clearing centre service for conversion of all transactions and messages sent to all target groups with the aim to reach a maximum connectivity between manufacturers and retailers;
- WebEDI & tracking solutions - for cost efficient EDI messaging and for tracking and tracing transaction information within the online portal.
- Two basic service functionalities are offered to the retailers:
- Download of the catalogues, online search for interesting suppliers and products, browsing through catalogues, contacting the suppliers directly
- Ordering through the B2B shop (or webshop), for suppliers who offer this option.

Technology used

The requirements for integration of different user groups and technology in the light of cost effective support and maintenance, with the aim to offer cheap scalable solutions, were the reasons for the technical partner 1eEurope to migrate the existing solution platform with a complete rewrite, based on the Miscrsoft.net framework. The resulting solution modules are now used in maximum complexity as basis of IWOfurn and were awarded with the third prize for “best vertical solution” in the Microsoft.net Solution Awards.

Moreover leading providers of software for retail – SHD Holding GmbH and Cogito Retail GmbH & Co. KG – are IWOfurn certified partners and have successfully accomplished the integration of their software packages. The online planning system by Crystal Design, was successfully certified for the “Online POS Integration”. Suppliers can offer it for the configuration of products instead of the IWOfurn standard configuration, to their retailers thus offering an increasing flexibility of the platform.

The situation today and e-business future implementation

The portal can now count on 100 registered members among representative companies of the furniture retailing and industry at a European level: this leads to a recognisable potential for both industrial and retailing partners.

At present, the first integration package containing, catalogue exchange and transactional workflow processing, has been successfully deployed. Additional packages are available or planned for deployment:

- e-billing, including the possibility of electronic signature,
- additional services in the value chain, i.e. increased functionalities for the manufacturers (logistics, warehousing, financial services),
- use of new technologies, RFID in particular, as a means to trace and track for example the transport and logistics areas.

Communication activities are particularly important for IWOfurn Service GmbH and are performed through mailing campaigns, directly addressed to sector companies, newsletters, articles in the press (both specialised magazines and newspapers), organisation of events involving FENA members, the co-operation with GS1 Germany (a leading global organisation dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility in supply and demand chains) and with the support of software vendors informing their customers about the IWOfurn platform.

The CATI Manufacturing Survey 2007 shows, however, that IWOfurn is a "good practice" example not widely followed in the EU: according to the survey results, only 32% of European furniture manufacturers offer to customers the possibility to order goods or services via the Internet (exhibit 3.4-2)

5.2.3 Impact

The major potential impacts are to be analysed directly on the business activities of the companies joining the IWOfurn platform. Since IWOfurn is a relatively young initiative, it is difficult to measure concrete impacts at present.

Expected impacts for registered companies are, in general terms: acceleration of workflows, cost optimisation and improvement of quality and creation of new sales channels throughout Europe.

More specifically, possible impacts for retailers are:

- widening of their assortments and optimisation of their workflow (searching products and ordering, downloading catalogues, contacting suppliers),
- possibility to run their business through a cost-efficient solution
- finding new suppliers.

Possible impacts for suppliers are:

- growth of sales by making themselves visible towards new retailers and retail chains, also widening their international sales areas,
- optimisation of their business process management with the possibility to integrate their existing ERP solutions,
- strengthening their customer relationships.

5.2.4 Lessons learned

The IWOfurn platform is a user-friendly solution, based on the final users' requirements. A lesson to be learned from the IWOfurn case is to develop technological solutions first of all able to satisfy the users' requirements. One of the most important sector stakeholders' needs is to receive up-to-date information; IWOfurn objective is to provide most recent or even real-time information regarding products, order management and tracking. Flexibility is another important need IWOfurn is satisfying; the platform flexibility allows companies with their own existing ERP systems to integrate with web-based solutions.

Besides that, as in the case of the most successful web platforms, IWOfurn is a complete and comprehensive solution portfolio, not only solving a single problem but a number of issues (order, financial, transport, logistics services). The IWOfurn structure is consolidating as a key to efficient business process management and optimisation.

The idea to find out solutions and modules to be used as sector standards is another important lesson to be learned in such a fragmented sector, as the furniture one, characterised by product differentiation, where standardisation has become a sensible issue.

5.2.5 References

This case study was conducted by Elisabeth Schmid, Databank S.p.A. on behalf of the Sectoral e-Business Watch.

References:

- Interview with Mr. Klaus Bröhl, Managing Director of IWOfurn Service GmbH, 18 July 2007
- Website:
  - IWOfurn, http://www.IWOfurn.com (October 2007)

5.3 Automation of logistics at Micuna, Spain

Abstract

Micuna, S.L., founded in 1973, is a family business dedicated to the manufacture and distribution of children's furniture and childcare articles. It has a production plant in Sollana (Valencia) and a warehouse 8 km away. The case describes the migration process from manual warehouse procedures to their fully computerised management, with renewal of the information and communications systems between the production plant and the warehouse. This process has involved a far-reaching change in the company's logistics processes and has led to significant improvements in delivery times, a critical factor in the sector, as well as in cost-saving and customer satisfaction.

Case study fact sheet

■ *Full name of the company:*	*Micuna Group (Micuna, S.L. and Mobiliario Infantil Valenciano, S.L.)*
■ *Location (HQ / main branches):*	*Sollana (Valencia) Spain*
■ *Main business activity:*	*Production of children's furniture. Childcare articles*
■ *Year of foundation:*	*1973*
■ *Number of employees:*	*170*
■ *Turnover in last financial year:*	*20,000,000 euros*
■ *Primary customers:*	*Large retail outlets and furniture and childcare shops*
■ *Most significant geographic market:*	*Spain and Portugal*
■ *Main e-business applications studied:*	*Supply Chain Management; RFID*

5.3.1 Background and objectives

Micuna, S.L., founded in 1973, is a family business dedicated to the manufacture and distribution of children's furniture and childcare articles. The company has 170 employees and a turnover of 20,000,000 euros in 2006. It has a production plant in Sollana (Valencia) and a warehouse 8 km away. Micuna has recorded significant growth in turnover over the past few years. This trend was actually compromising the future survival of the company itself, given that its traditional methods of warehouse management could not deal with such growth, as the company performed all its warehouse management tasks on a purely manual basis.

Facing this situation, the company's management took a key strategic decision for its business development, namely separating the operations of production and distribution.

Production would be performed by Micuna, S.L., and warehouse distribution and management operations would be the responsibility of the company Mobiliario Infantil Valenciano, S.L., with both belonging to the Micuna Group and located 8 km apart from one another.

This decision also entailed the e-business project outlined in this case, consisting of the computerisation of warehouse management in the Micuna Group and the enhancement of the communications networks between the two group companies.

Within this context, the project's overall objective involves separating the company's manufacturing and distribution operations and computerising its warehouse management.

In addition, there are further indirect objectives forthcoming from the above, being as follows:

- Reducing the costs of warehouse management processes
- Improving customer service from a twin perspective by shortening of product delivery times and reducing errors and incidents.

Shortening of product delivery times is a key factor for competitive success in the company's operating sector. At this moment in time, growing competition from China and other countries is forcing companies to differentiate themselves in terms of both product quality and customer service.

Furthermore, given that most of the company's catalogue, consisting of around 1,200 references, is made to order and very little stock is held, the shortening of delivery times is increasingly becoming a competitive variable of high importance.

5.3.2 e-Business activity

Warehouse computerisation

A decision was reached on the need to search in the market for a warehouse management product that would meet the company's requirements. Micuna already had a certain amount of working experience with the consultancy firm Ingeniería, Productividad y Sistemas, S.L[52], specialising in production-oriented IT systems, and was familiar with their products. Accordingly, the decision was taken to buy a fairly standard warehouse management product from that consultancy firm. It was a straightforward product that was easy to handle, catering for Micuna's requirements. The main feature Micuna required was that the warehouse management system would provide information in real time, thereby shortening customer response times. The management decided that the technology would have to be based on radio frequency identification (RFID).

Although it was a standard product, a minor adjustment was made to it, which affected the process of despatching the goods. This adjustment meant that comprehensive data was available on the status and position of products in the warehouse until they were despatched to the transport agency the company works with. The company does not have its own fleet of lorries, but instead subcontracts such operations. Accordingly, and in order to streamline the movement of goods in the warehouse, it was considered important to fully and constantly monitor the status of all goods. The aim was to ensure the traceability of each product, whereby when the product leaves the warehouse it carries a barcode with all the information the transport agency needs for delivery to the customer. This also makes the job easier for the transport agency, thereby shortening the delivery time to customers and reducing the number of incidents and errors in deliveries.

[52] For information see www.ipslan.es.

The warehouse computerisation process was completed in less than one year. Tests were conducted over a period of six months to ensure the system operated properly. In addition, training courses were provided for plant personnel (five employees), so that they could get used to working with the new system.

Communications Systems

The project's second major component involved equipping the two companies (Micuna, S.L. and Mobiliario Infantil Valenciano, S.L.) with a communications system that would ensure proper data and voice transmission as required for production and distribution operations. There was a very basic communications network before this project was implemented. The solution adopted consisted of setting up a virtual private network for communication between the two sites. The initial arrangement involved a virtual private network based on ADSL, but it subsequently proved possible to create the network with radio-based technology (without cabling). The appropriate tests were conducted and it was verified that the bandwidth provided by the radio-based network met the company's requirements.

Project costs

The project costs amounted to 60,000 euros. This investment included the purchase and implementation of the warehouse management system, as well as the commissioning of the virtual private network with radio-based technology. Although it was more expensive to set up the private network with radio-based technology than using ADSL, the former operating costs were significantly lower, with positive impacts on the overall cost

Personnel involved

The decision to separate the company's manufacturing and distribution operations was taken by the Director of Production, the Business Director and the CEO.

Once this decision had been taken, the e-business project was conducted internally by the company's Information Systems Department in partnership with the subcontracted consultancy firm and Micuna's communications provider.

Technology used

The technology used consisted of:

- IT application for warehouse management, adapting it to the company's requirements.
- Virtual private network with radio-based technology for communications between the company's two sites. This network has two unidirectional radio masts that provide the necessary bandwidth for the company's communications. The telephone system uses an IP platform.

Current status and future extension of the project

Micuna is very satisfied with the way the system works, although it is nonetheless subject to regular reviews in order to assess the necessity to include new functions.

Accordingly, one of the new functions that was decided to be incorporated involves adapting the warehouse for the management of certain products that are now being manufactured with significant stockpiling, therefore need specific handling.

5.3.3 Impact

The project's implementation has had a very positive impact on the company's operations. It has meant migrating from a manual and fairly rudimentary work process to an approach that is more in tune with market requirements.

The main impacts have been:

- Shorter delivery times. These are estimated to have fallen from 15 to 5-6 days from completion of the manufacturing process through to delivery to the customer, thanks to the streamlining of operations.
- Reduction in errors and incidents in product delivery that was made possible by the automation of the processes and the reduction of manual intervention.
- Cost-saving in the warehouse management process, thanks both to computerisation and reduction of errors.
- Fine-tuning of warehouse management processes and therefore a change in the way of working related to the automation of operations.

This case study shows the positive impact of ICT-based management processes, and should be used as an example in addressing all the companies in the sector that are not yet implementing such kind of systems: the results of the CATI Manufacturing Survey 2007 show that only 10% of European furniture manufacturers uses SCM systems.

5.3.4 Lessons learned

The main lessons learnt are:

- Importance of the choice of warehouse management tool. The Micuna Group opted for a straightforward tool that was easy to use and would suitably meet the company's requirements. This circumstance was singled out as a key factor underpinning the project's success.
- The need to constantly tweak the project, in order to overcome difficulties as they arise and furnish the warehouse management system with new functions.
- Project review that allowed improvement tuned with emerging requirements.

With respect to the context of this report, this case study investigates the positive effects of ICT on company's supply chain performance. In this particular experience, it is interesting the decision to separate activities (production and distribution) in order to achieve a better control of operations.

5.3.5 References

Research for this case study was conducted by DBK, S.A. C/Juan Bravo, 3. Edificio C. 28034 Madrid, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview with Juan Manuel Farga, Information Systems Manager at Micuna, September 6, 2007
- Websites:
  - Grupo Micuna, http://www.micuna.com, (September 2007
  - Instituto Tecnológico del Mueble, Madera, Embalaje y Afines (AIDIMA).

5.4 Benefits of ERP application at PROFIm, Poland

Abstract

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

Case study fact sheet

■ *Full name of the company:*	*PROFIm, spolka z o.o.*
■ *Location (HQ / main branches):*	*Turek, Poland*
■ *Main business activity:*	*Production of office chairs*
■ *Year of foundation:*	*1991*
■ *Number of employees:*	*1300*
■ *Turnover in last financial year:*	*35.5 million*
■ *Primary customers:*	*consumers, businesses*
■ *Most significant geographic market:*	*Poland, Russia and Europe*
■ *Main e-business applications studied:*	*ERP, CRM, e-Communication with customers*

5.4.1 Background and objectives

The PROFIm company was founded in 1991 and originally dealt with importing furniture. However, in a couple of years it created and developed its own production facilities and now is the main manufacturer of office chairs in Poland. At the moment, PROFIm has nearly 1300 employees in two production plants in Turek, central Poland, where the total output surpasses 70,000 chairs a month. The main customers are other businesses and retailers in over 30 countries. The company is also a manufacturer and supplier of IKEA chairs to its stores.

As in many manufacturing industries today, the furnishing sector is under increasing pressure to transform businesses from make-to-forecast (based on the predictions) operations to short lead-time, small batch made-to-order (MTO) production. The emphasis is also strong on just-in-time deliveries and minimal stockholding throughout the manufacturing process. The customer nowadays expects a fast delivery of quality products that are aligned with current trends. Flexibility on the shop floor is becoming

essential and attitudes have had to change from pre-set machine runs for manufacturing to stock to a new lean approach of making only what can be sold. Being an international supplier, PROFIm is deeply affected by these trends.

Much of PROFIm's growth has been based on the understanding of changing market demands, flexibility and innovation. The company has been specialising in customised production of quality office chairs. It developed over 170 different designs that are tested in-house. Today about 80% of the company's production consist of small customised orders of up to ten items with a two-week lead time for delivery.

The combination of steady business growth and the demanding nature of made-to-order production led PROFIm to reinvent its ICT strategy and implement new integrated ERP applications to replace old applications. As the company expanded, it became clear that there was a growing need to improve production and logistics. The management also set up a firm objective to respond to customer demands for speedy delivery, quality and innovative design which involved a high level of customisation and customer service. Therefore, access to accurate information about inventory management, production, orders and deliveries was essential. To achieve this, the company needed IT support via a sophisticated business application system that would enable better management of its business processes. *'Due to quick development of the company and, consequently, growing requirements with regard to the IT system supporting company management, the old system was no longer sufficient for our needs. Business reality forced us to introduce wide-ranging changes including new ICT applications'* – explains Grzegorz Dybus, the Director of Logistic and Metal Production.

Another important objective has been the improvement of cost control across all business operations. Prior to the installation of IFS, PROFIm used a number of disparate solutions to manage its business. Not only were the various applications incapable of talking to each other, but the whole structure was struggling to cope with the business' rapid change and growth.

5.4.2 e-Business activity

Before the new e-business solutions implementation started, there were many IT applications in use within the company handling communication and data processing. The systems were not integrated, and the lack of control meant that management had no consolidated view of their orders, material management, or maintenance requirements. The production was not automated either.

Towards the end of year 2004, the decision of implementing a modern ERP suite had been taken to create a uniform data processing environment for the whole company. The IFS Applications were chosen for its broad functionality and coverage including for example workforce and manufacturing management, finance, logistics, maintenance as well as flexibility. The fact, that IFS as a solution provider also had a proven record of successful implementations in Poland and in the furniture manufacturing industry, came reassuring. The attractive pricing, not only in terms of implementation but also in case of ownership and maintenance, was also an important factor.

PROFIm's management decided on an ambitious implementation of a complex enterprise resources planning application to completely cover nearly all areas of its business activities. '*We were searching for an IT system that would form a sound base for further growth encompassing an extensive materials index and at the same time provided a tool*

to calculate real costs and inventory, not only predictions', explains Mr Dybus. *Because the company specialises in made-to-order production, it is very important to be able to ensure timely deliveries. Only with the help of an integrated IT system supporting all the stages of production had it become possible.*

The IFS application implemented by PROFIm is a software solution optimised for ERP, Enterprise Asset Management (EAM), as well as Maintenance Repair and Operation (MRO). It consists of about 60 different functionalities structured within a few modules that can be implemented one by one and expanded according to company's needs It is a Service-Oriented Architecture (SOA), centred around actual business processes, such as processing purchase, requisitions or customer invoices.

In addition, the IFS Service-Oriented Component Architecture is an open architecture, allowing other applications to access information and trigger functionality in IFS Applications. By using open standards – not proprietary solutions – IFS is flexible software that can be easily integrated with other business software, as well as to new technology. The application uses standard tools and technologies and supports most platforms, including Microsoft® Windows®, major UNIX® variants, and Linux®.

Since IFS Applications is multi-tiered, with each tier separated through standard protocols, so mixing and match platforms is possible. Firstly, this facilitates integration, communication, and cooperation with customers as well as partners. Secondly, it gives the company the freedom to mix IFS modules with technology from other vendors to gain the most cost-effective solution. It also makes it easy to take advantage of new technologies as they emerged eliminating the need to change existing systems when new software is needed.

In PROFIm the implementation of the IFS system took place over a period of 18 months between 2005-2006. A team of 40 people drawn from the company was set up to support and conduct the project. In order to ease the process and minimise disruption, implementation was defined into three phases. At first, the modules of IFS Distribution, Financials, Human Resources and Production were implemented. The IFS distribution module had been enriched in IFS Customer orders to control delivery times and IFS Purchasing for all aspects of supply side in connection to orders. However, the most important was the implementation of the new IT system in Production that included an index of existing technologies and designs as well as tools for coordination and control of manufacturing in several different plants. In the next two phases the IFS modules covered areas of asset management and maintenance, quality control and customer management including the web portal for communication with customers. At the end of the implementation, 15 modules with nearly 30 functionalities were set up and are now used by over 200 employees including 100 on the production floor. As the software is component-based, with modules designed like building blocks, the integration of different functionalities was happening nearly automatically throughout the implementation process. Training was provided to key members of staff as the system was deployed and once it went live.

5.4.3 Impact

With a modern IT infrastructure PROFIm has gained better management tools to control the entire production process, from orders to delivery, and planning of the manufacturing capacity. All business processes at the company are now supported by interconnected ICT applications that help to streamline business operations, reduce costs and enable

quick deliveries. Up-to-date information enables staff to be more proactive in dealing with availability and supply issues.

The greatest tangible benefit PROFIm has achieved with IFS was to significantly shorten delivery time that now takes only up to 14 days (within Poland) from order to delivery. New applications have enabled a new approach to production planning, which reduce the time required to fulfil customer orders.

Some of the other tangible benefits include:

- Higher stock and materials turnover bringing better utilisation of resources and assets, therefore freeing up capital that was previously kept in overstock.
- Faster access to up-to-date information for stock control and monitoring production that enables accurate planning and forecasting for suppliers and logistics.
- More accurate costing as a result of clear information of how and where costs are generated.
- Calculation of costs of materials and of partly made products.
- The workforce gained additional skills that lead to improved productivity.
- Better communication with customers that get specific - not estimated - dates for order completion at the time of making an order, and can track their orders through the production process.
- Despite growing orders, the consistency, quality and accurate lead times are ensured without increasing the number of staff or costs.

Though the IFS implementation represented a significant investment for PROFIm, its management estimates that the financial benefits would enable the company to recover the cost in two to three years. Part of this is due to increased productivity and shorter production cycles as well as reduced stockholding which will allow further growth with no increase in resources.

Grzegorz Dybus, the Director of Logistic and Metal Production, explains: *'Thanks to these changes, we succeeded in improving the quality of our customer service. Customers in virtually any corner of the world are able to check the status of their orders. It is worth noting that following the introduction of the integrated management system the material turnover rate fell from 59 down to 33 days. But this is not all. The system covered nearly the entire scope of the company's business activity, including planning, production, procurement, warehouse management and finances. This way, we improved our organisation of work and increased efficiency. As a result, PROFIm became even more competitive – not only on the Polish market, but also on foreign markets*.

This case study shows how the implementation of an ERP system implies an upgrading of the work of the production team in order to ensure that the new ERP system is used in an effective way. In 2007, according to the CATI Manufacturing Survey, ERP software appears to be implemented in 39% of the European furniture manufacturing firms, with a wide space for improvement mostly in SMEs (that, with only 16% of ERP users, lag way behind the 71% of large companies like PROFIm).

5.4.4 Lessons learned

Based on the example of PROFIm, this case study illustrates how ICT applications can improve the interaction between the manufacturing and distribution processes leading to significantly reduced delivery times and increased production capacity with no additional costs.

There are a few lessons that can be drawn from the PROFIm case:

- A changing market and increasing demands from customers require efficient logistics. In order to achieve that, PROFIm needed improvement in its logistics to ensure timely deliveries as well as better production and cost control whilst maintaining a high quality of product. Especially in a company with a high level of customisation and product variants, control and planning of production needs to be sophisticated. The ERP applications help to manage and access up-to-date information therefore improving production, planning and goods flow leading to reduced delivery times and improvements in customer service.
- Changing staff attitude and training employees to use the system was a challenge, especially on the production floor where people did not use any computers and had to be trained from basics. It was very important though to give solid training in order to encourage people to use the IT tools and minimise possible errors. A number of people at the plant now work from terminals and a substantial training programme that was initiated at the implementation phase was necessary.
- The capability to perform follow-ups and even forecasts is an important ingredient for manufacturing and trading companies. PROFIm needs to use forecasts to meet customer demands and expectations of quick delivery without overstocking. With ICT applications it is easier to ensure that inventory and demand are as balanced as possible. At the same time it was decided that an integrated ICT system was the key to continued success.

The case of PROFIm shows that a company from the furniture sector can achieve tangible benefits and increase market position when it employs ICT and e-business solutions to innovate and adapt to the needs of its consumers. This result is in line with the hypothesis presented in Section 4.1. of this report

5.4.5 References

Research for this case study was conducted by Aneta Herrenschmidt-Moller, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interviews with Mr. Grzegorz Dybus, Director of Logistic and Metal Production at PROFIm, August & September 2007
- Websites:
  - Company website www.profim.pl (last accessed on 1st of October, 2007)
  - www.IFSWORLD.com (last accessed on 1st of October, 2007)
  - http://www.federmobili.com

5.5 e-Communication and e-sales at Quatuor, Belgium

Abstract

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

Case study fact sheet

■ *Full name of the company:*	*Quatuor*
■ *Location (HQ / main branches):*	*Quatuor is headquartered in Battice, near the City of Liège. The shop is located in Battice.*
■ *Main business activity:*	*Retail business of interior and exterior furniture and decoration*
■ *Year of foundation:*	*2004*
■ *Number of employees:*	*5 (3 full-time equivalent)*
■ *Turnover in last financial year:*	*Non communicated (about 350,000 € in 2006, 550,000 € in 2007)*
■ *Primary customers:*	*Consumers (about 80-85% of turnover) and companies*
■ *Most significant geographic market:*	*Belgium and France*
■ *Main e-business applications studied:*	*Benefits of ICT and e-business* *e-Communication with customers* *e-Sales* *e-marketing* *ICT standards* *ICT and e-business impacts on work processes* *ICT and e-business impacts on market structure and competition*

5.5.1 Background and objectives

Quatuor is a Belgian store of interior and exterior furniture and decoration. The business was created in March 2004 by four young graduates from the Liège Business School (HEC Liège). A loose preliminary market study on the furniture retail sector in the county of Liège and the wider Walloon region (French speaking area in South Belgium) helped to identify a business opportunity in the medium to up-market, with a strong emphasis on decoration. Therefore, despite fierce competition on the local market, the store was opened in the identified niche market.

From the early stage, Quatuor positioned itself on the market by putting the emphasis on the quality of products and services. Products are carefully selected and presented in a well designed “show room”, and high-quality service and advice to customers are the cornerstone of the marketing strategy (Quatuor employs an interior designer to assist clients).

The activity of the store has been supported by a website from its opening. Developed by one of the four associates, it was primarily aimed at offering a good visibility on the market at the lowest cost. Then, from a purely communication website (online catalogue), it progressively developed as an integrated marketing tool allowing purchase online.

Thanks to this website, Quatuor has succeeded in penetrating the market and attracting a diversified clientele. During the first three years of activity, the turnover grew at a 200% to 300% rate. In the fourth year, the store moved to a new location offering a four times bigger surface of sale. The local clientele from the county of Liège now represents about 50% of its turnover, while customers from the wider Walloon region and Brussels represent 25% to 30%, and French customers about 25%.

Quatuor’s innovative market strategy

In France and Belgium at least, the furniture retail market is ruled by informal rules and peculiar commercial practices. Retailers negotiate exclusive rights on a geographical basis (within a 20 km radius approximately), prices are barely advertised and manufacturers have a price differentiation policy. However, Quatuor has differentiated itself by showing transparency, publishing prices in its online catalogue and allowing easy price comparison by consumers. When introduced, this way of doing was a break in the sector’s practices and faced some reluctance from business partners. It required some flexibility, especially in order to compensate, with delivery costs, the difference in price between the Belgium and the French markets, the latter being 10% to 20% more expensive than the first one. e-Business activities are not very developed in the furniture retail sector. Big market players are reluctant to sale online, due to a strategy based on local implantation of stores and price differentiation. As for independent retailers, they usually hesitate to develop communication web-sites and online catalogues, and remains stuck to traditional business, despite a tendency for change. This underdeveloped e-market can also be explained by the fact that purchasing a piece of furniture implies a long and complex process, due to high cost and aesthetic function of products. This is also a challenge Quatuor had to tackle with.

On its sub-market (in terms of brands and range of products), Quatuor claims to be the only retailer who offers an e-catalogue and e-shop, and so is in a dominant position. Quatuor’s only competitors are purely e-business actors specialised in design furniture, a sub-market on which e-sales are very successful. In line with this, best sellers in Quatuor’s catalogue are decoration objects, design products and small and cheaper furniture. This can be partly explained by the strong position of famous brands on the market: on the one hand, manufacturers impose sale prices to retailers, the market is more transparent and retailers are more keen to develop e-sales activities; on the other hand, the brand and products awareness is high and purchase online appears to be less risky for consumers.

5.5.2 e-Business activity

Website development

Quator's website was launched two months after the store opened. The aim was to communicate on the store by publishing a catalogue online. Thanks to the capacities of one of the four associates, the first three versions of the website were designed internally, allowing lower cost and better flexibility.

From the very beginning, the PHP (Hypertext Pre-processor suited for dynamic websites) and MySQL (data base) open source technologies were used. After five months, the website initially developed in HTML was adapted according to XHTML (markup language) and CSS (stylesheet language) standards, which allowed better web ranking thanks to a split between content (recognised by search engines) and graphic elements. The language structure and semantic were also carefully addressed to ensure good visibility for search engines.

In late 2005, the website was substantially redesigned in order to increase the number of references in the catalogue, dedicate more space for products information and facilitate usability. These changes had a clear impact on the website audience and demand for online purchase facilities drastically increased. Then, Quatuor offered distance selling services with credit-card payment by phone, but it was time to move forward and develop e-sales activities.

Quatuor called on a local website developer, Globule Bleu[53], to add e-commerce functionalities to the website and develop a back-office system for order management. For payments, Quatuor choose Ogone[54]. Along to this, the catalogue functionalities, information and design were significantly upgraded. The new version was launched in October 2006. In July 2007, the catalogue included 1,200 products and e-sales weighted about 25% of the growing company turnover.

e-Business management and tools

From a usability point of view, Quatuor's website offers all the basic functionalities common to online shopping websites: the user can search some products, manage its shopping basket, create and manage its customer account and order online. More interestingly, different web-based management tools are used from order to delivery, while human intervention and follow-up is required at every stage. This non-integrated solution may appear to be archaic, but proves to be a critical success factor.

There are two distinct purchase procedures in Quatuor:

- Simplified procedure: Decoration products and small pieces of furniture can be purchased online in a classical one-shot procedure. Selected products are added

[53] Globule Bleu is a Belgian web agency specialised in web-building, e-marketing and web application development (www.globulebleu.com).

[54] Ogone is a Belgian company offering a range of services for processing electronic payments. Established in 1996, Ogone initially offered banking and financial IT consultancy services. After working with major banks on core banking applications, Ogone went on to develop electronic banking platforms for banks. The company now offers more than 25 local payment methods and works with over 6,000 traders and 80 banking connections in 25 countries (www.ogone.com).

to “my basket”, delivery costs are calculated automatically, and products can be ordered and paid directly.

- Normal procedure: For any other furniture, selected products are added to “my selection” and the customer is invited to ask for an estimate, which will be sent to him in a 48-hour time. When the email alert is received, the estimate is prepared manually (using the ERP system) by one of the members of Quatuor, who becomes the personal contact person for the customer until the delivery. During the estimate elaboration, the contact person evaluates delivery costs (which depend on many factors) and delays, but also verifies the coherence of the order (in terms of assortment for instance). Usually, the person in charge contacts the customer by phone of email to clarify certain aspects of the order and, if necessary, provide some advice. Then, when the final estimate is ready, it is sent by email to the customer who can pay online (down payment) by clicking on the attached hyperlink.

Hercule[55] is a tailor-made back-office software developed by Globule Bleu and used for e-*order management*. It is an extranet, which allows reactivity at any time and place to ensure that customers needs are taken into account and addressed in due time. When a payment is done (in both simplified and normal procedures), the person in charge receives an email giving access to the order details in *Hercule*. The order has to be validated manually so as to check its coherence and track stocks in the ERP system. The validation generates an e-mail, which is sent to the customer. This email confirms the undertaking of the order, and specifies the name and contact information of the person in charge (in the normal procedure, it remains the person who prepared the estimate). Then the product, if available, is prepared to be delivered .

Hercule includes a *delivery planning management system*, which is managed by the delivery manager. Access is given to independent delivery men working for Quatuor on a regular base (only in Belgium: for France, the delivery company has its own procedures and management tools). *Hercule* generates order sheets and address stickers for the parcels, which are prepared in the warehouse. When a product is ready to be delivered, the person in charge has to arrange the delivery schedule based on the client’s and delivery men’s availability, as well as other delivery delays.

To support its activity, both in the store and on the internet, Quatuor has a tailor-made and web-based *ERP system*. It is used for stock management, estimating and invoicing. The website is not fully integrated to the ERP. Three times a day, a script is launched automatically to download data from Hercule to the ERP system. In order to upload information from the ERP system (information on stock and product characteristics) one has to launch a manual script: during this procedure, information on stock and products characteristics can be modified to better suit the website requirements.

Navicat® is an additional tool used as a CRM system[56]. It helps to extract MySQL data from the website, generate statistics and build mailing lists for marketing operations. For a better follow-up of e-mailings (who clicked on what?), Quatuor works with a service provider.

[55] Hercule is not a registered brand, but the name given internally to the back-office software used by Quatuor.

[56] Navicat® is a MySQL database administration tool.

e-Business approach

The e-business solution developed by Quatuor is not fully-integrated. This is the consequence of a business strategy. Indeed, Quatuor's e-business tools were developed in order to keep flexibility and contact with clients. The web-site had to be in line with the store's marketing strategy based on high-quality service and advice to customers. The idea wasn't to create a fully integrated e-sale platform, but more to equip the store with distance-selling instruments, so that it could enlarge its clientele without creating a break with its core business and strategy.

When the decision was made to develop e-sales activities, Quatuor's managers explored the possibility of a system fully integrated with the ERP. In this perspective, they assessed the products available on the market. However, it appeared that the degree of flexibility they wanted would have required a very elaborated tool, too expensive to develop. Alternatively, they decided to go for a partially-integrated solution requiring human intervention at different stages and keeping the door wide open to any client specific demands. For instance, when an estimate enquiry is received, a manual check is necessary to evaluate, at least, the delivery costs. But it is also an opportunity to assess the client's demand, call him if there is any doubt or if the client expressly asks for it. Half-hour phone calls are very frequent, in order to assist the client with advice, telling him about materials, colours and alternatives, and helping him to make his final choice. Then, a second estimate can be sent to the client, taking fully into account his demand while avoiding asking him to formulate a new demand from the website. Efficiency is important, but at Quatuor, personal contact, flexibility and advice are core values.[57]

This approach has proved to be successful and e-sales are growing. One has to keep in mind that it is not easy to sell furniture online. Pieces of furniture have an important aesthetic function and can represent an important investment (general amount of order are about EUR 2,500-3,000). Therefore, keeping direct contact with e-customers is a key factor for success in this sector.

5.5.3 Impact

The impact of e-business activities on Quatuor is difficult to assess precisely due to the lack of good benchmarks: the turnover has continuously grown from the first year of activity, while the website has been progressively developed. Moreover, the turnover generated by e-business activities cannot be assed with e-sales only (the turnover generated by e-sales has been growing at the same path as the global turnover). e-Business activities have clearly had an impact on the activity of the shop as well, by an increase of the number of people visiting the shop. Statistically, 75% to 80% of the clientele visits the website before going to the shop, and 90% of the clientele have seen the website at least one time during the purchase process.

According to one of the four Quatuor's associates, the business would not have been so successful without the website, and perhaps not successful at all. The market was highly competitive, entrepreneurs had the minimum investment capital, were young and not experienced in this sector. Therefore, the website has been a key factor for success,

[57] In line with this, the website invites customers to ask for information on products which are not in the catalogue. To this purpose, a direct contact with Skype is proposed.

allowing efficient communication at a significantly lower cost than a paper-based catalogue. Quatuor had gained credibility and reputation thanks to its very well designed, aesthetic and ergonomic website providing clear and transparent information. With any doubts, Quatuor's first clients were brought to the shop by the website. Then, Quatuor's members had their chance to persuade their visitors that despite the small size of the store (it was a shop of 95m2 back then, five times smaller than the current on), the small quantity of furniture displayed and their lack of experience, they could show flexibility, reactivity and offer professional and high-quality information and advice.

The business has been very successful. During the first three years of activity, the turnover grew at a 200% to 300% rate. A new store, with a five time bigger surface, was open in March 2007. In 2007, Quatuor's turnover keeps growing fast and the number of single visitors in the website has significantly increased without any marketing actions (keyword buying and emailings), communication resources being focused on the opening of the new store. The average number of unique visitors per month in 2007 has reached 13,500, with more than one million pages viewed.

Finally, one shouldn't underestimate the impact of Quatuor e-business activities on the retail furniture sector in Belgium and France. Due to the dominant position of its catalogue on the web, thanks to intensive efforts to offer good visibility to the website, its reputation and number of visits, Quatuor is the top result in search engines for some brands. Therefore, manufacturers have noticed a price adjustment on some products in Belgium and France. However, Quatuor remains the only online catalogue in French communicating its price with such transparency.

Quatuor is a successful example of the implementation of e-business and web catalogues in B2C sales, a trend underlined by the results of the CATI Manufacturing Survey 2007 (see exhibit 3.4-3) showing that 30% of companies (and 46% of large companies) use e-catalogues. The Quatuor example is even more significant given the small size of the company.

5.5.4 Lessons learned

There are two main lessons to be learned from this experience. First, it clearly demonstrates how positive the impact of a website can be on the activity of small retail businesses. When appropriately used, it proves to be a very efficient communication tool, even for traditional small businesses. Quatuor started with a website somehow beyond the capacities of the store. But it proved to be a driving force: clients were convinced by the website to visit the shop and then, it was up to the Quatuor's team to demonstrate that it could be as professional as the website tended to suggest. Then, with its first clients very satisfied, the business was on track.

Second, and foremost, it shows that there is room between traditional business and purely e-business activities, which allows accommodating sectoral particularities and constraints. In Quatuor case, e-business activities are complementary to the store, and there is coherence between the two. Quatuor does not neglect the store clients. The website is as much a catalogue for its Belgium clients, who usually visit the shop before buying, as an e-shop for more distant customers. Quatuor accommodates both activities and simply keeps personalised contact with clients and offers the same quality of

service.[58] In a way, it does business as usual, but with more distant, diversified and finally more numerous customers. This strategy has proved to be successful, and constitutes a break in the very specific furniture sector, where B2C e-commerce is confronted with limits set by the price and the aesthetic function of the products, and by the manufacturers' and big retailers' business approach.

This case study illustrates the importance of skills and innovation on company's performance. Although no precise assessment can be made of the impact of e-business on sales and profit, there is clearly a link between the overall good company's performance and its innovative way of managing business.

5.5.5 References

Research for this case study was conducted by Xavier Le Den, Ramboll Management, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview with Benoit Rondeux, 19 July 2007, Battice, Belgium
- Agence Wallonne des Télécommunications, « E-Business et TIC dans l'entreprise, Témoignages : Quatuor », January 2007
- Websites:
  - Quatuor, http://www.quatuor.be
  - Agence Wallonne des Télécommunications, http:/www.awt.be

[58] Thanks to the Internet, Quatuor even goes further with services offered: In September 2007, it has launched a blog about furniture and decoration, where Quatuor associates keep up with the fashions and give some tricks and advice (www.madeco.be).

5.6 RobinWood.at: web platform and B2B Channel, Austria

Abstract

RobinWood.at is an online planning, ordering and calculation web platform for custom-tailored furniture in Seekirchen, Salzburg (Austria). Established by the joinery Schmidhuber, RobinWood.at is an additional e-distribution channel for the company. The web platform allows small joineries and furniture studios the online planning and calculation of customised furniture. Companies, however, cannot produce the furniture because of missing organisation infrastructure. At Schmidhuber, the orders from the companies created at RobinWood.at are transformed into machine-readable code which is suitable as input data for the CNC-machines in the production of Schmidhuber. Finally, the produced furniture is delivered to the joinery or furniture studio. Despite some initial problems concerning software partners and thanks to lessons learned, since 2001 RobinWood.at is a successful B2B application fulfilling the company's expectations.

Case study fact sheet

■ *Full name of the company:*	*RobinWood*
■ *Location (HQ / main branches):*	*Seekirchen am Wallersee, Salzburg, Austria*
■ *Main business activity:*	*Production of custom-tailored furniture with arbitrary design*
■ *Year of foundation:*	*2002*
■ *Number of employees:*	*5*
■ *Turnover in last financial year:*	*800,000 euros*
■ *Primary customers:*	*Small joineries (1 to 6 employees) and furniture studios*
■ *Most significant geographic market:*	*Austria, Germany*
■ *Main e-business applications studied:*	*Online platform, e-distribution, e-communication with customers*

5.6.1 Background and objectives

RobinWood's e-business activity and concomitant core service comprises an e-distribution platform, namely www.robinwood.at, providing the planning, calculating and ordering of customer-tailored furniture with personalised design. The platform is targeted to small joineries and furniture studios allowing them to accept (bigger) orders although the furniture is not produced in their joinery because of missing capacity.

In 1997, RobinWood started as a project within the joinery Schmidhuber in Seekirchen/Salzburg employing 22 employees. Due to several problems with software developer partners it took five years until the web platform was launched successfully in October 2002. However, in 2006, RobinWood was separated from Schmidhuber and is now an independent company with 5 employees and a turnover of 800,000 euros (in 2006). However, the management of RobinWood was also taken over by Mr. Schmidhuber, as well owner of the joinery Schmidhuber. The location of RobinWood is Seekirchen, too.

Although RobinWood is a young company, it managed to position itself on the market of e-distribution of custom-tailored furniture in Austria (market share of about 15%). With over 800 partners, primarily small joineries and furniture studios, the company is also an important market player in the field of the production of custom-tailored furniture in Germany (20% market share in the field of the production of custom-tailored furniture). The main difference to its competitors on the market is that RobinWood delivers its furniture fully completed, and not in separated pieces.

Analysis of market dynamics in the furniture sector shows that there are many (small) companies in the furniture sector that have no capacity (financial and/or spatial) to invest into expensive computerised numerical control (CNC) machines. This development led to a growing division of furniture manufacturing companies concentrating on production, and joineries concentrating on distribution including consulting and installation. Thus, efficient communication tools between production and distribution in the furniture industry became necessary. As a consequence of this trend, different companies have been setting up similar, specialised services as RobinWood.at targeting the furniture industry's needs. In order to succeed in this highly competitive market, RobinWood selected an approach which combines the use of new technologies with a maximum of personal contact, e.g. classroom trainings done by RobinWood's CEO, exhibits at fairs, etc. with its customers i.e. joineries.

The initial idea for implementing the project was to establish a new distribution channel at Schmidhuber. Another driving force for realising RobinWood was the vision to be an innovative company in the furniture sector using new technologies in order to attract attention on the market.

5.6.2 e-Business activity

The planning and implementation phase of www.robinwood.at took five years. The reason for this long duration was the wrong choice of software partners which led to a project stop after restarting it again with another software company. However, after a three month test period with joineries and small furniture studios in the immediate vicinity, the online platform www.robinwood.at was launched in October 2002. Four years later a new release, the so called "RobinWood Online-Kreativplaner", with a user friendly graphical interface and more functionality was developed and launched commercially.

Overall, RobinWood has over 800 registered users whereas 20 to 50 users are logged in on the system per day. Mainly, joiners between 25 and 35 years age are using the RobinWood online platform. Elder people or people without broadband internet access do not use the platform and send requests with appropriate data per fax or email to RobinWood where the offer is created by www.robinwood.at and again sent back to the client. The division between online and offline (email or fax) orders is roughly 50:50.

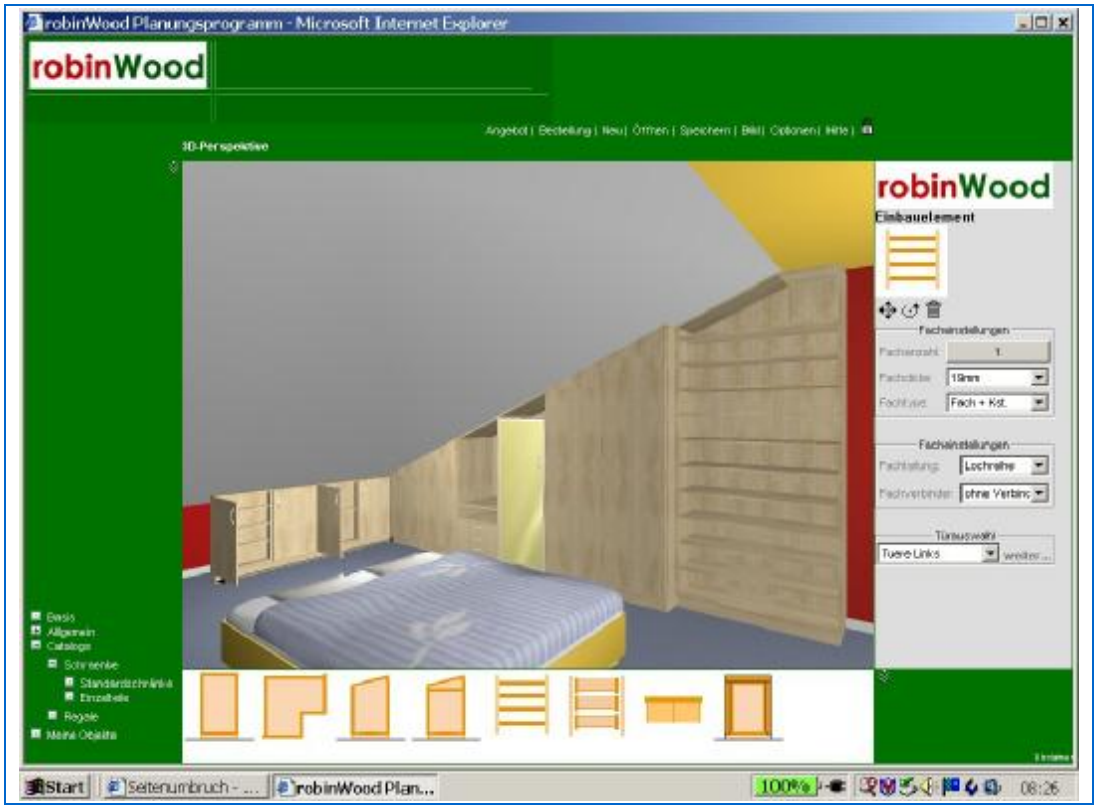
In total, RobinWood invested 70,000 Euro in software development for the platform which is implemented by means of Active Server Pages (ASP). Additionally, one million Euro were invested into new hardware infrastructure (Server, Desktop, etc.), personal as well as additional CNC machines for processing orders of RobinWood at the production at Schmidhuber. In the following two sub-chapters, the workflow of RobinWood is described in detail.

Online planning and calculation of furniture (client-side)

RobinWood's strategy is to compete by using up-to-date technologies which is reflected by outstanding graphical user interfaces and response times for planning furniture online on the platform. The basis for planning furniture at www.robinwood.at is a room with user-defined dimensions, windows, doors, wallpapers, incidence of light, etc. in order to simulate the end consumer's environment as well as to increase the end consumer's imagination. The perspective of the user in the room is changeable (2D, 3D, bird's eye view, etc.). After the room is defined, different templates for furniture corpuses are provided which can be placed via drag and drop into the virtual room and edited individually (dimension, colour, kind of wood, inlay, inner life of the corpus, e.g. drawer, board, etc.). Moreover, the platform offers a tool for custom-tailored bevels. When the user has finished planning, he can activate the function for calculating the price for all different furniture pieces. Furthermore, the user can define an additional mark up for installation costs. The whole calculation including the scheme can then be printed for the end customer.

The big advantage for the joiner or furniture studio is that it can provide the end consumer a complete individual offering including digital visualisation and calculation of the requested furniture within a short period of time. This creates a competitive advantage as well as the possibility of processing more requests in shorter time.

Exhibit 5.6-1: Screen shot robinWood



Source: www.robinwood.at

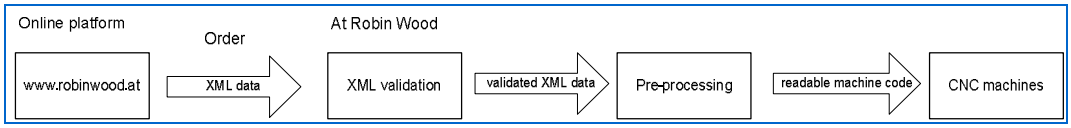
However, in the near future it is not planned that the online platform is also accessible for end customers. Problems concerning joiner know-how (e.g. metering dimensions of a

room) but also usability issues of the platform itself leading to image loss of RobinWood are arguments against it.

Ordering and production (server-side)

If the planned furniture is ordered by the joinery or furniture studio, appropriate data is encrypted and sent to RobinWood. The data format for exchanging data is the eXtensible Markup Language (XML). In particular, a general XML scheme for furniture is used. At RobinWood the received XML-data is validated according to the compliance with the XML scheme. Subsequently, the XML data is processed by means of a pre-processor which translates the data into machine code. It is therefore machine-readable and suitable as input data for CNC-machines in the production.

Exhibit 5.6-2: Data processing at RobinWood



Source: Salzburg Research, 2007

5.6.3 Impact

Based on the turnover figures of 2006, and assumed that the growth rate will continue throughout the next two years, it is expected that the turnover of RobinWood for 2007 and 2008 will be increasing about 30% annually. Overall, in 2006 about 600 orders were created by RobinWood. Furthermore, the additional channel of distribution increased the overall production at the joinery Schmidhuber about 30%.

Concerning the client structure, especially the German market is being covered via the online platform. Therefore, efforts in logistics have been rising considerably in recent years and consequently a new production location will be established in Hamburg in 2008 in order to reduce delivery costs from Austria to Northern Germany. Moreover, through new business relationships the professional appearance in terms of RobinWood's company events and participation at exhibitions, classroom trainings for RobinWood's users, etc. has been improved.

Generally, through RobinWood the time period in which a decision to order is made by a joinery or furniture studio has been reduced. Through the immediate visualisation of the future product as well as the presentation of the final calculation, end customers come faster to a final decision. Furthermore, also small joineries can accept more offers although they do not have CNC machines.

Overall, the project RobinWood leads to reorganisation of work and production processes which is continuously improved by minimising internal costs and failures. Examples are the expansion of Schmidhuber's production, new employees for attending RobinWood.at as well as the introduction of processing XML-based code generated by RobinWood.at to machine-readable code for Schmidhuber's CNC machines.

RobinWood is highly significant as an example of adoption by a small enterprise of standards such as XML (used by just 9% of European furniture manufacturers, according to the CATI Manufacturing Survey 2007), virtual reality and e-catalogues.

5.6.4 Lessons learned

Overall, the introduction of the online web platform www.robinwood.at has been very successful. Nevertheless, there are also some lessons learned. Initially, the importance of precise project objective definition was underestimated which led to a project interruption in the first stage of the project with high financial loss.

Furthermore, the introducing of new features or releases has to be concerted with the experience of RobinWood's users. Otherwise customers are overstrained with technical issues and the web platform is not accepted on the market.

Moreover, the experience of Mr. Schmidhuber showed that the success of new e-business solutions such as RobinWood.at requiring high data rates is strongly involved with the future roll-out of broadband internet connections. Especially, many small joineries and furniture studios are situated in the countryside where this technical infrastructure is not a matter of course and companies partly are not willing to invest in it heavily. Therefore, as already mentioned before, half of RobinWood's clients are still using fax or mail and not the platform itself. Furthermore, Mr. Schmidhuber expects an increasing demand in consulting end consumers on the spot and thus, a growing importance of the geographical extension of wireless internet connections such as UMTS.

As a final lesson learned, professional appearance is a key factor for success. Indeed, experience shows that marketing ideas have to be created by the businessman but realised by professionals. Thus for instance, marketing and auxiliary advertisement at RobinWood does not contain any illustrations of furniture, because, so Mr. Schmidhuber:

"I provide small joiners just a new web-based service allowing them to earn money with orders which they could not realise before because of missing infrastructure or capacity. So, the benefit is the service not the product - the furniture itself - which would be abasing for the joiner."

The RobinWood case study highlights the usage of ICT for increasing the customer base and improving the relationships with intermediate and final customers (see hypothesis in Chapter 4.2).

5.6.5 References

Research for this case study was conducted by Elisabeth Haid, Salzburg Research, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview with Mr. Schmidhuber on July 18th, 2007 in Seekirchen/Salzburg.
- Websites:
  - Company RobinWood, www.robinwood.at
  - Company Schmidhuber, www.schmidhuber.at

5.7 Intranet for internal document management at Scavolini, Italy

Abstract

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

Case study fact sheet

Full name of the company:	*Scavolini S.p.A.*
Location (HQ / main branches):	*Montelabbate (Pesaro), Italy*
Main business activity:	*Production of kitchen furniture*
Year of foundation:	*1961*
Number of employees:	*530*
Turnover in last financial year:	*185 million Euro*
Primary customers:	*Specialised furniture retailers*
Most significant geographic market:	*Italy, European and extra-European countries (India, Israel, China, Indonesia, the United States and Latin America)*
Main e-business applications studied:	*Intranet, e-invoicing*

5.7.1 Background and objectives

About Scavolini

With more than 40 years on the kitchens market behind it, Scavolini has been Italy's leading kitchen brand since 1984.

Scavolini represents one of the most evolved production models of the furniture sector in Italy. This result has been achieved by putting technology to the service of innovation, following a corporate philosophy towards continuous improvement involving any level of the corporate structure. Scavolini produces a vast collection of kitchens, offering a variety of design styles and functional characteristics (nowadays, Scavolini's product assortment consists of more than 1,500,000 items).

Scavolini sees communication as a major factor in success and growth, capable of establishing a strong link between company and consumers. The company has been running large-scale advertising campaigns in the main media on the national and international scale for years. Scavolini is also a pace-setter on the Internet, where it established its own site in 1996, followed in 2002 by the innovative and unique vertical portal in the kitchen sector (www.kitchens.it), offering articles and news on the kitchen world in general. The new version of the corporate web site pointing to an increased integration with the final customer was awarded with the interactive KeY Award by MediaKey, one of the most authoritative prizes for on-line communication in Italy.

Scavolini's distribution policy is one of the keys to the success of its products both in Italy and abroad and is based on two principles: full coverage of the domestic market, with approximately 1,000 selected points of sale in Italy and 300 abroad, and the use of top-class dealers and a wide range of before and after-sales services. Scavolini exports its products to more than 50 countries.

Scavolini is market leader in Italy with a 7.8% market share (2005) and a 14.2% increase on year earlier (source: Databank). The group is positioned in the high-medium market bracket with the brand Scavolini and in the high bracket with the brand Ernestomeda. Some of Scavolini's direct competitors, represented by large industrial concerns (Gruppo Febal and Gruppo Berloni) are located in the same district of Pesaro-Urbino.

The development of an Intranet application for document management: objectives

Scavolini has developed a particularly evolved Intranet application for internal document management. The need to weekly manage at least 10,000 paper and electronic internal and external documents (8,000 of which relative to the sole active cycle, e.g. offers, order management, invoicing, delivery notes etc.) was the driving force that convinced the company to develop this intranet application for document management. The basic objectives of this project were represented by

- a reorganisation of information flows not necessarily connected with existing management and ERP systems with the final aim to avoid information redundancies, integrate the existing information and make up-to-date information available at any time;
- a rationalisation of the document management, to identify and access more rapidly administrative documents and consequently increase the individuals' productivity;
- a drop of paper costs, thanks to the substitutive filing of documents and the digitalisation of any kind of communication papers towards the sales network;
- an easy integration with applications, services and systems already available within the company thanks to a platform using standard technologies.

5.7.2 e-Business approach

Timing and costs of the activity

The project for the creation of an intranet for internal document management started in 2005 and is still being implemented. The company's approach was to develop the Intranet application step-by-step by single corporate area; this step-by-step approach was chosen by Scavolini to better meet the requirements of each business area and implement the application according to their specific needs. The administrative and commercial departments were the first business areas involved with the intranet application (they manage the company's active cycle business area, which alone produces/manages at least 8,000 documents a week). The intranet application dedicated to the administrative/commercial branches is operational since 2006; it is now being extended to the quality and technical business areas.

The total investment for the development of the application (purchase of software / hardware and implementation costs) amounted to approximately Euro 30,000.

Technology used

The Intranet was developed with the Sharepoint technology by Microsoft. This technology was selected not only for its functionalities but also for the high level of integration with other internal and external applications.

The development of the Intranet for document management

The first objective of the development of the intranet was to simplify the document management in the commercial/administrative area (invoices, forms, promotions, circulars, information papers, etc.) In the past, both external documents (received via e-mail, fax or traditional mail service) and documents partially produced internally (through ERP systems) were managed by using a very simple system of file sharing (through shared folders on the company's LAN). A lot of time was spent to organise, manage and, above all, search for documents, with consequent problems of information filing/conservation. Currently the majority of commercial/administrative documents are managed and published by using the Sharepoint technology thus granting the possibility to have access to always available and up-to-date documents and cutting off any redundancies, with the additional benefit of managing different versions of the documents.

This application has been made available to the agents of the Scavolini group's extranet, with the final objective to strengthen their communication possibilities by directly publishing invoices on the intranet, thus avoiding to send any paper documentation via ordinary mail, as it happened in the past. The intranet was moreover integrated with the company's ERP on one side and on the other with a vertical module for the substitutive conservation of the documents (that can be now filed in electronic format and not necessarily on paper), which is now allowed by recent laws. In this way the company has started a process of progressive dematerialisation and is progressively cutting off management costs linked with paper production and management.

No particular security issues were faced during the development of the application thanks to the consolidated existing infrastructure represented by its internet web site and its extranet. According to Mr. Gentili, Scavolini EDP and IT systems Manager, it was just a

matter of aligning, testing and checking existing firewalls and security systems within the new intranet application.

The situation today and e-business future implementation

The development of the intranet in the commercial and administrative business areas, asked for a reorganisation of the workflows within these departments involving the direct co-operation of human resources. The intranet implementation is now involving the technical department for the management of technical documentation. The intranet application will also be extended to the quality area management with the introduction of BPM tools and consequently to the entire passive cycle with the aim to digitalize and manage all the documents that are currently available in paper only on the intranet. The reorganisation of the workflows as a consequence of the use of this application will finally involve the entire corporate organisation, always with a step by step approach.

Future plans point to consolidating information flows towards the outside (also with the direct involvement of suppliers) through more evolved and efficient developed workflows thus keeping the entire information process/flow under control.

5.7.3 Impact

The adoption of the intranet for document management has delivered remarkable benefits in terms of productivity and improved information workflow. Even if it is not possible to quantify the improvement of productivity of the single departments involved in the application of the intranet, the quality of the work organisation as well as of the human resources' work has improved.

More specifically the introduction of the intranet application for document management recorded positive impacts on:

- *rationalisation of document management* activities in terms of faster response times in document searching activities and document access with the consequent increase of human resources' productivity;
- *drop of costs for paper purchases* thanks to the electronic conservation of the documents and the digitalisation of any communication addressed to the sales network. Before the use of the intranet, the agents received the commercial information in different ways: a part of the documentation was published online and a part was sent them via the traditional mail system. Nowadays any kind of communication (information papers or invoices) is made available and published via intranet. Moreover the integration of the intranet with the vertical module for the substitutive conservation of digitalised documents, has contributed to a progressive dematerialisation of the company and to cut off paper and management costs;
- *quick response* in the business relationships with the agents: through the intranet the agents have direct access to any kind of commercial and administrative information and documents updated in real time;
- *improved quality* of the *human resources' work* and *productivity*: in the course of the intranet development human resources were directly involved, thus improving their technological skills and knowledge through specific training of their workflows. Faster response times in document searching activities and document access have

contributed to the increase of human resources' productivity thus positively influencing the workflow of the entire organisation and business processes.

5.7.4 Lessons learned

The most significant lesson to be learned in the development of the intranet application for document management by Scavolini was the approach of a step by step implementation. This process has made it possible to analyse the requirements of micro business areas within the involved departments (order processing, invoicing, etc.) each time, collecting the specific requirements of the staff, solving their problems and training human resources to reorganise their workflows. The adopted step by step approach made it easier to change the staff's working habits rather than reorganizing the entire working structure. For this reason Scavolini has decided to continue the intranet implementation with the same approach. The intranet development is still in progress and will finally involve any business area of the corporate organisation.

In terms of technological aspects, the development of the intranet application for document management immediately resulted successful thanks to the consolidated architecture of its more than ten years old extranet. The past experience and the choice of an open and easily integrable technology (Sharepoint by Microsoft) made it possible to easily find out the best solutions for the development application through an easy integration with the existing IT systems.

This case study provides an interesting example of productivity of internal processes induced by the introduction of ICT based process innovation.

The CATI Industry Survey 2007 shows, however, that DMS systems are implemented by only 19% of firms in the European furniture manufacturing sector.

5.7.5 References

Research for this case study was conducted by Elisabeth Schmid, Databank S.p.A. on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview with Mr. Edoardo Gentili, EDP and IT systems manager, 25 July 2007
- Report by School of Management of Politecnico di Milano "PMI: innovare con le ICT" (SMEs: innovation through ICT)
- Competitors report "Kitchen Furniture", Databank 2006
- Website: Scavolini, http://www.scavolini.com.

5.8 Webmobili, the Furniture Search Engine, Italy

Abstract

Webmobili is a spin-off from Federmobili, the Italian Association of Furniture Retailers. It is a publishing company running a search engine that provides consumers with a point of comprehensive information about the national offer of medium-high range furniture and related items. It is a marketing and communication service for independent retailers and manufacturers. The service is free for consumers. Customers of this service are retailers as well as furniture manufacturers.

Webmobili has built a database of catalogues of manufacturers and retailers: All collected information has been standardised and migrated to the service in such a way that it can be easily accessed by the public. The main objective of Webmobili is to give visibility to the offer of Italian furniture, which is mainly produced by small-medium sized manufacturers and sold by independent retailers with limited investment capability for advertising and promotion. A unique feature, at least on the Italian market, is that catalogues are edited and harmonised: they are designed and presented in a user-friendly way, in order primarily to provide objective and comparable information (including price range) to the public. Webmobili proved to be a communication channel bridging an information gap between demand and offer.

Case study fact sheet

■ *Full name of the company:*	*Webmobili S.r.l.*
■ *Location (HQ / main branches):*	*Milan, Turin (Italy)*
■ *Main business activity:*	*B2C Search engine for the furniture sector*
■ *Year of foundation:*	*2001*
■ *Number of employees:*	*12 employees and 3 full time consultants*
■ *Turnover in last financial year:*	*1,250,000 euros*
■ *Primary customers:*	*85-90% Furniture retailers (Shops) and Furniture manufacturers*
■ *Most significant geographic market:*	*Domestic Market*
■ *Main e-business applications studied:*	*e-Marketing; e-Communication with Customers*

5.8.1 Background and objectives

About Webmobili

Webmobili is a spin-off from Federmobili, the Italian Association of Furniture Retailers (http://www.federmobili.com). Webmobili is a publishing company, running a search engine that provides consumers with a comprehensive point of information about the available offer of medium-high range furniture and related items. It is a marketing and communication service for independent retailers and manufacturers. This service has been running since 2002. It is the leading provider in this field, as for the number of product sheets presented and for the number of hits.

The service ifs free for consumers. Customers of this service are retailers as well as furniture manufacturers. These pay a yearly fee (about 1,000 euros for shops and from

6000 to 30,000 euros for manufacturers). The shops pay to have visitors to their web pages (information about the show room, the services to the consumers, the brands they sell and the products). The producers pay to obtain more visibility for their products (being their catalogues on the Webmobili search engine because requested by the shops). As by July 2007, the search engine had 20,000 products of 350 producer catalogues, requested by 1,100 paying shops. Further, there are 60 producers paying to have their banners.

The service portal

Webmobili has built a database of catalogues of manufacturers and retailers (often supplied on paper) and all this information has been standardised and migrated to the service in such a way that it can be easily accessed by the public. A unique feature, at least on the Italian market, is that catalogues are edited and harmonised: they are designed and presented in a user-friendly way, in order to primarily provide information (including price range) to the public rather than being a promotional tool. The effort of standardisation was in fact the main challenge of this service and is considered its main point of strength. The purpose and the value added of this standardisation process is to offer actually comparable and objective information to consumers, therefore clearing the information normally provided on catalogues of the promotional content. It addresses the domestic market and mainly includes national manufacturers.

Products are divided into 16 compartments, including, among the others: kitchens, tables and chairs, sofas, living rooms, children furniture, lighting, office, bathroom, furniture complements, garden furniture, doors. The database, containing product's information of about 350 – mostly Italian – furniture manufacturers, can be considered a good representation of the offering of the medium and high range Italian players, while low range companies are less represented. For each product, Webmobili provides the following information: name of the product, manufacturer, designer, production year, style (contemporary, classic or rustic), dimension, material, price range, guarantee duration and awards. A photo and a description of the product are also available. It also provides information about the points of sales – next to the consumer – where the item can be purchased. All the information is organised according to the various parameters of the adopted taxonomies.

Objectives

The main objective of Webmobili is to give visibility to the offer of Italian furniture which mainly consists of small-medium sized manufacturers and independent retailers with limited investment capability as for advertising and promotion. It also offers the possibility to customers of high range products to reach fully detailed information about the available offer and prices. The rationale behind this business idea was that there was little awareness - among consumers - of the broad range of offer in this field. Webmobili proved to be a communication channel bridging an information gap between the demand and the offer.

It is still a unique initiative of this kind in this segment of the Italian market; other initiatives are either run directly by furniture suppliers or address the B2B market. It positioning and its success are related to the peculiar characteristic both of the offer and of the demand of the Italian furniture sector, in particular to the high relevance of the higher range and design –based products.

Challenges

The set up of this service faced two main challenges: technical challenges related to the standardisation of the product classification and market challenges related to the degree of acceptance by manufacturers of a third-party-run information service.

5.8.2 e-Business approach

Timing and costs of the activity

The service was set up in 2001 and started operations in 2002. In 2007 the web portal has been completely redesigned. The initial investment of this initiative was 750,000 euros, including both the purchasing of the technological infrastructure and the development of the content. The system requires constant maintenance both for the technical and the editorial features. Out of the 15 employees, seven work at the updating of the editorial content.

Technology used

The core of the service is the database where data are organised by, and can be accessed through, the three main categories: products, retailers and, in the new versions on line from December 2007, manufacturers and designers. The whole service runs on standard Microsoft ® environment (SQL)[59] and Dotnet 2.0. There is no integration between the Webmobili information system and those of shops and manufacturers, the necessary information is exchanged through standards means (e-mail but still on paper as well) and then processed locally. The site provides a set of functionalities for searching information. No e-commerce functionality is provided; therefore, security requirements are not particularly critical, standard firewalls are suitable.

Standardisation of catalogues

Standardisation was the starting point of the service, the main activity as for the involved resources and it is considered the main point of strength. The aim to provide actual and objective comparison of the high-range national offer of furniture was very ambitious and required a relevant effort for the identification of parameters (such as dimension, material, price range) and coding to be used. The services had to address the issue of the industrial categorisation of the presented items; it had to reach a common understanding of different classifications as the expected output was that consumers may have, within each product sheet, the same kind of standards information for each item. The main barrier was related to price transparency. Many retailers were initially resistant to the idea of providing information about prices on the web. The proactive role of Webmobili in involving relevant business players and promoting transparency of prices was one of the main challenges.

[59] SQL stands for Structured Query Language; it is a standard interactive and programming language for getting information from and updating a database

5.8.3 Impact

Webmobili reached the breakeven point in 2004 and has been profitable since 2006. The service does not provide e-commerce facilities; therefore it has not a direct impact on retailers' sales. For retailers being present on Webmobili implies an increase of additional contacts; being a communication platform for consumers to make enquiries, Webmobili acts as a customer service and a marketing channel, facilitates the spread of information about the available offer, and indirectly increases sales.

In the first semester of 2007, Webmobili carried out a survey[60] over 100 shops subscribing the service. The survey aimed at finding out the impact of the presence on Webmobili as for commercial contacts and sales. The results indicate that out of the sample of 100 interviewees, about 50% stated that they had been visited by customers who had collected information on the Webmobili site and 42% had purchased at least one item when visiting the shop. Interestingly, 34% had brought a printed product sheet downloaded from Webmobili.

Arredamenti Saraceni: good results from the web

Arredamenti Saraceni http://www.saraceni.it/index.html is a family owned shop operating in the high range furniture market, employing five people. This small company has always been very attentive to technological innovation both in the production and in the marketing area. It has been a subscriber of Webmobili for about one and a half year. "I came across this initiative during a workshop" said Luca Saraceni "after surfing the site, I decided to subscribe. What convinced me were completeness and the type of information provided, including price, as I strongly believe in transparency towards the public".

After this period of time, a few data seem to confirm that it was a good choice: the (physical) shop is visited yearly by about 500 customers. In only four months, Webmobili brought about 1,600 customers onto the site. Looking at "hard" selling data, the impact has been 18 sales in the first year and 16 in the first semester of 2007. Although these data may appear negligible in absolute terms, they are relevant in comparison with the size of the shop. Moreover, as Mr Saraceni pointed out "customers reaching us after surfing Webmobili, are well informed therefore the purchasing process is easier and much shorter, which is a great benefit for us". The cost/benefit ratio of being on Webmobili is also quite positive. With an investment of slightly more than 1,000 euros, sales were around 50,000 euros

Source: Interview with Mr Luca Saraceni

The total number of hits to the website has been steadily increasing from about 2.5 million hits in 2005 to 3.8 in 2007. This data are also mirrored by the increase in the number of subscription and by the very low share of firms giving up their subscription after using the service.

The main benefit brought by this initiative is that it filled a communication gap between the demand and the offer of small and highly qualified resellers and producers.

[60] Webmobili, sondaggio effettuato su un campione di 100 negozi, Webobili a customer survey over a sample of 100 shops, June 2007.

The possibility that this service could include e-commerce functionalities has been taken into consideration, however a few technical and market factors have hampered this. The diffusion of e-commerce for this kind of goods is still limited on the national market; secondly main customers of this service are retailer shops (not manufacturers) therefore an e-commerce service should be structured in such a way to avoid cannibalisation of their own sales; third - and most important - the structure of the site as it is now would not be sufficient to support - for over 350 suppliers - the huge amount of variants related to commercial orders for furniture goods. The most likely evolution is that Webmobili may set up a common platform that each individual subscriber may use for its own e-commerce activity.

The Webmobili case study is a good example of a trend toward e-communication that seems to be well set in the European furniture industry. According to the CATI Manufacturing Survey 2007, there is a relatively high adoption of e-catalogues, more evident in large companies (46% vs 30% average) and kitchen-office furniture manufacturers (36% vs. 30% average). See exhibit 3.4-3,).

5.8.4 Lessons learned

The idea of bringing together the offer of independent manufacturers and retailers through the standardisation of their catalogues was a real challenge, in such a fragmented sector where product differentiation is a key marketing tool. This was made possible by the clear strategy behind which gained the support provided of the retail association (Federmobili), and of the relevant stakeholders (retailers and manufacturers).

Another lesson learned through this experience is that in fragmented sectors where many SMEs operate, the standardisation of activities (in this case e-marketing and e-communication, and most importantly in the case of e-commerce) requires a big effort in terms of industrial categorisation and coding. Despite being a small sector with a relatively small number of manufacturers, the issue of identifying a common language to propose to the public proved to be the main challenge. This lesson confirms what the sectoral e-Business watch already found out in other manufacturing sectors[61].

5.8.5 References

Research for this case study was conducted by Elena Gaboardi Databank, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview(s) with Mino Politi Managing Director, July 16 2007, Milan; Simone Bracco, editorial Manager, Turin, July 18 2007
- Other sources. Webmobili, sondaggio effettuato su un campione di 100 negozi, Webobili (A customer survey over a sample of 100 shops), June 2007 (hard copy only)
- Websites: http://www.webmobili.it/, http://www.federmobili.com

[61] See, e.g. the case study about Textilebusiness, available at http://www.ebusiness-watch.org/resources/textile_generic/textile_generic_casestudies.htm

5.9 e-Business and B2B-integration to sourced warehouse at Stokke, Norway

Abstract

Stokke AS designs and creates products for children in three product categories: seating, nursery, and transportation. Stokke is located in the west coast town of Aalesund in Norway. The company has an export share of 95 % and in the past three years its annual turnover has grown by 25%-30%. Stokke's production and warehouse logistics activities are outsourced; 90% of the value added activities are created abroad. This case study focuses on Stokke's implementation and improved e-business solutions, experiences with implementing and improving sourcing strategy, especially within the area of warehouse and outbound logistics. Improvement in the sourced e-business value-chain over the last years is one of the important success factors for the development for Stokke.

Case study fact sheet

■ *Full name of the company:*	*Stokke AS*
■ *Location (HQ / main branches):*	*Skodje, Norway*
■ *Main business activity:*	*Manufacturing of products for children: high chairs, stroller, beds*
■ *Year of foundation:*	*1975*
■ *Number of employees:*	*140, 2/3 employed outside Norway*
■ *Turnover in last financial year:*	*750.000 euros*
■ *Primary customers:*	*Retailers, large chains and "mom & pop" shops , - special stores for children*
■ *Most significant geographic market:*	*EU, US, Japan*
■ *Main e-business applications studied:*	*Benefits of ICT and e-business* *Drivers of ICT and e-business* *ERP – Enterprise Resource Planning* *e-Sales* *ICT and e-business impacts on work processes*

5.9.1 Background and objectives

About Stokke

The company's business goal is to be the world's leading baby furniture manufacturer within selected products; the company sells and distributes highchairs, strollers and beds to specialised retailers in the area of special stores for children. Stokke's products are designed for children from 0 to 10 years. The most important markets are EU, US and Japan.

Stokke is one of the leading suppliers in the highchair market in EU and has recorded an annual sales growth rate between 25 and 30% in the past three years. Because of the increasing competition on Internet sales, at the end of the nineties Stokke started to focus on e-business development, both B2B and B2C.

Implementing integration strategy towards Sourced Warehouse: objectives

Taking into consideration the fact that B2B markets are mostly oriented towards reducing costs in the value chain, and on the "*ease of doing business with*", Stokke has developed a consistent sourcing strategy within production, logistics and warehouse. Since 1998 the e-business strategy and solution towards "sourced warehouse" has been improved in several steps. The market growth in this period has been around 400%, and has thus demanded improved efficiency in the internal and external value chains.

From 1998 to 2000, Stokke changed its distribution strategy from 80% sales through furniture stores and 20% children special stores, to 20% furniture stores and 80% children special stores. In the same period the product line strategy changed from covering the general need "to sit" to covering children's basic needs. Product materials changed from wood to be function-oriented, production changed from partly in-house to outsourced and the number of warehouses, from the existing 16, was limited to one.

By organising warehouse operations into one outsourced location, the first warehouse solution was implemented by focusing on the reduction of time from order to delivery in all the major markets. It was considered to be strategically important to build a new position within the market, by shipping the goods from the warehouse at latest on the day after the receipt of the order.

Several limitations in the sourcing partners' IT-resources and possibilities to integrate different system-platforms were identified; hybrid solutions were chosen as the optimum cost-benefit-solution. From 2000 to 2006, a period characterised by a considerable business growth, several areas of improvements at and towards the sourcing partner were identified and actions were taken to implement the existing solutions.

5.9.2 e-Business approach

Project description

Stokke's project aimed to implement the integration towards sourced warehouse. The strategic goal was to reduce the time from order to delivery in all the main markets concentrating warehousing operating within one location thus reducing costs in the value chain, to efficiently manage constantly increasing business volumes and to increase warehouse efficiency and effectiveness.

Implementing BIT branch-standard MRP-system (Movex), 1997-2004

Between 1999 and 2005 Stokke outsourced and centralized warehouse operations at one location (from the existing 16 warehouse locations). One of the major achievements was to link services based on Stokke's infrastructure and systems with the warehouse sourcing partner and this objective required change in the working process, organization, systems, technology and quality of data.

The combination of both upgrading into a new ERP system and the major change into one warehouse operation was a complex task. Implementation required more resources and time than planned. Planning was done together with the warehouse-sourcing partner and the ERP-vendor. The sourcing partner had no or limited possibilities to exchange EDI-files (this was restricted by proprietary systems). In 1999 Stokke upgraded to the

latest version of Move ERP system. This enabled Stokke to receive orders from decentralised customer service-offices on 5 locations in EU into one central order handling module. Sales orders allocated items at warehouse and picking and shipping list was sent as EDI-files to the warehouse. Warehouse and logistic partners imported the EDI-files into their logistic planning system. The sourcing partner's warehouse system could not be integrated with Stokke's ERP system; due to the lack of integration-possibilities, it was decided to implement Stokke's own infrastructure at the warehouse. This included broadband, firewalls, local server, printers, scanners and WLAN, linked together as an online solution towards Stokke's ERP system. Stokke organised users' training and chose local and external service providers and helpdesk. A considerable effort was required over a long time and in the end Stokke managed to achieve the Service Level Agreements (SLA) goals set for the whole warehouse and logistic operations

One way EDIFACT messages from Stokke to sourced warehouse, 2004-2006

From 1999 to 2006 the turnover had tripled and the need for further improvement became necessary: higher warehouse capacity, improved inbound and outbound logistic and higher efficiency, reliability and flexibility in the warehouse operation.

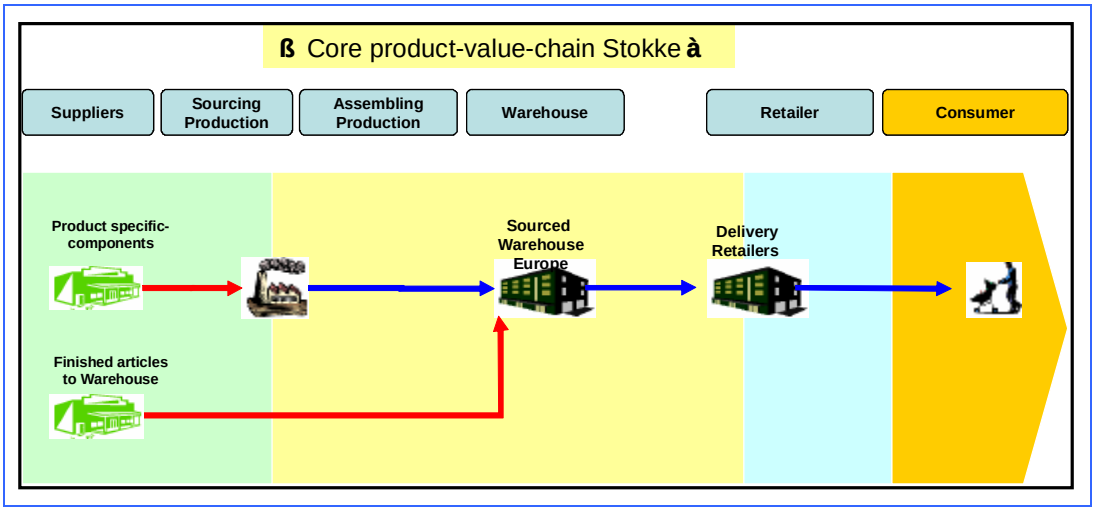
In October 2005 Stokke chose a new sourcing partner and moved the whole warehouse operation to new locations. Prior to the move, new and improved e-business solutions were implemented. This was basically a one-way EDI from Stokke to the warehouse system, for both distribution planning and warehouse pick and pack. Return messages were manually handled by the outsourcers own ICT directly into Stokke's ERP system. One of the technical goals was to eliminate the need to place Stokke's own infrastructure at the warehouse. The move of the warehouse to a new location was completed between October 2005 and April 2006 and included workshops, SLA–levels definitions, EDI communication protocols and EDI contents. Solutions were tested and approved prior to the implementation. Both the physical moving of goods and implementation of the e-business-solution were done more or less "over night". Even if errors related to technical IT-equipment were eliminated with the new solution, errors may occur and are basically due to human errors when entering warehouse picks and warehouse balance.

Full two-way XML integration, 2007-2008

With the goal to double Stokke's turnover to 1 billion NOK (125 million euro) in 2010, higher efficiency within all areas of the warehouse operations is required. The need for full 2-ways EDI and more seamless system integration has been identified and will be finally implemented within April 2008. Stokke also identified the need to upgrade the ERP system, to achieve the new e-business goals.

Stokke's goals are to reduce human errors, to implement a more online e-business warehouse solution and a seamless online integrated solution that will be the base for new third parties warehouse solutions at other locations in the world.

Exhibit 5.9-1: Core product value chain at Stokke



Source: Stokke AS

5.9.3 Impact

The successful integration towards a sourced warehouse enabled Stokke to achieve higher warehouse efficiency and effectiveness, thus reducing time from order to delivery and consequently meeting the market needs: ETDBW (Easy To Do Business With) and RCAP (Reduce Cost Adding Processes).

To attain the company's goal to double its turnover between 2006 and 2010, further improvements of the warehouse operations are therefore of outmost importance, as well as the improvement of information quality and operation efficiency for all aspects of Stokke's business relations.

Stokke has planned and organised these implementations in a project named "Moving", a business development follow-on project as much as an upgrade to a new version of Movex. In this early stage of the project the goals are to increase sales volumes (thanks to the retailers' perceived experiences: "It is easy to do business with Stokke") without an equal increase in administrative employees' costs and to ensure a low cost growth in existing markets and in new geographical markets. Low cost e-business portals to both chains and moms and pops-shops perceived to be efficient – reducing existing cost and increasing efficiency - are planned. To achieve these goals internal changes are required:

- New employees with new responsibilities; Owner of system basic data, Responsible for internal training; Responsible for integration towards retailers; Defined super users within area of customer service, and closer coordination and interaction between internal departments.
- New business relationships with retailers; new contact persons, and new relations towards retailer's e-business centres.

5.9.4 Lessons learned

The main business decision in Stokke is to buy or produce, depending on the known cost for products and services. An outsourcing decision also introduces a third cost element:

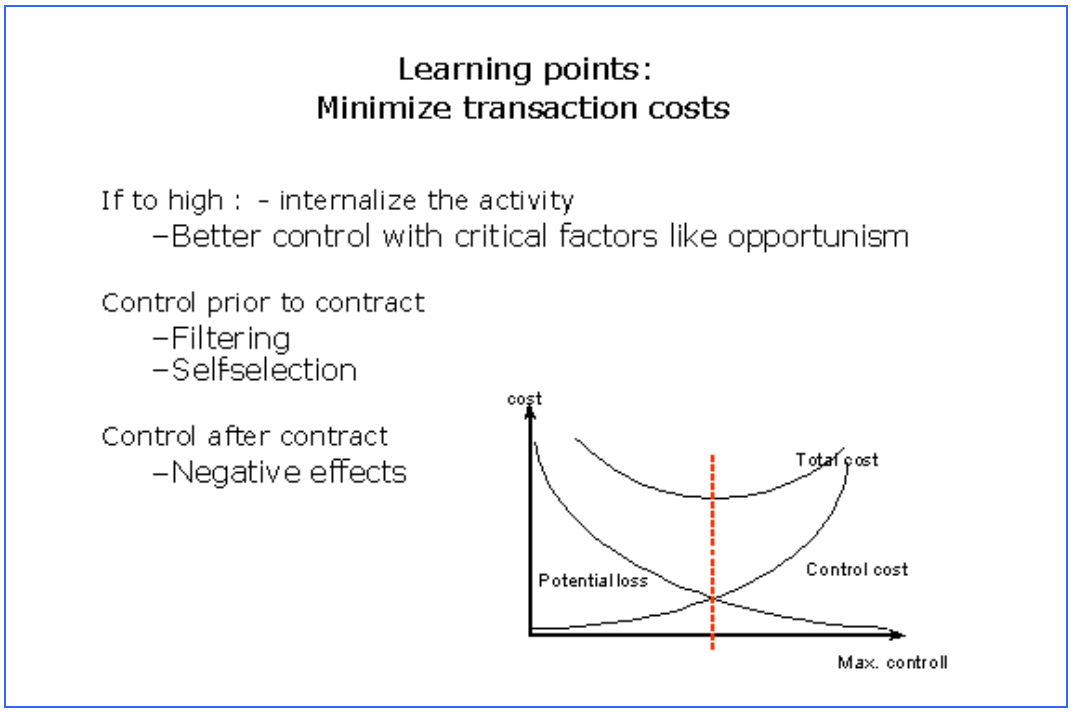
the cost of communication, transaction and control of quality of outsourced products and services. The outsourcing transaction cost is difficult to calculate beforehand. Stokke has experienced that outsourcing generates new costs within new areas:

- Costs of using the price mechanism and the operations of the economic system are mainly information and communication costs.
- Costs related to contracts: information seeking, negotiation costs, contract design, control costs, managing agreements, error adjustment costs, binding costs.
- Post-contract related costs: Adjustments of transactions in case they are not processed as planned, negotiation costs to correct deviation from goals, start-up costs and managerial costs of new solutions, costs of Intellectual Property Rights, human behaviour cost because human is limited rational and opportunistic.

Finally, Stokke experienced that specific investments are needed towards the warehouse sourcing partner. These types of Investments have low or no value outside the relation and create high control and negotiations costs. To increase the value of such investments Stokke chose international standards for communication-content and communication interface.

The goal for Stokke has been to find an optimum e-business solution balancing the cost of control with the cost of potential losses, as shown in Exhibit 5-4.

Exhibit 5.9-2: Stokke learning points: minimise transaction costs



Source: Stokke AS

When answering the question: "What would we have done different?" ICT Manager Per Henning Vågen at Stokke identifies several learning points:

- Spend more time together with the sourcing partner, defining the scope of the implementation process, and the importance of Stokkes business process.
- A lot more training of sourcing partners employees, to avoid misunderstanding or lack of action to correct errors.

- Even a more in depth work with contracts prior to signing, and developed a better contract design.
- Establish more binding continuous improvement plan for the business-interaction for both parties.
- Establish better and earlier a tool for common benchmarking of sourcing partners services and costs.

Besides that, technology has opened up new opportunities for the integration of value chains. Earlier limitation in systems and infrastructure is replaced by open standards and open interface for collaborative business development. Today there are less constrains and limitations in technology.

Stokke learned that changing the business process requires changes in the organisation, data, system and technology not only within the company, but even more in the relation with the same areas of the sourcing company. Integrated business processes require data integration, system and technology integration and new and closer relations between people in both organisations.

5.9.5 References

Research for this case study was conducted by Baard Krogshus, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interview(s) with Per Henning Vågen, December 2007, Oslo
- Internal strategic documents – Moving-project-doc
- Strategy plan 2010
- Information to “allmoete”, January 2006
- Public presentations
- Stokke’s annual report 2006
- Stokke–case eBSN 2007
- General info about Stokke: www.stokke.com

5.10 e-Communication with suppliers and distributors at Home Base, Denmark

Abstract

Founded in 2000 as a start-up, Home Base A/S is a designer and seller of outdoor furniture based in the city of Dragør, Denmark. The main challenge of the start-up was to efficiently manage the communication flow between the company's office in Denmark and factories in Indonesia as well as with a worldwide network of distributors and clients. It is important for the company to maintain a low level of stock to avoid storage cost but also to be able to respond quickly to seasonal market demands.

The case study shows how an ICT system facilitates a business model organised around efficient information flow within the whole operation from the design process and customer orders to production and delivery. The optimal use of information enabled the start-up to gain a competitive advantage and to maintain steady growth.

Case study fact sheet

■ *Full name of the company:*	Home Base A/S
■ *Location (HQ / main branches):*	*Dragør, Denmark*
■ *Main business activity:*	*Production of outdoor furniture*
■ *Year of foundation:*	*2000*
■ *Number of employees:*	*9 (Headquarter), 28 (salespeople Europe-wide), 700 (contractor in Indonesia)*
■ *Turnover in last financial year:*	*5 million euros*
■ *Primary customers:*	*Private customers and businesses*
■ *Most significant geographic market:*	*Europe, USA*
■ *Main e-business applications studied:*	*e-Communication with suppliers and distributors, AutoCAD, ERP*

5.10.1 Background and objectives

Background

Home Base A/S is a Danish company that specialises in designing and developing furniture for outdoor living. It was established in year 2000, but its products quickly become recognisable on international furniture fairs, increasing its sales very quickly by 50% for the first three years and 30% annually after. The company delivers designer outdoor furniture made of innovative materials, developed and patented by the company, that are recyclable, non toxic and environmentally-friendly.

Organisation and strategy

In its business model, Home Base planned that its headquarters' staff in *Dragør* would concentrate on the conceptual part of furniture production, i.e. sensing and anticipating fashion trends and consumer tastes, creating furniture designs, marketing and selling. The production was to be outsourced to Indonesian and Chinese factories. After shipping

it to Denmark, the furniture is distributed through a network of independent retailers and distributors. Home Base keeps stock at the production location and on a site in Denmark. The main clients of the company come from all over the world and include chains of hotels, restaurants and other businesses as well as private consumers buying the furniture from approved retailers.

An obvious advantage of such an organisation is its flexibility and low capital and labour intensity. Founders of Home Base did not have to make big up-front investments in production facilities or distribution network. Instead, they decided to rely on market-based transactions with other existing firms and focus themselves on managing activities along the value creation chain and furniture design. Therefore production has been subcontracted to factories in China and Indonesia while storage and distribution are outsourced to a Danish company.

Though very flexible, such a business model creates a challenge with respect to efficient information flow between the company, its contractors and distributors. This aspect is emphasised by the high level of international operations, cultural differences and various ways of communicating. Particularly when considering that the firm employs directly only 9 people at its office in Denmark but maintains close links with a number of independent entities. For example, since the start, the firm has extended its business to include more than 400 distributors all over the world. In this environment it is easy for an array of communication problems to arise, such as different time zones and languages as well as different technological advancement where some people would not have access to email. As an integrated company, Home Base would be able to easily manage operations of various units by adhering to the system of hierarchy. However, as the firm operates from various locations, it had to find creative but uncomplicated solutions to coordinate the flow of information and operations. The whole business concept has only become possible with the support of ICT tools. Home Base would probably find it hard to exist without the ICT technology and internet connectivity. That is why the company's founders put a great deal of thinking and research into finding the right IT applications to support their business from the start and then through planned growth. *''We needed a flexible, well known and reputable solution that could meet our needs both at the beginning and in the future,"* says company founder and director Mr Ian Sonders.

For a business that was created to survive and thrive in this demanding economy and highly competitive sector was necessary to have the support of adequate technology."At our office in Dragør, Denmark, we conduct design of products, marketing, sales and distribution operations, explained Mr. Sonders. We rely on meeting demand from stock already in Denmark or at one of our Asian factories. If we are unable to fulfil demand from stock, we would manufacture to order, so we keep only minimum stock. This would be shipped to Europe and distributed to the clients. We achieved solid market share by being innovative and flexible with minimal cost. All that would not have been achieved so fast without IT tools and internet communication."

5.10.2 e-Business activities

The founders of Home Base made ICT a vital part of their business model and spent a considerable amount of time searching for a suitable solution. It needed to be flexible and adaptable to the company's growth and as easy as possible for people to use in order to prevent future disruptions in business and minimise the cost of employees' time and training. The search began for something that would be comparatively open but which

could also easily be configured according to the company's requirements. ''Microsoft Navision was chosen as a right solution for a number of reasons - states company director, Ian Sonders. Firstly it is a well known business solution for small and medium enterprise. Secondly, we liked the fact that it was Windows based and fully integrated with other popular applications used worldwide. This was an important point since few people would need intensive training on a product as familiar as for example Microsoft Excel and Word. Furthermore, the ability of the system to grow and adjust to our needs was very important. Additionally, purchasing a widely-used system eliminated most of the technical support cost''.

Implementation of the chosen solution started in 2000 when the company was in its start-up phase. The founders firstly invested in a basic version of the software and the modules were added along with the company's development. The Navision applications provided Home Base from the start with an integrated system that includes financials, order processing, and warehousing and client management also with support for web portal. The implementation and usage of the ICT has been from the start an integral part of the company's business plan. The technology tools were chosen and were implemented at the beginning of Home Base's existence but with a defined vision for the future. Despite the investment cost of over 30k Euros, the founders of the company were convinced that only with the help of a good software package they would be able to start business and solve many problems in the long term, especially as they were planning international *operations. ''The return on investment was not the most important; we wanted to use IT to gain competitive advantage in the industry and have an efficient tool for solving problems should they arise''*, says Mr. Ian Sonders, Home Base director and co-founder.

The new solution offered integrated business applications that allowed a small organization like Home Base to connect its headquarters office with distant customers, suppliers, warehouse and logistic contractors. Communication documents are formatted in industry-standard XML which help interoperability between trading partners and their software applications even if it is different than Navision. Especially important is the communication and interoperability with the logistic and warehouse company that stores and delivers orders to Home Base clients.

The modules implemented at Home Base include; financial management, customer relationship management, distribution and warehouse management, order processing, shipment and delivery, production orders, bill of materials and some analytics applications as planning and dispatching and automated data capture systems. In addition there is an important commerce gateway portal module to give clients instant 24h/7d access to their accounts when they can check the stock available, order on line and verify status of their orders instantly.

The Navision package works also with other widely used Microsoft products such as Windows and Office which permits the system to be interconnected with other users even if they don't have Navision but only a simple MS office package. An additional advantage of the adopted solution is the fact that it is based on the user interface of Microsoft Office Outlook and this interface gives a familiar working environment. Additionally, the software provides an efficient user centre working screen through the ability to tailor screens accordingly to job functions and roles. 'Extracting information is made simpler by the system and the fact that it's compatible with Windows, means a new user doesn't have to learn the basics before sitting in front of it," comments Mr. Sonders.

In addition to the Navision package, designers at Home Base use AutoCAD software to modify and create furniture designs as well as exchange technical information and pictures between designers, the office and the manufacturing plant. The software helps to visualize the furniture prototype and put it to test. Firstly, a new piece of furniture is created in AutoCAD and then a few prototypes are made and sent to furniture fairs around the world. If the design is liked by viewers then it goes to full production line and items are included in the catalogue ready for orders. As the prototype model of furniture is a very important step towards full production, it is essential to prepare it and modify it quickly. The use of IT tools save time and cost, minimising errors.

Overall, the comprehensive package of IT applications enables Home Base to streamline communication with its clients, logistics and manufacturing operations. It allows rapid responses to emails and requests from all over the world overcoming time zone differences, helps planning and executes orders quickly, making the business truly operational 24hours a day. For example, when at the close of the office in Denmark orders are sent to factories in Asia and being produce while the office sleeps and at the same time queries about stock levels from the USA are getting a response from the system.

5.10.3 Impact

The implementation of a comprehensive ICT package like Navision was perceived as a necessary foundation for the Home Base business model. With the help of the ICT tools the company increased turnover, reduced the time needed for order processing achieving faster response times and reduced inventory. It is difficult, in Home Base's case, to estimate benefits in terms of numbers because there are no times ''before'' and ''after'' the ICT implementation. Nevertheless the company's management reveals that sales increased 100% in the two first years and have continued to do so at the rate of about 30% thereafter, when order processing is at least 50% more efficient than without ICT usage.

Without the ICT technology the company's director believes that they would not have been able to grow so fast and compete on the furniture market. The ICT tools have given the company a competitive advantage, and brought many benefits to business operations, in the following areas:

- **Order tracking** Complete detailed and up-to-date tracking of orders, efficient order processing capabilities, stock visibility and the ability to provide accurate information on product lead times – a feature that would not have been available without a modern integrated ICT business solution.
- **Communication** E-communication provides a valuable alternative to a costly paper-based information exchange like drawings, catalogues, letters, invoices, orders, etc. The company maintains cost savings derived from the elimination of printing, postage and overall handling of paper - orders, invoices, catalogues, etc. Costs of this nature could be a significant burden on a small enterprise.
- **Operations** Furthermore, e-communication at Home Base overcomes time zone differences making possible for the business to continue around the clock. This brings important speed into operations plus savings in time and manpower dedicated to maintaining communication links.

- **Design** AutoCAD accelerates the furniture design stage; therefore the production process also makes possible quick delivery of new models.
- **Production planning** ICT applications have helped to meet the rising demand for Home Base furniture allowing the company to react quickly to market and inventory conditions and matching that with production orders. Because garden furniture sales are based on seasonal demands the company must be prepared to quickly fulfil orders during spring and summer time and minimise stock holding for the rest of the year. Production is closely linked to sales and orders to avoid overstocking. A computer program also helps generate a manufacturing plan and calculates the amount of materials and components required.
- **Sales** Real-time sales information on inventory and logistics progress allows better management of small and complex orders and mean improved customer service and satisfaction. The company's sales people and clients are benefiting directly from having a 'live' stock balance. Mr. Sonders explains, "*When anybody enquires as to the availability of furniture, because we are operating Microsoft Navision, items can be located at any site. Arrangements can then be made through the system for items to be delivered to the required depot or customer within the shortest possible time."*
- **Skills** Reducing the learning time for any new user of the system due to the fact that implemented solution is operating in compatibility with widely known Windows though a new user doesn't have to learn all new functions and can use the system in conjunction with other known Microsoft products.

5.10.4 Lessons learned

Facing a highly competitive market brought Home Base significant challenges. Some of these were common to many businesses – the need to drive down business costs, improve on product delivery and customer satisfaction but also more specifically to quickly respond to customer tastes, seasonal demand and world wild cooperation with a worldwide network of clients, retailers and producers. The importance of having implemented adequate ICT tools cannot be over-emphasised.

As mentioned above, within a few years the company created a network of nearly 400 distributors dispersed all over the world, has two manufacturing contractors and a large European distribution centre. Furthermore, to optimise its inventory levels and product range, the firm needed to interact with a number of organisations. Without emails communication and cooperation would have been more expensive, time consuming, and demanding on a large number of sales staff. The level of capital available to this small size enterprise would not have had covered the start-up and running cost to survive in the competitive furniture sector. Mr Sonders confirms that Microsoft Navision, in conjunction with AutoCAD, have been vital to the existence and fast growth of the whole venture.

Home Base director, Mr. Sonders would like to stress the importance of investing in reputable and efficient ICT applications right at the start of the business venture. It is very important that the system is able to grow with the business. *''Even starting small but having the possibility to enlarge an existing ICT structure by adding needed modules would save time and money avoiding later ICT implementation normally needed when business grows.''*

It has been also mentioned by the company that they now communicate electronically with 75% of their partners from order placement and processing to invoicing. However, Home Base remarks that despite being ready to work paperless, they have a certain number of clients who do not support electronic data exchange. They are often not technically literate therefore prefer doing business the traditional way using telephone and fax. The company is ready for all data to be electronically exchanged but this is dependent on the future acceptance and diffusion of such applications in the furniture retail industry. The lack of wider acceptance of such practice in the industry hampers the cost saving and efficiency increase that would benefit all.

5.10.5 References

Research for this case study was conducted by Aneta Herrenschmidt-Moller, on behalf of the Sectoral e-Business Watch. Sources and references used:

- Interviews with Home Base director Mr Ian Sonders in September and October 2007
- Company website; Home Base A/S, http://www.home-base.dk/ (last accessed on 15 Oct 2007).

6 Conclusions: key findings and policy implications

6.1 Key findings

A highly competitive environment

A quickly changing and highly competitive environment is putting increasing pressure on EU furniture manufacturers. Reduced lead times and product innovation are the main key success factors for businesses to respond to such challenges and to remain competitive. A closer link with both intermediary and final customers is also a clue to keep the pace with market changes and provide adequate customer service. Horizontal and preliminary to these factors is the capability of furniture manufacturers to rely on properly skilled human resources.

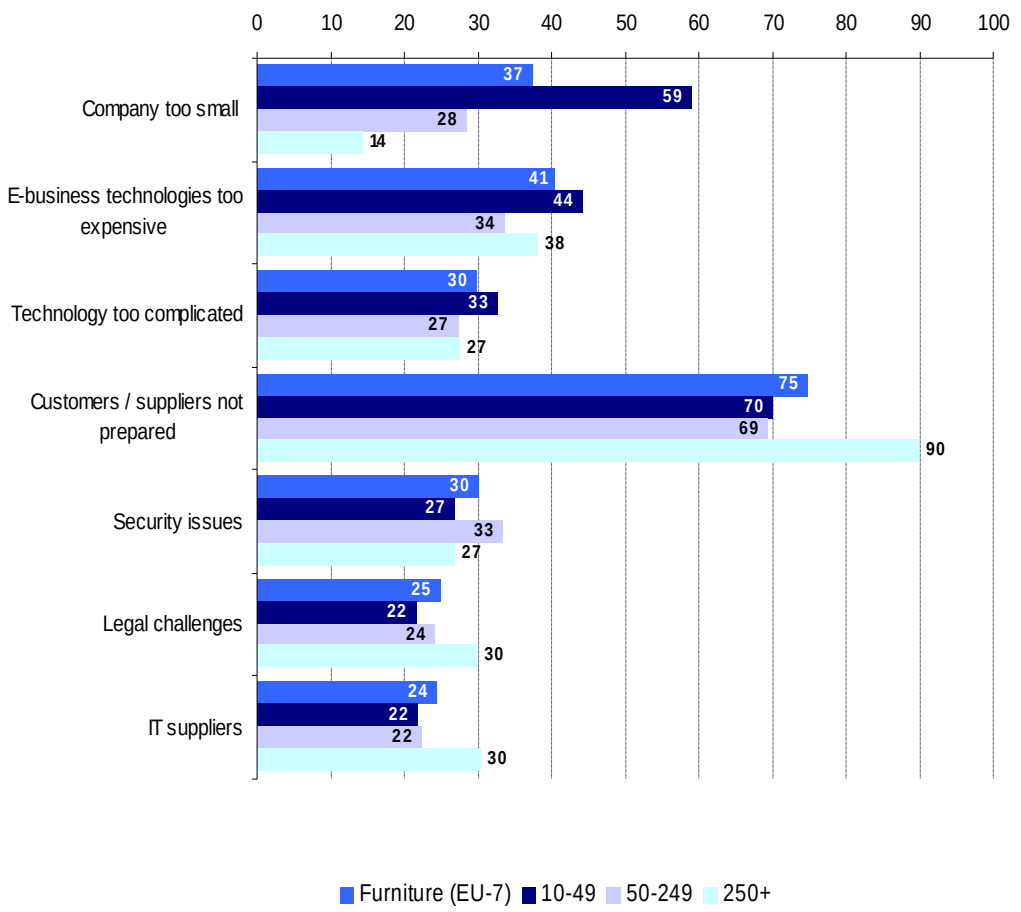
A fairly good basic infrastructure…

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

… with limited e-business integration

More sophisticated systems however, especially those, such as ERP and SCM, aimed at the integration of business processes, are still limited. Although potential benefits of advanced and integrated ICT and e-business solutions are evident, adoption and usage are still limited to larger firms, while smaller players face relevant constraints and barriers, as highlighted in the following exhibit. The high prevalence of small companies -many of which have a low propensity toward ICT adoption typically characteristic of traditional craft & trade companies- accounts for the limited adoption of more sophisticated ICT and e-business solution. As the following exhibit illustrates, however, a major hurdle is also the lack of “pull” potential from distribution chains and business partners. Most furniture companies, large ones (90%) above all, think that their business partners are not prepared to adopt ICT and e-business. All the other hampering factors, including cost of technology and company’s size are obviously somehow important. However, the lack of a market force, able to take the lead in, e.g., the adoption of standards or foster value chain development, through ICT and e-business use is a major issue .

Exhibit 6.1-1 Barriers. Percentage of users indicating that… (2007)



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

Base (100%) = Percentage of firms where some or none of the business processes are conducted as e-business. N (Furniture, EU-7 and USA) = 593.

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

Questionnaire reference: F2

Source: e-Business Surveys 2007 by the SeBW

In short, both for structural reasons and following a strategic choice, ICT investments are concentrated in the design and production area, while the integration between design, production and operation management is still weak; the different activities are often organised in clusters and not fully integrated.

A major lesson learned from the present analysis, however, is that full integration of all business processes is not always necessary, both because most small players would find it difficult to justify investments and because a relevant share of the manufacturing activities are organised in small batches. The identification of priority areas for investment is possibly the suggested path for companies embracing e-business, as the case studies Quatuor and Scavolini illustrate (section 5.6 and 5.7). The SeBW survey results also confirm that furniture firms are quite dynamic in adopting simple forms of ICT and e-business, such as web-based services for on-line orders and invoices, which suit their needs, size and financial capabilities. Full automation and integration of business

processes pursued by Ikea (section 3.2.3), is surely an outstanding example; it is nevertheless hardly replicable.

Importance of the design area

CAD and 3D tools are playing an increasingly important role for furniture companies. Exchange of data related to product design has a long tradition in this sector – the introduction of CAD dates back some decades – and is diffused even among micro and small companies, without striking differences among countries.

Case studies presented in Chapter 5 provide interesting insight on how design tools can be further exploited for the purpose of customer-driven production and innovation, allowing a cost and timely-effective way to meet customers' needs. In the Danona case study (section 5.1) made-to measure furniture is designed together with the client via a 3D CAD/visualisation system, and the relevant production data are sent directly to the mill. A similar approach is followed in a B2B context by the subject of another case study, the Austrian company Robinwood (section 5.5) that implemented an e-distribution platform that allows planning, calculating and ordering customer-tailored furniture with arbitrary design.

The green issue

The increasing importance of environmental issues is driven by regulation and is fostered by customers' awareness (still limited but increasing trend). In order to effectively respond to environmental challenges, a comprehensive approach is required: environmental issues need to be taken into account from the product concept and design phase, through procurement, production and post-sales, until de-manufacturing. This comprehensive approach allows more efficient sourcing and usage of raw materials. The role of e-business is mainly in supporting the concurrent engineering process, with a comprehensive approach that follows the global environmental impact of the product, as demonstrated by business examples presented in section 3.1.3.

e-Marketing and sales

The diversity of ICT systems and of competences is a major hurdle to integration, especially in the downstream part of the value chain. e-Business integration is still lacking between manufacturers and independent distributors, due to the characteristics of furniture distribution networks and to complexity of industrial categorisation and coding. The main challenge is to manage alternative product distribution mechanisms and resources effectively in complex and fragmented distribution networks. e-Marketing and e-sales activities towards final customers are still limited in this sector and are aimed at providing technical and commercial information rather than actual e-commerce functions.

Web catalogues as the most used web-based application, they may be used as a kind of customer service and are not always integrated with ordering and production/distribution systems. The Webmobili case study (section 5.8) e.g. illustrates the technical challenges related to the standardisation of the product classification for the purpose of e-commerce.

Furniture manufacturers (and retailers) may benefit from improved interoperability and standardisation both for integration of business processes and for the development of B2C and B2C commerce activities.

Impacts of ICT

The macro-economic analysis indicates that ICT and e-business have impacts on the furniture industry, but they do not change business fundamentally. ICT is as an enabler of innovation and positively impact on firm performance. the ICT-driven innovation process is linked to the share of employees with university degree and of ICT practitioners, as well as to the existence of long-standing and electronically-organised relations with business partners. Conversely, the overall impact of ICT on the furniture industry structure is limited. Finally, ICT and make-or-buy decisions are related, although it is not possible to establish the direction of this link.

6.2 Possible further developments

The market developments and changes in the business environment for the furniture sector have been comprehensively analysed in the "Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries", issued in May 2007 by the DG Enterprise and Industry of the European Commission.

Some of the main conclusions regarding the furniture industry and that are relevant for their e-business implications, can be summarised as follows:

- A thorough restructuring is taking place in this industry. This will bring a selection process for which many companies -especially small ones- will disappear. The most advanced competitors will, in turn, attempt at concentrating their activities, with a dual purpose: improving market positions and getting global. Concentration allows better market control, as well as cheaper outsourcing of components to remote competitive specialised suppliers.
- Competitive companies are investing in design technologies and skills, to build their own brands, and to heighten their service level, especially at the point of sale. Investments are being made to develop private retail networks in order to come closer to consumers' expectations and tastes and increase market response competencies as key elements of market strategies.
- The geographical relocation of markets is expected to continue and increase: the essential part of market growth will be located in now emerging economies which means that export skills and competencies are going to be increasingly necessary for EU industries. This will imply increased networking requirements for all players.
- Globalisation will also affect sourcing and sub-contracting strategies in order to improve cost control and time to market: more reactivity, better traceability, higher differentiation, and better environment care will be necessary to compete on an international market.

These trends will shape a scenario in which furniture firms are likely to face increasingly complex business environments and will have to rely on multi-skilled and flexible resources. Dynamic developments of ICT and e-business can be expected in response to such challenges. The market structure and trends, and the attitude of furniture companies, however, may hamper the full deployment of this process.

6.3 Policy implications

The analysis carried out in this report indicates that in the furniture industry ICT have a complementary role. By and large, furniture companies do not perceive ICT as a strategic priority that impacts on their competitive positioning and performance (less than half the companies think that ICT has a relevant influence). Quite pragmatically, ICT are seen as a mean to carry our in a more efficient way selected business processes, such as design and production. Furniture companies, on the other hand, appear to be aware of the benefits related to ICT have adopted advanced solutions, such as 3D, whenever they prove to bring real advantages.

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

Interoperability

The issue of interoperability and the limited usage of standards -such as EDI and XML- were highlighted in the analysis of the survey results. Most furniture firms are still relying on proprietary standards, a policy even more adopted by large industries that can impose their standards to business. While electronic exchanges with suppliers (more concentrated and linked with long-standing relationships) are relatively more advanced (see exhibit 3.3-4), interoperability with the downstream part of the value chain is still limited (see exhibit 3.4-2).

Currently, the number of business partners and of the systems in place are so high that the automation processes is practiced only with very few players, as it poses relevant technological challenges related to product coding, not to mention the economic justification of the necessary investments. This situation is common to other manufacturing sectors where most players are SMEs and both manufacturers and distributors are fragmented[62]. In other sectors, such as food[63] it has been the role of distribution -in general more advanced and concentrated than manufacturers- to drive the whole sector to the adoption of standards for interoperability on a large scale. The situation of the furniture sector is somehow in between and varies remarkably across different countries (see section 2.2 “The distribution structure).

Lacking this market force, it is an open question what can be done at public level. In this context important efforts have been made on the technological side at a European level especially. The subject of standards for interoperability has been addressed, e.g. by the SMART-fm[64] initiative, by the FunStep Interest group[65], and, presently, by the

[62] See e-Business W@tch Sector Study on the Footwear Industry (2006), see www.ebusiness-watch.org ('resources')

[63] See e-Business W@tch Sector Study on the Food Industry (2006), see www.ebusiness-watch.org ('resources').

[64] See http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/60707

[65] See http://www.fsig.funstep.org/funStep.htm.

INNOVAFUN[66] initiative. The progress on the technological side, however, has not been paired with large scale adoption in the sector.

Policy measures should now aim at fostering faster and wider implementation of standards both at sector and at cross-sector level, in particular as concerns the integration with distribution, and the target of SMEs.[67] This would ultimately bring relevant advantages to the whole furniture manufacturing industry in terms of efficiency and responsiveness to the market. It is the authors' opinion that the deployment and the success of interoperability initiatives will be conditional upon the involvement and the role of sector distribution networks.

At sector level, measures should also include awareness raising and support mechanisms for standardisation initiatives, with the aim to stimulate participation of SMEs. Relevant stakeholders, such as industry federations and standardisation bodies, should be encouraged in making information about and benefits arising.

One of the most important issues in the area of standardisation is the need for a shared classification and standardisation scheme of products coding of data; this is particularly crucial in relation to the huge variety of items that are manufactured and marketed in this sector. IWOfurn and Webmobili (see sections 5.2 and 5.8) are interesting examples of initiatives in this field.

Exhibit 6.3-1: Promoting interoperability in the furniture sector

Rationale	Possible actions	Links with DG ENTR policy
■ Limited usage of standards (large firms mostly adopt proprietary) ■ # of business partners and systems in place ■ Lack of "pull" from distribution ■ Need for shared classification and standardisation schemes for product coding	■ Foster implementation at sector and cross sector level ■ Involvement of all relevant stakeholders, including industry associations	■ Europe INNOVA standardisation networks "Applying open standards to INNOVAte FUrNiture business processes" (INNOVAFUN)

Promote a favourable environment for innovation

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

- Broadband has been diffusing and is presently used by a large share of companies. It should be assured that broadband is made actually available to all European

[66] http://standards.eu-innova.org/Files/Publication/EUR_Standards_INNOVAFUN.pdf.

[67] See also the EC's "Small Business Act" in European Commission (2008).

players in the various countries and regions, in order to avoid situations of e-exclusion. The availability of broadband connection, together with the development of standards, as pointed out above, are conditions for cooperation and activities of joint development of furniture enterprises.

- The macro-economic analysis presented in chapter 4, illustrates that the innovation activities of furniture firms are linked to the availability of ICT skilled resources and of personnel with university degrees. It is also well known that design and creativity are points of strength of the European furniture industry. Efforts should be made at a European and national level to encourage synergies between design and supporting technology in order to favour cross fertilisation between these two fields.
- Finally, ICT may have a relevant role in protecting innovation and IPR. Discussion should be promoted about technologies (such as RFID) that may help EU companies to control their IPR and fight counterfeiting.

Exhibit 6.3-2: Promoting a favourable environment for innovation in the furniture sector

Rationale	Possible actions	Links with DG ENTR policy
■ Highly competitive environment at an international level ■ Critical role of ICT in process innovation ■ Critical role of ICT in customer-driven product innovation ■ Role of ICT-skilled resources	■ Availability of necessary infrastructure (broadband) to all players ■ Enhancement of skills ■ Synergies between design and technological skills ■ Protection of IPR (counterfeiting)	■ DG ENTR industrial policy, involving: § Innovation centres and national / regional governments § Industry federations § Business support networks

Improve e-business skills within the furniture industry

ICT and e-business are rapidly changing the way business is conducted in this industry. Innovative applications require changes in organisation and working procedures. Skills upgrading and training of personnel are important to assure the successful implementation of new applications. However SMEs may have difficulties in exploiting opportunities related to the introduction of new technologies due to the lack of the necessary skills. Policy may have a role in:

- Promoting entrepreneurial and managerial understanding of e-business applications. The involvement of all the organisation layers and strong commitment of the management are essential whenever e-business initiatives are implemented. The experience from the usage of CAD in the Swedish industry (section 3.2) demonstrates that management support and company-specific training are essential for the successful implementation of CAD solution within furniture companies.
- Providing information about e-business and support to decision-making, as SMEs may have difficulties in selecting suitable systems and solutions. Furniture industry associations may support the sharing of successful e-business practices at sector level, between companies of similar size. Moreover, they should support dialogue and cooperation with software providers, with the aim to support the development and diffusion of sector-specific, scalable and short-term return solutions

- Encouraging the improvement of skills related to the reorganisation of working processes and procedures and the implementation of innovative technologies. The business example about the diffusion of CAD in Sweden (section 3.1.2) and the case study about Danona (section 5.1) are examples of the importance of skill improvement in e-business initiatives. The case of Danona illustrates how the involvement of key resources has been fundamental for the development and the adoption of an innovative solution.

Exhibit 6.3-3: Promoting e-business skills in the furniture sector

Rationale	Possible actions	Links with DG ENTR policy
■ Critical role of ICT-skilled resources (from business examples and case studies) ■ Co-operation with business partners and service providers necessary to successful implementation of e-business	■ Providing information about e-business and support to decision making ■ Encourage improvement of skills related to the reorganisation of working processes ■ Promoting managerial understanding of e-business	■ European e-Skills Forum

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Furniture Industry Research Association www.fira.co.uk

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Interviews conducted for this report

Simone Bracco, editorial Manager, Webmobili, July 18, 2007

Mino Politi Managing Director, Webmobili July 16, 2007

Annex I: Glossary of Technical Terms

Term	Definition[68]
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 Watch 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.
CIDX	Chemical Industry Data Exchange (CIDX) (www.cidx.org)
CRM	Customer Relationship Management. Software systems that promise the ability to synthesize data on customers' behaviour and needs and thus to provide a universal view of the customer.
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
EAI	Enterprise-Application-Integration
eBMS	ebXML Message Service Specification
e-Business	Electronic business. The Sectoral e-Business Watch 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),

[68] 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[68]
	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.
EDIFACT	Electronic Data Interchange For Administration Commerce and Transport. See UN/EDIFACT
EDM	Electronic Document Management. The management of different kinds of documents in an enterprise using computer programmes and storage devices. An EDM system allows an enterprise and its users to create a document or capture a hard copy in electronic form, store, edit, print, process, and otherwise manage documents.
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.
EU	European Union
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.
iDOC	Intermediate document
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.[69] 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

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

Term	Definition[68]
	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.
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.
NACE	Nomenclature Générale des Activités Economiques dans les Communautés Européennes; Classification of Economic Activities in the European Community
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 Watch. 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.

Term	Definition[68]
SOAP	XML based lightweight protocol for exchange of information in a decentralized, distributed environment (http://www.w3.org/TR/2000/NOTE-SOAP-20000508/)
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).
UN/EDIFACT	United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport http://www.unece.org/cefact/
Value added	Gross output minus intermediate inputs. It is valued at producers' prices and includes all indirect taxes, but excludes VAT and subsidies.
VMI	Vendor Managed Inventory
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.

Annex II: The e-Business Survey 2007 – Methodology Report

Background and scope

The Sectoral e-Business Watch collects data relating to the use of ICT and e-business in European enterprises by means of representative surveys. The e-Business Survey 2007, the fifth in a series of surveys conducted in 2002, 2003, 2005 and 2006, was based on 5,325 telephone interviews with decision-makers from five industry sectors in nine EU countries and the USA. Interviews were carried out from August to October 2007, using computer-aided telephone interview (CATI) technology. The overall survey was divided into four separate projects (each using a separate questionnaire) focussing on different sectors and specific topics (see Exhibit A.1-1). This document contains methodological notes for Projects 1 and 2, which accounted for 4,369 of the interviews.

Exhibit A1-1: Components ("projects") of the e-Business Survey 2007

Survey project	Focus	Sectors covered	No. of interviews
1	e-Business in manufacturing	• Chemical, rubber and plastics • Steel • Furniture	2121
2	e-Business in retail, transport & logistics	• Retail • Transport & logistics services	2248
3	RFID adoption	• Manufacturing sectors • Retail • Transport services • Hospitals	434
4	Intellectual Property rights in ICT SMEs	• ICT manufacturing • ICT services • Software publishing	683

Questionnaire

The questionnaires for Projects 1 and 2 contained about 70 questions which were structured into the following modules:

- A: ICT Infrastructure and e-Business software systems
- B: Automated data exchange (Project 1) / e-Business with customers and suppliers (Project 2)
- C: e-Standards and interoperability issues (Project 1)
- D: Innovation activity of the company
- E: ICT Skills requirements and ICT costs
- F: ICT Impacts, drivers and inhibitors
- G: Background information about the company

Some of the questions were the same or similar to those used in previous surveys in order to highlight trends in the answers (notably in previously surveyed sectors such as the chemical and retail industries). Other questions were introduced or substantially modified, in order to reflect recent developments and priorities. The survey placed special focus on the degree of process automation in companies, i.e. to what extent paper-based and manually processed exchanges with business partners had been

substituted by electronic data exchanges. Some questions were filtered, such as follow-up questions dependent on previous answers, and no open questions were used.

The questionnaires of all e-Business Watch surveys since 2002 can be downloaded from the project website (www.ebusiness-watch.org/about/methodology.htm).

Population

As in 2005 and 2006, the survey considered only **companies that used computers**. For the first time, a cut-off was introduced with regard to company size. When surveying the manufacturing sector in Project 1, only companies with at least 10 employees were interviewed. For the retail and transport sector in Project 2, the population also included micro-companies with fewer than 10 employees, reflecting their important contribution (see Exhibit A.1-2). Sector totals are therefore not directly comparable between the two projects.

The highest level of the population was the set of all computer-using enterprises (and, in Project 1, with at least 10 employees) that were active within the national territory of one of the eight countries covered, and whose primary business activity was covered by one of the five sectors specified in the NACE Rev. 1.1.[70] Evidence from previous surveys shows that computer use can be expected to reach 99% or more among medium-sized and large firms across all sectors.

Exhibit A1-2: Population coverage of the e-Business Survey 2007

No.	Sector name	NACE Rev. 1.1 activities covered	Population definition	No. of interviews conducted
Project 1 – Manufacturing				
1.1	Chemicals, rubber & plastics	24, 25	Companies which have at least 10 employees and use computers	911
1.2	Steel	27.1-3, 27.51-52		449
1.3	Furniture	36.12-14		761
Project 2 – Retail and transport				
2.1	Retail	52	Companies that use computers	1,151
2.2	Transport services and logistics	60.10, 60.21+23+24 63.11+12+40		1,097

Sampling frame and method

For each sector, the sample was drawn randomly from companies within the respective sector population of each of the countries surveyed. The objective of this approach was to fulfil minimum strata with respect to company size-bands per country-sector cell (see Exhibit A.1-3).

Exhibit A1-3: Strata by company-size

Size-band	Target quota specified	
	Project 1 Manufacturing	Project 2 Retail & transport
Micro enterprises (up to 9 employees)	--	up to 30%
Small companies (10-49 employees)	up to 40-50%*	at least 30%
Medium-sized companies (50-250 employees)	at least 40-45%*	at least 25%
Large companies (250+ employees)	at least 10-15%*	at least 15%

[70] NACE Rev. 1.1 was replaced by the new version NACE Rev. 2 in January 2008. Nonetheless when the survey was conducted, sectors still had to be defined on the basis of NACE Rev. 1.1 because business directories from which samples were drawn were based on the older version.

* depending on sector

Samples were drawn locally by fieldwork organisations based on official statistical records and widely recognised business directories such as Dun & Bradstreet (used in several countries) or Heins und Partner Business Pool.

The survey was carried out as an enterprise survey: data collection and reporting focus on the enterprise, defined as a business organisation (legal unit) with one or more establishments. Due to the small population of enterprises in some of the sector-country cells, the target quota could not be achieved (particularly in the larger enterprise size-bands) in each country. In these cases, interviews were shifted to the next largest size-band (from large to medium-sized, from medium-sized to small), or to other sectors.

Fieldwork

Fieldwork was coordinated by the German branch of Ipsos GmbH (www.ipsos.de) and conducted in cooperation with its local partner organisations (see Exhibit A1-4) on behalf of the Sectoral e-Business Watch. Pilot interviews prior to the regular fieldwork were conducted with about ten companies in each sector in Germany in August 2007, in order to test the questionnaire (structure, comprehensibility of questions, average interview length).

Exhibit A1-4: Institutes that conducted the fieldwork of the e-Business Survey 2007 and number of interviews conducted per country (total for Projects 1 and 2)

Country	Institute conducting the interviews	No. of interviews conducted
France	IPSOS Insight Marketing, 75628 Paris	551
Germany	IPSOS GmbH, 23879 Mölln	555
Italy	Demoskopea S.p.A., 20123 Milano	553
Poland	IQS and Quant Group Sp.z.o.o, 00-610 Warszawa	546
Spain	IPSOS Spain, 28036 Madrid	549
Sweden	GfK Sverige AB, 22100 Lund	542
UK	Continental Research, London EC1V 7DY	548
USA	Market Probe International, Inc, New York, NY 10168	525
TOTAL		**4,369**

The two sector surveys had a total scope of 4,369 interviews, spread across eight countries and five industries. In each of the eight countries, all five sectors were covered. The target was to spread interviews as evenly as possible across sectors; however, due to the comparatively small population of companies in the steel and (in some countries) in the furniture industries, some interviews had to be moved either between countries (within a sector) or between sectors (i.e. from steel or furniture to larger sectors, such as the retail industry). Exhibit A1-5 shows the final distribution of interviews across sectors and countries.

Exhibit A1-5: Interviews conducted per sector and country:

Sector Country	DE	ES	FR	IT	PL	SE	UK	USA	Total
Project 1 – Total	**305**	**290**	**235**	**303**	**254**	**170**	**264**	**300**	**2,121**
1.1 Chemical	100	120	135	105	120	105	126	100	**911**
1.2 Steel	100	50	20	87	24	30	38	100	**449**
1.3 Furniture	105	120	80	111	110	35	100	100	**761**
Project 2 – Total	**250**	**259**	**316**	**250**	**292**	**372**	**284**	**225**	**2,248**
2.1 Retail	120	131	166	126	151	184	148	125	**1,151**
2.2 Transport	130	128	150	124	141	188	136	100	**1,097**

Non response: In a voluntary telephone survey, in order to achieve the targeted interview totals, it is always necessary to contact more companies than the number targeted. In addition to refusals, or eligible respondents being unavailable, any sample contains a proportion of "wrong" businesses (e.g., from another sector), and wrong and/or unobtainable telephone numbers. Exhibit A1-6 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 raise questions about a possible refusal bias: that is, the possibility that respondents differ in their characteristics from those that refuse to participate. However, this effect cannot be avoided in any voluntary survey (whether telephone- or paper-based).

Exhibit A1-6: Interview contact protocol, completion rates and non-response reasons

		DE	ES	FR	IT	PL	SE	UK	US
1	Sample (gross)	6188	6435	6538	3071	10642	3016	8246	15862
1.1	Telephone number not valid	541	31	53	299	645	38	611	1811
1.2	Not a company (e.g. private household)	82	209	6	36	327	2	57	431
1.3	Fax machine / modem	19	0	72	9	300	33	69	389
1.4	Quota completed **à** address not used	973	2018	1531	101	2492	84	1087	193
1.5	No target person in company	992	267	264	129	975	101	662	821
1.6	Language problems	4	0	6	1	77	6	6	72
1.7	No answer on no. of employees	0	8	0	1	9	1	6	24
1.8	Company does not use computers	35	75	32	76	35	5	110	398
1.9	Company <10 employees (manufacturing only)	90	30	7	0	78	0	670	21
1.10	Not targeted sub-sector (transport only)	0	16	0	3	4	3	14	24
	Sum 1.1 – 1.10	2076	2654	1971	655	4942	273	3292	4184
2	Sample (net)	4112	3781	4567	2416	5700	2743	4954	11678
2.1	Nobody picks up phone	65	462	1061	0	440	147	112	2280
2.2	Line busy, engaged	0	0	37	0	54	479	82	99
2.3	Answering machine	0	0	1022	0	168	14	86	1655
2.4	Contact person refuses	1546	0	136	435	2207	236	1960	2242
2.5	Target person refuses	1666	2540	932	351	338	573	1558	3363
2.6	No appointment during fieldwork period possible	63	0	97	70	392	477	352	0
2.7	Open appointment	170	88	692	988	1384	261	140	1514
2.8	Target person is ill / cannot follow the interview	1	0	13	3	33	2	4	0
2.9	Interview abandoned	46	142	17	17	138	4	112	0
2.10	Interview error (**à** interview cannot be used)	0	0	9	0	0	8	0	0
	Sum 2.1 – 2.10	3557	3232	4016	1864	5154	2201	4406	11153
3	Successful interviews	555	549	551	553	546	542	548	525
	Completion rate (= [3]/[2])	**13.5%**	**14.5%**	**12.1%.**	**22.9%**	**9.6%**	**19.8%**	**11.1%**	**4.5%**
	Average interview time (min:sec)	**20:16**	**20:12**	**19:50**	**16:51**	**20:417**	**18:17**	**18:21**	**21:25**

Feedback from interviewers

No major problems were reported from the 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. More specific comments from fieldwork organisations, which point to difficulties encountered in the local situation, are available in the detailed field-report from Ipsos, which can be downloaded from the e-Business Watch website at www.ebusiness-watch.org/about/methodology.htm.

Weighting schemes

Due to stratified sampling, the sample size in each size-band is not proportional to the population numbers. If proportional allocation had been used, the sample sizes in the 250+ size-band would have been extremely small, preventing any reasonable presentation of results. Thus, weighting is required so that results reflect the structure and distribution of enterprises in the population of the respective sector or geographic area. The Sectoral e-Business Watch applies two different weighting schemes: by employment, and by the number of enterprises.[71]

- Weighting by employment: Values that are reported as employment-weighted figures should be read as "enterprises comprising x% of employees" (in the respective sector or country). The reason for using employment weighting is the predominance of micro-enterprises over other kinds of firms. If the weights did not factor in the economic importance of different sized businesses, the results would be dominated by the percentages observed in the micro size-band.
- Weighting by the number of enterprises: Values that are reported as "x% of enterprises" show the share of firms irrespective of their size, i.e. a micro-company with a few employees and a large company with thousands of employees both count equally.

The use of filter questions in interviews

In the interviews, not all questions were asked to all companies. The use of filter questions is a common method in standardised questionnaire surveys to make the interview more efficient. For example, questions on the type of internet access used were only asked to companies that replied affirmatively to having internet access. The question of whether a company has internet access thus serves as a filter for follow-up questions.

The results for follow-up questions can be computed on the basis of enterprises that were asked the question (e.g. "in % of enterprises with internet access") or on the basis of all companies surveyed. In this report, both methods are used, depending on the indicator. The basis (as specified in footnotes of tables and charts) is therefore not necessarily identical to the set of companies that were actually asked the filter question.

Statistical accuracy of the survey: confidence intervals

Statistics vary in their accuracy, depending on the kind of data and sources. A 'confidence interval' is a measure that helps to assess the accuracy that can be expected from data. The confidence interval is the estimated range of values on a certain level of significance. Confidence intervals for estimates of a population fraction (percentages) depend on the sample size, the probability of error, and the survey result (value of the percentage) itself. Further to this, variance of the weighting factors has negative effects on confidence intervals.

Exhibit A1-7 gives some indication of the accuracy that can be expected for EU-7[72] industry totals (based on all respondents) according to the weighting scheme used. The confidence intervals differ depending on the industry and the respective value; on average, they represent a 5 percentile fork around the results (in both weighting schemes). Confidence intervals for employment-weighted data are highest for the steel industry, due to the small number of observations and because this sector's structure makes it more sensitive to data weighting (i.e. large firms dominate in a comparatively

[71] 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.

[72] The EU-7 are composed of those countries which were covered by the survey. To ensure data comparability, only interviews from these countries are included in the aggregated "total" values.

small population). Employment-weighted data for this industry therefore have lower statistical accuracy than for the other sectors.

The calculation of confidence intervals is based on the assumption of (quasi-) infinite population universes. In practice, however, in some industries and in some countries the complete population of businesses consists of only several hundred or even a few dozen enterprises. In some cases, every enterprise within a country-industry and size-band cell was contacted and asked to participate in the survey. This means that it is practically impossible to achieve a higher confidence interval through representative enterprise surveys in which participation is not obligatory. This should be taken into account when comparing the confidence intervals of e-Business Watch surveys to those commonly found in general population surveys.

Exhibit A1-7: Confidence intervals for the sector surveys (EU-7)

		Confidence interval								
	Survey result	if weighted as "% of firms"			if weighted by employment			unweighted		
Sectors (aggregate, EU-7)										
Chemical, rubber and plastics	10%	**8.0%**	-	**12.4%**	**6.5%**	-	**15.0%**	**8.4%**	-	**11.9%**
Steel	10%	**7.5%**	-	**13.2%**	**4.8%**	-	**19.6%**	**7.7%**	-	**13.0%**
Furniture	10%	**8.0%**	-	**12.5%**	**7.1%**	-	**14.0%**	**8.2%**	-	**12.1%**
Retail	10%	**7.0%**	-	**14.0%**	**7.0%**	-	**14.1%**	**8.6%**	-	**11.7%**
Transport & logistics	10%	**7.0%**	-	**14.1%**	**7.4%**	-	**13.4%**	**8.5%**	-	**11.7%**
Sectors (aggregate, EU-7)	**30%**									
Chemical, rubber and plastics	30%	**26.8%**	-	**33.5%**	**24.0%**	-	**36.8%**	**27.4%**	-	**32.7%**
Steel	30%	**25.8%**	-	**34.5%**	**20.3%**	-	**42.0%**	**26.1%**	-	**34.2%**
Furniture	30%	**26.7%**	-	**33.5%**	**25.0%**	-	**35.5%**	**27.1%**	-	**33.0%**
Retail	30%	**25.0%**	-	**35.6%**	**24.9%**	-	**35.7%**	**27.7%**	-	**32.4%**
Transport & logistics	30%	**24.9%**	-	**35.7%**	**25.7%**	-	**34.7%**	**27.7%**	-	**32.4%**
Sectors (aggregate, EU-7)	**50%**									
Chemical, rubber and plastics	50%	**46.3%**	-	**53.7%**	**43.0%**	-	**57.0%**	**47.1%**	-	**52.9%**
Steel	50%	**45.2%**	-	**54.8%**	**38.2%**	-	**61.8%**	**45.6%**	-	**54.4%**
Furniture	50%	**46.3%**	-	**53.7%**	**44.3%**	-	**55.7%**	**46.8%**	-	**53.2%**
Retail	50%	**44.2%**	-	**55.8%**	**44.1%**	-	**55.9%**	**47.4%**	-	**52.6%**
Transport & logistics	50%	**44.1%**	-	**55.9%**	**45.1%**	-	**54.9%**	**47.4%**	-	**52.6%**
Sectors (aggregate, EU-7)	**70%**									
Chemical, rubber and plastics	70%	**66.5%**	-	**73.2%**	**63.2%**	-	**76.0%**	**67.3%**	-	**72.6%**
Steel	70%	**65.5%**	-	**74.2%**	**58.0%**	-	**79.7%**	**65.8%**	-	**73.9%**
Furniture	70%	**66.5%**	-	**73.3%**	**64.5%**	-	**75.0%**	**67.0%**	-	**72.9%**
Retail	70%	**64.4%**	-	**75.0%**	**64.3%**	-	**75.1%**	**67.6%**	-	**72.3%**
Transport & logistics	70%	**64.3%**	-	**75.1%**	**65.3%**	-	**74.3%**	**67.6%**	-	**72.3%**
Sectors (aggregate, EU-7)	**90%**									
Chemical, rubber and plastics	90%	**87.6%**	-	**92.0%**	**85.0%**	-	**93.5%**	**88.1%**	-	**91.6%**
Steel	90%	**86.8%**	-	**92.5%**	**80.4%**	-	**95.2%**	**87.0%**	-	**92.3%**
Furniture	90%	**87.5%**	-	**92.0%**	**86.0%**	-	**92.9%**	**87.9%**	-	**91.8%**
Retail	90%	**86.0%**	-	**93.0%**	**85.9%**	-	**93.0%**	**88.3%**	-	**91.4%**
Transport & logistics	90%	**85.9%**	-	**93.0%**	**86.6%**	-	**92.6%**	**88.3%**	-	**91.5%**

confidence intervals at α=.90