EUROPEAN COMMISSION

e-Business W@tch

ICT and e-Business Impact in the **Transport and Logistics Services Industry**

Study report
No. 05/2008

European Commission, DG Enterprise & Industry

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Impact Study No. 05/2008

ICT and e-Business Impact in the Transport & Logistics Industry

A Sectoral e-Business Watch Study by

***consultrans, Member of Altran**

Final Report

Version 4.1

September 2008

This report was prepared by Consultrans 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 report presents the results of a sector impact study, focusing on electronic business in the transport and logistics services 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 findings are based on an international survey of enterprises on their ICT use, case studies and an econometric analysis of the ICT impact on productivity growth in the sector.

Disclaimer

Acknowledgements

This report was prepared by Altran Group & Consultrans on behalf of the European Commission, Enterprise & Industry Directorate General. It is part of a deliverable in the context of the Sectoral e-Business Watch, which 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 (principal contact and coordination: Dr. Hasan Alkas).

The SeBW would like to thank Mr Javier Mendez from the Madrid Chamber of Commerce, Mr Reinhard Pfliegl from Austria Tech, and Mr Dolf Tuinhout, independent consultant, who are members of the Advisory Board in 2007/2008, for their valued feed-back, suggestions and contributions to this study.

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Bonn / Brussels, September 2008

Table of Contents

Executive Summary

About this study

This study focuses on the adoption and implications of information and communication technology (ICT) and e-business activity in the transport and logistics services industry (TLS). The study shows how companies in this sector use ICT for managing their business processes, internally and in exchange with suppliers and customers. It identifies related opportunities and drivers as well as possible barriers for ICT adoption and digital integration and assesses the impact of ICT deployment on firms and on the industry as a whole. Possible implications for policy actions are indicated.

Findings presented in this report are based on literature, expert interviews, 12 company case studies, an international survey among 1,097 enterprises form the sector on their ICT usage conducted by the SeBW in September 2007. (see Section 1.3 and Annex I for more information about data sources). For data analysis, descriptive and analytical statistical methods were used, including advanced statistical methods such as growth accounting.

The sector at stake

The transport and logistics industry, as defined for the purpose of this study (see Section 2.1), covers the following business activities: rail transport (both passengers and freight) and land/road transport (passengers and freight) (NACE Rev. 2[1], 49.1; 49.2; 49.3 and 49.4). Furthermore, the logistics sectors of warehousing and storage, cargo handling and other transportation support activities (NACE Rev. 2, 52.10, 52.24, and 52.29) are considered, to the extent that these sectors interact with the main business activities covered by the study (49.1-4).

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

Transport and logistics are key components of a successful economy: they play a major role in national economies and are significant contributors at both the national and local level. Transport and logistics underpin the economy, enabling the movement of goods, services and people as efficiently as possible. The transport sector in Europe plays a significant role in its economic development. It currently generates 7% of European Union's gross domestic product (GDP) and accounts for around 5 % of employment in the EU (see Section 2.2).

The fast growth of freight transport – driven to a large extent by economic decisions – contributes to growth and employment but also causes congestion, accidents, noise, pollution, increased reliance on imported fossil fuels, and energy loss. The challenge for the European policy for transport services is to find solutions for freight and passengers that are economically viable and that also promote sustainable growth, fuel economy, the reduction of emissions, safe and healthy lifestyles and social inclusion (see Section 2.3).

ICT adoption and usage in transport and logistics services

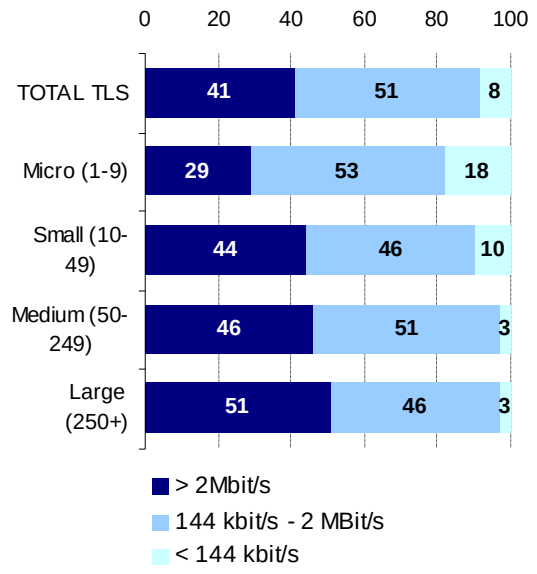
ICT can have a significant influence on the mobility of people and goods. ICT is also a potentially important enabler of change in social and organisational practices, thus affecting the demand for transport in spatial and temporal terms. Technological trends will meet the demand for comfort, safety and speed through advances in ICT in the field of telematics. This covers systems for traffic and transport management, travel information and reservations, vehicle guidance, and mobility cards. Over the last few years firms operating in the transport and logistics sector have made significant progress in their adoption of new technologies, particularly those linked to the internet and e-business (see Chapter 3).

Basic ICT infrastructure

Nearly all companies which use computers in the TLS sector said in 2007 that they were con-

nected to the internet (97%). There is a clear trend towards broadband connections: except for micro-firms, more than 40% of all companies are connected by broadband, i.e. with a bandwidth of more than 2 Mbit/s (see Section 3.1 and following Exhibit). Broadband is seen as an important precondition for the wider diffusion of e-business applications in general.

Bandwidth of companies' internet access
(in % of companies*, TLS industry, 2007)



* figure for TLS total (EU-7) weighted by employment

13% of all companies from the sector (accounting for 21% of employment) said that they used Voice-over-IP services. It can be expected, in general, that usage will increase rapidly over the next few years.

The demand for e-skills and ICT practitioners

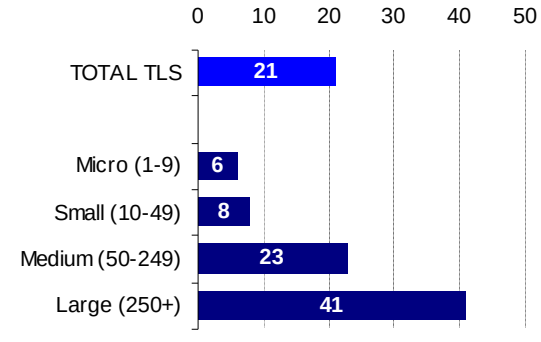
Only 8% of all enterprises actually employ ICT practitioners (most of the small companies cannot do so). The percentage is higher among medium (33%) and large companies (66%). 45% of companies said in the survey that they had outsourced ICT services to external service providers in the past 12 months prior to the interview (see Section 3.2). Nevertheless, survey results also indicate a certain lack of awareness regarding the importance of ICT skills and resources which are needed to exploit technological innovation and to support the reorganisation of work processes. It appears that the availability of qualified personnel with specialised skills is quite limited in the transport and logistics sector. This could be a critical issue for the sector in the future, as it might be a barriers for innovation.

The digitisation of business processes

The continuous improvement of the basic ICT infrastructure in the TLS sector has allowed companies to embrace opportunities to substitute paper-based and manual processes by electronic exchanges, thus optimising the flow of information and documents in and between companies, taking advantages of the increased diffusion of advanced e-business software systems.

ERP (Enterprise Resource Planning) systems are one of the main platforms to enable this goal. If a customer or supplier has an ERP system, data related to orders (received or placed) is typically exchanged in a paper-less way between the ERP systems of the two companies trading with each other. However, there is still a considerable gap in the diffusion of ERP systems between micro and small firms on the one hand and the medium-sized and large firms on the other (see following Exhibit). The relatively high implementation costs for ERP systems remain a critical challenge for SMEs (see Section 3.4).

% of companies* using an ERP system



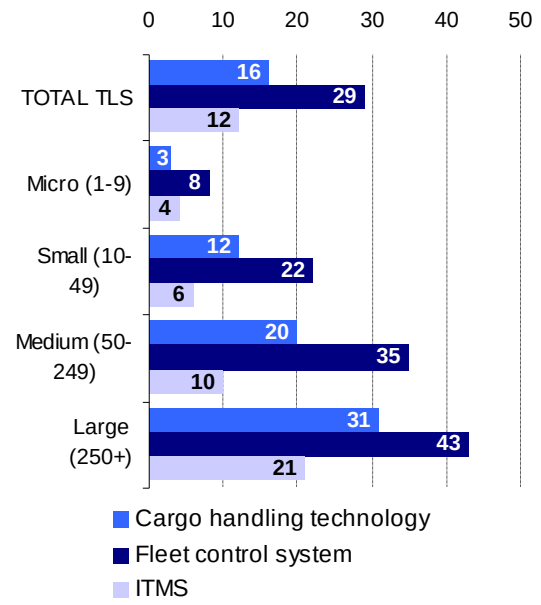
* figure for TLS total (EU-7) weighted by employment

Use of specific software systems for transport & logistics management

Specific software solutions for the TLS sector, such as Cargo Handling Technology, Fleet Control System and ITMS (Intermodal Transportation Management Systems) are also mostly used by large transport and logistics companies. For example, only about 20% of the small firms reported that they used Fleet

Control Systems, but diffusion increases to about 35% of medium-sized and 43% of large firms. The pattern is similar for Cargo Handling Technology and ITMS (see Section 3.4).

% of companies* using specific transport & logistics software systems



* figures for TLS total (EU-7) weighted by employment

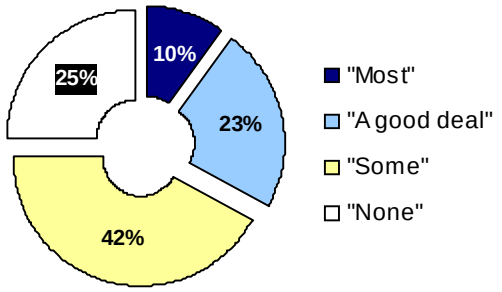
Deployment of e-standards

With regard to the deployment of standards for e-business, the survey found that about a third of the medium-sized and more than 40% of the large firms in the sector use Electronic Data Interchange (EDI). Only 7% of micro companies and 12% of small companies use EDI-based standards. Thus, the size of a company has an enormous influence on the adoption of standards: the smaller the company, the more unlikely it is that it adopts any of these standards. It looks like EDI based standards will continue to play an important role for e-business messaging in TLS industries in the near future (see Section 3.3).

Overall assessment

Asked for a general assessment of the status of e-business in their company, more than a quarter of the companies (by their share of employment) felt that at least "a good deal" of their exchanges with business partners were conducted electronically (in 2007); three quarters said that at least some of their processes are conducted as e business (see Exhibit). A quarter of all companies said they did not use any kind of e-business.

% Companies* saying that ... of your business processes are conducted as e-business (2007)



* weighted by employment (read: "companies representing x% of employment")

e-Commerce and e-marketing in the transport & logistics industry

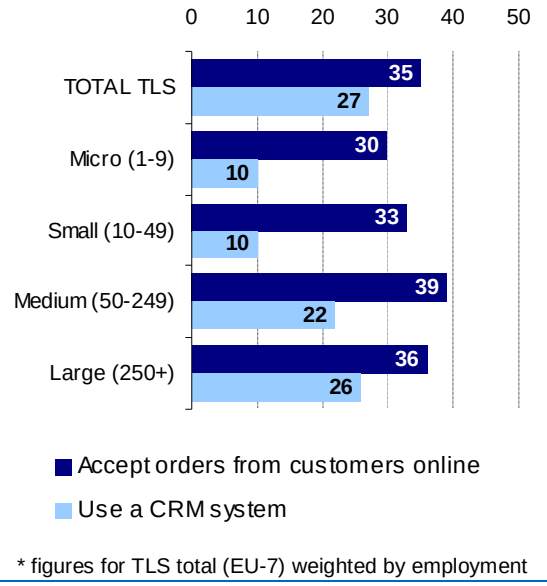
"e-Commerce" can mean different things in the TLS sector (see Section 3.6). In passenger transport, it can mean "e-ticketing", enabling customers to order and receive their ticket online. In freight transport and logistics, e-commerce includes initiating, tracking, and acknowledging shipments online. The special role of this subsector in this context is that its business is exactly to provide these services to other industries. Thus, logistics companies are not only users of e-business themselves, but, in a way, provider of e-services. In all cases, e-commerce is in this sector closely linked with the objective to optimise business processes: paperless trade eliminates the operational costs related to manual paper processing and increases the transparency of the supply chain and information exchange between trading partners.

Another e-commerce application is e-ticketing in passenger transport. This is a ticket-less concept, which ideally provides companies with the opportunity to reduce administrative costs and, at the same time, offer a higher level of service to travellers (see Section 3.6.2).

All in all, 35% of TLS firms (by their share of employment) said they accepted orders from customers online. There is practically no difference between companies from the various size-bands in this respect. Even among small firms, 30-35% said that they allowed customers to order services online. This appears to be

quite a high figure at first sight. However, a majority of close to 95% of those companies also said that online orders accounted for up to 25% of their total orders received. Only about 5% receive more than a quarter of their orders online. CRM (customer relationship management) systems, a comprehensive software to capture, storage and analysis customer data in an integrated way, is not yet widely used in the TLS sector (see Section 3.6.3).

% Companies* accepting orders online / using a CRM system



* figures for TLS total (EU-7) weighted by employment

ICT adoption by European vs. US transport services companies

According to the survey, US companies from the TLS industries are slightly better equipped with ICT infrastructure and systems than their European counterparts. For example, the diffusion of Intermodal Transportation Management Systems (ITMS) or RFID technology is more widely used in the US. On the other hand, in some other areas, European companies appear to be more active using specific software systems, like Warehouse Management Maintenance Management Systems (MMS).

The self-assessment of firms to what extent their data exchanges with business partners are conducted electronically, however, suggests that enterprises in Europe and in the US have reached a similar status.

e-Business adoption in EU vs. US firms (in %, by their share of firms) - 2007

ICT adoption indicator	USA	EU-7*
Internet Access	100	97
Wireless LAN	43	22
Intranet	29	24
ITMS (Intermodal Transportation Management System)	8	4
RFID (Radio Frequency Identification Device)	7	2
Data Exchange mostly electronically	13	13
WMS (Warehouse Management System)	6	15
ITS (Intelligent Transport System)	1	7
MMS (Maintenance Management Systems)	11	15
SMC (Supply Chain Management)	4	6

** EU-7 include UK, SE, PL, IT, FR, ES, DE*

The economic impact of ICT and e-business

Chapter 4 presents an economic analysis of the impacts of ICT adoption, focusing on implications for productivity growth, innovation dynamics and market competition. The analysis used data from the EU KLEMS Productivity and Growth Accounts[2] (macro-data) as well as from the e-Business Survey 2007 (micro-data).

Regarding the relationships between ICT capital investment and productivity growth (see Section 4.1), the results indicate that an instantaneous impact of ICT capital investment on total factor productivity growth does not take place in this sector. This is not in line with the typically reported results in the standard growth accounting literature, where total factor productivity (TFP) tends to instantaneously rise with increased investment in ICT capital.

Regressions based on the micro-data from the e-Business Survey 2007 aimed to explore links between ICT usage, companies' innovation activities and their performance (measured as increases in market share and turnover).

[2] see www.euklems.net

Results indicate that the following factors are positively correlated with ICT adoption and could thus be drivers of ICT adoption (see Sections 4.1 and 4.2):

- Increasing market competitiveness is one of the driving forces behind ICT usage.
- The relationships between companies interacting with each other play an important role in the diffusion of ICT applications supporting inter-firm collaboration.
- The success of the ICT-driven innovative process depends on the availability and quality of complementary assets such as employee skills and IT know-how.

Statistical regressions also found evidence that ICT adoption is linked with innovation, outsourcing activities and organisational change (see Sections 4.2 and 4.3):

- Advanced ICT users are more likely to have outsourced business activities.
- The intensity of ICT usage and the level of ICT-skills available in the company are positively linked with organisational change.
- ICT usage has a positive impact on company performance. Firms in the TLS sector that introduced ICT-enabled innovations were more likely to have experienced sales growth and an increase in market share.

Policy implications

The empirical study findings (micro-data and case study analysis, macro-economic analysis) lead to the conclusion that the following issues are particularly relevant for policy considerations (see Section 6.3):

- *Promoting ICT solutions for SMEs, in particular the development of affordable ERP systems for SMEs*. As in other sectors, small businesses are slower than large ones to adopt new ICT. For instance, there is still a considerable gap in ERP adoption. Furthermore, considering that e-collaboration increases innovative output, initiatives to encourage cooperation among SMEs and the formation of networks and clusters are recommended.
- *Improving ICT skills and managerial understanding for e-business*. ICT usage and high levels of employee's skills complement each other, leading to skill-biased technological change and an advantage for TLS firms with highly skilled employees in adopting and using ICT. The picture that emerges from the survey is that ICT skills are a decisive issue, especially among SMEs, notably at the managerial level, i.e. how to use e-business to support a company's strategy. Training programmes need to be more focused on managerial understanding and skills for e-business, such as how to effectively integrate e-business processes into existing business models and strategies to change organisational structures.
- *Developing standards for e-business, facilitating the process of interoperability.* Despite the wide diffusion of ICT applications in the sector, there is still potential for further productivity increases through supply chain integration. This potential currently remains underutilised due to interoperability problems. Public bodies might help firms to overcome the market failure resulting form the co-ordination problem.
- *Promoting efforts towards innovation*. ICT adoption and complementary investments in skills enhance innovation, which is positively associated with turnover growth. As a result, innovative firms are more likely to grow. The empirical evidence presented in this study corresponds with theoretical predictions that suggest that ICT and innovation are positively associated with turnover and productivity growth at the firm level.

1 Introduction

This study focuses on the adoption and implications of ICT and e-business practices in the transport and logistics services (TLS) sector.[3] It describes how companies in this sector use information and communications technology (ICT) for managing their business processes –internally and in exchanges with suppliers and customers– and assesses the impact of ICT for firm performance in a context of global competition. It identifies related opportunities for companies, drivers and possible barriers for ICT adoption and digital integration. Conclusions point at possible implications for policy.

The analysis is based on literature, interviews with industry representatives and experts, company case studies and a telephone survey among decision-makers in European enterprises from the TLS industries. It is the first time the Sectoral e-Business Watch conducts a study on this sector; a comparison with an earlier point of measurement is therefore not possible. The study addresses, in particular, policy makers (in the fields of innovation and ICT-related policies and in sectoral economic policy) and representatives of the transport and logistics industry (notably firm managers, decision-makers in marketing, procurement, ICT and e-solutions, and human resources managers).

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 TLS industry in Europe. It introduces the sub-sectors: road transport, rail transport, maritime transport, and logistics services. 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. This chapter is mainly based on survey data from the Sectoral e-Business Watch. Chapter 4 assesses the impact of the developments described in Chapter 3 on work processes and employment, innovation and productivity, and –at sector level– on value chain characteristics. This chapter has been mainly developed by economists from DIW Berlin, who used econometric statistical methods to explore how ICT capital and e-business activity are linked with firm and industry characteristics and influence those. 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.

Combining descriptive and analytical approaches

The study approach is exploratory, descriptive and explanatory, applying a broad 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 practice in the industry, while

[3] See Section 2.1 for the sector definition in terms of business activities covered.

also assessing the economic effects of this practice, for instance on firm productivity and innovation. While the results from these different approaches are presented like self-sustained pieces of research in separate chapters, they are intertwined and cross-referenced.

1.1 The Sectoral e-Business Watch

Mission and objectives in general

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 in the logistics and transport sector. This mission can be broken down into the following main objectives:

- to assess the **impact of ICT** with regard to productivity and growth on enterprises, industries 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 assess the role of ICT as an enabler of **organisational changes** and **business process innovation** in the sector;
- 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 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**, 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,*

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

leading to business innovations in key sectors" (p. 6).[5] 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).

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.

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

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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.

- 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.[8]

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, amongst others, 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**[9] 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 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.

[8] 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.

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

1.2 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 1.2-1).

Exhibit 1.2-1: The EU ICT market according to EITO (2007)

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

Source: EITO 2007

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

Gaining momentum after a phase of disappointment

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

implications and it is widely recognised that 'e'-elements have become an essential component of modern business exchanges. In short, e-business has regained momentum as a topic for enterprise strategy both for large multinationals and SMEs.

> *"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 requires not only optimised cost structures, maximal efficiency, and products or services of excellent quality but also the ability to communicate effectively and cooperate with business partners and potential customers.

A definition of e-business

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

If transactions are conducted electronically ('**e-transactions**'), they constitute e-commerce. Transactions can be broken down into **different phases** and related **business processes**, each of which can be relevant for e-commerce (see Exhibit A.V-2). The pre-sale (or pre-purchase) phase includes the presentation of (or request for) information on the offer, and negotiations over the price. The sale / purchase phase covers the ordering, invoicing, payment and delivery processes. Finally, the after sale /

purchase phase covers all processes after the product or service has been delivered to the buyer, such as after sales customer services (e.g. repair, updates).

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, realised 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]*

Exhibit 1.2-2: 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[10]. 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

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

phase and focuses instead on the ordering process. The SeBW follows the OECD position on this issue,[11] while fully recognising the importance of the internet during the pre-purchase phase for the initiation of business.

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.*

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[12] proposes a definition of e-business as "*automated business processes (both intra-and inter-firm) over computer mediated networks*" (OECD, 2004, p. 6). In addition, the OECD proposed that e-business processes should integrate tasks and extend beyond a stand-alone or individual application. 'Automation' refers here to the substitution of formerly manual processes. This can be achieved by replacing the paper-based processing of documents by electronic exchanges (machine-to-machine) but it requires the agreement between the participants on electronic **standards** and processes for data exchange.

e-Business and a company's value chains

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

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

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

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[13] 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*".[14] These linkages can lead to competitive advantage through optimisation and coordination. This is where ICT can have a major impact, in the key role of **optimising linkages** and increasing the efficiency of processes.

The **value system** expands this concept by extending its scale beyond the single company. The firm's value chain is linked to the value chains of (upstream) suppliers and (downstream) buyers; the resulting larger set of processes is referred to as the value system. All e-commerce and therefore electronic transactions occur within this value system. Key dimensions of Porter's framework (notably inbound and outbound logistics, operations, and the value system) are reflected in the **Supply Chain Management** (SCM) concept. Here, the focus is on optimising the procurement-production-delivery processes, not only between a company and its direct suppliers and customers, but also aiming at a full vertical integration of the entire supply chain (Tier 1, Tier 2, Tier n suppliers). In this concept, each basic supply chain is a chain of sourcing, production, and delivery processes with the respective process interfaces within and between companies.[15] Analysing the digital integration of supply chains in various industries has been an important theme in most sector studies by the SeBW.

Applying the concept to the transport & logistics services industry

The conceptual framework outlined is mostly applicable to e-business in the transport and logistics services industry. However, as this broad sector covers diverse segments such as freight transport and passenger transport, the focus of ICT usage and e-business differs between the sub-sectors. In freight transport and logistics, the management of logistics services is the vary nature of the business activity; ICT are mainly used to support the management of complex logistical processes (e.g. for fleet control in larger transport firms with a large fleet of vehicles). In passenger transport, by contrast, online passenger services are a key issue in this sector, notably the online provision of tickets.

Although the key applications differ between the various sub-sectors, all basic goals of e-business are relevant: reducing costs by increasing the efficiency of processes (notably in logistics), optimally serving the customer (relevant in all sectors, but in particular in passenger transport), and enabling growth and expansion by increasing the market reach. This study shows how various e-business applications contribute to these goals in the different segments of this industry.

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

[14] ibid., p. 48.

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

1.3 Study objectives and study methodology

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

Research objectives

The overall objectives of this study are to describe how companies in this industry use ICT for conducting business, to assess the impact of this development for firms and for the industry as a whole, and to indicate possible implications for policy. Within this framework, the study addresses in particular the following research questions:

- **Drivers and barriers**: What drives e-business adoption in various segments of the TLS sector, what do companies perceive as the main challenges and barriers?
- **Impact on firm and sector level**: What are the main impacts of ICT adoption with regard to employment, competitiveness, economic growth, transport safety, efficiency and possible cost reductions (distribution costs), technological innovation and for entering into new markets?
- **Technological innovation** in transport and logistics companies related to e-business technologies: To what extent do companies in the sector use specific ICT systems for transport & logistics management, such as applications for fleet control, GPS, transport communications or warehouse management systems?
- **Policy implications**: Do the findings on these research questions above have implications for policy, for example in the fields of economic, competition, industrial or innovation policy? Do ICT-related developments call for adaptations of the regulatory framework?

Data and information sources

The study is based on a mix of data sources and methodologies, including primary data collection, desk research and case studies. More specifically, information was collected from the following sources:

- **Sectoral e-Business Watch Survey** (2007): The TLS sector was one of five sectors covered by the SeBW Survey of 2007. About 1100 interviews were conducted with decision-makers in companies from 7 EU countries and in the USA in the TLS sector. The SeBW Survey was the main source for analysing the state of play in ICT adoption, B2B process integration and automation. Detailed information about this survey is available in Annex I.
- **Eurostat Community survey on ICT usage in enterprises** (2006): Results of the Eurostat survey are used as a source for the analysis of ICT adoption in companies from the sector. The transport sector was covered by the Eurostat survey (2006); although the NACE aggregation used by Eurostat deviates from the sector definition in this study, results can be used as a good proxy.
- **EU-KLEMS**: The EU KLEMS Growth and Productivity Accounts are the result of a research project, financed by the European Commission, to analyse productivity in the European Union at the industry level. This project is meant to support the

analysis of the relationship between skill formation, technological progress and innovation on the one hand, and productivity on the other. EU-KLEMS Growth Accounts include measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for 25 EU Member States as well as for the United States. In general, data for 1970-2005 are available for the former EU-15 EU MS and for the US, while data from 1995-2005 are available for 10 new MS that joined the EU in 2004. The growth accounts are based on the growth accounting methodology as theoretically seminal contribution by Jorgenson and Griliches (1967) and put into a more general input-output framework by Jorgenson, Gollop and Fraumeni (1987). The data sources that have been used to create the EU-KLEMS data series are large based on series from the national statistical institutes (e.g. investment series), but also from a variety of national sources, in cases where no international database or statistics from the NSIs were available (e.g. for hours worked by labour type). Various series were linked in order to bridge different vintages of the national accounts according to a common methodology. Due to the broad range of sources used and data limitations in these sources, the level of detail in the EU-KLEMS database varies across countries, industries and variables.[16]

- **Case studies**: 12 case studies on e-business adoption in companies from the sector covered are 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 (sub-sectors), and company size-bands. Cases may include best practices, innovative e-business approaches, as well as typical examples of e-business activity (state-of-the-art) in the sector.
- **Information from industry federations**: Annual reports and position papers of industry federations were a further source, for example from:
  - International Road Transport Union
  - European Conference of Ministers of Transport
  - Permanent International Association of Roads Congresses
  - CER: Community of European Railways
  - ERTMS: European Rail Traffic Management System
  - ERFA: European Rail Freight Association
  - European Railway Agency
  - T&E: European Federation for Transport and Environment
  - European Logistics Association
  - European Freight and Logistics Leaders Club
  - CLECAT, European association for forwarding, transport, logistic and customs services.

[16] For more information about the database, see: EU-KLEMS Growth and Productivity Accounts, Version 1.0, Part I Methodology. March 2007, prepared the Groningen Growth and Development Centre and the National Institute of Economic Research on behalf of the EU-KLEMS consortium, available via www.euklems.net/.

Data analysis

For data analysis, descriptive and analytical statistical methods were used:

Descriptive statistics: The discussion of the SeBW 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. The requirement for this step is that micro-data have been aggregated and that weighting has been applied. Weighting is an important issue for data presentation, as –unfortunately– it is not well understood by many users of data. However, **weighting** is necessary, as due to stratified sampling the sample size in each size-band is not proportional to the population numbers. If proportional allocation had been used, the sample sizes in the 250+ size-band would have been extremely small, not allowing any reasonable presentation of results (see Annex I for details).

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 limited in its power to explain ICT impact. Therefore, advanced statistical methods (such as growth accounting) were used to gain better evidence on the economic impact of ICT. This economic analysis, which is mainly presented in Chapter 4, focuses on links between ICT adoption on the one hand and productivity growth, innovation dynamics and market characteristics on the other. It combines micro-data analysis (using data from the e-Business Survey 2007) and macro-data analysis (using the EU-KLEMS Growth and Productivity Accounts). More information about the econometric analysis methodology is provided in Annex II.

Analytical statistical methods that were used include:

- **Relationship identification analysis**: a statistical method that combines, cross-tabulation, multivariate charts and statistical hypothesis testing to assess possible relationships between variables and their statistical relevance, at a given significance level. With this method we can conclude if the variables are interrelated.
- **Chi-square analysis**: is a powerful interdependence analysis technique that can assess the independence in the variable relations and its main correlation patterns. Using some advance algorithms on the multivariate analysis results, we try to assess the patterns existing among the variables, thus explaining the variable relationships. We combine this technique with the clustering analysis.
- **Cluster analysis**: is an advanced data analysis technique useful to group cases based on their internal similarities. With this technique one can build groups of cases (companies) with a similar profile based on some relevant indicators or variables (like the percentage of employees with internet access at their workplace) and analyse their main characteristics in terms of e-business adoption and results.

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 have been:

- Mr Pietro Evangelista, National Research Council (CNR).
- Mr Javier Mendez, Madrid Chamber of Commerce
- Mr Reinhard Pfliegl, Austria Tech
- Mr Dolf Tuinhout, Independent consultant

Three meetings of the Advisory Board were held, in addition to informal exchanges with the members in between and to their contributions on specific sections of the study. The first meetings took place on 29 May 2007 in Brussels. At this meeting, the study exposé and research plan were validated. At the second meeting on 18 January 2008 in Brussels the interim report was discussed. The third meeting took place in May 2008 (in the context of the e-Business Conference 2008) to draw conclusions for future research.

2 Context and background

2.1 Sector definition – scope of the study

The transport and logistics services sector has not been covered by earlier sector studies of e-Business Watch. The availability of high quality transport and logistics services is of paramount importance for growth and competitiveness of the European economy. Strengthening the competitiveness of European transport companies is therefore a leverage European and national policy makers could use to enhance the economy in general. While the transport industry services other sectors, ICT and e-business have a crucial importance for the competitiveness of European transport companies themselves. Using e-business technologies, European transport and logistics companies can improve their productivity, create an integrated approach linking transport modes in innovative ways and, thus, improve the quality of their services. This has an impact on the European economic development as a whole.

The analysis carried out in this study is based on literature, interviews, case studies and a survey among decision-makers in European enterprises from the transport and logistics industry about the ICT use of their company. It covers business activities specified by NACE Rev. 2, 49.1, 49.2, 49.3, and 49.4: rail transport (both passengers and freight) and land/road transport (passengers and freight). Furthermore, the logistics sectors of warehousing and storage, cargo handling and other transportation support activities (NACE Rev. 2, 52.10, 52.24, and 52.29) are considered, to the extent that these sectors interact with the main business activities covered by the study (49.1-4) (Exhibit 2.1-1).

Exhibit 2.1-1: Business activities covered by the transport and logistics sector study and their NACE Rev. 1.1 and NACE Rev. 2 correspondence[17]

NACE Rev. 2	NACE Rev. 1.1	Business activities Manufacturing of…
49.1		Passenger rail transport, interurban
49.2		Freight rail transport
49.3		Other passenger land transport
49.4	60.24	Freight transport by road and removal services
52	**63**	Warehousing and support activities for transportation
52.10	63.12	Warehousing and storage
52.24	63.11	Cargo handling
52.29	63.40	Other transportation support activities

The selection of activities covered in this study responds to the need of having comparable e-business data and results for the land transport and logistics sectors, due to their huge importance in the European competitiveness and future economic challenges of the region. Especially, given that the selected sectors of transport and logistics are covered for the first time in this study of the SeBW.

[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.

Although the NACE Rev. 2 class 49: "Land transport and transport via pipelines" includes transport via pipelines, this category has not been included for the study, given the big difference in terms of activities, technologies and operations of this sector compared with the rest of the selected sector, for example the type of load, the usage of vehicles and the means of transport employed.

2.2 Industry background

Transport and logistics are key components of a successful economy, and governments worldwide seek to increase competitiveness through new or replacement infrastructure. The transport and logistics sector plays a major role in nationals' economy and is a significant contributor at both the national and local level. It underpins the economy, enabling the movement of goods, services and people as efficiently as possible. The transport sector in Europe plays a significant role in its economic development. It currently generates 7% of European Union gross domestic product (GDP) and for around 5 % of employment in the EU.

The growth of goods transport within the EU, at a rate of 2.8 % per year since1995–2004, was broadly in line with economic growth, which was 2.3 % on average in the same period. The fast growth of freight transport – driven to a large extent by economic decisions – contributes to growth and employment but also causes congestion, accidents, noise, pollution, increased reliance on imported fossil fuels, and energy loss.[18] This growth is mainly due to changes in the European economy and its system of production. In the last 20 years, we have moved from a 'stock' to a 'flow' economy. The abolition of frontiers within the Community has resulted in the establishment of a 'just-in-time' or 'revolving stock' production system. Specialisation, globalisation, the search for manufacturing scale economies, and rationalisation of production facilities have also increased freight movements.

The expected increase in road freight of 38% until 2010 will far outstrip the existing and planned capacity in road infrastructure.[19] Road delays and congestion will therefore probably get worse. Combating Europe's worsening road congestion – and the increased costs and environmental damage it causes – requires new attitudes and recourse to resolutely modern logistics and transport systems. The challenge is to find solutions for freight and passengers that are economically viable and that also promote sustainable growth, fuel economy, the reduction of emissions, safe and healthy lifestyles and social inclusion.

[18] Although a major contributor to growth, transport also involves a cost to society. Its environmental cost is estimated at 1.1 % of GDP (See UNITE project — Final report. Environmental costs cover air pollution, noise and global warming costs. Unification of accounts and marginal costs for transport efficiency. Fifth framework — Transport RTD. November 2003 (www.its.leeds.ac.uk/unite/).

[19] European Commission (2001), White Paper "European transport policy for 2010: time to decide"

2.2.1 Road transport

The greatest competitive advantage of road transport is its capacity to carry goods all over the European Union, and indeed the entire continent, with unequalled flexibility and at a low price. Road transport services account for 1.6 % of the EU GDP and give jobs to 4.3 million people.[20] The whole economy and society depends heavily on efficient road transport: 44 % of the goods are moved by trucks[21] (compared with 41 % for short sea shipping, 10% for rail and 4 % for inland waterways) and 85 % of the persons are moved by cars, buses or coaches (compared with 5 % by air and 6 % by railways). Demand factors, such as a reduction in heavy bulk transport and the increasing importance of door-to-door and just-in-time services, undoubtedly contributed to the strong sustained growth of road transport.

However, the disadvantage of this situation rely in its harmful effects on the environment (road construction, land use for parking, emissions etc.) and on public health and, of course, the heavy toll from road accidents. Road transport is the main source of CO_2 emissions since it alone accounts for 84% of the total attributable to transport. In this context, efforts already made, particularly in the road sector, to preserve air quality and combat noise, have to be continued. This is in order to meet the needs of the environment and public concerns without compromising the competitiveness of the transport system and of the economy.

2.2.2 Rail transport

Rail is a contrast: a mixture of ancient and modern. On the one hand, there are high performance high-speed rail networks serving their passengers from modern stations; on the other, antediluvian freight services and decrepit suburban lines at saturation point, with commuters jammed into crowded trains which are always late and eventually release their floods of passengers into sometimes dilapidated and unsafe stations.[22]

Between 1970 and 2003 the share of the goods market carried by rail in EU-15 fell from 20% to 8% (down from 283 billion tonnes per kilometre to 241 billion). For the 25 Member States of the European Union, the modal share of rail freight declined from 20,9% in 1995 to 17,4 % in 2005.[23] In absolute terms, the number of tonne-kilometres dropped from 494.3 billion in 1970 to 391,6 billion tkm in 2005 in the EU25, which represents a decrease of more than 23 %.[24]

Passenger transport by rail also declined, though less dramatically: in 1970, the modal share of rail was 10.2 % and fell to 6.3 % in 2003 in the EU15. The modal share of passenger transport by rail in the EU25 (excluding air and sea transport) dropped from

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[20] European Commission, Road Transport Policy: http://ec.europa.eu/transport/road/policy/index_en.htm.

[21] Road's share of the goods market has been growing constantly, from 41 % in 1990 to 44 % in 1998, and, if no action is taken, is expected to reach 47 % by 2010.: White Paper "European transport…*ibid.*

[22] European Commission (2001), White Paper "European transport…*ibid.*

[23] COM (2007) 609 final. Communication from the Commission to the Council and the European Parliament on monitoring development of the rail market.

[24] European Commission, Rail Transport and Interoperability. Rail transport: the current situation and the Commission's initiatives. http://ec.europa.eu/transport/rail/overview/current_en.htm.

6.8 % in 1995 to 6,5 % in 2004. In absolute terms, the number of passengers-kilometres (pkm) rose from 302,5 bln pkm in 1970 in the EU25 to 364,6 bln pkm in 2005. Transport carried out by high-speed trains accounted for 4.2 % of all rail transport in 1990. In 2004, this share rose to 21.6 %.[25]

The goal of the European Commission to achieve in 2010 is to maintain the modal share of rail transport at the same level of 1998, thus reversing the decline of rail transport observed over the last 30 years. Rail transport is thus expected to grow significantly as the total transport demand in 2010 is expected to be 40% higher than in 1998.[26] The facts and projections of the sector are shown in Exhibit 2.2-1. The rail stakeholders, who engaged on a joint definition of a common strategy for European rail, agree to achieve the objective to increase its market share of passenger traffic from 6 to 12 % and of goods traffic from 10 to 15 % by 2020. [27]

Exhibit 2.2-1: The transport sector – facts and projections

	Direct employment	Share in total freight transport	Share in total passenger transport	Growth between 1995 and 2004	Expected increase until 2010 (for a transport demand 40% higher than 1998)
Road transport	4.3 million (2.6 million in freight transport 1.7 million in passenger transport)	44 %	85%	+ 35 % in freight transport 19 % for passenger cars and + 5 % for buses and coaches	38%
Rail Transport	1.2 million.	10 %	7 % (6 % for interurban trains, 1 % for urban rail (tram and metro).	+ 6 % in freight transport (+ 13% in the EU-15, – 9 % in the EU-10). + 9 % in passenger transport (+ 8 % for interurban trains, + 14 % for urban rail (tram and metro)).	Same level

In a recent report leading to establishing a framework strategy for freight transport logistics, it has been pointed out that: “Rail freight transport suffers from a lack of reliability and efficiency, caused, amonst other things by insufficient technical and administrative interoperability, and by the priority given to passenger trains on lines with

[25] European Commission (2007) Rail Transport and Interoperability. Rail transport: the current situation and the Commission's initiatives. http://ec.europa.eu/transport/rail/overview/current_en.htm

[26] European Commission (2006) "Keep Europe Moving". Sustainable mobility for our continent. Mid-term review of the 2001 Transport White Paper. COM (2006) 314.

[27] Strategic Rail Research Agenda (SRRA) of the European Rail Research Advisory Council (ERRAC). The Agenda identifies key scientific and technological priorities for both passenger and freight rail transport over the next 20 years.

mixed traffic. Action is needed to enhance interoperability and reduce delays generated by mixed traffic."[28] If railways are ever to be competitive with other modes of transport, technological development has to be at the core. In other words, the utilisation of the most up-to-date technologies, including ERTMS,[29] will lead to a reduction of costs, an improvement of reliability and punctuality, an increase in flexibility and much improved safety. Railways are an environmentally friendly and sustainable alternative to road, air and short-sea shipping, but if rail cannot offer its customers a cost-effective alternative service, it will never be able to make a real contribution to the expected increasing demands for European transport.

2.2.3 Maritime transport

High quality waterborne transport is less costly and more environmentally friendly than road transport, and a shift between the two modes could lead to millions of euros of savings. Almost 90 % of the European Union's external trade and more than 40 % of its internal trade goes by sea. That equates to about 3.5 billion tonnes of freight loaded and unloaded in EU ports every year. Short-sea shipping grew by 32 % between 1995 and 2004, a similar growth rate to road freight transport. Short-sea shipping carries 39 % of all tonne-kilometres in the EU-25, comparing favourably to road's share of 44 %.[30]

The Commission is promoting EU internal short shipping motorways of the sea also as an environmentally friendly alternative to overcome bottlenecks in other modes of transport. Through its trans-European networks (TEN-T) programme of activities, the Commission is supporting the development of motorways of the sea in four regions:

- The Baltic Sea;
- Western Europe – Atlantic Ocean, North Sea/Irish Sea;
- South-western Europe – the western Mediterranean Sea;
- South-eastern Europe – the Adriatic, Ionian and eastern Mediterranean Seas.

Essentially, the aim is to develop high-quality, integrated short-sea shipping connections that provide door-to-door services which can match or better those offered by road-only journeys.

During the last decades the information and communication technologies (ICT) did also influence this transport mode significantly resulting in the realisation and implementation of so-called River Information Services (RIS): information services to support traffic and transport management in inland navigation. Based on the EU RIS Directive

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[28] COM (2006) 336 final. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Freight Transport Logistics in Europe – the key to sustainable mobility.

[29] On July 1996 the European Parliament and Council adopted **Decision N° 1692/96/EC** on Community guidelines for the development of the trans-European transport network (TEN-T). These guidelines comprises roads, railways, inland waterways, airports, seaports, inland ports and **traffic management systems** which serve the entire continent, carry the bulk of the long distance traffic and bring the geographical and economic areas of the Union closer together. The ERTMS will enhance interoperability between national networks which is a pre-requisite for effective long distance rail operations.

[30] European Commission (2006). Maritime Transport Policy. Improving the competitiveness, safety and security of European shipping, Directorate-General for Energy and Transport, B-1049 Brussels: http://ec.europa.eu/transport/maritime/doc/maritime_transport_policy_en.pdf.

(2005/44/EC)[31] basic RIS (traffic information, traffic management, information for law enforcement support, etc.) have been adopted into regulations of the European Commission. River Information Services can provide benefits both for public authorities and for commercial enterprises in the transport and logistics sector (shippers, carriers, logistics operators, ports and others).

2.2.4 Logistics

Logistics is the process of planning, implementing and controlling the movement of raw materials, half-finished products and finished goods. These should arrive in time at the right destination and retain the right quantities and quality, while respecting the level of service selected for the process. The global logistics industry is estimated at roughly EUR 5.4 trillion, or 13.8% of the global EU GDP. On average, logistics costs account for 10-15% of the final cost of the finished product. Although logistics is becoming increasingly important, there is a lack of reliable statistical information on the situation. Nonetheless, EU companies do increasingly recognise that there are competitive alternatives to road freight.

The availability of high quality transport and logistics services is of a crucial importance for the competitiveness of the European economy. Co-modality[32] and high efficiency in the transport system are also indispensable for Europe to manage the increasing flows of goods. However, globalisation and a wider Europe create new challenges. In June 2006, a communication from the EC outlined the main problems faced by the organisation and operation of the European Transport system:[33]

"The organisation and operation of the European transport system are not optimal. The efficiency of the system and its integration are not as advanced as they could be. Rapid growth of freight transport with consequential congestion, accidents, noise and pollution are amongst the economic, social and environmental problems that need to be addressed. Furthermore, effective planning, management and control of unimodal and multimodal transport chains through logistics solutions are not sufficiently developed for the objectives of co-modality to fully materialise. Freight transport needs to do more to maintain and increase European competitiveness."

Despite various advances in European transport policy, the measures planned in 2001 are not sufficient in order to achieve the formulated objectives. For this reason, the Commission announced further measures to reach the 2001 proposed goals. These include amongst others: (a) a plan of action for goods transport logistics, (b) the promotion of intelligent transport systems and new technologies for a more environ-

[31] DIRECTIVE 2005/44/EC of the European Parliament and of the Council of 7 September 2005 on harmonised river information services (RIS) on inland waterways in the Community.

[32] 'Co-modality' means the efficient use of transport modes operating on their own or in multimodal integration in the European transport system to reach an optimal and sustainable utilisation of resources.

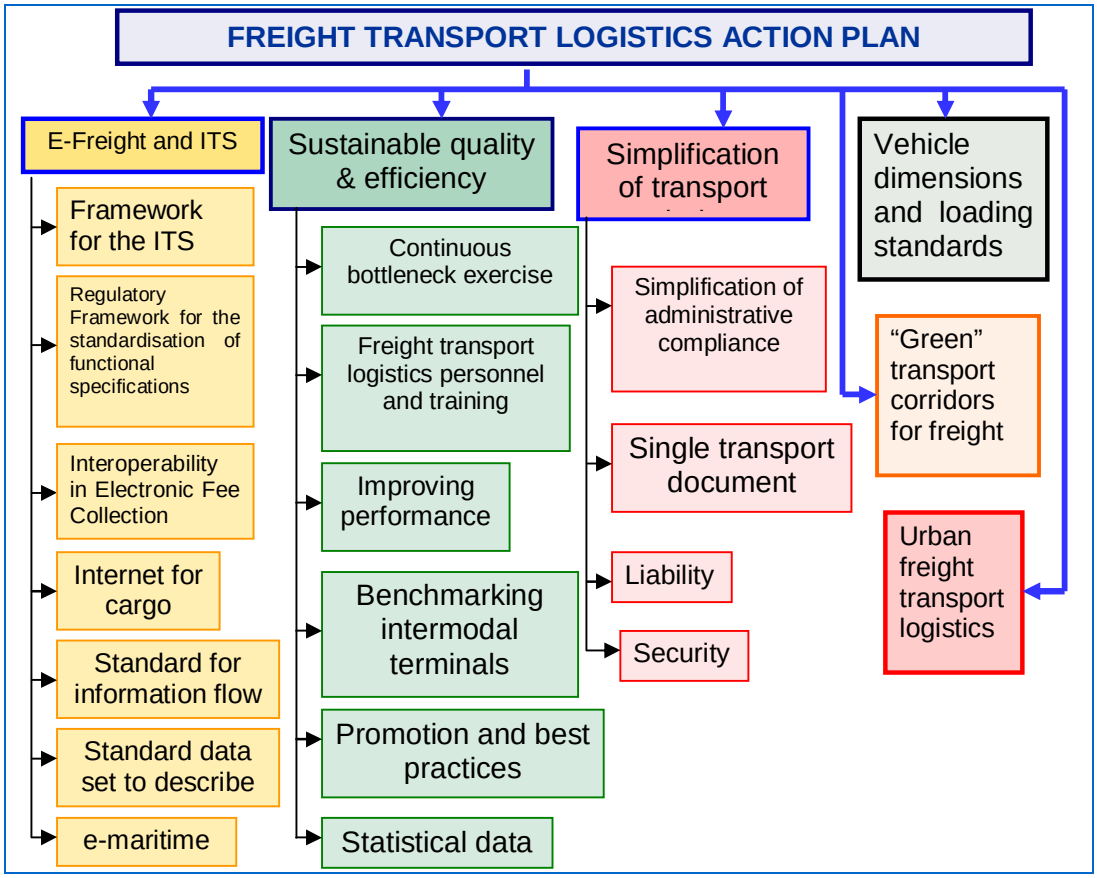
[33] European Commision (2006). Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. "*Freight Transport Logistics in Europe – the key to sustainable mobility*" Summary of the Impact Assessment - Points for Reflection, Brussels, 28.06.2006 SEC (2006) 820.

mentally friendly and efficient mobility and, (c) European approaches to mobility in urban areas.[34]

Therefore, advanced quality solutions are needed for Europe to improve its transport and logistics position in the world market. Being a centre of transport and logistics excellence, with the appropriate measures and incentives in place, would help economic, social and environmental sustainability in Europe and attenuate negative trends, such as relocation of business activities and employment away from Europe.

Following consultation with stakeholders, the European Commission has presented an Action Plan for Freight Logistics in 2007. Potential measures include actions in relation to: research and the use of information and communication technologies (ICT), infrastructure planning, service performance, and multimodal supply chains.[35] The main ideas of the Action Plan are shown in Exhibit 2.2.-2. It presents a number of short- to medium-term actions that will help Europe address its current and future challenges and ensure a competitive and sustainable freight transport system in Europe.

Exhibit 2.2-2. Main Activities of the Action Plan for Freight Logistics



Source: COM (2007) 607 final. Freight Transport Logistics Action Plan

[34] COM (2006) 314 final - Communication: Keep Europe moving - Sustainable mobility for our continent: Mid-term review of the European Commission's 2001 Transport White Paper (Energy and Transport DG)

[35] European Commission (2007). Information Society and Transport: Linking...*ibid.*

2.3 Trends and challenges

There are a vast number of trends and challenges in the transport and logistics industry. The UE transport policy identifies these challenges: to offer a high level of mobility to people and business throughout the EU; protect the environment; ensure energy security; promote minimum labour standards for the sector; protect passengers and citizens; innovate in support of the above aims; and finally connect Member States and the Union internationally.

In evaluating the progress of the transport sector over the past five years, there is a need for new initiatives since existing ones will not be enough to achieve the fundamental challenges of EU policy, in particular to contain the negative environmental and other effects of transport growth while facilitating mobility as the quintessential purpose of transport policy.[36]

As stated above, transport has grown constantly throughout the years faster than gross domestic product (GDP). One central question of European transport policy is therefore how to manage the transport growth in Europe. At the same time, the external costs of congestion due to road traffic alone represent approximately 0.5% of the GDP in the European Union (EU), and this could rise to 1% of GDP by 2010.[37] Road and maritime transport take, between them, the largest share in freight transport. Their growth has been most impressive, while the growth of inland waterways has been much lower and rail has lost custom in terms of market share.

Combining all modes of transport

The use of resources in Europe's transport system needs to be optimised. The efficiency of the system and the integration of transport services are not as advanced as they could be. Complementarity of modes and their integration in the transport system and with each other should be improved. Europe needs efficient freight transport logistics combining the benefits of all modes to maintain and increase European competitiveness and prosperity in line with the Lisbon agenda and concept of co-modality introduced in the mid-term review of the White Paper on European Transport Policy.[38] This policy of modal shift or 'intermodality' consists of linking short sea shipping, rail and inland waterways better into the logistics chain.

Europe at large is affected because its transport system is not used in a balanced way but emphasises the road component even over longer distances. Without new measures, transport modes in the European transport system would continue developing in contrasting ways and not achieve a sufficient degree of synergy. Optimisation of modes and their integration in the whole system would not occur. With the unbalanced growth of road transport, infrastructure resources could become exhausted in a few years' time and the European transport system would become crippled. European competitiveness and prosperity would be at risk.[39]

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[36] EEA Report No 1/2007: Transport and environment: on the way to a new common transport policy. TERM 2006: indicators tracking transport and environment in the European Union.

[37] Tostmann S., (2004) Trends in European Transportation – Challenges and Opportunities for the Supply Chain, Business Briefing: Global Purchasing & Supply Chain Strategy.

[38] Karel Vinck (2007). ERTMS Project, Annual Activity Report of Coordinator, Brussels.

[39] COM (2006) 336 final. Communication from the Commission to the Council, the European Parliament, the European Economic and…*ibid.*

Supporting intermodal transport is a major part of the Commissions White Paper: *European Transport Policy for 2010: Time to decide*. It contributes to the objective of shifting the balance between modes. The aim of the Commissions policy on Intermodal Freight Transport is to support the efficient "door to door" movement of goods, using two or more modes of transport, in an integrated transport chain.

Each mode of transport has its own advantages e.g. potential capacity, high levels of safety, flexibility, low energy consumption, low environmental impact; intermodal transport allows each mode to play its role in building transport chains which overall are more efficient, cost effective and sustainable. For instance, combined rail–road transport chains reduce the CO_2 emissions by 55% and save 29% of energy compared with road. The whole European combined rail–road transport sector reduces CO_2 emissions by 1.8 million tons per year, with estimated yearly environmental savings of about €180 million.[40]

Advanced logistics solutions would allow co-modal freight transport operations to be carried out optimally in all circumstances thereby giving Europe a competitive edge. Furthermore, when optimising their supply chains, enterprises in the EU increasingly recognise that there are competitive alternatives to road freight. For instance, large carriers provide comprehensive logistics services integrating more modes, because this provides them competitive cost advantages. All modes must become more environmentally friendly, safer and more energy efficient.

Logistics planning should enable a more balanced use of transport solutions whether unimodal or multimodal. The objective would also include decreasing the number of vehicle-kilometres performed by unimodal road transport vis-à-vis tonne-kilometres. However, this decrease should not be confined to road transport alone.[41]

To encourage modal shift, i.e. to ensure the expected increase in road freight transport is diverted to other modes, the Commission has run the Marco Polo programme to provide support to commercial operators setting up services which focus on modes other than road. Marco Polo funds may be used to support the initial operation of new services, although these should become self funding once established, as well as encouraging cooperation amongst different operators in the freight logistics sector. A new phase of the Marco Polo programme, running from 2007 to 2013,was adopted in 2006, and will have a total budget of EUR 400 million.[42]

Revitalising the railways

Transport is a key driver for the EU-25 outlook in terms of both energy and emissions. Energy demand in the transport sector is projected to remain a very important segment of energy needs in the EU-25 energy system. Transport is also the fastest growing demand sector in New Member States (NMS), with its share in final energy demand in these states rising from 19.2% in 2000 to 25.4% in 2030. Given the importance of transport for the economy and the daily lives of citizens, and because of its impacts on oil supply security and environmental emissions, this sector has been a priority policy area within the EU for many years. CO_2 emissions from transport are expected to increase by 40%

[40] Tostmann S., (2004) Trends in European Transportation…*ibid.*

[41] Commission Staff Working Document**,** Annex to the COM (2006) 336 final.

[42] European Commission (2006). Maritime Transport Policy. Improving the competitiveness…*ibid.*

between 1990 and 2010 in EU-25. Road transport is the main source since it alone accounts for 84% of the total CO_2 emissions attributable to transport.[43]

The environmental performance of the transport sector is still unsatisfactory. There is a need to intensify efforts to improve it, not least concerning the sector's contribution to climate change. Using the least polluting mode of transport is a rather straightforward way of reducing the environmental impact of transport. Rail is in most cases cleaner than other land transport modes. Therefore, the 2001 transport policy included a specific aim of reversing the gradual loss of market shares by the rail sector.

The introduction of policies to promote railways (both in passenger and freight transport) and public road transport leads to more favourable development of the EU-25 transport sector. Intelligent Transport Systems could make public transport more efficient and attractive and therefore stimulate a shift from private car to public transport. ITS also increases the time efficiency of traffic, which implies that more pkm can be achieved in the same time. Different modes of transport offer different time utilisation potentials, and ICT development also creates new potentials. Instead of changing to a faster mode of transport, time pressure can also motivate time utilisation in public transport or the use of virtual modes of mobility.

These changes in the structure of transport activity, lead to significant reductions in energy use by the transport sector. Energy requirements in the transport sector will decline by -3,5% in 2010 and by -3.7% in 2030, compared to the 1998 levels, with the corresponding decline in CO_2 emissions ranging from -4.0% in 2010 to -4.1% in 2030.[44] The impact of ICT-related technologies on these results is established in a 2004 technical report by the European Commission: ICT reduces the greenhouse gas emissions *per pkm* by 7% to 12%.[45]

Rail transport is, in some ways, the key to the success of efforts to shift the modal balance, particularly in the case of goods. However, deliberate policies normally fail to take the 'transport impact' into account. They are therefore likely to favour the flexibility that road transport offers rather than the environmental advantages of rail.[46]

Centralised vs. decentralised logistics

There are a number of trends, some of which are contradictory. On the one hand, centralisation of logistics organisation in European and regional distribution centres is taking place, and, on the other, decentralisation is emerging in the light of saturation on the European roads, enabling quick response from local warehouses or buffer storages to customer requirements. A noticeable trend is also outsourcing logistics activities whereby shippers buy multifunctional logistics services from external service providers (such as third-party logistics providers). In recent years, this co-operation between shippers and service providers has become more long-term in nature and has been combined with a high level of integration in the organisational structures and informatics.[47]

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[43] European Commission, (2004) Directorate-General for Energy and Transport, *European Energy and Transport Scenarios on Key Drivers.*

[44] European Energy and Transport Scenarios on Key Drivers…*ibid.*

[45] European Commission, (2004). The future impact of ICTs on environmental sustainability, Technical Report EUR 21384 EN.

[46] EEA Report No 1/2007: Transport and environment: on the way to a new common…*ibid.*

[47] Freight Transport Logistics in Europe – the key to sustainable mobility…*ibid.*

Efficient and effective Urban Transport

In urban areas, motorised transport has many negative localised side effects. The challenge for future urban transport systems is to meet the demand for accessibility for people, while at the same time minimising the impact on the environment. European cities increasingly face problems caused by transport and traffic. The question of how to enhance mobility while at the same time reducing congestion, accidents and pollution is a common challenge to all major cities. They are usually in the best position to find the right answer to this question that takes into account their specific circumstances.

However, at the same time, urban transport policy is of increasing importance for the EU. Efficient and effective urban transport can significantly contribute to achieving objectives in a wide range of policy domains for which the EU has an established competence. The success of policies and policy objectives that have been agreed at EU level, for example on efficiency of the EU transport system, socio-economic objectives, energy dependency, or climate change, partly depends on actions taken by national, regional and local authorities. An example of the role of those authorities as driving forces to implement solutions for public transport - in terms of comfort, quality, security and environment – is illustrated by *Värmlandstrafik AB* case study, in Sweden (see Section 5.12). The Public Transport Authority (PTA) in Sweden was under pressure from the Government to better control the pollution generated by the public transport. The end solution implemented by *Värmlandstrafik AB* has generated great benefits for the public transport (bus, train and tram) in terms of a better control of the operators' activities and the environmental impacts, in providing better security and comfort to transport passengers, and in a better standard of the overall transport service.

Existing EU legislation, for example on public service obligations in public transport, air quality and noise and vehicles standards, does have a direct impact on the transport policies of Europe's cities. EU policy and financial programmes for regional development and research provide significant resources for the renewal and innovation of urban transport infrastructures, technologies and services in many European cities.[48] In collective transport, the use of ITS ensures a better management of operations and new services (fleet management, traveller information systems, ticketing systems, etc). The case study on real-time passenger information system at *Trafikanten*, Norway confirms this asseveration (see Section 5.11). *Trafikanten* implemented an innovative information system providing travellers with reliable information on real-time departure times of public transport vehicles. The system is a combination of location positioning systems, distance measures devices, travel planning information and other ICT-related technologies.

Freight transport to/from and in city areas is an essential element of the quality of life of the 80% of Europe's population that live in urban areas.[49] Freight distribution in urban environments also creates a number of challenges for citizens. A holistic vision at the local level would be needed to consider all urban logistics together as a single logistics network that covers passenger and freight transport, and that pays attention to the aspects of land use planning, environmental considerations, traffic management and a number of other factors. The efficiency of urban freight distribution can be increased with

[48] Directorate-General for Energy and Transport, Clean Urban Transport. http://ec.europa.eu/transport/clean/index_en.htm.

[49] COM (2004) 0060 final Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Towards a thematic strategy on the urban environment.

the help of ITS, in particular through better timing of operations, higher loading factors and more efficient use of vehicles. It requires integrated systems that combine intelligent route planning, driver assistance systems, intelligent vehicles and interaction with infrastructures.

Performing information and communication systems

To obtain the quality solutions needed in the organisation and operation of the European transport system, the use of interoperable ICT and Intelligent Transport Systems (ITS) in the transport logistics chain should be encouraged further as a matter of priority. A specific role for interoperability could be found in the exchange of information between businesses and administrations. However, the interconnectivity in business-to-business and business-to-consumer logistics is also vitally important. The proper functioning of the logistics chain requires well *performing information and communication systems*. Thus, means of transport synchronize their activities and the transported goods reach their destination on time and in full transparency of information.

Smart technologies should be introduced to avoid delays in the supply chain for security and other reasons. One such technology is radio frequency identification (RFID) which is a growing market but requires further research and work on radio spectrum management, interoperability and standardisation. In transport and logistics, RFID is expected to contribute to improved efficiency and security, and provide new quality services for mobility of people and goods. For instance, the railroads, have fortified RFID with even more advanced technologies, including GPS, real-time engine-health monitoring and wireless data.

RFID-enabled supply chains are beneficial in the following ways:

- reduce inventory levels due to increased confidence in on-hand, in-transit, and manufactured inventory levels
- minimize stock-outs and inventory shortages
- decrease operating costs due to obsolescence, expiration, and spoilage
- reduce labour costs through automatic identification and physical inventory counts
- streamline recall processes due to ability to identify possible impacts to damaged product
- improve security, resulting in decreased theft and tampering
- maximize revenue and market share
- optimise logistics costs and effectiveness.

Further elements in the equation are common messaging standards (e.g. EDI/EDIFACT) and new communications platforms (e.g. XML). Using e-business technologies, European transport and logistics companies can improve their productivity, create an integrated approach linking transport modes in innovative ways and, thus, the quality of their services.

The emergence of new technological solutions, such as the Galileo satellite navigation system[50] and European Rail Traffic Management System (ERTMS) are creating major

[50] Galileo is the informal name for the European Global Navigation Satellite System (GNSS), a system that will offer users anywhere in the world "near pinpoint" geographic positioning. The Galileo satellite system will be operational from 2010 and provide navigation signals to be combined with ground- or space-based communication. Tracking and tracing of cargo in all

new opportunities that could constitute components of an integrated approach towards intelligent logistics. Much of today's applications of information technologies and intelligent transport systems are modal. Intermodal or cross-modal applications are only slowly developing and cannot at this time rely on Europe-wide architectures or frameworks. Some obstacles in this direction could be formulated this way:

- Intermodal Transport Systems seek local solutions with their partners, no EU-wide approach in reach.
- Cooperative systems have to invent their rules with the danger of resulting in several island solutions.
- Complexity- ITS applications use a variety of technologies with different terminology, different protocols & data formats proprietary data processing.

Thus, the development of ICT supporting planning, optimisation, and monitoring of freight haulage for terminals as well as for all other service providers of intermodal transport chains is one of the most challenging application domains for computer and business sciences in the transportation sector.

Such an approach is circumscribed, for example, by the concept of "e-freight", which denotes the vision of a paper-free, electronic exchange of freight transport-related documentation. Possible initiatives to accelerate the application of ITS/ICT to freight logistics could encourage the emergence of an open architecture that is based on interoperable components and supported by common messaging. This would require standardisation efforts towards a single platform for applications, data and inter-connectivity. In the one hand, the EU is investing considerable public funds in these systems and accompanies their roll-out with the necessary regulatory framework, and in the other hand the International Organisation for Standardisation (ISO) recently released the ISO 24014-1:2007 - Public transport - Interoperable fare management system - Part 1: Architecture,[51] which provides the basis for the development of multi-operator/multi-service interoperable public surface (including subways) transport fare management systems (IFMS) on a national and international level.

The standard was developed by ISO/TC 204 - Intelligent transport systems (ITS), which covers standardisation of information, communication and control systems in the field of urban and rural surface transportation, including intermodal and multimodal aspects of traveller information, traffic management, public transport, commercial transport, emergency services and commercial services in the ITS field.

modes is a prerequisite for efficient logistics. The introduction of the satellite navigation system GALILEO will have a substantially positive impact on this development.

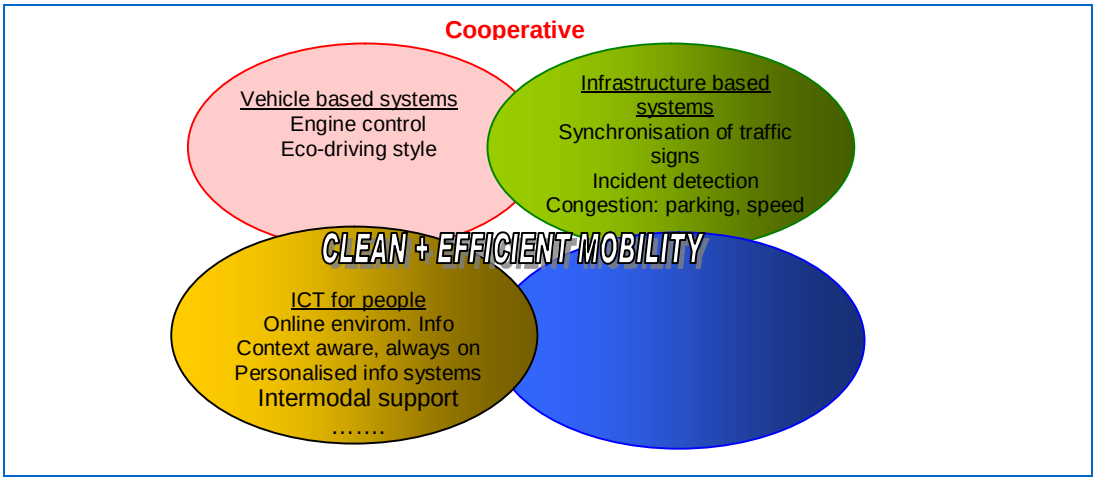
[51] http://www.iso.org/iso/catalogue_detail?csnumber=41985.

3 Deployment of ICT and e-business applications

ICT are major potential influences on the mobility of people and goods. ICT are also potentially important enablers of changes in social and organisational practices, thus affecting the demand for transport in spatial and temporal terms. Technological trends will meet the demand for comfort, safety and speed through advances in ICT and telematics (traffic and transport management systems, travel information and reservation systems, vehicle guidance systems, mobility cards).

Overall business growth is likely to cause an increase in road traffic and hence, an increase in CO_2 emissions. Presently, transport is responsible for about 28% of total CO_2 emissions. Road transport alone represents about 84% of all transport related CO_2 emissions.[52] With 98% dependency on oil, the transport industry not only has a big impact on air quality and greenhouse gas emissions, but high oil prices also have a significant influence on the transport sector and the economy as a whole.

Exhibit 3.1.1 EC activities towards ICT for Clean and Efficient Mobility



Source: Working Group- ICT for Clean & Efficient Mobility Meeting, 1-6 December 2006, eSafety Forum

Applications of ICT-based energy efficient activities searching to de-couple energy consumption from growth, will improve the efficiency of transport, reducing the energy use or even the need for transport. Exhibit 3.1.1 shows the main areas of the EU initiatives, activities and projects in the sphere of ITS for a more clean and energy efficient that have been taken into consideration in the 5th, 6th and 7th Framework Programme. These areas are:

- **Vehicle-based**, for example driver support and eco-driving;
- **Infrastructure-based**, for example synchronisation of traffic signals;
- **People**, for example online environmental information and intermodal support;
- **Goods**, for example route and load optimisation.

[52] Sector futures (2004). *The automotive sector at crossroads,* European Foundation for the Improvement of Living and Working Conditions.

A new e-Safety Forum Working Group on "ICT for Clean and Efficient Mobility" has been established to investigate the ICT-related technologies impact on transport safety, clean and energy efficient mobility of people and goods.[53] There are many practical examples that would help the Working Group to collect data as is the case of the FRIDA solution developed and implemented by Nordic Port in Sweden (see Section 5.12.2). The deployment of the FRIDA system allows the Sweden authority today not only to measure the pollution generated by the public transport all over Sweden but also to set up concrete and achievable goals for the environment for the different regional authorities.

Road safety remains a major concern. Each year in the EU around 40.000 people are killed and more than 1.2 million injured in road accidents.[54] Information and communication technologies can contribute significantly to improving road safety, enabling the development of sophisticated safety systems that improve road users' chances of avoiding and surviving accidents. ICT also provide new systems for enhanced traffic management e.g. receiving the latest information shortly before departure on the best way to reach a destination or being warned about congestion ahead, before the user get caught up in it.

There is no doubt that the ICT is playing also an important enabling role in logistics. The ICT that may be used by firms in order to improve their competitiveness may be classified into three categories: i) identification technologies, ii) data communications technologies; and (iii) data acquisition technologies.[55]In what concerns the identification technologies, firms may appeal to bar-coding or to RFID. The bar-coding and RFID are identification technologies that facilitate logistics information collection and exchange.

As regards data communications technologies, firms may appeal to the electronic data interchange (EDI), the Internet, the Value Added Network amongst others. Nowadays, as regards the data acquisition technologies, the firms usually deal with a large amount of goods and data which means that data collection and exchange are critical for logistics information management and control. Good quality in data acquisition can help firms deliver customers' goods more accurately and efficiently.

Firms need to be able to manage information effectively, and to integrate several logistics activities by including inbound and outbound transportation, distribution, warehousing, and fleet management, in order to streamline the physical product flows of their customer companies. Through the intensive use of ICT (acquisition, communication, and identification technologies) in logistics, the information flows, efficiently used by firms, will reinforce the existent competitive advantages, or alternatively, will create new competitive advantages. The ICT are important to logistics, since they make available the right information, at the right time and at the right place.

This popular logistical paradigm, which most often refers to physical goods, is shown to have equal relevance in the management of information. Introna[56] (1991) demonstrates that while the logistical system converts materials into products, through the creation of

[53] ICT for Clean and Efficient Mobility: http://www.esafetysupport.org/en/esafety_activities/esafety_working_groups/ict_for_clean_mobility.htm.

[54] European Commission (2007). Information Society and Transport: Linking European Policies.

[55] Garrido Azevedo, S., Ferreira, J. and Leitão, J. (2007). The Role of Logistics' Information and Communication Technologies in Promoting Competitive Advantages of the Firm, University of Beira Interior, Munich Personal RePEc Archive.

[56] Introna, L.D., (1991). The impact of information technology on logistics, *International Journal of Physical Distribution & Logistics Management,* 21(5), 32-7.

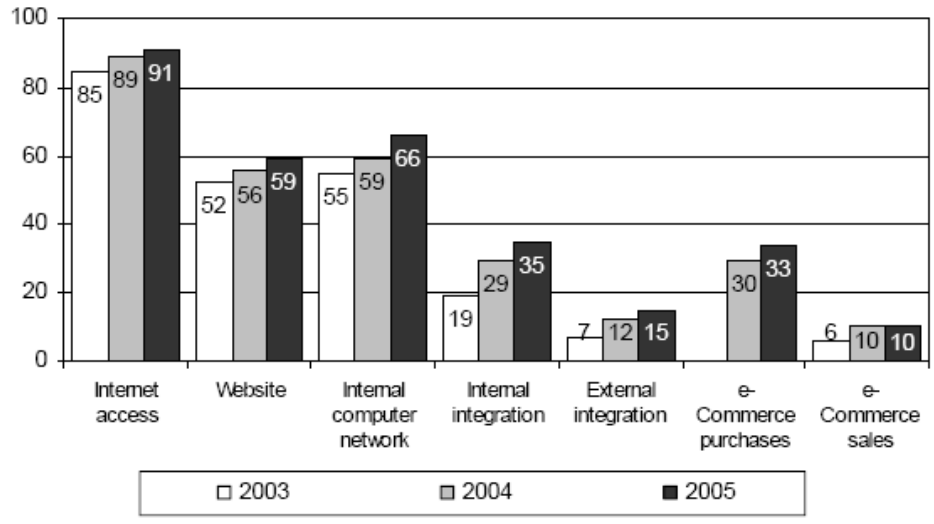
value for customers, the information and communication systems convert data into information, in order to facilitate managerial decision making. The author argues that information is a resource to be used for decision and which can subsequently enhance logistical effectiveness, efficiency, and flexibility. These factors improve a company's competitiveness.

This chapter provides insights into current trends of ICT use and e-business activity in the transport and logistics industry. The chapter does not claim to provide a comprehensive analysis, as that would exceed the limits of this report. In fact, it would be difficult to realise, as ICT and e-business are relevant for nearly all core business areas of the TLS industry. Therefore, the issues analysed should rather be understood as representative examples of current practice and the related opportunities and challenges. However, where needed, the SeBW survey results are linked to the drivers and impacts of ICT adoption (Chapter 4) and to the case studies presented in Chapter 5. The focus and issues discussed have been selected in coordination and agreement with DG Enterprise and Industry and with industry federations as particularly relevant and topical.

3.1 Access to and usage of ICT networks

Current ICT technologies provide new possibilities for networks, the distribution of information and the design of business logic. The accessibility and the numerous opportunities to creatively use the Internet has brought many implications to the organisations core business processes to generate enormous benefits in terms of performance as well as provide greater value-added products and services. The use of ICT by European enterprises has grown steadily from 2003 to 2005 for several technologies. Even internet access, reaching saturation, still increased by 2 percentage points, from 89% to 91% (Exhibit 3.1-2).[57]

Exhibit 3.1-2: Percentages of enterprises adopting several technologies (2005) – EU25



Source: Eurostat, Community survey on ICT usage and e-commerce in enterprises
Notes: (i) Enterprises with 10 or more persons employed. (ii) EU25 aggregate not including FR, as data is not available.

[57] Reis F. The internet and other computer networks and their use by European enterprises to do eBusiness, Statistics in focus, Industry, Trade and Services, 28/2006.

Over the last few years firms operating in the transport and logistics sector have made significant progress in their adoption of new technologies, particularly those linked to the Internet and e-business. ICT and e-business activities deployment has thus become increasingly important for the industry. Low-cost access to the Web and the dissemination of e-business technologies provide firms with a tool to satisfy customer demand by using traditional services in conjunction with growing information-based services. Firms can automate existing processes and dramatically reduce cycle times throughout the supply chain. They can enhance communication, collaboration, and cooperation between knowledge teams (including virtual teams) using *intranet* technologies as well as between the organisation and members of its external constituent organisations using *extranet* technologies. Firms may link their electronic systems to those of their suppliers, distributors, and dealers in powerful inter-organisational network to support effective supply chain management objectives, including integrated production life cycle planning.

In logistics, the new methods of distribution, such as just-in-time (JIT) manufacturing—where warehousing seems to be unnecessary because products are shipped directly to customers, led warehousing companies to strive to become more than simply storage facilities. They are transforming themselves into "third-party logistics providers" or "3PLs" that provide a wide array of services and functions. In addition to packing and staging pallets, contemporary warehousing facilities offer light manufacturing, call centres, labelling, and other non-storage options.

In the past, warehouse management was very paper-intensive in its coordination of a multitude of activities. This has changed with the introduction of warehouse management system software. Warehouse management systems (WMS) assist managers in tracking products throughout the entire storage and distribution process. These systems span from simple computer automation systems to high-end, feature-rich management programs that improve order picking, facilitate better dock logistics, and monitor inventory management. Case studies about *Geodis* (Belgium) and *AIT* (France) (Chapter 5) represent the range of actual possibilities available to logistics companies – large or small-sized- to develop WMS. The main issues or trends in warehousing include radio frequency identification (RFID), transportation management systems, pick-to-light technology, and voice-activated receiving and packaging.

Exhibit 3.1-3 below shows that the transport and logistics patterns of enterprises adopting several ICT technologies (as a percentage of the total number of enterprises with 10 or more persons employed) is quite similar to the overall percentage of enterprises in EU 25 (including all sectors).

Exhibit 3.1-3: Enterprises use of ICT (2005) (as a percentage of the total number of enterprises with 10 or more persons employed)

	Internal Computer Network	Intranet	Online purchases business model	Online sales business model	External integration of business processes*
Transport & Logistics	59	29	21	12	13
EU 25 (ii) – all sectors	65	34	24	12	15

Notes: (*) External integration of business processes refer to the automatic linking between a computer system for managing orders and a supplier's or customer's business system. (ii) EU25 aggregate not including FR, as data is not available..

Source: Eurostat, Community survey on ICT usage and e-commerce in enterprises.

Today, the main transport and logistics service firms are in a position to provide a variety of information via the Internet and to secure transactions online with customers. Modern information systems and technology offer opportunities for fast and safe sharing. Key findings regarding use of and access to ICT in the TLS are summarised below.

Internet access

Internet access is seen more and more as a vital utility, such as water or electric services. The prominence of the internet among all computer networks is evident, because of its size in terms of the number of persons and enterprises it connects and its worldwide scope. Internet access is therefore fundamental for enterprises to start benefiting from the Information Society. For most EU Member States internet adoption is approaching saturation point. Overall, for the EU, by 2005, 91% of enterprises with 10 or more persons employed had internet access.[58] In line with this tendency, in the present study, nearly all companies (97%) which use computers in the TLS sector said that they are connected to Internet.

Exhibit 3.1-4 Internet access and bandwidth (2007)

Transport & logistics services (TLS)	Companies with internet access		Of those: Internet access with a maximum bandwidth of …					
			…< 144 kbit/s		…< 144 kbit/s – 2 Mbit/s		…>2 Mbit/s	
Weighting scheme:	% of empl.	% of firms	% of empl.	% of empl.	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**99**	**97**	**8**	**17**	**51**	**52**	**41**	**31**
Passenger transport	99	95	9	20	41	50	50	30
Freight transport	98	97	9	17	58	53	33	30
Logistics	100	100	6	14	46	51	48	35
TLS (USA)	**100**	**100**	**3**	**16**	**52**	**34**	**45**	**50**
TLS – by size (EU-7)								
Micro (1-9 empl.)		97		18		53		29
Small (10-49 empl.)		98		10		46		44
Medium (50-249 empl.)		100		3		51		46
Large (250+ empl.)		100		3		46		51
Base (100%)	all firms		firms with internet access					
N (TLS, 2007, EU-7+USA)	1097		857		857		857	
Questionnaire reference	A4a		A3a		A3b		A3c	
The survey was conducted in 7 EU Member States (DE, FR, IT, ES, PL, SE, UK) and in the USA.								

Sectoral e-Business Watch (Survey 2007)

Only among passenger transport firms, a minority of 5% responded that they have no Internet connection. By share of employment, firms representing 99% of the sector workforce are connected to Internet.

A relevant indicator is the existence of broadband connection. On the path to the adoption of e-business, connectivity is the first step and also a precondition for all potential benefits of the use of computer networks. Exhibit 3.1-4 shows also a tendency of the firms to have a higher broadband connection. Only 17% of the sector companies (representing 8% of the sector workforce) still use an Internet access up to 144 kbit/s,

[58] Reis F. The internet and other computer networks and their use by European…*ibid*.

while a half of the sector firms have bandwidth connection ranging from 144 kbit/s to 2 Mbit/s. One third of the firms have more than 2Mbit/s bandwidth connection. The quality of the Internet connection is paramount to the development of e-business. This connection enables an exchange of more information per unit of time and supports the exploitation of sophisticated IT systems.

Exhibit 3.1-5 Internet access and bandwidth by countries

Transport & Logistics Sector	**Companies with Internet Access**		**Average share of employees with internet access in firms**		**Companies whose Internet access has a maximum bandwidth of…**					
					…< 144 kbit/s		**…< 144 kbit/s – 2 Mbit/s**		**…>2 Mbit/s**	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS- total (EU7)	**99**	**97**	**39**	**53**	**8**	**17**	**51**	**52**	**41**	**31**
Germany	99	95	42	47	9	27	35	33	58	39
Spain	99	96	32	37	2	6	28	34	70	61
France	99	96	26	36	8	18	64	48	28	34
Italy	100	100	32	52	3	9	52	57	45	35
Poland	97	96	53	57	20	24	68	68	13	8
Sweden	100	99	48	56	11	5	24	36	65	58
UK	99	96	42	63	2	10	53	19	45	71
USA	**100**	**100**	**59**	**57**	**3**	**16**	**52**	**34**	**45**	**50**

Source: Sectoral e-Business Watch (Survey 2007)

By countries, Poland has the lowest number of firms with Internet access in this higher level, although also presents most of the firms in the middle level (Exhibit 3.1-5). The only remarkable difference between the European countries and USA related to connectivity seems to be the percentage of firms in the highest broadband (31% and 50%, respectively).

Use of internal computer networks

The use of computer networks internally in the enterprise is believed to yield potential gains in efficiency and productivity. The adoption of internal computer networks is a first step towards the computer integration of business processes. Such integration potentially streamlines and boosts the efficiency of the enterprise. A computer network is composed of multiple connected computers that communicate over a wired or wireless (Local Area Networks – LAN, and Wireless LAN) medium to share data and other resources. In the TLS industry, as shown in Exhibit 3.1-6, a half of all firms (75% for the Logistic sub-sector) representing 75% of employees operate a LAN.

However, the deployment of the Wireless LAN technology only reach 22% of the sector companies, although it is already used by about a half of the large-sized firms, and even one third of the small companies. As it can be seen, the use of ICT to connect computers internally to a company network increases with company size. For both of these ICT infrastructure indicators, there is a difference between the EU countries (LAN, 50%; WLAN, 22%) and USA (LAN, 66%; WLAN, 43%).

Exhibit 3.1-6 Networks and protocols used

Transport & Logistics Sector	Companies having …									
	LAN		WLAN		Intranet		Extranet		Remote access	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**75**	**50**	**39**	**22**	**52**	**24**	**24**	**6**	**49**	**24**
Passenger tr.		43		22		17		5		21
Freight transport		44		20		25		5		26
Logistics		75		27		30		7		21
TLS – by size										
Micro (1-9 empl.)		48		20		23		5		23
Small (10-49)		62		33		26		9		32
Medium (50-249)		87		43		55		23		57
Large (250+)		95		52		77		42		74
TLS – by country										
Germany		50		26		12		2		18
Spain		58		36		18		13		23
France		32		20		14		6		17
Italy		71		14		27		10		24
Poland		34		18		29		0		26
Sweden		37		35		17		6		21
United Kingdom		50		38		30		35		61
TLS – USA		**66**		**43**		**29**		**11**		**38**
N (TLS EU-7+ USA)	1097		1097		1097		1097		1097	
Questionnaire reference	A5a		A5b		A5c		A5d		A4	

Source: Sectoral e-Business Watch (Survey 2007)

The size and scalability of any computer network are determined both by the physical medium of communication and by the software controlling the communication (i.e., the protocols). An Intranet is a specific application of the internal computer network which serves as a communication tool within the enterprise, and an Extranet can be viewed as part of a company's Intranet that is extended to users outside the company. As such, both can be regarded as a next step in the use of the internal computer network as e-business. Around one quarter of the TLS sector firms use an Intranet and, again, it depends on the company size, ranging from a relative small 23% for micro-sized firms to a high 77% for large firms. Only a few firms in the industry use an Extranet (6%), most been used by large-sized firms (42%).

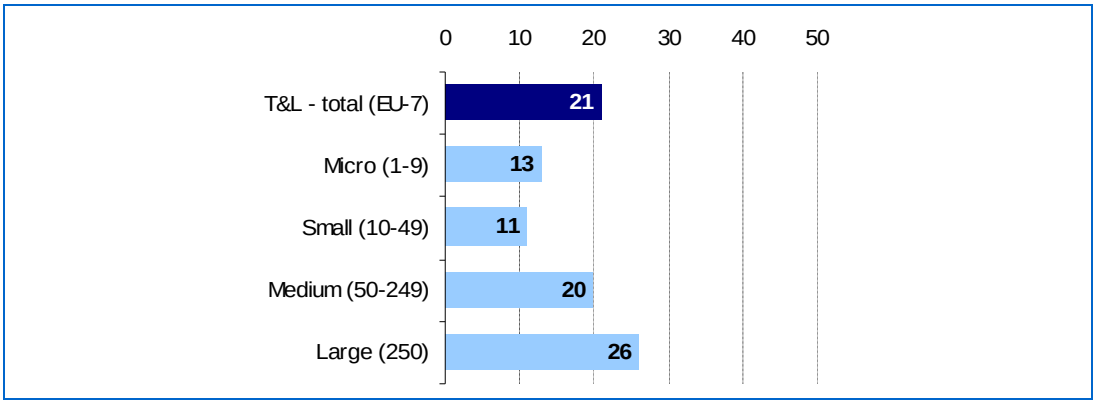
Remote access means that employees can access data from the company's computer system remotely, e.g. when working from home or travelling. In the TLS industry, 24% of firms (comprising about half of the sector's employment) enable remote access. This infrastructure indicator is quite common among large firms (74%) and medium-sized ones (57%); however, is not yet widely used by small firms (23%). Again, this fact strongly indicates the different stage of ICT architecture maturity levels of companies from different size-bands.

Voice-over-IP

Voice over Internet Protocol, also called VoIP, IP Telephony, Internet telephony, Broadband telephony, Broadband Phone and Voice over Broadband is the routing of voice conversations over the Internet or through any other IP-based network. Some VoIP services offer features and services that are not available with a traditional phone, or are available but only for an additional fee. The provision of VoIP is driven by increasing broadband penetration. Some cost savings are due to utilising a single network to carry voice and data, especially where users have existing underutilised network capacity that can carry VoIP at no additional cost. VoIP to VoIP phone calls are sometimes free, while VoIP to public switched telephone networks (PSTN),[59] may have a cost that's borne by the VoIP user.

A major development starting in 2004 has been the introduction of mass-market VoIP services over broadband Internet access services, in which subscribers make and receive calls as they would over the PSTN. VoIP offers all the options that callers are used to using such as call waiting, caller ID, unified messaging, directory services and vertical-specific applications. In addition, VoIP is a standard, open protocol, allowing companies to build their own audio applications or purchase other applications that will come from software developers.

Exhibit 3.1-7 Percentage of firms who uses Voice-over-IP in the TLS sector



Source: Sectoral e-Business Watch (Survey 2007)

13% of all companies from the sector (accounting for 21% of employment) said that they used Voice-over-IP services (see Exhibit 3.1-7). Yet, the results vary between different company size classes. With a diffusion rate of 13%, micro enterprises are behind the level of usage of large companies, where 26% reported using Voice-over-IP services. Curiously, the reported usage of this technology by the medium-sized firms is lower than that from the micro enterprises. It can be expected, in general, that usage will increase rapidly over the next few years; a common scenario predicts that all fixed network voice telephony might be converted to internet protocol.

[59] The public switched telephone network (PSTN) is the network of the world's public circuit-switched telephone networks, in much the same way that the Internet is the network of the world's public IP-based packet-switched networks. Originally a network of fixed-line analog telephone systems, the PSTN is now almost entirely digital.

3.2 ICT skills, outsourcing and ICT budgets

As ICT has become such an important element in the working lives of many European citizens, so has the demand for ICT-related skills. Improving e-business skills, especially among SMEs, has been identified as a relevant concern for policy in several *e-Business Watch* sector studies.[60] In particular in sectors where processes are increasingly supported and managed by ICT systems, for example in large logistics companies, the percentage of employees that uses ICT in its daily work routines has increased. The competitiveness of European industry is dependent on both the effective use of ICT for industrial and business processes and the knowledge, skills and competences of existing and new employees. The raising of ICT skills within the EU will form part of the means by which the challenging Lisbon objectives (for Europe to become *"the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth, with more and better jobs and greater social cohesion"*)[61] are to be achieved.[62]

Acquiring, generating, and exploiting knowledge are increasingly key determinants of success for enterprises and individuals in a knowledge-based economy. The development of human capital, research and adaptation of new knowledge and skills is the source of growth in the competitiveness of the economy, labour force and in the quality of life. As it will be presented later (Chapter 4), capital-intensive investment is only profitable in the TLS sector only if the workforce has the skills and capacities to make effective use of the ICT capital stock. e-business and ICT skills (e-skills) are thus fundamental for the further enhancement and development of knowledge-intensive products and services, especially in the TLS sector. e-business applications is increasing the demand for individuals with creativity and higher-level conceptual skills that will enable enterprises to increase productivity and harness ICT to produce greater economic value. The econometric analysis presented in this report using the EU KLEMS database shows that in the transport and logistics industries, high-skilled labour is more important than either medium- or low-skilled labour for productivity increases (see Section 4.1).

To a large extent the demand comes from SMEs, which often face substantial difficulties in attracting qualified ICT and e-business professionals in competition with larger players which absorb most of the available expertise.

3.2.1 Demand for ICT skills and skills development

Employment of "ICT practitioners"

The e-Skill Forum, established by the EC in March 2003, defined, in the one hand, *ICT practitioner skills* as the "capabilities required for researching, developing and designing, managing, producing, consulting, marketing and selling, integrating, installing and administrating, maintaining, supporting and service of ICT systems" and, in the other

[60] For example, see: e-Skills for Europe: Towards 2010 and Beyond (2004), http://ec.europa.eu/enterprise/ict/policy/doc/e-skills-forum-2004-09-fsr.pdf

[61] See: Lisbon European Council, Presidency Conclusions, http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/00100r1.en0.htm

[62] CEN Workshop Agreement, (2006), European ICT Skills Meta-Framework, ftp://ftp.cenorm.be/PUBLIC/CWAs/e-Europe/ICT-Skill/CWA15515-00-2006-Feb.pdf.

hand, *ICT user skills* as the "capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the utilisation of common generic software tools and the use of specialised tools supporting business functions within industries other than the ICT industry".[63] There are companies - usually medium and large-sized firms - that can afford employing ICT practitioners, while small companies usually do not employ practitioners. This fact is corroborated in the TLS present study.

Exhibit 3.2-1 below shows that one third of medium-sized firms have specialists for ICT tasks; among large firms, this proportion rise: two of three companies employ practitioners. Less than 10% of micro- and small-sized firms employ practitioners.

Exhibit 3.2-1: Demand for ICT skills and skills development

Transport & logistics sector (TLS)	Companies employing ICT practitioners		Average number of ICT practitioners employed		Companies having outsourced ICT services		Companies saying that e-business developments have a significant impact on skills requirements	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**35**	**8**	**6**	**2**	**56**	**45**	**45**	**33**
Passenger transport	45	7	(7)*	(1)*	56	40	52	36
Freight transport	25	7	4	2	50	41	34	31
Logistics	46	12	7	1	65	60	60	38
TLS – by size								
Micro (1-9 empl.)		7		(-)**		43		33
Small (10-49 empl.)		9		(2)*		51		30
Medium (50-249)		33		3		72		49
Large (250+ empl.)		66		8		66		61
TLS – by country								
Germany	35	10	(11)* *	(2)* *	62	32	50	15
Spain	23	9	(4)* *	(3)* *	41	24	51	23
France	31	4	(4)* *	(2)* *	53	31	31	18
Italy	47	7	7	(1)*	73	77	43	27
Poland	17	7	4	(2)*	38	31	65	59
Sweden	45	11	8	(2)*	61	30	42	18
United Kingdom	42	8	4	(1)*	61	30	38	15
USA	14	10	(3)* *	(3)* *	38	36	46	25
Base	all firms		companies with practitioners		all firms		all firms	
N (TLS EU-7+ USA)	1097		212		1097		1097	
Questionnaire reference	E1		E2		E3		E5	

* Percentage only indicative, due to small number of observations (n = 25 – 50)

** Percentages not displayed because they are based on a very small number of observations (N<25).

Source: Sectoral e-Business Watch (Survey 2007)

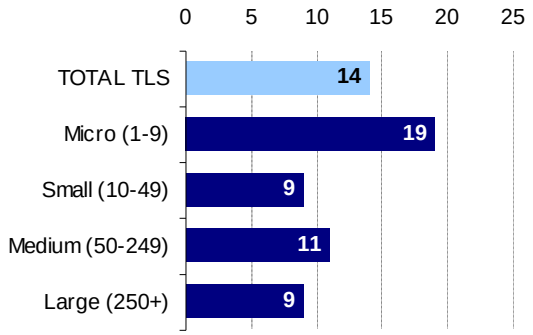
Based on the data from the TLS SeBW Survey 2007, where companies were asked if their product or service innovations introduced by the company in the last 12 months

[63] Cf. e-Skills For Europe: The Way Forward", Synthesis Report by the e-Skills Forum, September 2004.

were directly related or enabled by ICT technology, a probit regression was run in the present report (see section 4.3.1) in order to test the relationship between ICT-enabled innovation and the share of employees with an university degree. The result leads to the conclusion that changes in share of employees with a higher university degree positively affect the likelihood of conducting ICT-enabled innovations

According to the survey, about 14% of the workforce in the TLS industry has a college or university degree. The share is highest (about 20%) among micro-firms (Exhibit 3.2-2). However, at the same time, an important conclusion arises from the test: employing IT practitioners significantly increased the company's propensity to use ICT to develop new products and services. Again, large companies in the sector are thus in a better position to conduct innovation processes than micro and small companies.

Exhibit 3.2-2 Average percentage of employees with a college/university degree (by firm size)



Source: Sectoral e-Business Watch (Survey 2007)

It is estimated that there are 4.2 million ICT practitioners within the EU and that approximately 180 million people are using ICT at work.[64] According to a Cedefop study released in 2004, the number of ICT practitioners in Europe is estimated to reach 5.1 million by 2010. The total demand for ICT practitioners in Europe has been roughly estimated at about 0.23 million persons per year including replacement demand.[65] The sectoral survey on e-business in 2006 reported that enterprises are anticipating skills shortfalls for ICT practitioners, particularly in ICT strategy, security and new business solutions.[66]

ICT training for employees

Obtaining e-skills is not a one-off event – the speed of technological change requires that skills need continually to be kept up-to-date and relevant. The need to maintain and continuously upgrade e-skills stems from technological change an increasingly from Internet-enabled global sourcing.

Employers are now less likely to see training just as a cost but also as an investment. They also recognize that it is not enough to just have IT workers who are trained in one set of skills; rather workers must be constantly engaged in learning and upgrading their skills profiles. About one third of the TLS companies (representing 45% of the sector workforce) said that e-business developments have a significant impact on skills requirements. While 33% of micro enterprises with up to 9 employees confirmed this asseveration, it is true for 61% of large-sized firms (see Exhibit 3.2-1)

64 CEPIS, "Thinking Ahead on e-Skills for the ICT Industry in Europe", February 2007.

65 Cedefop 2004 (editor): Towards a Comprehensive European e-Skills Reference Framework: ICT and e-business skills and training in Europe, Final Synthesis Report, authors: Willi A. Petersen, Meter Revill, Tony Ward and Carsten Wehmeyer (Flensburg University, Germany and York University, UK).

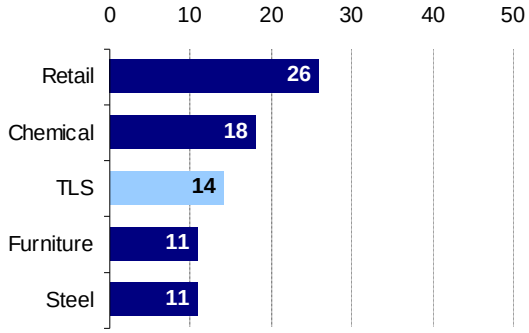
66 e-Business Watch Survey 2006.

The delivery of e-skills training can benefit from the development of work-based training concepts and innovative new education and training channels including e-learning. In many areas this is aided by the proliferation of distance learning technologies. These new forms of partnerships and flexible approaches need to be much more actively promoted.[67]

In a knowledge economy driven by rapid technical change, investments in high-skilled labour, training and skill-formation become more important than investments in ICT. The intelligence and skills of ICT users determines the positive or negative impact that ICT investments may have on the success of the TLS business (see Section 4.1).

In terms of policy implications it has to be said therefore, that managers in the TLS industry should pay more attention to the needs of the workforce training and skill-formation for the optimal use of the ICT technical equipment. 14% of the TLS workforce with university or college degree (Exhibit 3.2-3) represents a higher value of high-educated employees compared to other sectors included in the 2007 e-Business Watch Sectoral studies (Steel 11%; Furniture 11%), but behind the Chemical sectors (18%) and Retail (26%).

Exhibit 3.2-3 Employees with university degree (by sectors)



Source: Sectoral e-Business Watch (Survey 2007)

3.2.2 Outsourcing of ICT services and ICT investments

Outsourcing

Outsourcing is considered a useful way to provide immediate ICT and e-business skills and processes that a company needs with very little investment of time, money and training. As more of the routine operational tasks of a company become automated, the task of turning them over to providers becomes easier and more economical. As Internet commerce grows in popularity and importance, companies are finding that designing, developing, and maintaining cutting edge Web-sites and e-business applications is increasingly time consuming and expensive. In response to this development, a new breed of outsourcing services are being introduced to managing high-volume Web sites and their interactivity. For these companies, outsourcing is an organisational innovation which has a very important impact on firm-level productivity.

In this study, firms were asked whether they had outsourced any of their ICT services, which had previously been conducted in-house, to external service providers in 2007. Focussing on core competencies by outsourcing non-critical activities to specialised providers is a general trend in the TLS industry, with about 45% of companies having

[67] COM (2007) 496 final, E-Skills for The 21st Century: Fostering Competitiveness, Growth And Jobs.

outsourced some services in 2007, whereby medium and larger companies generally tend to outsource more of their services (66%) than smaller-sized ones (43%) (see Exhibit 3.2-1). Interestingly, this share is higher for medium companies (72%) compared to large-sized firms (66%). The small share of micro and small CE enterprises saying that they employ ICT practitioners can be explained by the fact that it seems to be more economic for smaller companies to outsource ICT services (e.g. desktop management or web hosting) than to employ their own ICT practitioners. The case study *AIT* (France) confirms this observation (Section 5.2). The choice of a small company as a solution provider allows the AIT to achieve great benefits.

Although outsourcing is often considered to be driven exclusively by the search for ever-lower costs, the reality is more complex and different elements, including non-cost related factors, are among the driving forces for ICT service outsourcing, including the business function involved, company size and structure, and the specific situation in particular labour market segments and national or regional contexts.

Concerning countries, Spain shows the lowest average of firms having outsourced any ICT services to external service providers (only 24% of sectoral firms, see Exhibit 3.2-1), which do not mean, however, that there are more companies employing ICT practitioners (only 9% of companies do so, very close to the 8% for the EU-7 studied countries. These results are congruent with the obtained value related to technical efficiency (Chapter 4, Figure 4.1-3) which is the lowest (0,83) for the Spanish TLS industry in comparison with the other analysed countries,[68] all other technical efficiency values lying somewhere between 0,92 and 0,98. On the other hand, Italy, having the highest percentage outsourcing any ICT service (77%, Exhibit 3.2-1), shows also the highest value in technical efficiency (0.98) among all studied countries.

ICT expenditure and investments

There is consensus that EU faster growth during the last decade has been related to higher investments in ICT. The highest performing countries have been those that have been more innovative in ICT products and services and more active in adopting such innovations in other sectors of the economy, in particular in the service sectors.[69]

Although this asseveration is true in general, it has to be pointed out that ICT investments does not lead to productivity growth at firm-level by itself (it depends on how the technology is actually used in business processes to innovate work processes and business routines with support of ICT). Complementary investments in human capital, organisational changes and working practices, combined with ICT investments will have an impact on firm performance.

About 30% of all firms planned to further increase their ICT budgets in 2008, compared to the current budget. Only about 2% say that they will reduce their budgets. The remaining two thirds said that they would maintain their current level of spending. The ICT

[68] Technical efficiency is a measure to determine the relative distance of a country's industry from the stochastic possibility frontier. A value of 1,0 is equal to full efficiency, whereas values below measure the inefficiency in percentage points of industry production being below the industry's possibility frontier at a certain period of time (see Section 4.1).

[69] Strohmeier R. (Speech) ICT and innovation in a globalised economy, YES event, European Parliament, Brussels, 24 November 2006.

investment behaviour in the TLS sector appears, in general, more intensive than in other sectors studied: more than a half of TLS companies (56%), representing more than three quarters of the sector's employment, said that they have invested in ICT in 2007– more than the average of the 10 sectors studied in 2006 by the *e-Business W@tch* (50%).

Exhibit 3.2-5 ICT budgets and investments

Transport & logistics sector (TLS)	Companies expecting that their ICT budget will … in the forthcoming financial period						Companies which made investments in ICT hardware or networks during the past 12 months	
	… increase		… decrease		… roughly stay the same			
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**33**	**30**	**3**	**2**	**59**	**65**	**76**	**56**
Passenger transport	27	29	1	1	70	67	76	56
Freight transport	34	28	3	2	58	68	72	53
Logistics	34	37	5	5	53	56	82	68
TLS – by size								
Micro (1-9 empl.)		30		2		65		55
Small (10-49 empl.)		26		2		68		63
Medium (50-249)		32		3		63		81
Large (250+ empl.)		37		4		53		92
Base	all firms		all firms		all firms		all firms	
N (TLS EU-7+ USA)	1097		1097		1097		1097	
Questionnaire reference	E6a		E6b		E6c		E9	

* Percentage only indicative, due to small number of observations (n = 25 – 50)

** Percentages not displayed because they are based on a very small number of observations (N<25).

Source: Sectoral e-Business Watch (Survey 2007)

3.3 Standards and interoperability

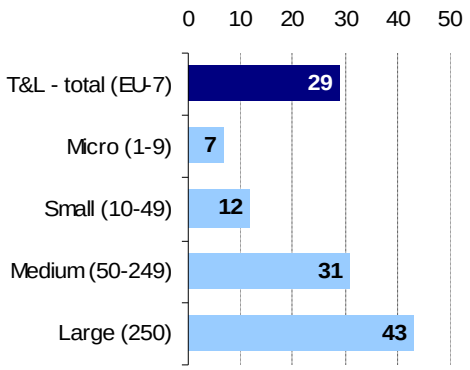
3.3.1 Types of e-standards used

Electronic Data Interchange (EDI) is a set of standards[70] for structuring information that is to be electronically exchanged between and within businesses, organisations, government entities and other groups. The standards describe structures that emulate documents, for example purchase orders to automate purchasing. The term EDI is also used to refer to the implementation and operation of systems and processes for creating, transmitting, and receiving EDI documents. Despite being relatively unheralded, in this era of technologies such as XML services, the Internet and the World Wide Web, EDI is still the data format used by the vast majority of electronic commerce transactions in the world. The problem with EDI is that it does very little to improve and automate business processes to effect real business change. While EDI is able to automate many fundamental business transactions such as a purchase order, or an invoice, the

[70] A 'standard' is "a technical specification approved by a recognised standardisation body for repeated or continuous application", Directive 98/34/EC of the European Parliament and the Council of 22 June 1998, available at: http://www.anacom.pt/streaming/98_34_EC.pdf?categoryId=94579&contentId=159752&field=ATTACHED_FILE.

technology is very message centric, as opposed to understanding a more complicated business "dialog" or process flow.

Exhibit 3.3-1: Use of EDI-based standards



Data for TLS total weighted by employment (read: "firms representing x% of employment"), data for size-bands in % of enterprises.

Source: Sectoral e-Business Watch (Survey 2007)

Figures related to the TLS sector shows (Exhibit 3-3-1) that about a third of medium-sized companies and more than 40% of large firms report that they use EDI. Only 7% of micro companies and 12% of small companies use EDI-based standards. Thus, the size of a company has an enormous influence on the adoption of standards: The smaller the company, the more unlikely it is that it adopts any of these standards; the larger the company, the more likely it is that it uses one of these standards. It looks like EDI based standards will continue to play an important role for e-business messaging in TLS industries in the near future.

For e-business, ebXML[71] is the most important standard within this group. ebXML is a single set of internationally agreed technical specifications and common XML semantics to facilitate global trade. The widespread adoption of XML as a common data language is giving B2B integration the critical mass it needs for rapid growth. B2B standards built on XML will accelerate this adoption and tightly integrate companies within specific vertical industries and around common well-defined business processes. The ebXML framework for e-business is a joint initiative of UN/CEFACT and OASIS.[72] The initiative started in November 1999 with the aim to "enable anyone, anywhere to do business with anyone else".[73]

Variations and inconsistencies in the International standards, rules and regulations that govern logistics add costs to the supply chain and create impediments to the efficiency and quality of service to customers. The impact of these limits and difficulties are steadily increasing as logistics operations become multimodal and supply-chain focused. The need for standards creates an imperative for various firms to work together to develop, establish, endorse, and promote those standards.

3.3.2 Interoperability challenges

Within the last years e-business has increasingly gained importance. e-business presents both opportunities and challenges for the TLS sector: opportunities to improve service,

[71] ebXML: electronic business using eXtensible Markup Language.

[72] See www.ebxml.org.

[73] For detailed information about the background and adoption of XML and ebXML, see *e-Business W@tch* Special Study on "e-Business Interoperability and Standards" (September 2005), available at www.ebusiness-watch.org.

increase productivity and reduce cost, and challenges as it creates new supply chain requirements and capabilities and new marketplaces with particular demands. Managing the supply chain — all the firms and processes involved in producing and delivering a product — involves planning, execution and control of these processes to deliver products at the lowest cost. At the same time, the need to be responsive to customer demand — just in time delivery, make to order manufacturing systems, and so on — results in the movement of smaller quantities of goods more frequently.

Transportation has a significant influence on the speed and reliability of the order cycle and the quality of the customer experience. As critical supply chain members, transportation suppliers must be able to function as partners, to produce, share and manage information and to provide higher levels of service in terms of speed and reliability. They have to be able to trace and track shipments under their control and make the information readily accessible to customers or supply chain partners. Transportation or logistics services companies, providing real-time information in a customized way, can become an integral part of their customers' supply chains, creating the opportunity to secure long-term business by embedding their processes in those of their customers and adding value beyond traditional transportation and logistics offerings.[74] e-Business technology enables logistics and supply chain managers to meet these demands by integrating systems, collaborating within and across firms, and sharing information throughout the supply chain, enabling supply chain participants to plan and synchronize their processes.

Interoperability refers to the "ability of two or more systems to exchange data, and to mutually use the information that has been exchanged."[75] Especially the interoperability of systems became an important factor within this area since it is often necessary to exchange information between heterogeneous information systems.[76] Standards such as ebXML can help by simplifying this process. They promise a flexible coupling of heterogeneous systems. Behind these powerful new tools is a myriad of standards and standards development organisations, some proprietary and others more open. All are seeking their rightful place in the emerging Business Interoperability Frameworks.[77]

A good example of the European Commission efforts in the interoperability challenge in the transport sector is the project "*Interoperability of Electronic Road Tolling Systems and related services in the EU and EFTA".*[78] The objective for the project is to make a finalised standard on "Application interface definition for Electronic Fee Collection (EFC) based on Global Navigation Satellite Systems and Cellular Networks (GNSS/CN)". The standard will provide the main technical requirement for the achievement of interoperability. Another example of interoperability efforts is the Im@gine-IT project (as a

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74 The Impact of E-Business on Transportation. Canada Transportation Act Review, Final Report.

75 Definition by IEEE and ISO, cf. *e-Business W@tch* (2005) Special Study on "e-Business Interoperability and Standards". A Cross Sector Perspective and Outlook*.*

76 In the context of information systems, heterogeneity means that the systems are somehow different from each other. Two heterogeneous systems are difficult to integrate and hence, they are said to have low interoperability.

77 According to the European Interoperability Framework for pan-European eGovernment services, an Interoperability Framework can be defined as the overarching set of policies, standards and guidelines which describe the way in which organisations have agreed, or should agree, to do business with each other (see e-Business Interoperability and Standards. A Cross-Sector Perspective and Outlook, e-Business W@tch Special Report, 2005).

78 Technical Committee 278 (2007) "*Road Transport and Traffic Telematics",* Open Call for Project Team Experts: http://www.cen.eu/cenorm/tc278.pdf.

part of Projects in the field of 'ICT for Transport' funded under the 6th Framework Programme), related to mobile personal assistance for travel information, published by ICT Results[79] (see business example).

Business example:

Mobile personal assistant for travel information (Im@gine-IT)

A mobile, personal access device providing location-based transport information, mapping and routing, navigation and other related services anywhere in Europe has been successfully pilot tested at five European sites. Existing travel and transport information services often lack data outside a limited range of general facts. In addition they tend to employ a variety of user interfaces and service delivery platforms. This limited content and lack of standardisation have been major limiting factors in their attraction to users, inhibiting the wider spread of useful, real-time location-based information services.

Participants in the IST-funded IM@GINE-IT project (www.imagineit-eu.com) aimed to overcome such limitations by developing a platform that had to function in real-time, offer multimedia, intermodal transport information, and take account of the personal preferences of the user. IM@GINE-IT will end in June 2006, having built defined system architecture, a data management module and a localisation algorithm, as well as having developed information services for multimodal forms of transport. That the participants have largely achieved their aims is a credit to the cooperation between the various partners involved, as well as to a successful blend of major private companies and public institutions.

The IM@GINE-IT personal assistant is a small additional piece of software that will run on any mobile device, be it a mobile phone, mobile PC, PDA or in-car system. By communicating with Web-based services hosting the relevant information, the IM@GINE IT device offers an integrated route-guidance system which combines in-vehicle, pedestrian, public transport and public building route guidance modules. Transport advice is multi-modal, covering car, bus, train, metro, tram, ship, airplane, airport facilities and even tourist information kiosks.

The system has been tested by around 100 users at five European sites in Finland, Germany, Italy, Greece and Hungary.

Sources: ICT Results: Mobile personal assistant for travel information, http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/id/81610;

IM@GINE IT website: www.imagineit-eu.com)

Although this business example shows a well managed and successful initiative, there is still a lot of scope for new implementations concerning interoperability issues in the TLS sector. Other projects, like INTEROP FP6 Network of Excellence[80] and ATHENA FP6

[79] *ICT Results* (2006). *ICT Results* is an editorial service created for the European Commission to showcase EU-funded ICT research and activities. *ICT Results* features online news and analysis on the emerging results from information and communications technology research.

[80] INTEROP-VLab is the "European virtual laboratory for Enterprise Interoperability", INTEROP-VLab is stemming from the Network of Excellence INTEROP-NoE (Interoperability Research for

Integrated[81] project have been initiated in Europe which focuses on methods to encourage and enable implementation of e-business standards and interoperability by and for SMEs.

3.3.3 Use of Open Source Software

The open source model

Open source software (OSS) is computer software which source code is available under a license (or arrangement such as the public domain). This permits users to use, change, and improve the software, and to redistribute it in modified or unmodified form. Open source is frequently cited as one of the most important movements in modern software creation. Related projects are supported by the European Commission[82] and almost every further and higher education institution makes use of open source software. The promise of open source is better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in. Open source licenses define the privileges and restrictions a licensor must follow in order to use, modify or redistribute the open-source software.

OSS includes software with source code in the public domain and software distributed under an open-source license. It is often developed in a public, collaborative manner and is the most prominent example of open source development and often compared to user generated content. The cost of immediate acquisition to the end-user is usually minimal; this is because the right to freely redistribute the software makes selling licences for copies of open source software an unlikely business proposition.

The following research example shows the possibility of OSS in the logistics field: the Open Source Warehouse Management System, developed at *Fraunhofer-Institut für Materialfluss und Logistik* in Dortmund, Germany:

MyWMS- The Open Source Warehouse Management System

Modern Warehouse Management Systems (WMS) have to operate quite a number of different interfaces, consider restricted storage strategies, minimize transport routes and times, support different kinds of stocktaking and many other things. Despite of existing standards, e.g. VDI or FEM which cover partial fields, there are no generally accepted standards for WMS. The suppliers of WMS have to use their own, often limited development capacities to their activities. Because there are no generally accepted interfaces, they often have no possibility to purchase external module - for example for the optimisation of trips, for the prohibition to store goods together or for the optimal

Networked Enterprise Applications and Software, FP6 508011), coordinated by University Bordeaux 1 with 47 partners and more than 300 researchers.

[81] ATHENA Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications - is an Integrated Project sponsored by the European Commission in support of the Strategic Objective: Networked businesses and government set out in the IST 2003-2004 Work programme of FP6.

[82] The European Commission has taken several strides towards encouraging the development of open source software. In October 2006, it granted €3m towards a project, called SQO-OSS, to test the quality of open source software. And just days before, the Commission extended its open source web portal, the Open Source Observatory, (http://ec.europa.eu/idabc/en/chapter/452) to develop interoperability between applications.

distribution of weight. To solve the present problems – classical standardisation methods with their long iterative finding, identification and appeal processes seldom offer the quick solution, the pragmatic approaches and the universality which are required in practice.

Open Source development

Another approach which has already been implemented successfully in many projects is based on openness and transparency and parallelizes some of the above mentioned processes. The keyword is “Open Source”: disclosure of all documents and the source codes of a software project as well as a permanent communication between all participants. This makes the interface specifications, the system architecture and the data models available to everyone.

The WMS can also benefit from such a development style. Such project is presently being developed at the Fraunhofer-Institut für Materialfluss und Logistik in Dortmund: *myWMS,* the Open Source Warehouse Management System. This system is designed with modern software technologies and tools with the aim to create a widely accepted WMS with well-defined interfaces and data models. *myWMS* will be object oriented and coded in the programming language JAVA. Free software products will be used for the development and operation. LINUX, for example, will be the preferred operating system and PostgreSQL the preferred database. The complete user interface is browser-based, i.e. it uses the common web browsers. This allows for the use of existing network structures and inexpensive personal computers with almost any operating system as workplace computer.

The first level includes a core system with the inventory management, the master data management and the possibility to enter and process storage and retrieval orders. For practical use *myWMS* has to support concrete interfaces to ERP-systems and the conveyors. For this purpose, corresponding programme modules will be developed and saved in a driver library. The further development of *myWMS* includes a coupling to ERP-systems, an extension of the supported conveyor elements, the integration of simple storage strategies and the optimisation of and coupling to an e-shop. The interface to SAP-systems will be certified for *myWMS.*[83]

Deployment of Open Source Software

Deployment of open source software should follow the same pattern of evaluation of needs, testing, and acquisition from a supplier and so on as would be used with proprietary software. The cost of deploying and supporting software, whether open source or closed source, is very often much higher than the simple cost of licence acquisition, and will often be the principal component of the total cost of ownership.[84]

There are clearly a number of Open Source products that can offer a fast return on investment, because they are genuinely excellent software products and the support is acceptable. In comparison with proprietary software OSS is more inexpensive in acquisition and use (total costs of ownership), also because the direct and indirect maintenance costs are significantly lower. By integrating open standards in designs and other

[83] Available at: www.mywms.org/export/sites/default/introduction/downloadGallery/myWMS_Beschreibung_EN.pdf.

[84] Joint Information Systems Committee (JISC), (2006) Open Source Software briefing paper, http://www.jisc.ac.uk/publications/publications/pub_ossbp.aspx.

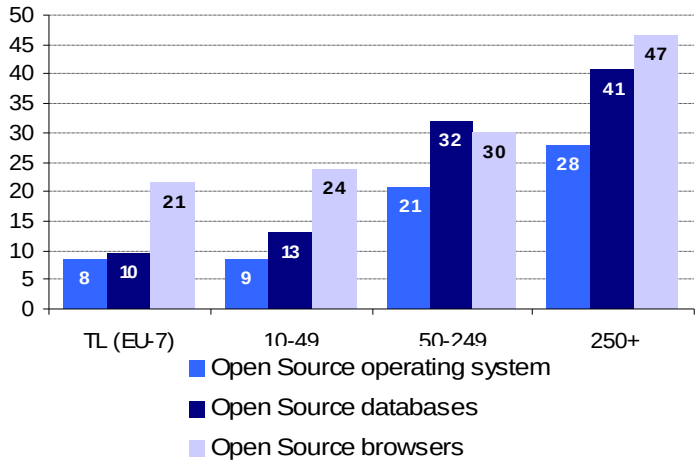
applications and platforms OSS heightens the efficiency of which ICT-applications are developed.

The availability of the source code supports a high innovation grade, next to more efficient maintenance of the software which will result in a more effective effort by ICT experts. The cost is very low, but it has to take into account the learning curve and the cost of deployment and also the potential impact on the rest of the software that they are expected to integrate with. OSS doesn't exclude the use of proprietary "closed source" software. The owner of a closed system can let his programme cooperate with open-source software; after all he has access to the complete source. The opposite - closed source code, not able to cooperate with other programs - is more common than an exception in the world of modern IT. Frequent implementation of OSS within companies improves interoperability of computer systems and with that the strategic strength.

A recent research has found that almost 40% of European companies already use some type of open source software, and a further 8% reported plans to pilot it during 2006. Web server and server operating systems are the top two areas, with two-thirds of firms using alternatives like Apache, Tomcat, or Linux.[85] The e-Business Watch 2007 sectoral study confirmed that operating systems (including Linux) based on OSS are widely used by large companies (nearly 50%).[86]

Exhibit 3.3-3 shows that for the TLS industry the use of OSS clearly increases by firm size: more large companies use OSS than small companies. In particular, internet browsers (including Mozilla and Firefox) based on OSS appear to be widely used by companies from the TLS industry (21%). Among the large sized firms, about 47% say that they use OSS browsers. Special emphasis should be put on the deployment of OS Software in micro and small enterprises which constitute the vast majority of TLS companies.

Exhibit 3.3-3: Companies using Open Source Software



Base (100%): Companies using computers. N (for sector, EU-7) = 997. Weighting: Totals (for the sector and for all 7 sectors) are weighted by firms. Figures for size-bands are in % of enterprises from the size-band.
Questionnaire reference: A13a, A13b and A13c

[85] Forrester Research, Inc. (2005). "Is Open Source Gaining Adoption In Europe?" http://www.forrester.com/Research/Document/Excerpt/0,7211,38061,00.html.

[86] See e-Business Watch (Survey 2007).

Source: Sectoral e-Business Watch (Survey 2007)

In addition to the possible cost savings of using OSS that can be essential for SMEs, OSS provides a number of attributes that favour SMEs. One of them is the ability to adapt software for local needs. Proprietary software companies are usually global, concentrated in a few parts of the world. This is the nature of the software market, which, thanks to network effects and proprietary standards tends towards natural monopolies.[87] Also, as is the case in the TLS sector, many large corporations are now deploying Open Source products at the heart of their IT, but doing so in a considered and responsible way.[88]

Digital signature

In cryptography, a **digital signature** or **digital signature scheme** is a type of asymmetric cryptography used to simulate the security properties of a signature in digital, rather than written, form.[89] Digital signatures use what is known as "public key cryptography" (PKI), which employs an algorithm using two different but mathematically related "keys": one for creating a digital signature or transforming data into a seemingly unintelligible form, which involves the user's secret or private key, and another key for verifying a digital signature or returning the message to its original form which involves the user's public key. The output of the signature process is called the "digital signature". A digital signature can be used with any kind of message, whether it is encrypted or not, simply so that the receiver can be sure of the sender's identity and that the message arrived intact.

The prospect of fully implementing digital signatures in general commerce presents both benefits and costs. The costs consist mainly of:[90]

- **Institutional overhead:** The cost of establishing and utilising certification authorities, repositories, and other important services, as well as assuring quality in the performance of their functions.
- **Subscriber and Relying Party Costs:** A digital signer will require software, and will probably have to pay a certification authority some price to issue a certificate. Hardware to secure the subscriber's private key may also be advisable. Persons relying on digital signatures will incur expenses for verification software and perhaps for access to certificates and certificate revocation lists in a repository.

On the plus side, the principal advantage to be gained is more reliable authentication of messages. Digital signatures if properly implemented and utilised offer promising solutions to the problems of:

- **Impostors**, by minimising the risk of dealing with impostors or persons who attempt to escape responsibility by claiming to have been impersonated;
- **Message integrity**, by minimising the risk of undetected message tampering and forgery, and of false claims that a message was altered after it was sent;

87 UNU-MERIT, (2006). Economic impact of open source software on innovation and the competitiveness of the Information and Communication Technologies (ICT) sector in the EU. Final Report. http://ec.europa.eu/enterprise/ict/policy/doc/2006-11-20-flossimpact.pdf.

88 Bloor R. (2005). Open Source: Revenge of the Nerds, IT DIRECTOR.

89 Wikipedia, http://en.wikipedia.org/wiki/Digital_signature.

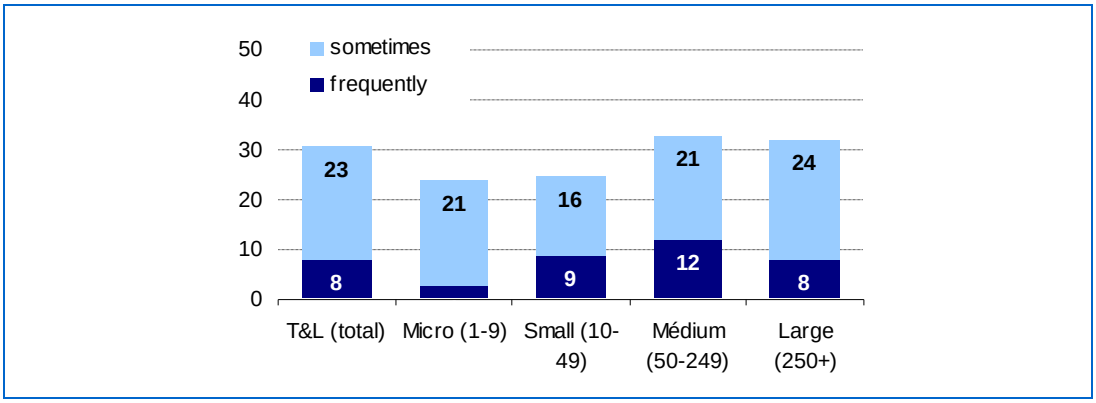
90 American Bar Association Section of Science and Technology Information Security Committee

- **Formal legal requirements**, by strengthening the view that legal requirements of form, such as writing, signature, and an original document, are satisfied, since digital signatures are functionally on a par with, or superior to paper forms; and
- **Open systems**, by retaining a high degree of information security, even for information sent over open, insecure, but inexpensive and widely used channels.

In logistics, for example, where identifying and tracking vehicles is of major importance, combining the successful technologies of digital signatures and the Global Positioning System (GPS) allows the secure identification of any car and checking its location. Both types of information can improve the fleet management and offer new fields of applications for both the private and the public sector.

In the TLS industry, only 4% of firms (representing 8% of employees) reported the use of digital signature frequently, while 20% said to use that technology sometimes. Interestingly, the percentage is very similar for the different size classes of TLS companies when it is used sometimes.

Exhibit 3.3-4: Percentage of firms using digital signature sometimes / frequently (2007)



Source: Sectoral e-Business Watch (Survey 2007)

In 2006, e-*Business W@tch* had asked companies whether they had *"rules that specify the use of digital signature or Public Key Infrastructure"*, as part of a question on the use of ICT security measures. In total, about 15% of firms (accounting for 21% of employment) reported that they had such rules. Figures shown in Exhibit 3.3-4 appear to be slightly higher to the 2006 SeBW survey.

3.3.4 Deployment and implications of RFID technology

Factors determining the use of RFID in the TLS industry

The current business environment requires that companies cut inventory and operational costs, and optimise supply chain management (SCM). The resultant savings translate into innovative and cost-effective solutions that attract customers. One such measure is the use of RFID. In transport and logistics, RFID is expected to contribute to improved efficiency and security, and provide new quality services for mobility of people and goods. Using RFID, companies can track and monitor goods without scanning them using bar code scanners. Thus, RFID Technology and Systems RFID can be viewed as a competitor to the barcode, or a more advanced technology than the barcode. This technology streamlines warehouse management systems, encouraging its adoption and that of other SCM solutions.

As the use of RFID touches a wide range of policy issues, including spectrum policy, privacy, food and drug safety, identity cards, biometric passports, e-payments, e-procurement, counterfeiting, homeland security, and environment, the European Commission has launched a wide-ranging public consultation on the policy issues and possible concerns raised by the deployment of RFID technology and its applications.[91]

In practice, although the technology is not new, the applications are very much at an exploratory stage. Interest exists across many sectors, and trials are underway across Europe. It is an enormous step to move from the present market to one where RFID is ubiquitous, but there are clear signs that the market is moving. [92] A more widespread RFID deployment could strengthen the role of ICT in driving innovation and promoting economic growth. In the transport industry, RFID systems have the inherent capacity to assist in vehicle identification, tracking and tracing and thereby enhance both economic efficiency and security. RFID systems are playing a role in increasing load factors and hence reducing empty running. They have the potential to make better use of the infrastructure, help increase use of alternative modes, enhance enforcement and facilitate road charging.

In logistics applications, RFID enables service providers and forwarders to better track and trace consignments on the different legs of transport processes. Intercontinental container shipping provides a good example for the value of reliable tracking and tracing: very often more than 20 different companies need to cooperate in transport of one single container. Railway operators suffer from poor monitoring of their wagons, which are spread across the rail network. By tagging not only packages and consignments but also transport units and vehicles with RFID technology, the asset management of these transport operators can be improved.

The costs for ticketing in the public transport sector still has a high share of the ticket price due to the costs for ticket production, distribution, fee collection and money management. Using RFID technologies for **ticketing** in **public** transport will not only lower transaction handling costs and reduce fare dodging, but open new service

[91] European Commission (2007). Information Society and Transport: Linking…*ibid.*

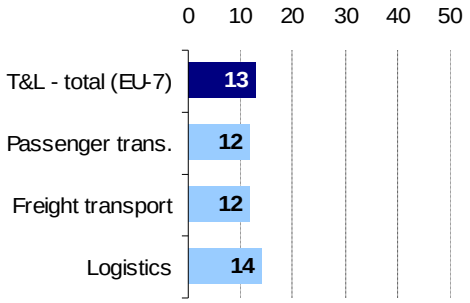
[92] IDTechEx Ltd. (2004) RFID Logistics Case Studies - Thirty detailed RFID logistics case studies.

opportunities for public transport companies and strengthen their competitiveness in the transport market.[93]

Several large European enterprises, including technology companies and service providers, are at the forefront of bringing RFDI solutions to the market and many small- and medium-sized enterprises have successfully introduced this technology. Current trends and forecasts indicate that the RFID market will grow fast in the next 10 years. Although RFID technology was proven and tested in the past 3 years under a huge variety of operational conditions, environments and applications, enterprises that commit to the RFID journey are and will still be facing some challenges that need to be overcome as to lower implementation risks and consequently maximize investment returns. As an example, while the European Commission, ETSI, industry associations and commercial entities such as EPCglobal and GS1, together with local governments, large enterprises and technology vendors, continue to drive progresses towards the attainment of a global standard, work still need to be done to achieve this end-goal.

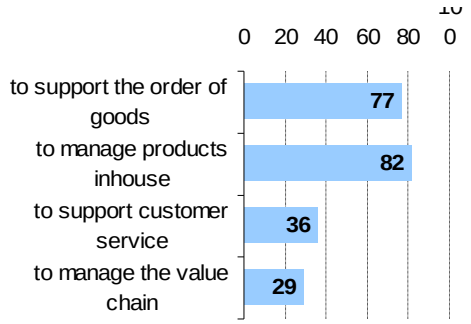
Results from the present SeBW survey show a very limited use of RFID technologies yet. Only 2% of firms (23 from a total of 1097 surveyed firms), accounting for 13% of the sector's employment (Exhibit 3.3.5), have declared that they do use this technology. By sub-sector, about 6% of the logistics firms, 1% of passenger transport firms and 1% of the freight transport companies said they used RFID. The highest percent of those firms (77%) said that they use RFID technologies to manage goods, products and services in-house. Only large firms show the higher adoption of RFID technologies (24%).

Exhibit 3.3-5: % of companies using RFID – by sub-sector



Data are weighted by employment (read: "firms representing x% of employment" in the sector).
Base: all companies.

Exhibit 3.3-6: RFID application areas (% of RFID users applying it for a given purpose)



In % of firms (out of those using RFID).
Base: companies using RFID.

Source: Sectoral e-Business Watch (Survey 2007)

Nevertheless, if the typical innovation life-cycle applies to RFID technology, a possible scenario for the TLS industry is that the technology will be adopted by medium-sized and smaller companies once it has proven successful in larger firms, and when the technology has matured and become more affordable to SMEs.

[93] Towards an RFIC Policy for Europe (2007), *RFID in Transport and Logistics,* RFID Consultation Web Site: http://www.rfidconsultation.eu/workshops/18/124.html.

3.4 Internal Process Integration

More and more the Internet is becoming a major part of the corporate environment and driving decisions. The new capabilities to use the Internet to supply large amounts of relevant information from multiple internal and external sources give the possibility to move from isolated information systems toward an integrated environment in every business organisation. Current opinion holds that Internet-based supply chain integration with upstream suppliers and downstream customers -"e-integration"- is superior to traditional ways of doing business.

True process improvements can only be achieved through automation, which implies the integration of business applications and data with the Internet and with the systems of the company's trading partners. True end-to-end process integration can offer more efficiency in virtually any business process ranging from procurement, to logistics coordination, to customer service, to development and engineering processes, and virtually any other aspect of business dialog between two entities. Improved efficiency in these core business processes leads to faster cycle times, reduced overhead, more competitive offerings, and increased visibility into business drivers.

When business process integration is ultimately achieved across an entire supply chain, or between a manufacturer and its distribution channels, the financial return dwarfs the gains realised by setting up a disjoint web front-end. The difference between the two approaches can mean taking a leadership position in the industry due to significant competitive advantage. An effective e-business solution must address the fundamental technical challenges of interoperability, communication and process management while delivering a secure, scalable and reliable solution suitable for running a company's most critical core business processes.

3.4.1 Use of software systems for internal process integration

Specific software applications for knowledge management are intended to help companies organising information that is relevant for employees in a way that they can easily retrieve and use it. A *document management system* (DMS) is a computer system (or set of computer programs) used to track and store electronic documents and/or images of paper documents. A DMS 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 in image, video, and audio, as well as in text form, to fulfil an organisation purpose. DMS may be needed in enterprises that capture and store a large number of documents such as invoices, sales orders, photographs, phone interviews, or video news clips.

To add intelligence and automation to the business process, companies began deploying ERP applications that could handle customer information, material planning forecasts, pricing information, and so on. These systems could now automatically initialize a procurement process and rely on the EDI system for the message exchange. ERP systems integrate (or attempt to integrate) all data and processes of an organisation into a unified system. A typical ERP system will use multiple components of computer software and hardware to achieve the integration. A key ingredient of most ERP systems is the use of a unified database to store data for the various system modules. Although the term ERP originated in the manufacturing environment, today's use of the term ERP systems has much broader scope. ERP systems typically attempt to cover all basic

functions of an organisation, regardless of the organisation's business or charter. ERPs are cross-functional and enterprise wide. All functional departments that are involved in operations or production are integrated in one system. In addition to manufacturing, warehousing, logistics, and information technology, this would include accounting, human resources, marketing, and strategic management.

In the TLS sector the use of ERP systems is notably low (6%), compared, for example, to most other sectors (10) studied by *e-Business W@tch* in 2006 (45%). Yet, there is still a considerable gap in ERP adoption between small firms on the one hand (14%) and the medium-sized (23%) and large firms (41%) on the other (see Exhibit 3.4-1). The relatively high implementation costs for ERP systems remain a critical challenge for SMEs. Outsourcing of ICT services could be a viable alternative to buying ones own system. Thus, this is then one of the main challenges for further expanding B2B e-business activity, because if a business partner does not have an ERP system, the exchange of data in standardised, electronic format is hardly possible.

One of the main causes regarding this situation is also that the change from the non-ERP to the ERP environment requires a considerable amount of effort for change management. This step constitutes the single most important and most difficult step for the company with regard to e-business, as confirmed interviewees for this report.

Exhibit 3.4-1 Use of e-business software systems

Transport & logistics sector (TLS)	**Companies having…**									
	… an ERP system		**… an SCM system**		**… a CRM system**		**… a software application to manage the placing or receipt of orders**		**… a warehouse or depot management system**	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**21**	**6**	**21**	**6**	**17**	**10**	**44**	**20**	**42**	**15**
Passenger transport	16	1	5	1	17	6	37	9	42	6
Freight transport	17	8	17	7	15	11	43	19	33	14
Logistics	30	4	41	6	21	11	52	35	59	25
TLS – by size										
Micro (1-9 empl.)		6		6		10		19		13
Small (10-49 empl.)		8		8		10		29		22
Medium (50-249)		23		16		22		44		45
Large (250+ empl.)		41		36		26		67		69
TLS – by country										
Germany	39	7	22	7	22	11	35	10	46	11
Spain	33	11	25	20	25	8	49	30	48	23
France	21	5	22	2	11	3	54	17	48	13
Italy	16	10	16	7	23	11	54	31	63	24
Poland	7	4	8	7	16	15	21	16	16	11
Sweden	14	2	9	2	22	3	48	17	33	10
United Kingdom	18	1	37	1	9	3	51	16	37	5
TLS - USA	**16**	**1**	**13**	**4**	**16**	**2**	**49**	**36**	**41**	**6**
Base	all firms		all firms		all firms		all firms		all firms	
N (TLS EU-7+ USA)	1097		1097		1097		1097		1097	
Questionnaire ref.	A9a		A9b		A9c		A9d		A9e	

Source: Sectoral e-Business Watch (Survey 2007)

In 2007, about a fifth of firms (representing about 44% of sector employment) in the TLS industry reported the use of software solutions or internet-based services for e-procurement (see Exhibit 3.4-1). This shows that there is a gap between the percentage of companies placing at least some orders online (41%) and those that use special software for this (20%). It can be assumed that companies without such software place orders mainly through websites or extranets of suppliers, which does not require any special e-procurement system. The digital back-office integration of procurement related processes (all the way from ordering to the receipt of goods/services) is probably not in advanced state in these cases. It is interesting to observe that the percentage of firms with special ICT systems for e-procurement is more than three times (20%) than those firms with an ERP system (6%).

SCM software can help companies from the TLS industry to match supply and demand through integrated and collaborative interaction tools. SCM provides an oversight of the flows of products/materials, information and finances, as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. SCM coordinates and integrates these flows both within and among companies. However, as can be seen from Exhibit 3.4-1, in the TLS industry 6% of enterprises representing about 21% of employment say they have an SCM system. The use of SCM systems is clearly a domain of the large firms: while only about 6-8% of SMEs said they had adopted a SCM system, about 36% of large firms did so.

Use of specific ICT solutions for TLS industry and information sources

ICT systems are critical for managing large-scale logistics operations The characteristics of the TLS industry have determined the introduction of specific ICT technologies accordingly to sectors operations. More advanced systems, for example for cargo handling and fleet control, are mostly used by mid-sized and large companies in the freight transport and logistics sectors.

Exhibit 3.4-2 shows the state of assimilation of those technologies by TLS firms.

Exhibit 3.4-2 Use of specific ICT solutions for TLS

Transport & Logistics Sector	Companies having…											
	a maintenance management system		a cargo handling technology		a fleet control system		an intermodal transportation management system		a telematics system		an ITS	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS- total (EU7)	**32**	**15**	**16**	**5**	**29**	**10**	**12**	**4**	**26**	**14**	**16**	**7**
Passenger Transport	29	18	3	0	24	3	1	0	8	6	10	2
Freight Transport	32	13	18	4	26	9	10	6	34	17	18	10
Logistics	28	20	24	8	39	17	24	2	25	12	17	1
TLS- by size (EU-7)												
1-9		14		3		8		4		13		6
10-49		23		12		22		6		27		8
50-249		34		20		35		10		34		14
250 +		47		31		43		21		35		25
TLS - by country												
Germany	30	15	26	5	40	15	11	2	45	27	20	4
Spain	49	37	32	16	29	15	20	15	28	24	18	10
France	35	15	22	4	29	10	12	1	52	34	11	3
Italy	43	14	10	7	35	10	8	7	11	7	17	4
Poland	17	15	0	0	11	7	3	2	19	16	15	13
Sweden	31	11	40	13	21	8	19	3	3	2	6	3
UK	30	14	15	3	29	6	19	1	15	3	14	3
USA	**38**	**11**	**19**	**10**	**20**	**7**	**10**	**8**	**6**	**2**	**8**	**1**
N (TLS EU-7+ USA)	1097		1097		1097		1097		1097		1097	
Questionnaire reference	A9j		A9k		A9l		A9m		A9n		A9o	

Source: Sectoral e-Business Watch (Survey 2007)

As depicted in some of the case studies presented in Chapter 5, many companies have developed a proprietary solution, making difficult to place that specific solution in one of the groups showed in Exhibit 3.4-2. However, some conclusions can be drawn from the presented data: one tenth of the TLS sector firms use a fleet control system, the rate of adoption depending again on firm's size. The less used technologies are the intermodal transportation management system (4%), a cargo handling technology (5%) and an Intelligent Transport System (7%).

In some areas, the EU companies in the sector seem to be better equipped on average than their US counterparts (maintenance management systems, fleet control systems, telematics systems and Intelligent Transport Systems, while in some other areas, US companies appear to be more active using specific software systems, like cargo handling technology and intermodal transportation management systems.

As in many other ICT technologies, Poland shows the lowest values in the adoption of some of the specific technologies for the TLS sector such as cargo handling technology and intermodal transportation management system (Exhibit 3.5-3). Surprisingly, however, it shows the highest value in the adoption of Intelligent Transport Systems and a similar

development to some other "veteran" EU countries in the adoption of technologies such as maintenance management systems, fleet control systems, telematics systems and intermodal management systems.

3.4.2 Use of ICT for cooperative and collaborative business processes

Collaboration denotes communicating and working together across organisational boundaries.[94] Virtual collaboration, on the other hand, refers to the use of ICT for supporting the collective interaction among multiple parties involved.[95] ICT tools can support the cooperation of companies in supply chain processes; both cooperation in production processes within the same link of the supply chain, and at the interface between different links. The challenge is how to re-design and integrate business processes across enterprise boundaries, so that multiple enterprises can co-operate closely to achieve shared business objectives.

From the early successes of internal application integration and the business drivers of the Internet economy to companies to more tightly integrate their processes, the next wave of business communication centres around cross-enterprise application integration, collaborative workflows, and sophisticated business process dialogs. Unfortunately many of the earlier successful technologies have been found to be lacking across company boundaries. Whereas one company can decide to adopt a proprietary messaging technology to integrate its applications internally, it is unreasonable to expect many, if any, trading partners to commit to identical messaging solutions, and certainly not if integrating with multiple partners means adopting multiple infrastructures. Future networks will be based on well founded models and theories, and generic infrastructures, and will be able to call on reliable and re-usable tools and services. In short, they will become "breeding environments" for sustainable virtual organisations (VOs).[96]

In the other hand, it has been proven that for the TLS sector that e-collaboration increases innovative output of the firms involved in that inter-organisational collaboration (see section 4.3.1). This collaborative integration enhance the innovation capabilities by providing opportunities for shared learning, transfer of technical knowledge and resource exchange.

3.4.3 Deployment of e-invoicing

The commercial invoice is the most important document exchanged between trading partners. In addition to its commercial value, the invoice is an accounting document; it

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[94] Baker, W. E. (1992). The network organisation in theory and practice. In N. Nohria and R. G. Eccles (Eds.), Networks and organisations: Structure, form, and action (pp. 397-429). Cambridge, MA: Harvard Business School Press.

[95] Hossain, L., and Wigand, R. T. (2003). Understanding virtual collaboration through structuration. *Proceedings of the 4th European Conference on Knowledge Management*, 475-484; Kock, N. (2000). Benefits for virtual organisations from distributed groups. *Communications of the ACM, 43*(11), 107-112.

[95] Porter, M. (1980). *Competitive Strategy*. New York. The Free Press.

[96] European Information Society, Thematic Portal, INFSO Projects impacting EU Policies: ECOLEAD, an integrated project under IST-FP6, is developing technologies for these networks of collaborative enterprises.

has legal implications to both transacting parties. e-invoicing is a computer-mediated transaction between a seller/invoicer (invoicing entity) and a buyer/payer (receiving entity), which replaces traditional paper-based invoicing processes.

Exhibit 3.4-3: Adoption of e-Invoicing (2007)

Transport & logistics sector (TLS)	Companies that send electronic invoices		Companies that receive electronic invoices		Companies sharing information on inventory levels electronically with business partners	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	33	25	55	46	19	4
Passenger transport	26	16	54	43	4	2
Freight transport	26	24	48	42	19	2
Logistics	52	36	66	64	32	12
TLS – by size						
Micro (1-9 empl.)		24		45		3
Small (10-49 empl.)		24		53		8
Medium (50-249)		38		63		22
Large (250+ empl.)		39		56		38
Base	all firms		all firms		all firms	
N (TLS EU-7+ USA)	1097		1097		1097	
Questionnaire ref.	B7		B8		B9	

Source: Sectoral e-Business Watch (Survey 2007)

The use of e-invoicing has increased rapidly, as this application promises enterprises a fast return on investment, also for SMEs. Currently, 25% of firms accounting for about 33% of employment in the TLS industry say they send e-invoices, and about 46% receive e-invoices (accounting for 55%of employment). Among SMEs, about 24% send and 53% receive e-invoices (Exhibit 3.4-3). This is an example confirming the overall impression arising from this survey that there is a certain alignment of most of the TLS industries as regards the state of play in e-business.

There are many different ways of processing, sending, receiving and storing invoices electronically. The intention of the EU policy regarding the facilitation of using e-invoicing in business is to diminish the risk of such transactions by introducing some uniform rules regarding e-invoicing throughout the European Union. Therefore, the EU adopted in 2001 Directive 2001/115/EC[97], often referred to as the "e-Invoicing Directive". It stipulates that the authenticity of the origin and the integrity of contents must be safeguarded by means of either an advanced electronic signature as defined in the “e Signature Directive” (1999/93/EC)[98] or by EDI.

[97] Council Directive 2001/115/EC of 20 December 2001 amending Directive 77/388/EEC with a view to simplifying, modernising and harmonising the conditions laid down for invoicing in respect of value added tax. Available at http://europa.eu.int/eurlex/pri/en/oj/dat/2002/l_015/l_01520020117en00240028.pdf (October 2007).

[98] Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures. Available at http://europa.eu.int/eurlex/pri/en/oj/dat/2000/l_013/l_01320000119en00120020.pdf (October 2007).

3.4.4 Substitution of paper-based processes

An important focus of e-business activities in the TLS industry is intended to increase the supply chain efficiency by eliminating paper-based processes as much as possible in all stages of B2B trade, thus optimising the flow of information and documents in and between companies. The implementation of new ICT-related technologies presented in all case studies contained in this report has eliminated, in a greater or lower degree, the amount of paper used. If a customer or supplier has an ERP system, data related to orders (received or placed) is typically exchanged in a paper-less way between the ERP systems of the two companies trading which each other. This enables the automated processing of data during all transaction phases (request for quotations/proposals, placing the order, order confirmation, invoicing process, dispatch confirmation).

Data exchange between ERP systems represents the most sophisticated form of e-business. However, due to the low rate of adoption of ERP systems in the TLS sector (see Section 3.4.1), a typical method currently used by many firms (especially small- and medium sized firms) is to send the delivery note by e-mail as an attached document. This can be regarded as an intermediate stage between paper-based and more advanced automated processing.

Exhibit 3.4-4 Data exchange with business partners

Transport & Logistics Sector	Companies characterising their typical data processing and exchange with business partners as …							
	"mostly verbally"		"mostly in paper based format"		"mostly electronically processed, but exchanged in paper based format"		"mostly electronically"	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl	% of firms	% of empl.	% of firms
TLS (EU-7, total)	**26**	**43**	**36**	**34**	**15**	**10**	**23**	**13**
Passenger transport	24	43	43	32	19	20	14	5
Freight transport	33	48	39	33	12	8	17	11
Logistics	17	26	25	40	18	8	40	27
TLS – by size								
Micro (1-9 empl.)		45		34		9		12
Small (10-49 empl.)		31		40		15		14
Medium (50-249)		18		30		26		26
Large (250+ empl.)		16		35		18		31
N (TLS EU-7)	1075		1075		1075		1075	
Questionnaire ref.	10a		10b		10c		10d	

Source: Sectoral e-Business Watch (Survey 2007)

As expected, most of the companies where data with business partners is processed and exchanged mostly verbal are the small-sized ones (76%). Inversely, almost one third of the large-sized companies use to process and exchange data with business partners mostly electronically (Exhibit 3.4-4).

An example of a transport document management system

The case study about CEMAT (see Section 5.4) presents a concrete example of ICT-supported transport document management in the transport & logistics industry. It also demonstrates how an e-solution can significantly improve the operation of transport terminals and secure the transport delivery process. The solution is based on a software solution that allows automating the exchange of documents between customers, partners, and suppliers regardless of source, format, and destination. The solution also allows automatically transforming documents from different sources and delivering them through different formats like e-mail, fax, SMS, XML, etc. This software is linked to the internal information system of CEMAT, an Italian company specialised in combined transport of containers, trailers, swap bodies and vehicles on land and sea. The case also highlights the difficulties faced in the adoption of the solution by the end users.

3.5 e-Procurement and Supply Chain Integration

Integration of different supply chain actors and processes is one of the most important goal in any SCM project considering that the more integrated, the better the performance of the supply chain. Procurement is a support activity for the purchase of inputs (raw materials, office and production supplies and information systems) for all parts of the value chain. Procurement activities aim at anticipating requirements, sourcing and obtaining supplies; moving supplies into the organisation, and monitoring the status of supplies as a current asset.

Improvement of procurement processes in B2B markets can lower the costs incurred in the identification and subsequent selection of the best suppliers, increase the value of purchases in terms of their price-quality relationship, and lower transaction costs associated with greater process efficiency. The most common business process that companies first automate is their procurement process. ICT permits the use of electronic technologies for procurement (e-procurement). Internet technology provides ways of drastically reducing different categories of transaction and communication costs. In that respect, the potential merit of various electronic procurement forms, such as electronic catalogue systems, electronic auctions, intelligent agent applications, electronic market places seems largely undisputed.

However, in these supplier-buyer relations a hold-up problem arises because a number of applications require involvement of both transaction sides (for example, who invest first). This is a problem dealing with inter-firm cooperation and usually depends on the pressure coming from suppliers or customers. To measure the impact of those pressures the SeBW survey has asked firms in the TLS sector if they have experienced some pressure from customers/suppliers that their ICT solutions should be applied. As shown in Exhibit 3.5-1, 12 % of firms have declared the existence of those pressures, while 57% have introduced new ICT solutions in order to comply with customers' request and 74% have done the same in order to comply with supplier's request. Suppliers are not a main driving force to introduce new ICT solutions as only 8% of suppliers' firms have exercised some kind of pressure over their business partner in order to get new solutions. Rather, pressure is coming from customers (12%).

In many cases, suppliers become a barrier to firms trying to put in place an ICT solution which completely depends on the reliability of information provided by them. The case study *"Cargo Tracing at Saima Avandero"* (Section 5.10) demonstrates that if a company depends on a third party to provide the data, it is very important to get a clear

commitment of this third party on the respect and correct application of processes deployed with the solution. The "pressure" that has to be exercised by *"Saima Avandero"* over its suppliers highlighted the advantages to convince the suppliers to adopt the solution. The key lesson learned from this case is that it is very important to involve the most important suppliers in the project from its early beginning.

According to the results of the SeBW survey, only 9% and 6% of firms have demanded from suppliers and customers, respectively, that they implement new ICT solutions. According to Thompson (2004), when relationship investment are indispensable or specific assets are procured, firms will create networks in which suppliers and buyers form closed business relationships. This situation helps to overcome the hold-up problem and permits firms to create relations which are additionally strengthened by ICT.

There has been a great deal of enthusiasm around B2B procurement portals, designed to ease the way in which companies purchase materials. This can lead to faster, more efficient markets and reduced material costs, but it still does not address automation of the procurement process, which can lead to dramatically more efficient operations. By themselves, B2B portals do nothing to determine *when* materials should be ordered to optimise inventory and delivery, or how an entire supply-chain can be coordinated and optimised for maximum efficiency. Main advantages of e-procurement include getting the right product, from the right supplier, at the right time, for the right price and the right quantity.

E-procurement has the advantage of taking supply chain management to the next level, providing real time information to the vendor as to the status of a customer's needs. E-procurement alters the traditional supply chain structure, bypassing the channels to deal direct with customers. It is in direct contact with suppliers, the benefits spill over to the back-end through feedbacks and customer-relationship management analysis to improve core business processes. For these type of reasons, e-procurement has been seen to have the potential to play a pivotal role in a firm's endeavours to "create a competitive cost advantage that lasts for many years"[99], hence grounding sustainable competitive advantage.

[99] Bloomberg et al. (2002). Logistics, Prentice Hall.

Exhibit 3.5-1: Pressure from customers/suppliers to adopt e-business

Transport & Logistics Sector	e-Business pressure from costumers: companies …				eBusiness pressure from suppliers: companies…			
	… which experienced pressure from costumers that their ICT solutions should be adapted		… having introduced new ICT solutions in order to comply with costumers' request		… which experienced pressure from suppliers companies that their ICT solutions should be adapted		… having introduced new ICT solutions in order to comply with suppliers' request	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl	% of firms
TLS (EU-7, total)	**27**	**12**	**78**	**57**	**14**	**8**	**77**	**74**
Passenger transport	10	9	(--)**	(--)**	8	2	(--)**	(--)**
Freight transport	26	13	68	57	12	9	63	68
Logistics	41	10	92	81	24	12	(91)*	(87)*
TLS – by size								
Micro (1-9 empl.)		11		(53)*		9		(--)*
Small (10-49 empl.)		11		80		4		(--)*
Medium (50-249)		32		82		16		(80)*
Large (250+ empl.)		44		(83)*		19		(--)*
N (TLS EU)	B11a		B12		B13		B14	
Questionnaire ref.	1097		216		1097		107	

* Percentage only indicative, due to small number of observations (n = 25 – 50)
** Percentages not displayed because they are based on a very small number of observations (N<25).

Source (both tables): Sectoral e-Business Watch (Survey 2007)

Exhibit 3.5-2: Companies demanding from suppliers that they adapt their ICT solutions to their requirements

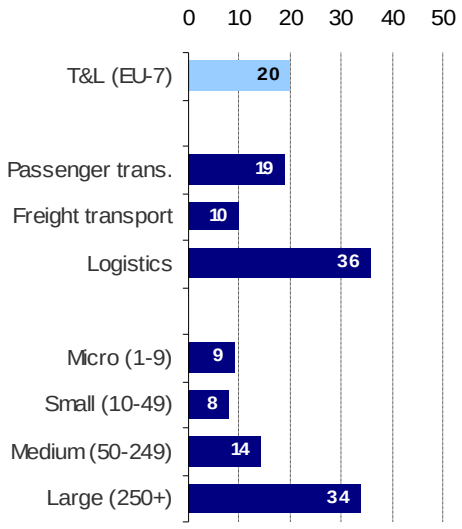
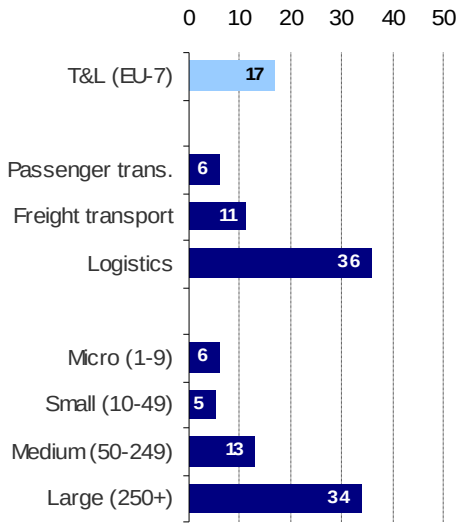


Exhibit 3.5-3: Companies demanding from customers that they adapt their ICT solutions to their requirements



Data for TLS total weighted by employment (read: "firms representing x% of employment"), data for size-bands in % of enterprises. Base: all companies.

3.5.1 B2B online trading: companies placing orders online

Typically, B2B is about transforming the back office functions of firms to make them more efficient and impacts along the entire value chain of an industry. B2B accounts for a significant amount of the trade which is conducted on the Internet, and is expected to account for the vast majority of it within a few years. As trade between businesses increasingly moves online, so it follows that the processes and services which support this trade, such as logistics and warehousing, is also moving online.

41% of all firms active in the TLS industry said that they place at least some orders to suppliers online. The incidence increases by firm size (see Exhibit 3.5-2). However, a significant percentage (54%) of firms that purchased online said that these purchases account for less than 5% of their total procurement. Only 13% of firms purchased online for more than 25% of their total procurement.

Exhibit 3.5-2 Companies placing orders online

Transport & logistics sector (TLS)	**Companies ordering supply goods or services online**		**Companies that order … of goods online**									
			<5%		**5-10%**		**11-25%**		**26-50%**		**>50%**	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS (EU-7, total)	58	41	54	54	15	16	16	16	7	6	8	7
Passenger transport	50	36	58	45	22	29	15	16	4	2	1	8
Freight transport	56	41	57	53	13	13	18	21	6	5	6	9
Logistics	67	43	47	62	13	18	12	4	12	14	15	2
TLS – by size												
Micro (1-9 empl.)		39		54		14		18		6		8
Small (10-49 empl.)		53		52		29		8		6		4
Medium (50-249)		61		48		17		22		11		2
Large (250+ empl.)		75		51		13		14		11		11
Base	all firms		firms ordering goods online									
N (TLS EU7)	1097		526		526		526		526		526	
Questionnaire reference	B1		B2a		B2b		B2c		B2d		B2e	

Source: Sectoral e-Business Watch (Survey 2007)

Case study

Fret SNCF (see Section 5.6) handles freight carriage for SNCF (Société Nationale des Chemins de Fer, French railways). It provides three general types of service, which are merchandise transport, container transport and lorry transport. The e-services project, launched by Fret SNCF in 2006 is part of this new strategy and aims to provide customer services over the Internet for a simpler, faster and more reliable exchange of information with the customer. The “Clic Services Fret SNCF” portal went live in July 2007, providing four major e- services to customers allowing them to directly order transport services on the Internet (Commande@RESAFRET), follow transport progression in real time (Info@RESAFRET), transmit their transport documents (e-LV) and consult their invoices (Info Facture). The “Clic Services Fret SNCF” portal was developed using PHP and Dot Net languages. Security is guaranteed via SSL encryption of information and via a dedicated login and password for each user. The service has been a success on the

customer side as the number of connections is continuously growing since the launch of the service.

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

SCM – Supply chain management

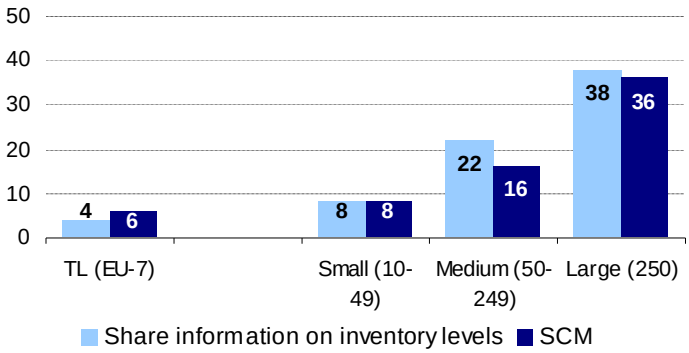
One of the major challenges of e-business is the potential change in the value chains of different industries. Organisations increasingly find that they must rely on effective supply chains, or networks, to successfully compete in the global market and networked economy. Because every activity involves the creation, processing, and communication of information, ICT has a pervasive influence on the supply chain. Supply chain integration can refer to internal and external integration. In an internal integration perspective, ERP systems are often recognised as essential ICT for supporting the internal sharing of information between functions and departments in an organisation. In an external integration perspective IOIS[100] constituting automated information systems shared by two or more companies, can be used to support information-sharing with customers and suppliers. The IOIS concept can be considered an overall term for a group of technologies that support information sharing across organisational boundaries as e-mail, EDI, extensible mark-up language (XML), electronic data access (EDA) and the Internet.

To meet customer demand for seamless, comprehensive and reliable information on which to base business decisions today, companies must integrate data from the many sources involved in a customer's supply chain. It means that collaborating with the customers and own business partners and vendors, and also with the customers other vendors and even with own competitors is the key to help smooth workflow. SCM encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. Thus, one of the main areas of interest that has emerged in recent years concerns the effects of ICT on SCM. One of the key objectives of any effective SCM system is to reduce inventory.

The Sectoral e-Business Watch also asked companies whether their ICT system was linked to that of suppliers, sharing information on inventory plans. As expected, practically the same number of firms report ICT links with suppliers compared to the share of firms with an SCM system (see Exhibit 3.5-3). This is somewhat in frequency to the idea of SCM where some form of linking ICT with suppliers can be regarded as prerequisite. There are some differences, however in the medium-sized band of companies. For those companies, a possible explanation is that many companies have software for managing their inventory and supplies internally, without really integrating suppliers directly through the system.

[100] ICT used to exchange information in the supply chain is often named interorganisational ICT or interorganisational information systems (IOIS).

Exhibit 3.5-3 Supply chain integration: % firms using SCM software / sharing information on inventory levels with suppliers (2007)



Source: Sectoral e-Business Watch (Survey 2007)

In essence, Supply Chain Management integrates supply and demand management within and across companies. Successful SCM requires a change from managing individual functions to integrating activities into key supply chain processes. An example scenario: the purchasing department places orders as requirements become appropriate. Marketing, responding to customer demand, communicates with several distributors and retailers, and attempts to satisfy this demand. Shared information between supply chain partners can only be fully leveraged through process integration.

At this time supply chain management has moved from low level and highly fragmented set of administrative and overhead operations— to a strategic enterprise initiative by a systemic integration of the following components:

- Customer service management
- Procurement
- Product development and commercialisation
- Manufacturing flow management/support
- Physical distribution
- Outsourcing/partnerships
- Performance measurement

SCM software is thus intended to manage numerous and different activities and tasks, many of which have their own specific software. Some vendors have assembled these different chunks of software together under a single solution, but the development of a complete package that is right for every company is a big challenge. As a result, SCM has been one of the fastest growing segments in the information field. 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 is unlikely to be achieved unless internal process integration has been previously and effectively achieved.

Data on SCM usage in the TLS sector in Europe are analysed in Section 3.5.1 of this Report. As can be observed, the evolution of SCM had followed that of ERP and heavily relies upon it. The two areas, intra-enterprise integration (mainly represented by ERP) and inter-enterprise integration (mainly represented by SCM) present a low rate of adoption in the TLS sector and have similar features (6% of enterprises say they have an SCM system and the same percent say they have an ERP system). In certain way, they

are complementary approaches for addressing the same strategic challenges. It is worth noticing that most suppliers address these two areas with interlinked modules. SCM however provides the opportunity to expand the advantages of optimisation and integration to the entire supply chain through the creation of a collaborative, networked environment.

The use of applications and practices supporting the electronic exchange of information between companies occurs simultaneously with close relations with business partners. This provides support to the hypothesis that close relationships facilitate investments in specific technologies. Collaborative practices and ICT applications, in turn, further strengthen the relationships between the companies and lead to a creation of organisational networks. These hypotheses have been positively tested for the TLS sector as can be found in section 4.5.1 of the present report.

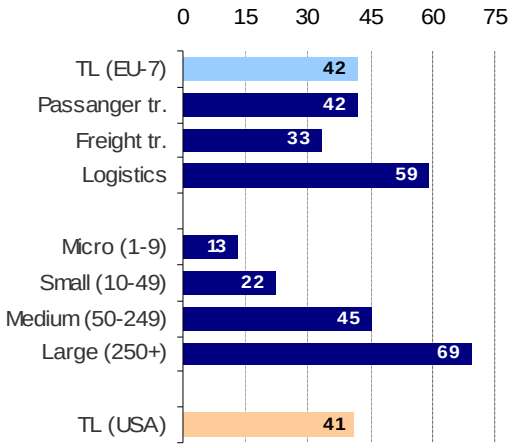
WMS - Warehouse Management Systems

Warehouse Management Systems (WMS) are a key part of the supply chain and primarily aim to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving, put-away and picking. The systems also direct and optimise stock put-away based on real-time information about the status of bin utilisation. Warehouse management systems utilize Auto ID Data Capture technology, such as barcode scanners, mobile computers, wireless LANs and potentially RFID to efficiently monitor the flow of products. Once data has been collected, there is either batch synchronisation with, or a real-time wireless transmission to a central database. The database can then provide useful reports about the status of goods in the warehouse.

The detailed setup and processing within a WMS can vary significantly from one software vendor to another; however the basic logic will use a combination of item, location, quantity, unit of measure, and order information to determine where to stock, where to pick, and in what sequence to perform these operations.

In the TLS sector about 15% of companies use a WMS. Generally, larger companies tend to make more use of WMS than smaller ones:[101] while only 13% of micro enterprises reported using a WMS, 69% of large TLS companies said that they use this tool (Exhibit 3.5-4). However, there is an important trend in the small-sized companies in the sector, forced by competition – as shown by case studies on AIT (France) and N.C. Cammack & Son (UK) – to adopt warehouse management solutions. There are of course significant variations between different sub-sectors of the TLS industry: while only 5% of passenger transport companies reported using a WMS, 14% in the freight transport and about 25% in the logistics sector did so.

Exhibit 3.5-4 Deployment of WMS in the TLS industry



Data for sector totals and sub-sectors are weighted by employment; data for size-bands in % of firms.

Source: Sectoral e-Business Watch (Survey 2007)

Case studies about WMS in France

Geodis Group

The case study about Geodis Group (see Section 5.7) shows a typical example for automated warehouse management as it is used in the logistic sector. It demonstrates the benefits and requirements for a successful implementation of such a solution. The Geodis Group (France) is a global logistics player and present in all segments of the transport and logistics market. The warehouse management system of Geodis manages all activities of their warehouse. It handles the product architecture, multiple references (shipper, commercial, supplier, manufacturer, etc.) and multiple packaging schemes. These systems are fully compatible with the most common ERP applications today on the market and allow an easy set-up of connectivity. In the world of global logistic service providers, today warehouse management systems form the backbone of operations and represent and are a prerequisite for global logistic service providers to remain competitive in this market.

AIT

AIT is a supplier of transport and logistics services (for all kind of goods) located near Lyon, in France. AIT, employing 42 people, faces huge competitors precisely like Geodis as well as a myriad of small companies. ICT technology is the main key to support AIT in its market position. The solution implemented by AIT allowed the company to organize their multimodal transport taking into account the whole transport process with, at the

[101] See case study on *Saima Avendero* (Italy) and *Geodis* (Belgium) in Chapter 5.

same time, a flexible and ergonomic interface to manage its warehouse activities. The solution also provided the company with detailed data analysis on the whole company activity and the optimisation of different processes like customer billing, purchasing and business operations. This is also a good example to demonstrate - especially to small companies – the major advantages that can be achieved through outsourcing business processes, since the solution is managed by specialists in a controlled technical environment (see Section 5.2).

These cases were selected in order to illustrate how two different sized firms can successfully coexist in a market where the competition is very aggressive. The first case study focuses on a company that operates in 120 countries and has about 26,000 employees. Geodis posted nearly €3.8 billion in net sales in 2006. The second case study illustrates an ICT empowered small company - which provides the organisation of Euro-national transport services throughout Southern Europe (AIT has generated, employing 42 people, a turnover of about €8,5 million in 2006) - has evolved into a competitor for traditional and well established companies.

3.5.3 Supply chain developments and urban freight

Freight transport is an essential and unavoidable fact of city life involving a large number of affected user groups. Private actors involved in freight transport include shippers, transport operators, logistics service providers, receivers (shop owners), vehicle manufacturers, consultants and various trade associations.

The negative aspects of urban freight growth are most visible in all European urban areas: congestion to which lorries and small delivery vehicles contribute; noise emissions, emission of pollutants and accidents are problems that decrease the quality of the urban environment substantially. Allen *et al* identifies the changes in the supply chain management practices that have a growing impact on city traffic and on the related urban environment. These are: [102]

- An increase in the intensity of daily and weekly deliveries;
- A bigger proportion of larger and heavier vehicles appearing on the streets, driven by the cost advantages for the carriers;
- An increasing reluctance by retailers to retain stock and to expect just-in-time deliveries from their suppliers.

The demand by retailers for smaller, more frequent deliveries to premises generates additional traffic. In addition the out-sourcing of logistics services by companies to sub-contractors adds to the numbers of commercial vehicles accessing the city and may militate against the most efficient consolidation of loads and may add to traffic. These trends are taking place against a background of a growing public demand for more sustainable urban living and a more acceptable quality of life. Better approaches for managing all forms of urban transport including city freight, is expected by the public.[103]

[102] Allen *et al,* University of Westminster, January 2003, Modelling policy measures and company initiatives for sustainable urban distribution – Final Technical Report

[103] O'Mahony, M. et al, (2004). Sustainable Freight Distribution in a Historic Urban Centre: Final Report, Centre for Transport Research, Trinity College, Dublin.

The increasing use of information and communications technology (ICT) based solutions in logistics will ease the consolidation of cargoes and in that sense decrease the number of deliveries in urban areas.[104] Intelligent Transport Systems and Services (ITS) are potential means to help in solving all five key challenges identified for European owns and cities. The five challenges include:[105]

- Free-flowing towns and cities
- Greener towns and cities
- Smarter urban transport
- Accessible urban transport
- Safe and secure urban transport

There are various supporting technologies for ITS, including vehicle telematics (on-board units), global positioning systems (GPS), smart cards, and video messaging signs that can be linked to traffic management systems and/or to freight transport management systems.. Many of these systems have been initiated and operated by urban authorities as part of the traffic management systems used to improve the traffic situation within the urban area. The Spanish road passenger transport company *ALSA* (see case study 5.11) illustrated the successfully adoption of those technologies.

The Green Paper's list of questions (25 in total) forms the basis of a further round of consultation on the European Commission's role and policy responses in the area of urban transport. The International Association of Public Transport (UITP) has given its support to the Green Paper, stating that the European Commission "*has a major role to play to foster sustainable urban mobility for all, providing frameworks that can empower our cities and regions to take appropriate actions, while fully respecting the subsidiary principle*" [106](UITP, 2007).

3.6 Improving Customer Service by means of ICT

ICT, and in particular the internet, can be used in various ways to support marketing activities, including the communication with customers, offering products for sale, and developing new marketing strategies.[107] e-Business leads to a fundamental shift in the structure and services of transportation and logistics businesses. Firms are transporting more online purchased goods and they are actually subordinating their individual business plans and identities that becoming an integrated part of their electronic business customers' supply chain. The role of the order and its delivery is evolving to one that includes full-scale logistics, supply chain management and warehousing. For individual

[104] PLUME, PLanning and Urban Mobility in Europe Synthesis Report: Urban Freight Transport measures; see case study on *N.C. Cammack & Son (Section 5.7)*. The main benefit of the ICT management solution is a superb "just in time" performance.

[105] ERTICO – European Commission releases Green Paper on urban mobility ITS Europe eNewsletter: No. 20/07 – 19 October 2007.

[106] International Association of Public Transport – UITP (2007). European public transport undertakings welcome Green Paper on Urban Transport. UITP Press Release 27-09-07. UITP,Brussels.

[107] A detailed analysis of all case studies presented in this report shows that customer service is the main driven force in the adoption of ICT-related technologies.

customers, studies have shown that online shoppers check the status of their package an average of seven times from the moment the "buy" button is clicked until the package arrives.[108]

This basically implies that e-business must be able to initiate, track, and acknowledge shipments online. Paperless trade eliminates the operational costs related to manual paper processing, increases the transparency of the supply chain, the exchange of information between the trading partners, improves trade and finance processes and establishes collaborative processes. It favours the use of common standards and helps integrate supply-chain processes and their automation, reducing the need for repeated data entry and reduces errors and delays. It also allows companies to develop new, value-added services such as automated track and tracing systems, monitoring of document processing, security and non-repudiation. An example of the benefits of the implementation of a track and trace solution is the case study *"Cargo Tracing at Saima Avandero"*, Italy (see Chapter 5, section 5.10). The goal of the solution was to provide the status of the transport over a Web interface to customers. Although some customers are very satisfied with the solution, the case also contains lessons to be learned about the different obstacles that a small company had to overcome to implement such a solution.

3.6.1 Companies receiving orders from customers online

30% of all firms active in the TLS industry said that they enabled customers to order products online. There is practically no difference between companies from the various size-bands in this respect (see Exhibit 3.6-1). However, a majority of close to a half of those companies that enable customers to order online say that these orders account for only up to 5% of their total orders received. Only about 20% receive more than a quarter of their orders online.

Exhibit 3.6.1 Companies that receive orders online

Transport & Logistics Sector	Companies whose customers can order goods or services online		Companies that receive ... of orders from customers online									
			<5%		5-10%		11-25%		26-50%		>50%	
Weighting	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl	% of firms	% of empl.	% of firms	% of empl.	% of firms
TLS- total (EU7)	**35**	**30**	**42**	**51**	**19**	**12**	**13**	**14**	**12**	**16**	**15**	**7**
Passenger Transport	40	38	49	62	24	29	7	6	18	2	3	1
Freight Transport	28	29	47	52	13	8	17	15	11	15	13	10
Logistics	43	27	28	35	23	7	12	22	8	34	29	3
TLS- by size (EU-7)												
1-9		30		52		11		14		17		7
10-49		33		48		16		20		9		7
50-249		39		42		22		14		8		13
250 +		36		30		26		9		6		28
N (TLS EU7)	1097		342		342		342		342		342	

[108] E-Logistics, Free Essays, Cliff Notes and Term Paper Database. Available at: http://www.essays.cc/free_essays/b2/utv192.shtml.

Questionnaire reference	B1	B2a	B2b	B2c	B2d	B2e

Source: Sectoral e-Business Watch (Survey 2007)

Case studies: improving customer services

Hupac

The case study about Hupac, Switzerland (see Section 5.8) deals with the integration of a software management ("GOAL") system with GPS train control ("e-train"). Hupac is a leading company in combined transport across the Swiss Alps and in transport of containers, swap bodies, semi-trailers, and trucks by rail in Europe. Hupac has implemented an innovative information technology solution that manages transport information in real time and coordinates all phases of intermodal traffic from departure to arrival. Together, "GOAL" and "e-train" allow a constant updating of the situation for each load so that customers can be kept precisely informed about their shipments. An aspect to be taken into account is roaming costs. Depending on the number of GPS units deployed and number of messages exchanged, this point can be another barrier for companies who want to provide this solution or free for their customers.

Trafikanten

Trafikanten is the joint information provider for the three public transport authorities in the Oslo region of Norway. Trafikanten's main objective is to promote public transport and ensure easy access for passengers to the network of all public transport operators in the region, regardless of transport mode or company, providing travellers with real time accurate information about vehicle arrival and departure time via Internet, mobile channels and through signs available at the stops. The solution is a proprietary solution based on meter measuring, GPS and General Packet Radio Service (GPRS) technologies. This case demonstrates a successful solution implementation in the public transport area that allowed achieving significant benefits in terms of passenger communication and service improvement, lower travel times and increased planning efficiency for the Public Transport Authorities and operators (see Section 5.11).

3.6.2 e-Ticketing: a commitment towards innovative retailing and ticket solutions

The continued growth of urban transit will depend on its ability to respond to individual travellers needs through the spread of e-ticketing, interoperability and journey planning information. Electronic ticketing provides a striking example of the benefits of ICT to the transport industry. E-ticketing is a ticket-less concept. It provides total fulfilment for the passenger without the worry of lost or forgotten tickets. E-ticketing provides companies with the opportunity to reduce administrative costs and, at the same time, provide a higher level of service to travellers.

Case study and business example of e-ticketing

The case study about CFR Călători (see Section 5.5) outlines the importance of e-business solutions for the modernisation of the public rail transport sector in Romania. The two main strategic goals of the national company for passenger railways in Romania

are to modernise the rolling stock and to improve the service for the customer. Among its strategic priorities, CFR Călători (the passenger service division of CFR) has identified the need to have a national system for e-ticketing. The solution has been implemented in over 245 railway stations where each selling point is equipped with a PC and a printer linked to the different systems. 90 million tickets have been sold through the system and 23 millions passengers have been served between January 2007 and July 2007.

The following business example shows how the five largest public transport operators in the Netherlands have created a joint venture –the Trans Link Systems (TLS)– to build a nationwide e-ticketing system. Passengers will no longer have to queue to buy their tickets, regardless of whether travel by train, metro, tram or bus is involved.

Business example:

National e-ticketing system in the Netherlands

After a long process that lasted more than 15 years, the five largest public transport operators in the Netherlands created a joint venture – the Trans Link Systems (TLS) - to build a nationwide e-ticketing system. The Netherlands is the first country to implement an e-ticketing system on a national scale in an overall context of complex fare structures. Trans Link Systems is responsible for the completeness of the entire new system and responsible for the issue of the OV-chipkaart which is required to be able to use the new payment system. This system consists of various system elements and public transport smart cards which interact in specific ways, thus ensuring that the passenger can travel without problems using the services of multiple public transport companies. The OV-chipkaart system will ensure that all transactions generated by the use of the public transport smart card are processed.

Electronic payment in practice: The passenger has an OV-chipkaart. The passenger holds the OV-chipkaart near the card reader when entering and leaving the public transport vehicle. The fare to be paid will be deducted when leaving the vehicle. The new payment system will have an open architecture. It complies with a series of broadly accepted, technical standard protocols to allow public transport companies to select connectable partial systems and system elements that suit the procedures of these companies best. The new payment system for the Dutch public transport system will make things easy for passengers: Change is not required and passengers will no longer have to queue to buy their tickets. Regardless of whether travel by train, metro, tram or bus is involved, the OV-chipkaart is valid.

Sources: website of Trans Link Systems http://www.translink.nl/; ERTICO – ITS Europe e-Newsletter: Nº 19/07, 5 October 2007.

3.6.3 e-Integration of marketing processes

Customer relationship management (CRM)

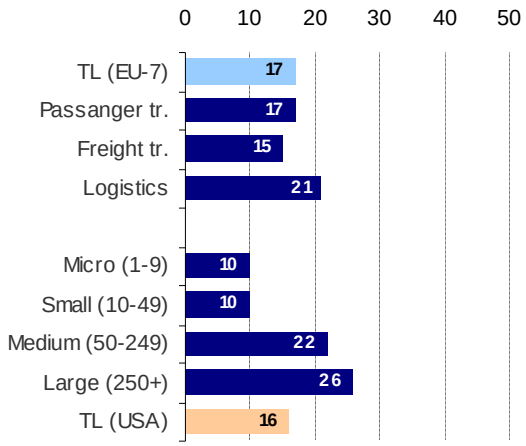
CRM is a broad term that covers concepts used by companies to manage their relationships with customers, including the capture, storage and analysis of customer, vendor, partner, and internal process information CRM is not just a technology, but rather a comprehensive approach to an organisation's philosophy in dealing with its customers. This includes policies and processes, front-of-house customer service, employee training, marketing, systems and information management.

There are three aspects of CRM which can each be implemented in isolation from each other:

- Operational - automation or support of customer processes that include a company's sales or service representative. Operational CRM provides support to "front office" business processes, including sales, marketing and service.
- Collaborative - direct communication with customers that does not include a company's sales or service representative (self service). Interaction can be through a variety of channels, such as web pages, email, automated phone (Automated Voice Response AVR) or SMS.
- Analytical - analysis of customer data for a broad range of purposes (for example, in order to segment customers or to design and execution of targeted marketing campaigns to optimise marketing effectiveness.

According to the results of the e-Business Survey 2007, CRM is not yet widely diffused in the TLS industry (10% of firms), as show in Exhibit 3.6-2. CRM systems are used mainly by the sector's medium (22%) and large enterprises (26%). In other industries studied last year by the *e-Business W@tch,* CRM is similarly diffused, at least among the larger companies – e.g. in ICT manufacturing (31%), consumer electronics (25%), and the pulp and paper industry (22%). In some service sectors, in particular, CRM is a key application for many of the larger companies, for example in telecommunication services (48%) and in the tourism industry (23%).

Exhibit 3.6-1: Percentage of firms with a CRM system



Data for sector totals and sub-sectors are weighted by employment; data for size-bands in % of firms.

Source: Sectoral e-Business Watch (Survey 2007)

The relatively low diffusion of CRM technology within micro and small firms should not come as a surprise: CRM software suites are quite expensive and require intensive organisational preparation to be effectively introduced in a company. Consequently, these could be major barriers for smaller firms to adopt CRM solutions.

As has been tested in Chapter 4 (see Section 4.4.2) ICT endowment is positively correlated with a change of market share. In other words, companies in the sector that intensively use ICT applications, such as CRM, are likely to take advantage of their potential to increase their market reach and relative position to the competitors.

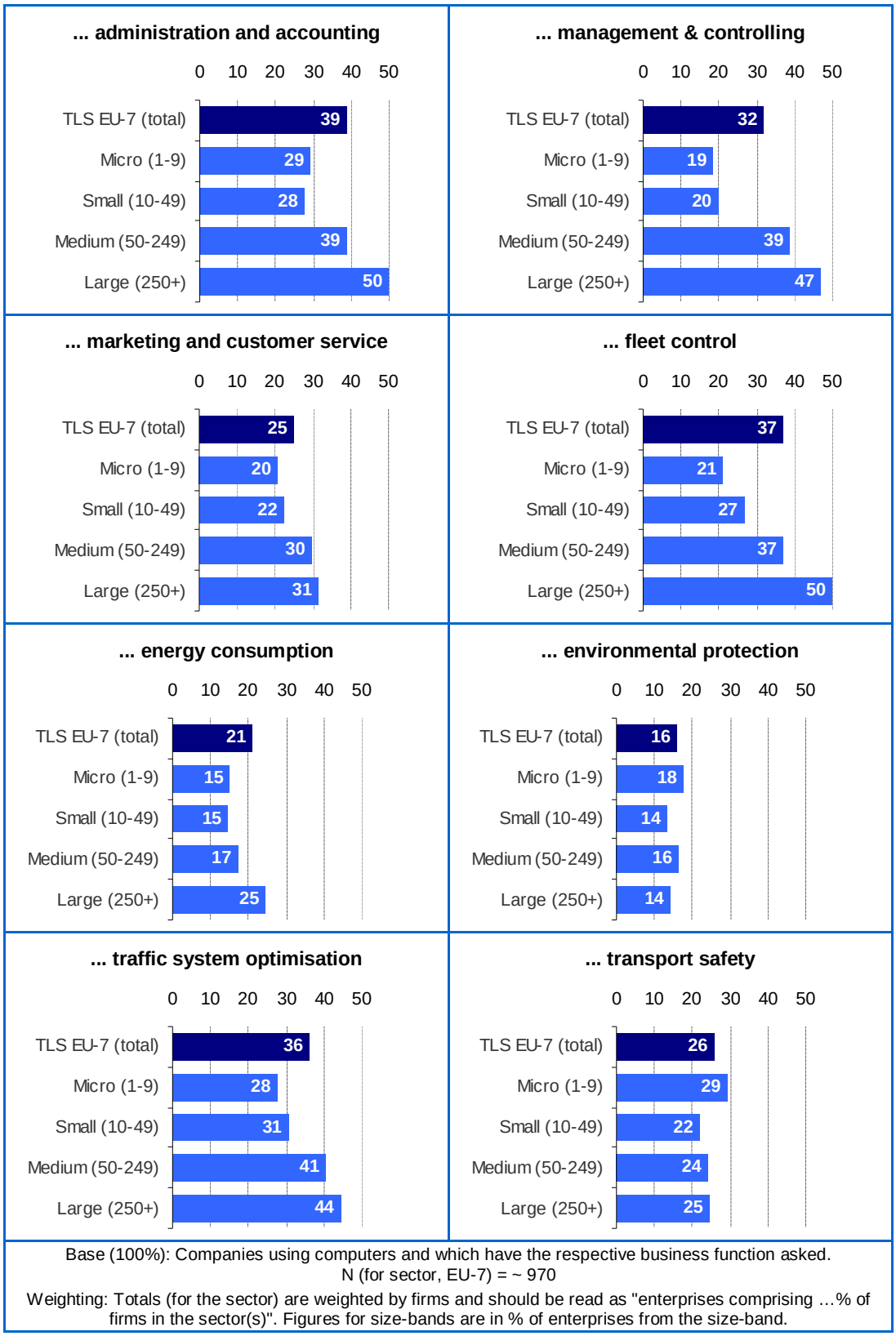
3.7 Drivers and inhibitors for the uptake of e-Business

3.7.1 Drivers of e-business adoption

The majority of companies said that they perceive at least some significance of e-business for their operations (see Exhibit 3.7-1). As shown by replies recorded for the follow-up question, TLS companies perceive some suggested reasons as relevant factors that drive the adoption of new technologies. Almost 40% of firms said that ICT-enabled technologies have a significant influence on competition in the TLS sector. The hypothesis that increasing rivalry in the market is an important driver for the adoption of ICT was tested and confirmed in this report (see section 4.4.1). Competitive pressure forces companies to use innovative technologies to cut costs and look for more innovative ways for conducting business. Next, two main reasons related to managerial issues (management and controlling; marketing and customer services) were asked to indicate the impact they were expecting in the future performance of the company concerning those two factors. The responses - quite similar for the two reasons suggested - showed that those motives were considered less important drivers for ICT adoption compared to competition: about one fifth of the companies considered a high future ICT impact on management, marketing and customer services.

Five more main reasons were suggested in order to see whether some specific for the TLS factors could be considered as important drivers to ICT adoption. The companies were asked about the importance of ICT adoption on fleet control, energy consumption, environmental protection, traffic system optimisation and transport safety. A percentage of firms ranging form 15% to 29% perceive those factors as relevant, with "**impact on transport safety high"** (29%) and **"impact on traffic organisation high"** (28%) as the most important reasons. Except for fleet control, reasons for introducing ICT technologies for micro and small companies seem to be similar to the ones reported by medium and large enterprises. Curiously, environmental protection and transport safety were considered by micro-sized firms more relevant as large-sized firms did.

Exhibit 3.7-1: % of companies expecting that ICT will have a high impact on … in their company in the future



Base (100%): Companies using computers and which have the respective business function asked.
N (for sector, EU-7) = ~ 970

Weighting: Totals (for the sector) are weighted by firms and should be read as "enterprises comprising …% of firms in the sector(s)". Figures for size-bands are in % of enterprises from the size-band.

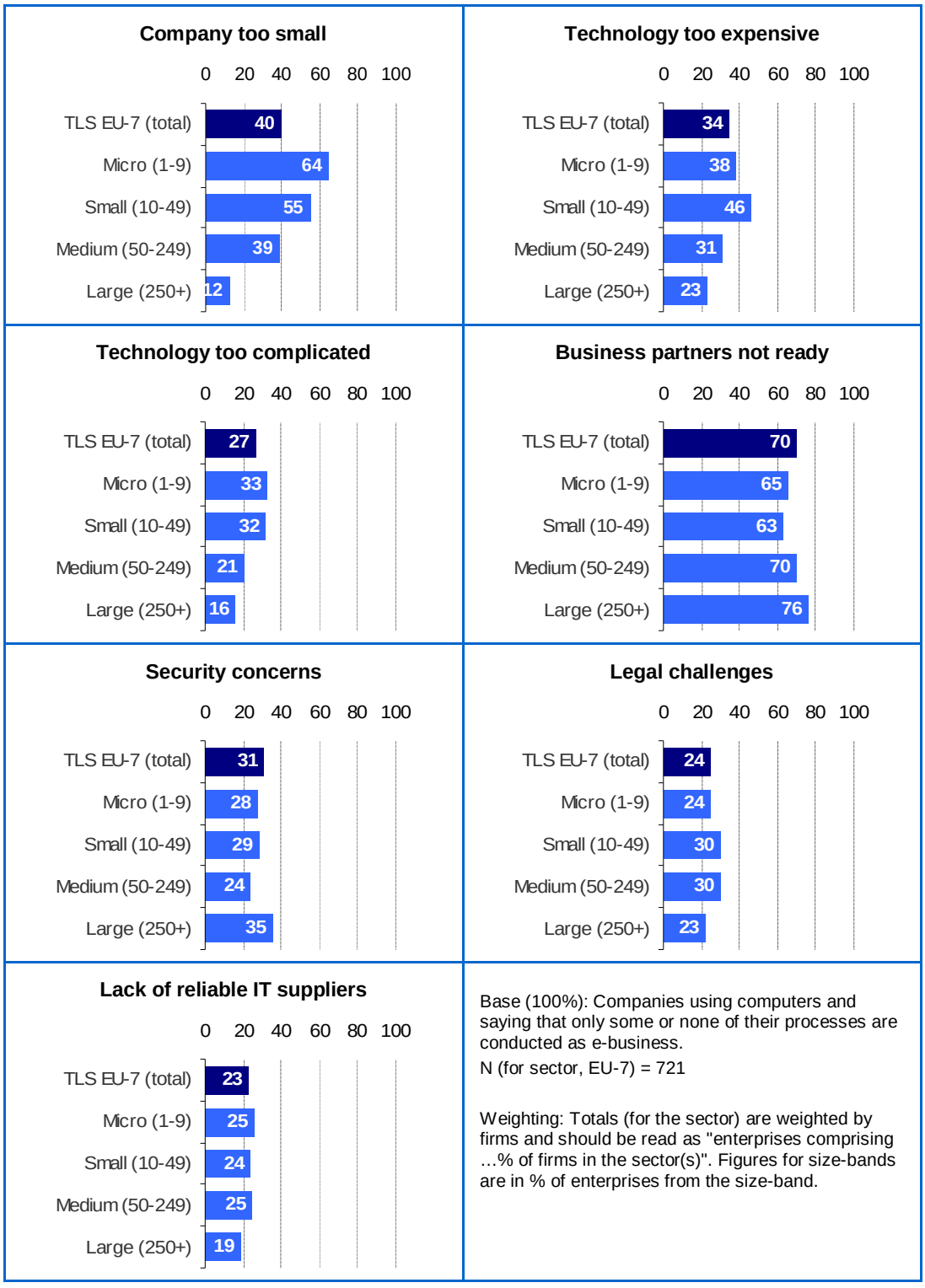
Source: Sectoral e-Business Watch (Survey 2007)

3.7.2 Barriers to e-business adoption

Companies saying that e-business does not play a role in their operations were asked to indicate important reasons why they do not practise e-business. Accordingly to their replies, the main reason TLS firms do not adopt e-business is that they feel that *customers/suppliers are not prepared (65%).* This explanation was given by 65% of micro and 63% of the small companies in this sector but also by a more significant share of medium (70%) and large ones (76%). This perception is also mirrored, almost in the same scale, by the perception that their *size is too small to take benefits (63%)*, which of course, is more accentuated between smaller firms and only shared by 12% of large firms (Exhibit 3.7-2).

A percentage of firms ranging form 25% to 39% perceive lack of reliable IT providers (25%), legal (25%) and security (31%) issues, technology too complicated (32%) and e-business technologies too expensive as a barrier to e-business adoption.

Exhibit 3.7-2: Perceived barriers to e-business adoption: % companies saying that … is an important reason for not using e-business more intensively



Base (100%): Companies using computers and saying that only some or none of their processes are conducted as e-business.
N (for sector, EU-7) = 721

Weighting: Totals (for the sector) are weighted by firms and should be read as "enterprises comprising …% of firms in the sector(s)". Figures for size-bands are in % of enterprises from the size-band.

Source: Sectoral e-Business Watch (Survey 2007)

3.8 Cluster analysis: Employees with internet access at their workplace

In this section we perform an advanced cluster analysis on the survey results using the percentage of employees that have internet access at their workplace as the main clustering analysis. With this type of analysis we use the clustering data analysis technique to group the different transport and logistics sector companies in order to have three different clusters of similar companies based on the percentage of employees that have internet access at their workplace. Then we try to assess statistical relationships between the different internet access and usage by employees at the work place clusters and different variables.

In the following table we have the clustering algorithm results for the variable "Percentage of employees that have internet access at their workplace". We also include the means for each cluster for the variables of percentage of firms having a LAN, a W-LAN and their on website.

Exhibit 3.8-1: Cluster centres (means) and number of cases for the percentage of employees that have internet access at their workplace

Clusters	Number of firms in each cluster	Percentage of employees that have internet access at their workplace	Percentage of firms having a LAN	Percentage of firms having a W-LAN	Percentage of firms having their own website
Weighting:	% of firms	% of firms	% of firms	% of firms	% of firms
1. Low	374	9	52	19	22
2. Medium	257	44	48	29	20
3. High	440	98	71	38	35
Total (EU-7 + USA)	**1071**	**54**	**59**	**29**	**27**

The table shows the results for the three clusters of Percentage of employees that have internet access at their workplace, in the low cluster the mean of percentage of employees that have internet access at their workplace is 9%, the medium cluster has a mean of 44% of employees that have internet access at their workplace and the high cluster 98% of employees that have internet access at their workplace.

Exhibit 3.8-2 shows a clear correlation between the percentage of employees that have internet access at their workplace clusters and the means of variables like percentage of firms having a LAN, a W-LAN and their on website. Showing that the level of internet access among the employees (and the implied computer usage) is related to the LAN, W-LAN and own company website adoption.

In Exhibit 3.8-3 we analyse the relationships between clusters and number of employees of the companies by groups (% of firms weighting). The chart reveals that mid sized groups tend to have relatively more companies in the low cluster compared to small and large companies, which have relatively more companies in the high cluster, especially those with 1 to 9 employees.

Exhibit 3.8-2: Clusters of percentage of employees that have internet access at their workplace vs. LAN and W-LAN and company website usage variables (means of percentages of firms)

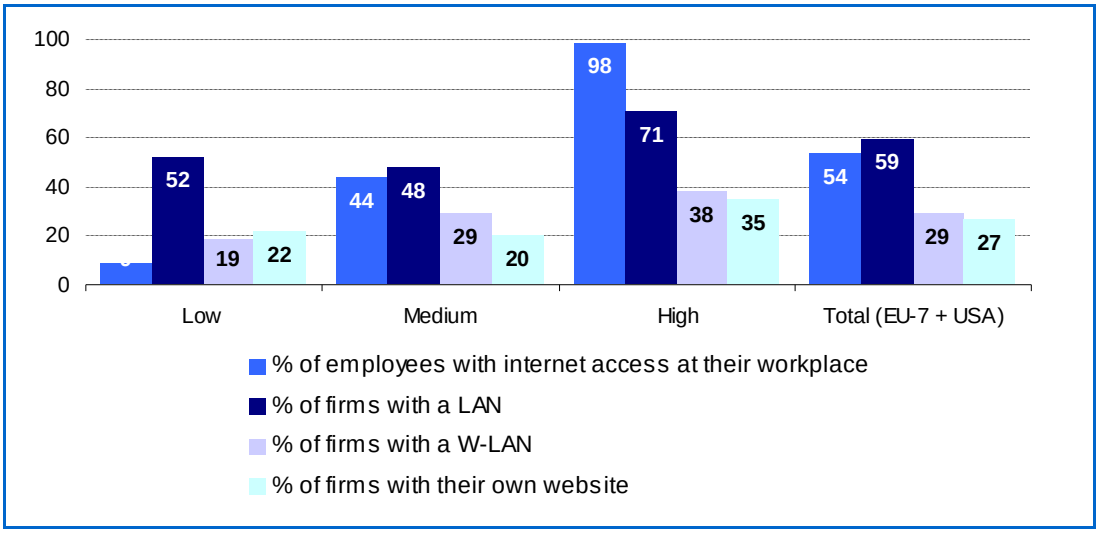


Exhibit 3.8-3: Clusters of percentage of employees that have internet access at their workplace vs. company size groups (percentage of companies)

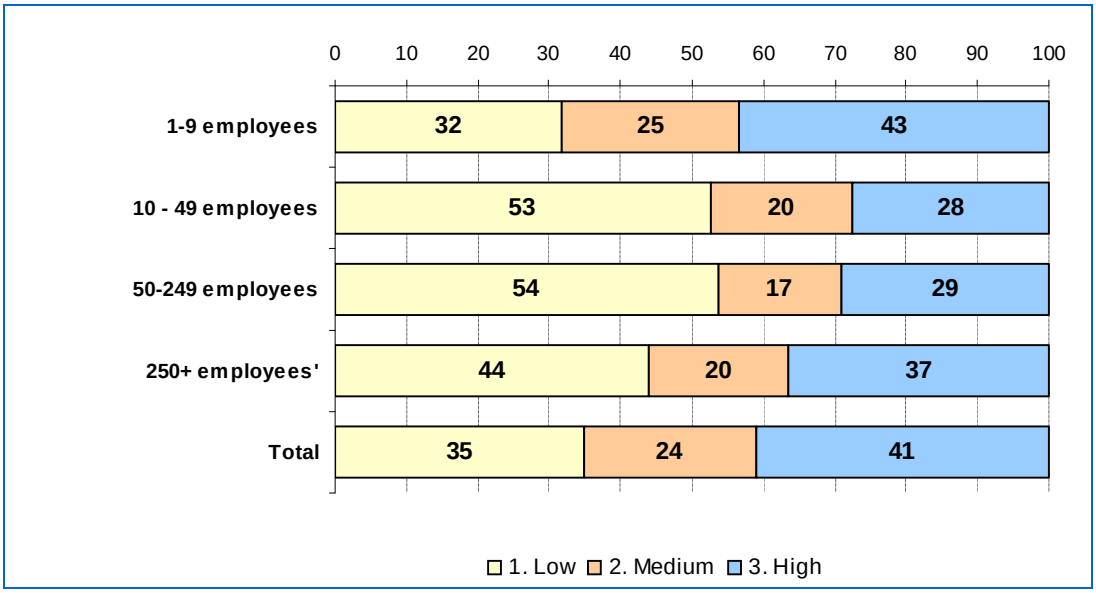
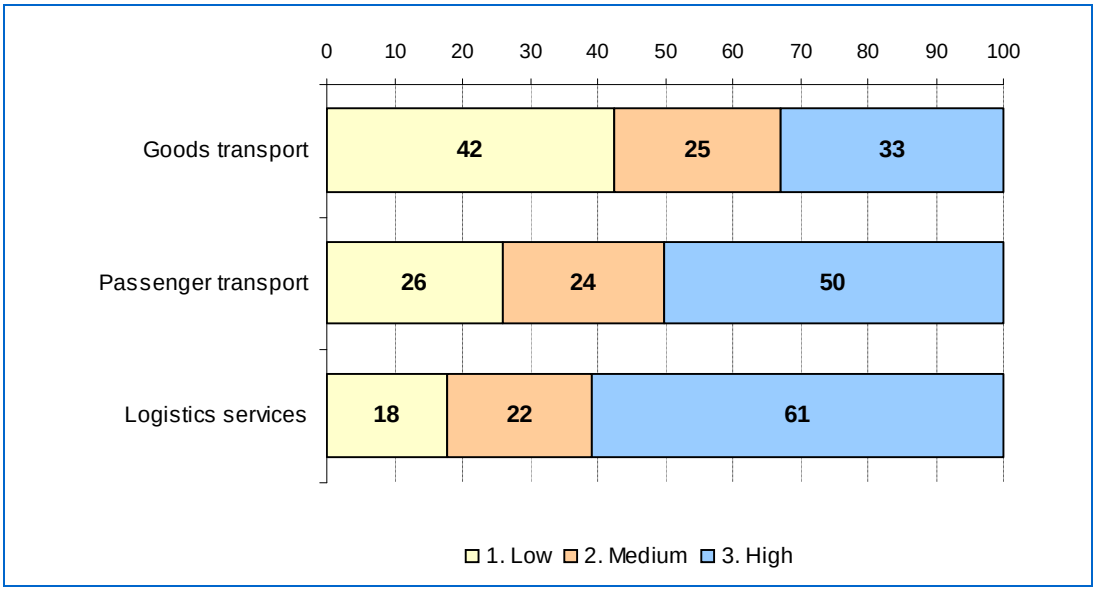


Exhibit 3.8-4 shows that the TLS sector with a bigger relative percentage of companies in the low cluster is the Goods transport sector, with 42% of the companies in the low cluster. On the contrary, the Logistics services sector has a relatively bigger percentage of firms in the high internet usage by employees cluster. The passenger transport sector is in an intermediate position regarding the cluster distribution. So with this cluster analysis we detect some adoption and usage differences based mainly to the profiles of activity and positions in the different transport and logistics sectors.

Exhibit 3.8-4: Clusters of percentage of employees that have internet access at their workplace vs. Transport and Logistics sectors (percentage of companies)



The next chart (Exhibit 3.8-5) analyses the relationship between the clusters and the increase or decrease in market share of the company (Survey question G7: Has the share of your company in this market increased, decreased, or stayed roughly the same over the past 12 months?). The conclusion of this analysis is that we can see that the variables are statistically correlated; being the medium internet usage cluster the cluster of companies with more probability of increasing their market share and improve their competitive position in the market.

The result of the Chi-square statistic for this analysis is significant at the 0.05 level, wich demonstrates that the variables are linked. Also the medium cluster registers the smaller relative percentage of firms with market share loss in the past 12 months (2%). So we can conclude that being in the medium cluster in terms of percentage of employees that have internet access at their workplace is positive to improve the competitive position of the company in the transport and logistics sectors. Both of the 'extreme' clusters, low and high, present a relatively smaller percentage of firms that have increased their market share in the last 12 months.

Exhibit 3.8-6 shows that being in the medium cluster of percentage of employees that have internet access at their workplace also yields more relative probabilities of increasing the turnover (in the last financial year). The chart analyzes the relationship between the clusters and the variable of question G9: Has the turnover of your company increased, decreased or stayed roughly the same when comparing the last financial year with the year before? The analysis shows that there is a bigger relative percentage of firms in the medium cluster that have increased the turnover the last financial year (51%) versus those in the other low and high clusters (42%) That would suggest that companies in the medium cluster are in a better relative position to be more competitive and increase their turnover. The result of the Chi-square statistic for this analysis is also significant at the 0.05 level and demonstrates that the variables are not independent. The Chi-square algorithm is a statistical technique that tests the relationship between analysed variables. If the Chi-square statistic is significant at a certain alpha level (i.e. 0.05) it means that there is statistical relationship between them as in the last two analyses..

Exhibit 3.8-5: Clusters of percentage of employees that have internet access at their workplace vs. Increase or decrease in market share of companies in the last 12 months (percentage of companies)

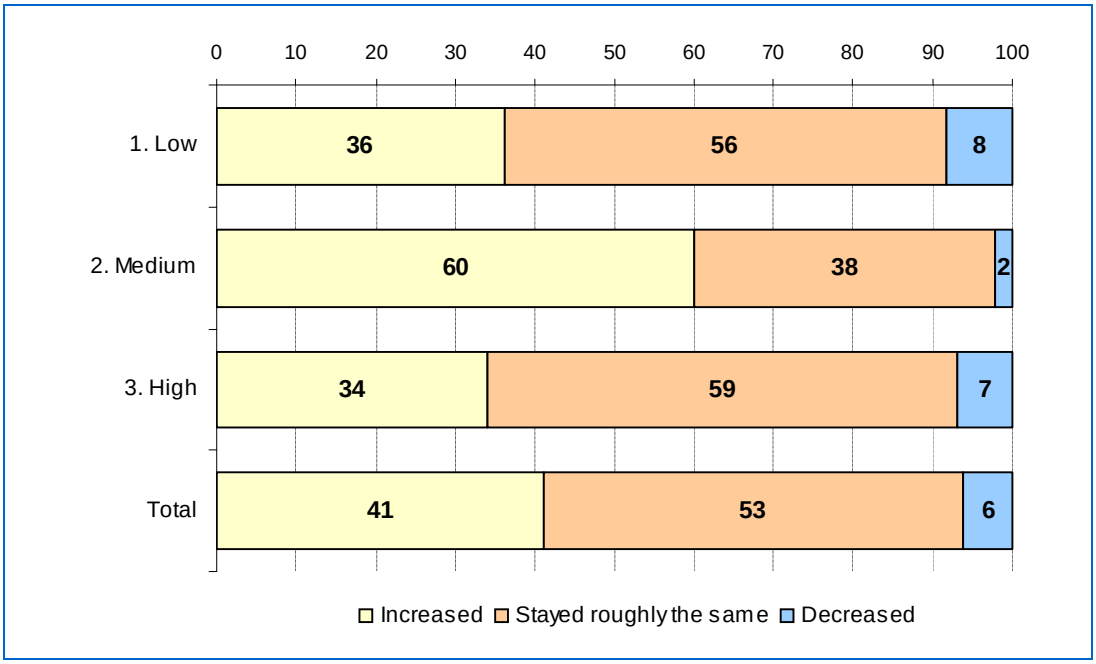
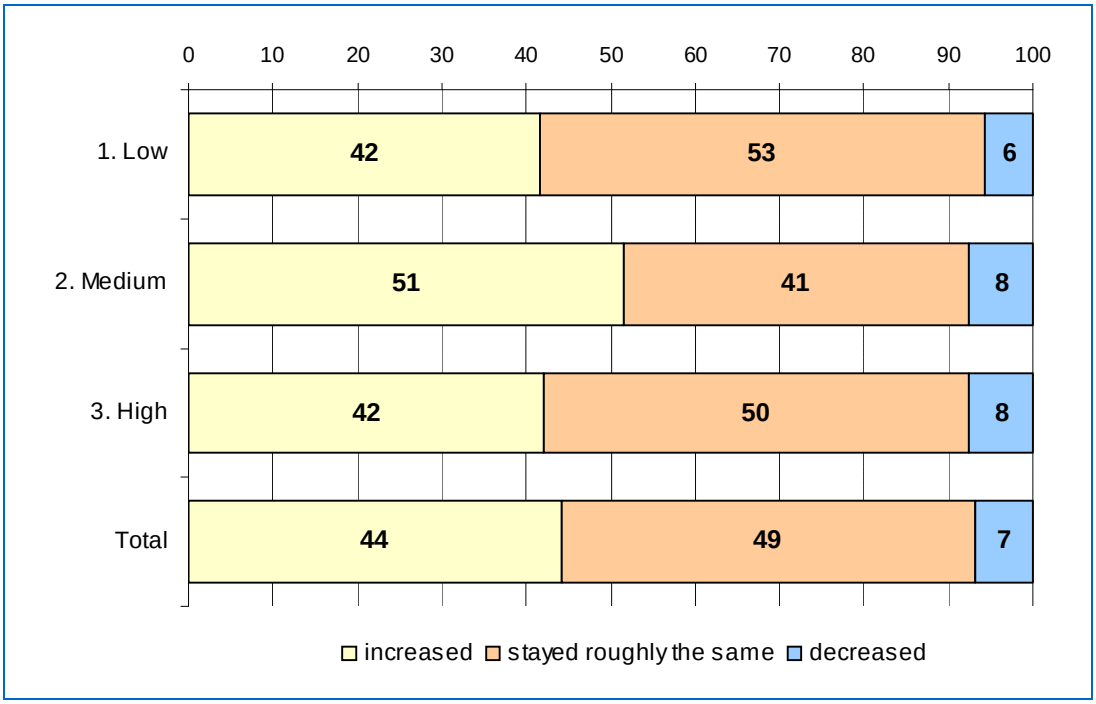


Exhibit 3.8-6: Clusters of percentage of employees that have internet access at their workplace vs. Increase or decrease in turnover of companies in the last 12 months (percentage of companies)

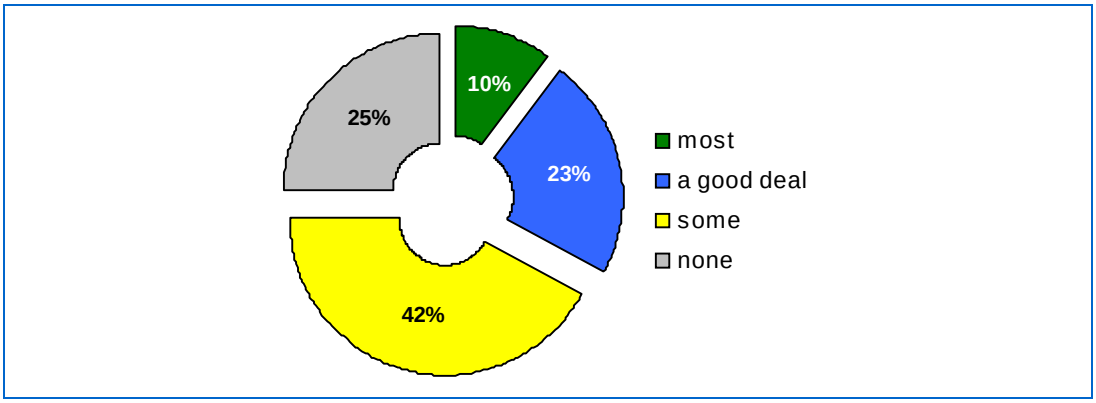


3.9 Summary and conclusions of ICT and e-business deployment

Concerning the rate of Internet adoption, the TLS sector infrastructure, (which values close to saturation point)) and the rate of connectivity (more than a half of the sector firms have bandwidth connection, ranging from 144 kbit/s to 2 Mbit/s and other one third have more than 2 Mbit/s bandwidth connection) is totally prepared and ready for e-business development. For this reason, it will be practically unnecessary the inclusion of questions related to Internet or connectivity in future surveys.

Thus, the existing ICT infrastructure and e-business software systems analysed in the preceding sections led the TLS sector to a situation in which only a quarter of firms have not introduced any e-business activity in their normal operations. In the other hand, 10% of companies carry out most of their business processes in the e-business mode, while almost another quarter do so with a good deal of their processes and 42% use e-business with some of their business operations. In a general view, it can be concluded that 3 of 4 companies in the TLS industry use e-business in one way or another to realize their business activity (Exhibit 3.9-1).

Exhibit 3.9-1: Overall deployment of e-business in the TLS sector: % of companies* saying that most / a good deal / some / none of their processes are conducted electronically (2007)

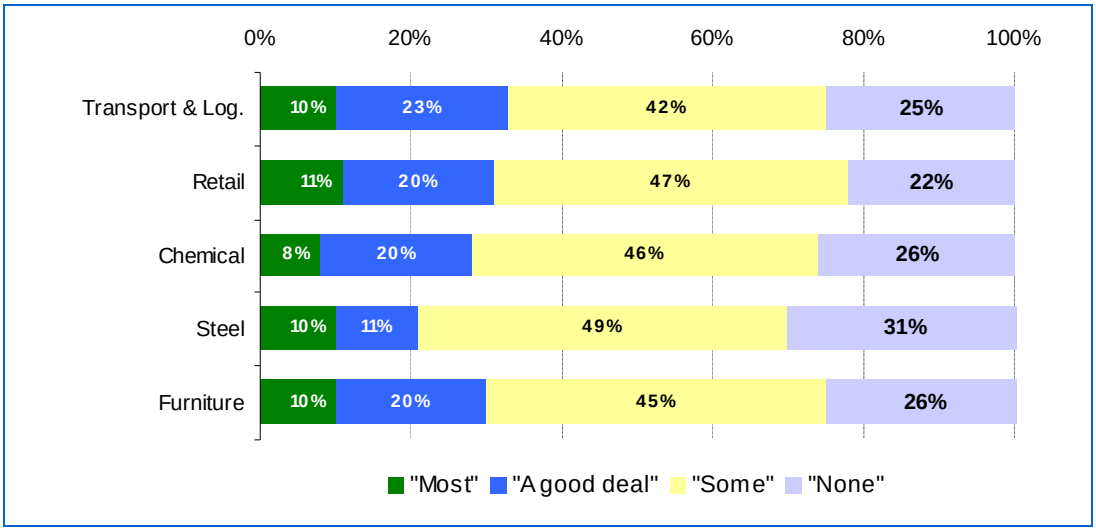


* weighted by employment ("firms representing x% of employment say that …")

Source: Sectoral e-Business Watch (Survey 2007)

The TLS sector presents, compared to four other sectors studied by the Sectoral e-Business Watch in 2007, a very similar uptake of e-business (Exhibit 3.9-2). For many of the indicators, figures for the TLS are ranked at the average of the four surveyed sectors.

Exhibit 3.9-2: Deployment of e-business in five studied sectors: % of companies* saying that most / a good deal / some / none of their processes are conducted electronically (2007)

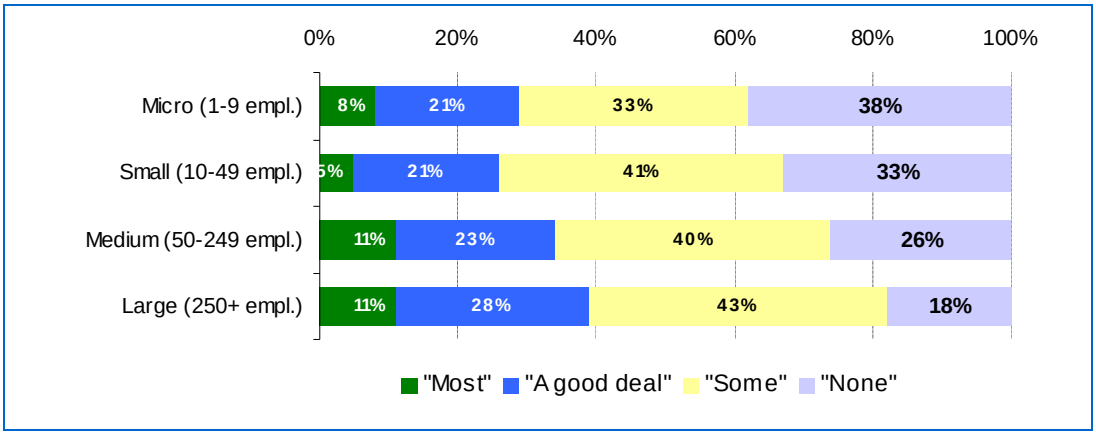


* weighted by employment ("firms representing x% of employment say that …")

Source: Sectoral e-Business Watch (Survey 2007)

The good news is that the usage of e-business in firm's daily business operations is almost the same for companies in the transport and logistics sector, independent of their size. Exhibit 3.9-3 shows this fact, where it can observed that overall, three third of small firms (67%) have adopted e-business in some more or less significant way, while 74% of medium-sized firms and 82% of large firms did the same. The figures for TLS micro enterprises (not shown in Exhibit 3.7-5) are quite relevant too: more than a half of micro firms (53%) in the sector ascribe e-business a more or less significant usage in their business operations.

Exhibit 3.9-3: Deployment of e-business in the TLS sector by firms' size: % of companies saying that most / a good deal / some / none of their processes are conducted electronically (2007)



Source: Sectoral e-Business Watch (Survey 2007)

This confirms the overall impression arising from this survey that there is a certain alignment of most of the TLS companies as regards the state of play in e-business. However, looking into the issue of company size, it is obvious that the size of an enterprise represent a barrier to ICT uptake. Small enterprises have fewer needs but they usually also have less resources to put into ICT – they employ fewer ICT practitioners and have less financial resources than their larger counterparts. Examples are the low adoption of ERP systems and advanced e-procurement solutions adopted by micro and small firms in the sector. However case studies as N.C. Cammack & Son (UK) (Section 5.9) and AIT (France) (Section 5.2) are good examples proving that cost and time savings for SMEs by effective use of ICT and e-business tools are equivalent with business development. The use of ICT will allow SMEs to make considerable gains from it as they can optimise business process and time.

According to the survey data, **large TLS enterprises** are currently **increasing focus on ICT issues**, as they have started introducing more advanced ICT solutions such as e-procurement systems, WMS, SMS, CRM systems and so on. This is in line with the discussion and case studies presented in chapter 5 of this report.

In this context and in light of the 2007 e-Business Survey findings, the most important conclusions about the use of ICT by TLS companies are summarised in the following box.

- **ICT practitioners**. Only medium (33% of firms) and large-sized firms (66% of firms) can afford employing ICT practitioners, while small companies usually do not employ practitioners (7% of micro and 9% of small-sized firms).
- **ICT standards**. The size of the company has too an enormous influence on the adoption of standards. About one third of medium-sized companies and more than 40% of large firms report that they use EDI. Only 7% of micro and 12% of small companies use EDI-based standards.
- **Open Source Software**. The use of OSS seems to be positively correlated to the size of the company in employees. In particular Internet browsers (including Mozilla and Firefox) based on OSS appear to be widely used by companies from the sector.
- **RFID**. There's a very limited use of RFID technologies yet. Only 2% of firms (23 from a total of 1097 surveyed firms) have declared that they do use this technology, mainly large-sized firms.

4 Drivers and impacts of ICT adoption

Chapter 3 assessed the current state-of-play in e-business in the TLS industry. It focused on trends in ICT usage, the diffusion of ICT-based applications and how they are used by companies, both for internal processes and for exchanges with other organisations or consumers. This Chapter focuses on the **economic impact of ICT** in the TLS industry, in particular by analysing links between ICT adoption and productivity growth, innovation, market structure and value chain characteristics. Econometric analysis and other statistical tools such as discrete choice models are used to explore ICT impacts in this sector.

The analysis is based on a conceptual framework that was developed from the "structure-conduct-performance" (SCP) paradigm (see below). For the analysis of the impact on productivity and links with the skills base, EU-KLEMS data have been used.[109] The analysis of links between ICT adoption and innovation, market structure and value chain characteristics is based on micro-data from the e-Business Survey 2007.

The "structure-conduct-performance" paradigm

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. For this study, an extended **Structure – Conduct – Performance (SCP)** paradigm was used as a conceptual framework for the analysis of ICT impacts.[110] 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 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

[109] EU-KLEMS is a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards. The compilation of this database was a project funded by the European Commission, Research Directorate General, as part of the 6th Framework Programme, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs". See www.euklems.net.

[110] 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.

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.

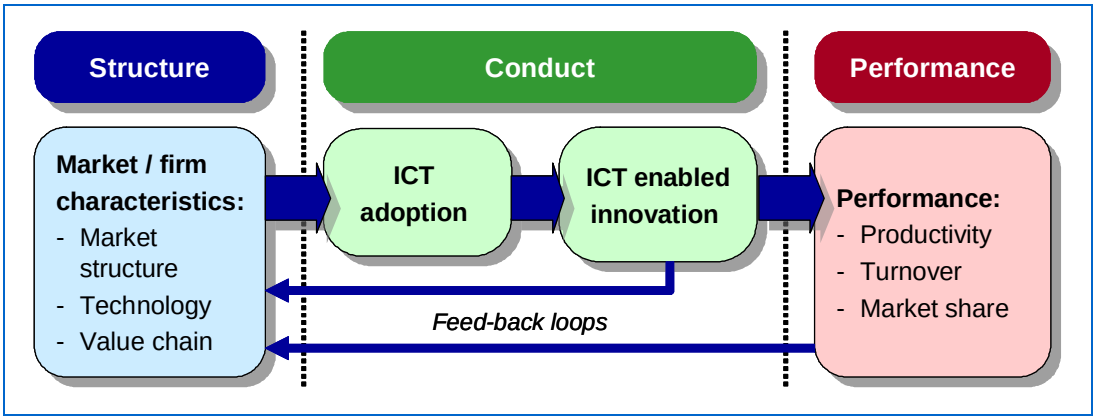
These industry structure components influence a firm's **conduct**. The conduct aspects most important here are production strategies, particularly with regard to inter-firm collaboration, as well as investments in ICT and in ICT-enabled innovation.

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 SCP 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 4.0-1: Conceptual framework for the analysis of drivers and impact of ICT adoption



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

Exhibit 4.0-1 illustrates the SCP model and the bi-directional relationships of its elements. The model allows one to identify firm and industry dimensions that can be considered as

relevant for the diffusion of ICT. For each of the links to be analysed, a number of hypotheses are proposed, based on a literature review and considering the data that are available for a given sector in EU-KLEMS and from the Sectoral e-Business Watch surveys. These hypotheses can be mapped against the extended SCP paradigm. For example, it will be empirically tested how certain aspects of market structure ("structure") are linked with the degree of ICT adoption ("conduct"); it will be assessed how the adoption of ICT hardware and software correlates with innovation activity of firms ("conduct"), and whether there are any significant links between innovation activity ("conduct") and turnover growth ("performance").

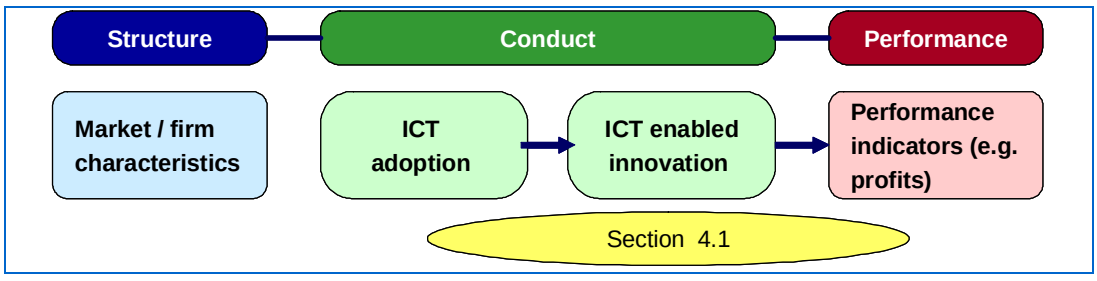
The Chapter is structured in three sections, each of which explores links between ICT adoption and a specific segment of the SCP model: Section 4.1 focuses on ICT impacts on **output** and **productivity growth**, considering the skills composition of the workforce as a complementary factor; Section 4.2 analyses links between ICT and **innovation dynamics**; and Section 4.3 looks at the relationship between ICT deployment and **competition** (market structure implications) and implications for outsourcing decisions.

4.1 ICT and productivity growth

4.1.1 Background and hypotheses

Studies on the impact of ICT confirm productivity increasing effects in both the user sectors and in the ICT producing sectors (Oliner and Sichel, 2000). In particular, ICT was found to have positive effects on labour productivity and total factor productivity (Pilat, 2005). An important finding is, however, that ICT-induced productivity effects vary significantly between sectors and among countries (Nordhaus, 2002). Recent research suggests that the largest productivity growth effect occurs in the ICT-producing sectors themselves, and in selected service industry sectors like banking, wholesale, retailing, and telecommunication (Jorgenson, Ho, Samuels, Stiroh, 2007, Jorgenson, Ho, Stiroh, 2007, Inklaar, Timmer, van Ark, 2007).

These results indicate that ICT-induced productivity effects are relatively less pronounced in other sectors, including transportation and logistics. On the other hand, empirical evidence shows that particularly the larger companies in the steel industry have dynamically adopted ICT. To further investigate this issue, this section will specifically analyse to what extent ICT-capital investments have effects on productivity growth (as compared to other factors) in the transportation and logistics sector. With reference to the Structure-Conduct-Performance framework (see introduction to this section), the analysis in this section focuses on the links between conduct (ICT adoption and innovation) and performance.



ICT-capital investment and total factor productivity growth

For the study of ICT impacts on firm-level productivity, two considerations are essential. First, as depicted in the conceptual framework (see above), ICT investment does not lead to productivity growth at firm-level by itself. It depends on how the technology is actually used in business processes, i.e. on a company's ability to innovate its work processes and business routines with support of ICT. Thus, only if ICT investment is combined with complementary investment in working practices, human capital, and firm restructuring will it have an impact on performance (cf. Brynjolfsson and Hitt, 2000).

The case study on *ALSA*, a Spanish road passenger transport company, confirms the success of combining the correct technology usage and the full use of the new ICT benefits (see Section 5.3). Moreover, although in general terms it can be said that *ALSA* have succeeded, the company have faced important challenges due to the poor workforce educational level (80% of the employees don't have high school studies). *ALSA* has detected some resistance to the changes and now is implementing training programs and looking for adequate intermediate manager positions profiles that help to tackle the organisational changes of the new e-business systems successfully.

These complementary investments and organisational changes are highly sector- and firm-specific; therefore, returns to ICT investments vary strongly across organisations (Pilat, 2005). Second, it has to be considered that outsourcing is an organisational innovation which can change firm-level productivity (Erber, Sayed-Ahmed, 2005).

Notwithstanding these considerations, the first step of the analysis is to assess the contribution of ICT-capital investment to productivity growth. It is assumed that it has become a key component of total factor productivity (TFP) growth (see Hypothesis P.1).[111]

Hypothesis P.1: ICT-capital investment has become a key component in value added and productivity growth in the transportation and logistics sector, while other capital inputs summarised as non-ICT-capital have diminished in their respective importance.

However, there are complementarities between other factor inputs which are imperfectly incorporated in the traditional other factors included in productivity measurement and growth accounting, such as labour and intermediate inputs. Therefore, it can be expected that total factor productivity growth jointly accelerates with higher investment in ICT-capital. This will be tested as a second hypothesis:

Hypothesis P.2: TFP growth in the transport and logistics sector has accelerated together with increased investment in ICT-capital.

Another important factor that may influence the extent to which ICT enables productivity growth is the complementarity between ICT capital and **skills**. A large body of literature on **skill-bias** in technical change supports the finding that technical change is biased towards skilled workers, reducing demand for unskilled labour and increasing wage

[111] TFP is a measure for disembodied technical change in a production process. Since no particular factor could be assigned as its sole origin, it has been labelled by some economists as a measure of ignorance. It is a residual between growth of an output indicator like gross value added or gross production value minus an aggregate index of factor inputs weighted by their respective factor shares. TFP is also named Solow residual, because Robert Solow (1957) was one of the first economists who pointed out the significance of disembodied technical change for economic growth opposite to the classical view that in particular capital accumulation, i.e. embodied technical change is the key driver of growth.

inequality and polarisation (Acemoglu, 2002). The impact is clearly visible in today's advanced economies; unskilled jobs have long been declining in absolute terms in Europe and growing only slowly in the US, while skilled jobs for educated workers are being created at a faster pace in most countries (Pianta, 2004). ICT tends to be a skill-biased technology and, thus, the application of ICT may increase the demand and wages for skilled labour and decrease the same for unskilled labour ('digital divide'). The analysis will therefore focus on the interdependence of ICT investments with skill requirements in the transport and logistics sector. This will help to understand the impact on employment dynamics in a more nuanced way than just assessing the net impact on total sector employment. The following hypothesis addresses this issue.

Hypothesis P.3: ICT and high- and medium-skilled labour have a positive impact on TFP growth in the transport and logistics sector.

The analysis to confirm or reject these hypotheses has been conducted in the following steps:

1. Section 4.1.2 looks at the overall development of **value added growth** in the transport and logistics sector and analyses the **contribution of different factors** including ICT-capital and non-ICT-capital, working hours and labour quality by means of growth accounting.
2. Section 4.1.3 looks at the overall development of **labour productivity growth** in the transport and logistics sector (from 1985-2004) and analyses the **impact of ICT-capital** investment on labour productivity growth (in terms of gross production value per total hours worked), based on an econometrically estimated stochastic production possibility frontier (SPF).
3. Finally, on the basis of the results, it is assessed whether the initial hypotheses can be confirmed or not (Section 4.1.4).

The empirical analyses in sections 4.1.2 till 4.1.4 will be based on data from the EU KLEMS project. In contrast to NACE 1.1 (classification code 60t63 "transport and storage"), the EU KLEMS database published by the Groningen Growth and Development Centre (GGDC) in March 2007 does not allow the retrieval of the data for land transport activities and related logistics services sector alone.[112] Hence our empirical analysis must focus on the more broadly defined sector "transport and storage" (code 60t63). The fact that the internet and globalisation have led to many closely-knitted inter-linkages between land, water and air transport and related services can be employed as an argument in favour of looking at the data at a somewhat higher aggregation level than the one envisaged for the qualitative research reported elsewhere in this text.

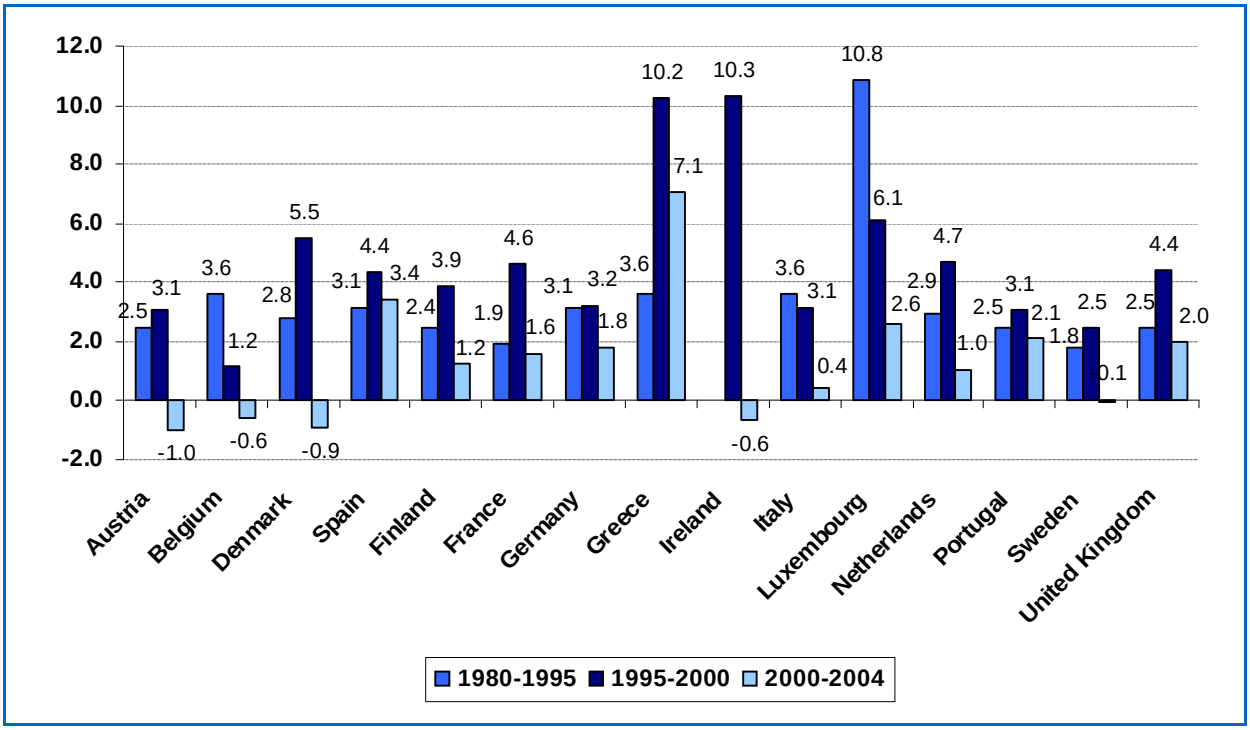
[112] NACE 1.1 defines the transport and logistics services sector as inland transport, water transport, air transport, and supporting auxiliary transport activities and activities of travel agencies.

4.1.2 ICT impact on value added growth

Gross value added growth in the TLS sector

Exhibit 4.1-1 depicts the annual average growth rates of gross value added (GVA) for three different time periods for the EU-15 countries. The pattern here is rather homogeneous for most of the countries reported, in that GVA was highest in the period 1995-2000 (12 out of 15 countries), and negative in a few occasions in the period 2000-2004 (4 out of 15 countries).

Exhibit 4.1-1: Annual growth of gross value added in the transport sector of the EU-15 (in %, three sub-periods)



Source: EUKLEMS database, GGDC; own calculations

Growth accounting of gross value added

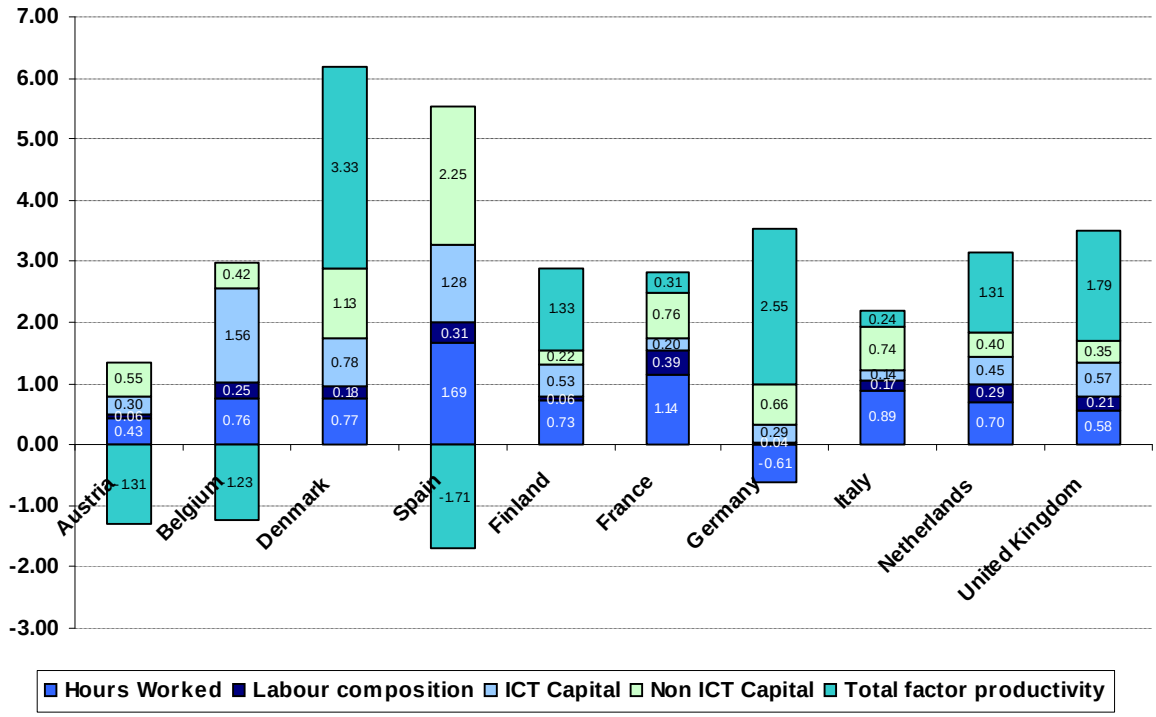
Growth accounting of gross value added components is a commonly used approach that enables the study of the relative contribution of different factor inputs to overall growth of output. In the following we analyse the composition of growth value added for a selection of EU member countries (for a somewhat more detailed account see also Table A.III-1 in Annex III).

Exhibit 4.1-2 presents the growth accounts for the average annual gross value added of ten EU member countries for which the necessary data was available over the period from 1995-2004. It can be seen that the contributions of the different components vary greatly among the member countries studied. Interestingly, we also find negative contributions in four out of fifteen countries, namely Austria, Belgium and Spain (total factor productivity growth) and Germany (hours worked), respectively.

For the seven countries where **total factor productivity (TFP) growth** is shown to be positive, it makes the largest contribution to value added in five cases. The contribution of **ICT capital** is larger than that of **non-ICT capital** in some of the countries (4) but smaller in others (6). Finally, it is rather unsurprising that **hours worked**, in general, contributes more to value added than labour composition.

Overall, we find hardly any evidence that ICT capital has an overarching role to play in terms of growth in gross value added. Belgium, however, stands out as an exception with a remarkable contribution of ICT capital of 1.56% on average to total gross value added growth of almost 3%. In another six out of the 10 analysed countries[113], changes in ICT capital are only the third-important component of value added growth. In the remaining four countries, changes in ICT capital are of even lesser importance.

Exhibit 4.1-2: Growth accounts for gross value added, transport and storage sector, in selected EU member countries, 1995-2004 (annual average growth rates in %)



Source: EUKLEMS database, GGDC; own calculations

4.1.3 ICT impact on labour productivity growth

Labour productivity growth in the transport and logistics sector

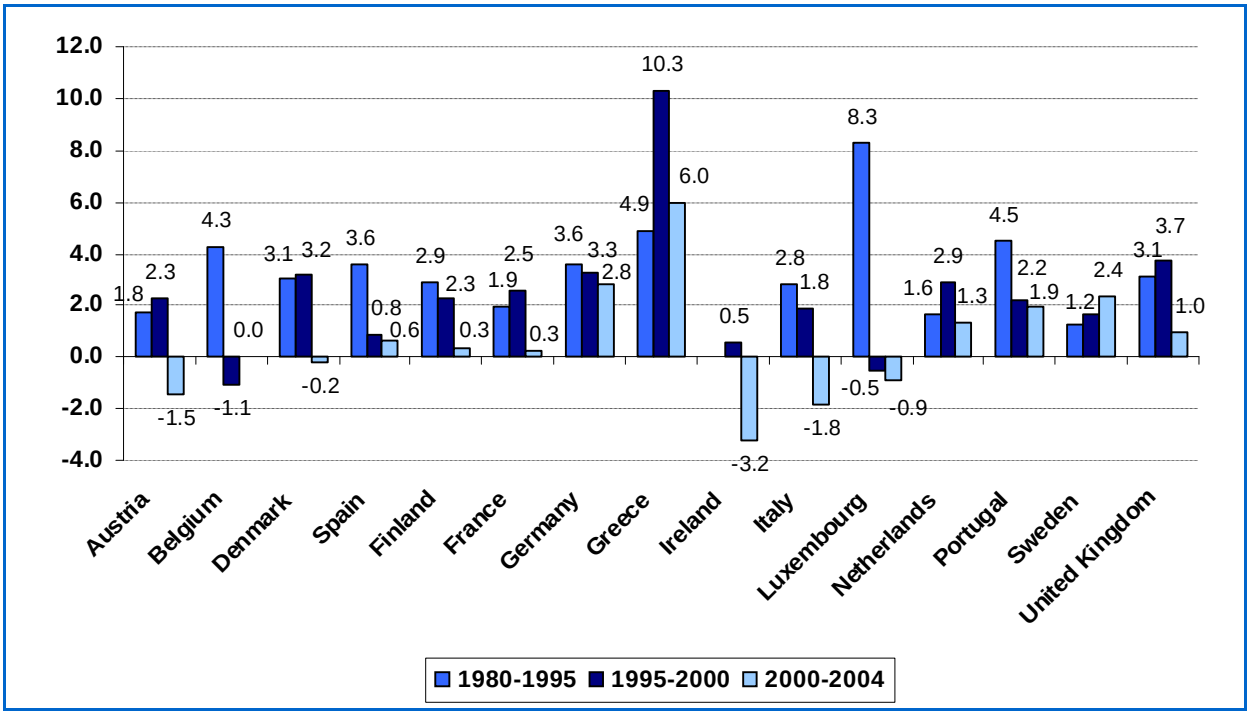
The EU KLEMS data contains consistent annual data for a subset of the EU-27 (typically the EU-15 or less). Data on labour input are available in terms of labour productivity, employment, average hours worked per employee and total working hours. The latter is further broken down in different skill categories (low, medium and high).

Exhibit 4.1-3 shows that pattern of labour productivity growth **varies a lot across the EU member countries**. Only a few countries exhibit negative growth in this sector, mostly in

[113] Namely Austria, Denmark, Spain, Finland, Germany and the UK.

the period 2000-2004. Also the trends in the growth rates between the different time periods considered are quite diverse: in some countries growth rates have been declining steadily (e.g. Finland, Germany and Portugal), while the reverse pattern can be identified for Sweden. Still other countries have experienced the highest growth rates in the late 1990s (e.g. Austria, Greece and the UK, among others).

Exhibit 4.1-3: Labour productivity growth in the transport and storage sector in the EU-15, 1980-2004 (annual average growth rates in %, various sub-periods)



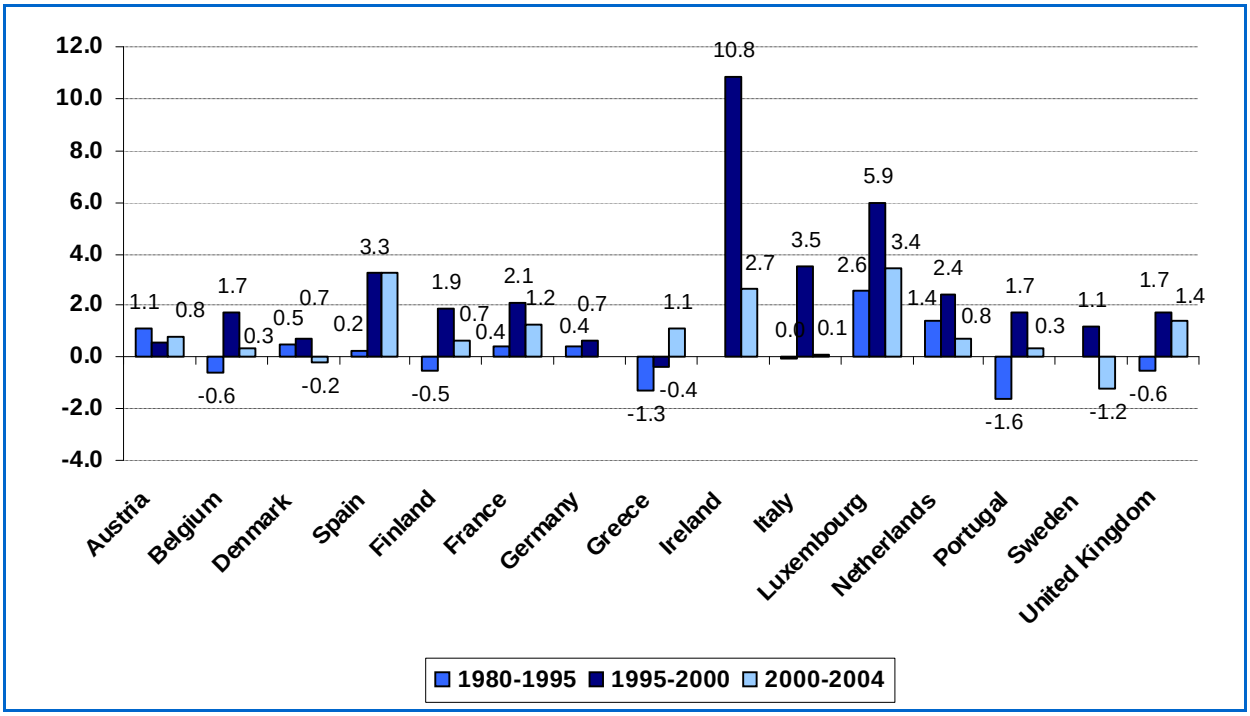
Source: EUKLEMS database, GGDC; own calculations

Expectedly and in line with other research (e.g. van Ark et al. 2003), we cannot detect an acceleration in labour productivity growth similar to that reported for the U.S. (Gordon, 2004; Jorgenson et al., 2007). High average growth in labour productivity can virtually only be detected for Greece (with remarkably high average labour productivity growth rates between 4.9 and 10.3%), and there seems to be not a single country where the growth rates are sustained over all observation periods (maybe apart from Sweden, which exhibits steadily increasing growth rates starting from a low 1.2% level). Overall, at least up to 2004 there seems to be little convergence among the EU-15 member states regarding common labour productivity growth patterns in the transport and storage sector.

Exhibit 4.1-4 reports the employment growth figures. Again, a rather **heterogeneous picture** can be detected, partly due to the negative figures of several member countries between 1980-1995 and the highly positive growth rates of others in the period 1995-2000. In many countries analysed, the growth rates for employment were highest in the period from 1995-2000. Overall, employment growth in the transport and storage sector has been rather modest, with few exceptions.

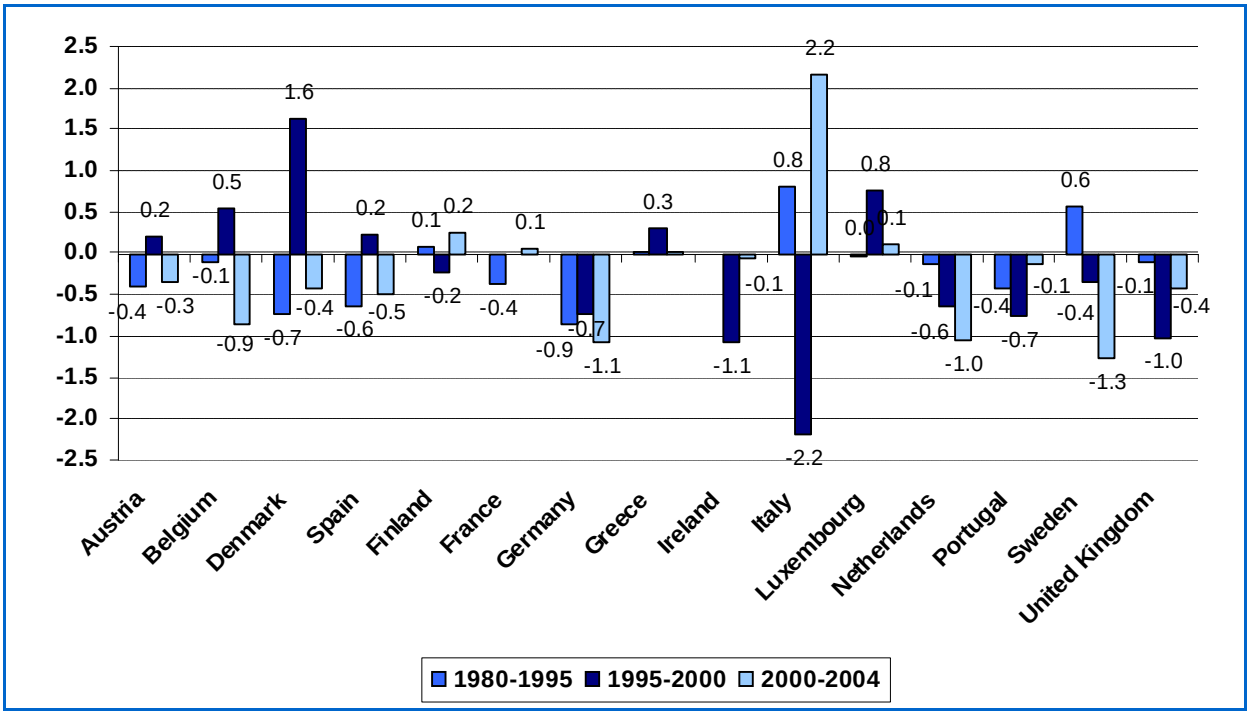
Exhibit 4.1-5 shows the comparison among the EU-15 countries in terms of average working hours per employee. Again, the picture is not very clear and steady trends rare.

Exhibit 4.1-4: Employment growth, transport and logistics services in EU-15 member countries, 1980-2004 (annual average growth rates, various sub-periods)



Source: EUKLEMS database, GGDC; own calculations

Exhibit 4.1-5: Average working hours per employee in transport intermediation services, EU-15 member countries, 1980-2004 (annual average growth rates, various sub-periods)



Source: EUKLEMS database, GGDC; own calculations

The impact of ICT on labour productivity growth

Based on the secondary intermediate inputs and the two primary input factors (i.e. capital, broken down into two different types of capital, and labour input measured in working hours, broken down into three different types of skills), we have estimated a **stochastic production possibility frontier** (SPF) model by using a panel data set for 14 EU member states for which all necessary data was available (defined as EU-14).[114] Specifically, we have used the error component model suggested by Battese and Coelli (1992), which allows for estimating the industry's efficient, state-of-the-art production possibility frontier at a certain time period (see Annex II for a description of the econometric approach).

In order to guarantee constant returns to scale for the production possibility frontier, the output and input variables were normalised by the total working hours. This led to a stochastic production possibility frontier restricted accordingly, where the real gross production value per working hour is explained by six factor intensities (i.e. using total working hours as a common denominator). To account for autonomous technical change, a time trend was included as an additional variable beside the constant term. Exhibit 4.1-6 shows the estimation results from using a Cobb-Douglas production function specification.[115]

Exhibit 4.1-6: Parameter estimates of a Stochastic Production possibility frontier (SPF) for the transport and storage industries, Error Component Model, 1995 – 2004

(Gross production value per total working hours based on EU-14[1] Multi-Country-Panel)

Explanatory variables	Coefficient	Standard error	t-value
Constant	0.03	0.01	2.66
Intermediate Input per TWH[2]	0.22	0.03	7.45
ICT-Capital Stock per TWH[2]	0.03	0.02	1.27
High-Skilled-WH per TWH[2]	0.21	0.09	2.37
Medium-Skilled-WH per TWH[2]	-0.05	0.03	-1.75
sigma squared	0.02	0.01	1.99
Gamma	0.96	0.02	49.68
Eta	-0.14	0.02	-6.10
Log-Likelihood	244.3		
No. of iterations	29		

[1] EU-14 - Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, UK

[2] TWH - total working hours

Source: EUKLEMS database of GGDC, own calculations. DIW Berlin 2008

The parameter estimates obtained are measures for the respective output elasticity of the input factor concerned. In other words, an increase by one unit in the respective input factor increases the output variable by one unit of the respective output.

[114] These are Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, and the UK. Data requirements include gross production value, total intermediate inputs, total working hours, ICT-capital stock, non-ICT capital stock and total working hours, where the latter are broken down further into three different skill classes (high, medium, and low skills).

[115] For the econometric estimation, the software package Frontiers 4.1 was used (Coelli, 1996).

With respect to the significance of the estimated parameter values we observe that except of the ICT capital stock and medium-skilled labour intensity, all other parameter values in Exhibit 4.1-6 are significantly different from zero at the 5% significance level.[116] Low-skilled labour and non-ICT-capital intensities are not included here since we found them to be insignificant even at the 10%-level.

As Exhibit 4.1-6 shows, based on the model coefficient values, the **intermediate inputs intensity** (0.22) and the **high-skilled labour intensity** (0.21) are found to be a **key components** of labour productivity growth. With respect to skill levels, **high-skilled labour** has a positive impact on productivity increases in the EU transportation sector while both, medium-skilled and low-skilled labour does not have a significant impact.[117] Compared to the results of analogous modelling exercises that we performed for other sectors, we found that labour skills play a more important role in influencing productivity in the transportation sector than in the steel industry, but a less important role than in the financial intermediation sector (essentially banking and insurance industry). Overall, this finding seems to be plausible.

In contrast, physical **ICT-capital investment** does not have a significant impact on labour productivity. This result contradicts other studies in this field such as Jorgenson et al. (2000) who found a high impact of ICT capital on U.S. labour productivity growth.[118]

Finally, **no significant average annual rate** of technical progress for the common production possibility frontier was found (see description of the approach in Annex II) for the transport sector.

4.1.4 Summary: ICT impact on output and labour productivity growth

This section analysed by means of econometric tools to what extent ICT adoption (measured as ICT capital investments) contributes to growth of value added and productivity. The results indicate that ICT capital by itself is not the main element, but that it rather requires complementary investments and organisational innovation.

- Growth accounting for the transport sector in 10 EU Member States suggests that changes in the ICT-capital stock have accounted only for minor shares of overall value added growth in this sector. Rather, the by far strongest contribution was found for TFP growth.
- Changes in ICT and non-ICT capital have had about the same importance for value added growth.
- However, ICT can be embedded in other infrastructure, for example in the complex equipment of the transport and logistics sector. Thus, there is probably a "hidden ICT-impact" which cannot be measured by means of the data on ICT-investment available in the database.

[116] *t*-values above 2 assure by a rule of thumb this 5%-signficance threshold of the test.

[117] For medium-skilled labour the estimated coefficient is not only insignificant but also exhibits a negative sign.

[118] In contrast to many related studies, our approach is also more disaggregate and avoids a bias in favour of physical input factors. Specifically, we have broken down labour input by skill class and based our analysis on gross production values instead of gross value added excluding intermediate inputs, i.e. accounting for primary input factors only.

- High-skilled labour intensity and intermediate inputs intensity are found to be key drivers for labour productivity growth (measured as gross production value per working hours).
- No significant average annual rate of technical progress towards the estimated production possibility frontier was found.

These observations have implications for policy. They suggest that **investments in training and skill-formation** are at least equally important as investments in ICT capital themselves in order to realise the optimal benefits. In other words, in a knowledge economy driven by rapid technical change, the ability to empower the work force is a necessary complementary measure to ICT adoption. Without having the right skills in place, costly investments bear the risk of becoming ineffective. Thus, revisiting the two initially specified **working hypotheses** (see 4.1.1), these cannot be confirmed:

No.	Hypotheses	Results	
P.1	ICT-capital investment has become a key component in value added and productivity growth in the transportation and logistics sector, while other capital inputs summarised as non-ICT-capital have diminished in their respective importance.	Cannot be confirmed. Growth accounting indicates that TFP changes have plaid a dominant role while ICT and non-ICT capital inputs have about the same importance; SPF analysis points at intermediate inputs as key drivers of labour productivity growth. **à** ICT by itself is not the key driver of growth in this sector	**no**
P.2	TFP growth has accelerated together with increased investment in ICT-capital.	No significant average annual rate of technical progress for the common production possibility frontier was found.	**no**
P.3	ICT and high- and medium-skilled labour have a positive impact on TFP growth.	Only high-skilled labour had a positive growth impact **à** indicates a skill-biased technological change with ICT-capital as its complementary factor driving growth of the transport sector.	**(yes)**

With regard to Hypothesis P.1, there is **mixed evidence** On the one hand, growth accounting confirms that, on the whole, ICT-capital has played a positive role in this industry in all countries. On the other hand, the analysis based on a stochastic production possibility frontier revealed that, due to greater detailed structure on the labour inputs decomposed on skill-classes and the inclusion of intermediate inputs, the direct positive link between ICT-capital investments and labour productivity growth is probably much weaker. Rather, the share of high-skilled labour and the intermediate inputs intensity appear to be of higher importance.

With regard to Hypothesis P.2, the growth accounting analysis in section 4.1.2 has not supported a possible relationship between investments in ICT-capital and TFP growth. Probably, this might be due to the time structure between investments in ICT-capital and its impact on TFP. The standard approach in growth accounting typically assumes that TFP-growth instantaneously increases with increased investments in ICT-capital. There might, however, be a time lag between the initial investment and implementation of new technology (and the respective organisational changes) and their actual impact on TFP-

growth.[119] This could partly explain why we could not find any strong relationship between the two in this analysis (see Exhibit 4.1-2). However, on the basis of this empirical evidence the hypothesis that there is an instantaneous impact of ICT-capital investments on total factor productivity growth has to be rejected.

Hypothesis P.3 was largely confirmed (see Section 4.1.3). The analysis indicates a skill-biased technological change with ICT-capital as the complementary factor driving productivity growth in the transportation sector.

4.2 ICT and innovation

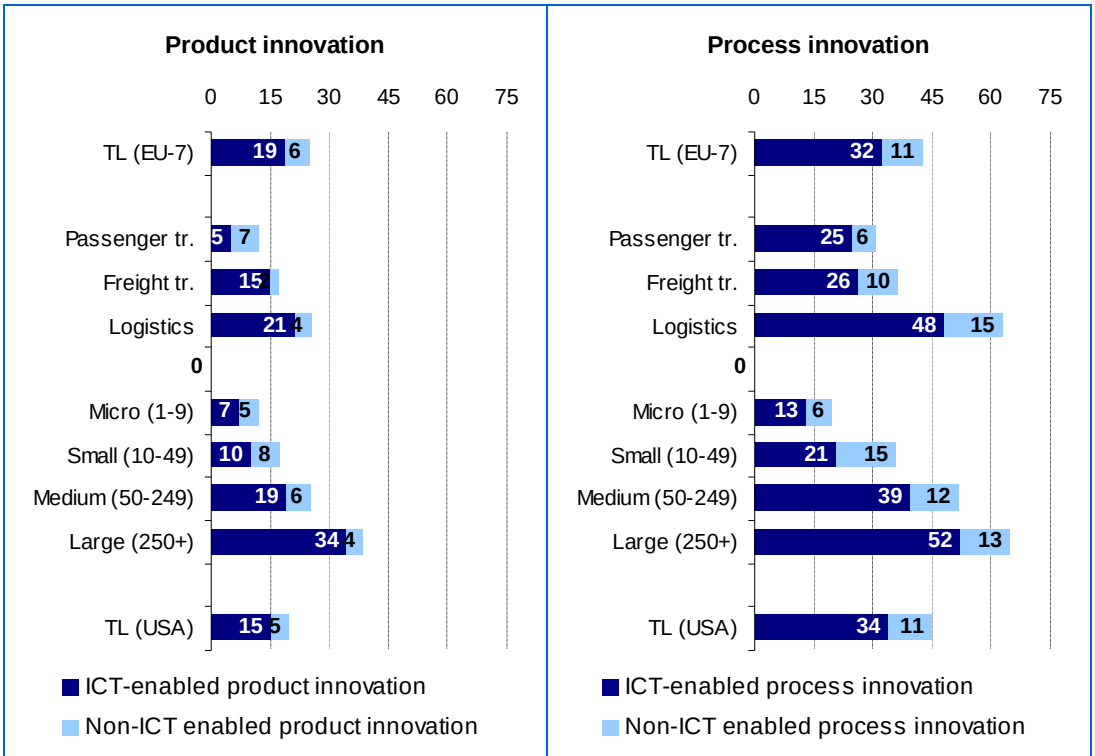
The growing diffusion of ICT in all areas of business is a major enabler of technological change, innovation and thus –ultimately– economic development. ICT-driven innovation activity is central to the subsequent effects of ICT economic impact. As a general purpose technology, ICT can have significant effects for downstream innovation in several sectors. For example, service innovation in the logistics industry can enable manufacturers to improve their customer service.

The links between the adoption of new e-business technologies and innovation are broadly recognised. ICT investments in general and e-business applications in particular, enable and drive process innovation. They are drivers, because ICT implementation, to be successful, typically requires changes in working routines. In micro-economic terms, a product or service innovation corresponds to the generation of a new production function. A process innovation, on the other hand, can be viewed as an outward shift of an existing supply function. One of the key findings in this study is that ICT is an important driver and enabler of innovation. The survey results show that 13% of enterprises (accounting for 25% of the workforce) in the TLS industry said that they had launched new or improved products in the 12 months before the survey. About 57% of these product innovations had been directly related to or enabled by ICT (see Exhibit 4.2-1). In the other hand, 22% of companies in the sector said that they had introduced new or improved processes during the last year, two third of them been ICT-enabled.

Notably, the relation of process and product innovation with ICT-enabled technologies is more evident in large-sized companies as can be seen in Exhibit 4.2-1. 38% of large companies had introduced some product innovation in the past 12 months, mostly (90%) related to ICT technologies, while the figures are 65% of companies that had introduced new or improved processes during the last year, 80% of them related to ICT technologies.

[119] This was confirmed, for example, for the telecommunication industry by an analysis on the J-curve of innovation (Erber 2005, Aral, Brynolfsson, Wu 2006).

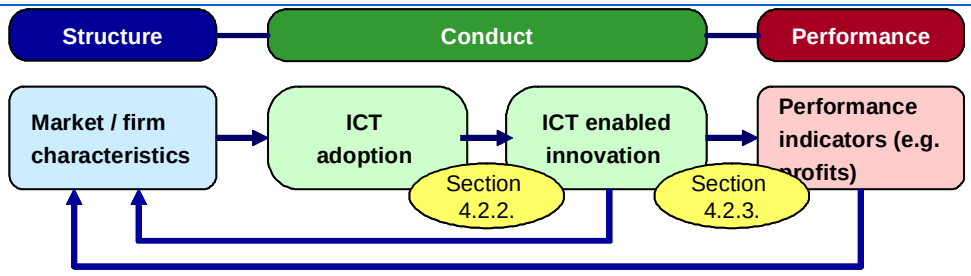
Exhibit 4.2-1: % of companies having introduced product/ process innovation (ICT enabled vs. non-ICT enabled, 2007)



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 (TLS, EU-7) = 997.
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.

Source: e-Business Survey 2007 by the SeBW

The following sections offer further insights to what degree specific factors are linked with ICT-enabled innovation in the TLS industry (4.2.2), and whether companies which conduct ICT-enabled innovation are likely to exhibit superior performance (4.2.3). In the Structure-Conduct-Performance framework (see introduction to this section), this analysis explores links between ICT adoption and ICT-enabled innovation, links between innovation and performance.



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

This section explores how the following two factors are linked with the degree of ICT-enabled innovation in a company.

- the **skills composition** of a company (measured as the percentage of employees with a college or university degree
- the use of **e-collaboration tools** (such as SCM or other applications to share information about inventory levels with business partners) to share data with business partners

The analysis is conducted at the micro-level, using data from the e-Business Watch Survey 2007.

Internal capacity

Knowledge stock and skills found a firm's absorptive capacity to adopt new technologies (Cohen and Levinthal, 1989). This, in turn, has positive impact on a firm's innovation performance. Thus, in order to develop marketable products or feasible production processes based on GPT, a firm needs to build up its knowledge stock and expertise, i.e. complementary assets. The most obvious example of investments in complementary assets include investments in software, training and organisational transformations that accompany ICT investments. In other words, firms that combine high levels of ICT and high levels of worker skills have better firm innovation performance. Thus, the following hypothesis can be formulated:

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

The hypothesis is tested on the basis of data from the e-Business Survey 2007. In order to focus the analysis only on ICT-enabled innovations, a dummy variable was constructed out of companies' answers to the questions on whether their product or service innovations introduced by a company in the last 12 months were directly related or enabled by information or communication technology. It takes a value of "1" if any product or process innovations were directly related to or enabled by ICT, and "0" otherwise. The main explanatory variable is the share of employees with a higher 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. Furthermore, the model includes also variables controlling for firm size, age and country of origin. Except for the variable on the share of educated employees, all independent variables are dummy variables, taking a value of "1" if a specific characteristic is identified, and "0" otherwise. To analyse the relationship between ICT-enabled innovation and the share of employees with a university degree, a probit regression was run.[120]

[120] Probit regressions are used to estimate the effect of a set of explanatory variables on a dependent variable that only takes on values of 0 or 1 (binary indicator variable).

Exhibit 4.2-2 reports the results of the regression.[121] An analysis of the results leads to the following conclusions:

- *Skills matter:* Changes in share of employees with a higher university degree positively affect the likelihood of conducting ICT-enabled innovations. Similarly, employing IT practitioners significantly increases firm's propensity to use ICT to develop new products and services. This finding provides further evidence that the success of the ICT-driven innovative process depends on the availability and quality of complementary assets.

Exhibit 4.2-2: Effect of employee skills on ICT-enabled innovation activity

Independent variable [a]	**Coefficient**	**Standard Error**
% of employees with higher university degree (G11)	0.005**	0.002
IT practitioners (E1)	0.920***	0.117
Less than 249 employees (Z2b)	-0.014	0.230
Firm founded before 1998 (G2)	-0.046	0.103
Model diagnostics		
N = 845		
R-squared = 0.09		
Note: Probit estimates. The table does not report the country coefficients. Base: Firms with >250 employees, founded after 1998 and based in the USA [a] Questionnaire reference. Dependent variable: D2 and D4 * Significance 90%, ** Significance 95%, *** Significance 99%		

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

Intra and inter-firm collaboration

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

The most obvious benefit of information integration with the help of ICT is the optimisation of the value chain that eliminates the bullwhip effect. Other, less obvious consequences for firms' innovativeness include creating communication infrastructures facilitating production networks or enabling partners to align the incentives of multiple players by creating joint business units or teams managing the same tasks (McAfee, 2006).

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

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

[121] 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.

The hypothesis is tested on the basis of data from the e-Business Survey 2007. Again, the analysis focuses only on ICT-enabled innovations. Independent variables control for the use of SCM systems and sharing information on inventory levels or production plans electronically with business partners. The regression includes also variables controlling for firm size, age and country of origin. All independent variables are dummy variables, taking a value of "1" if a specific characteristic is identified, and "0" otherwise. To analyse the relationship between ICT-enabled innovation and the use of electronic data and information exchange between business partners, a probit regression was run.

Exhibit 4.2-3 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 affect the likelihood of conducting ICT-enabled innovations.

Exhibit 4.2-3: Effect of electronic collaboration with business partners on ICT-enabled innovation activity

Independent variable [a]	Coefficient	Standard Error
Use of SCM (A7)	0.704***	0.139
Share information (B9)	0.599***	0.122
Less than 249 employees (Z2b)	-0.183	0.185
Firm founded before 1998 (G2)	-0.016	0.098
Model diagnostics		
N = 932		
R-squared = 0.09		
Note: Probit estimates. The table does not report the country coefficients. Base: Firms with >250 employees, founded after 1998 and based in the USA [a] Questionnaire reference. Dependent variable: D2 and D4 * Significance 90%, ** Significance 95%, *** Significance 99%		

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

4.2.2 Impact of ICT-enabled innovation

ICT-enabled innovation and firm performance

The effects of ICT on corporate performance are not clear because not all studies have demonstrated clear payoffs from ICT investments (Chan, 2000, Kohli and Devaraj, 2003). In addition, the results vary depending on how performance and ICT payoffs are measured and analysed. For example, 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 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 2005).

Indeed, Clayton and Waldron (2003), in a study on e-commerce adoption and business impact, find that businesses maintaining higher levels of new and improved product sales relative to turnover achieve above sector average rates of sales growth, i.e. they increase market share. The effect is present in both manufacturing and service sectors. Thus, the following hypothesis can be formulated:

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

The hypothesis is tested on the basis of data from the e-Business Survey 2007. The analysis focuses only on whether and how ICT-enabled innovations affect firms' performance. The dependent variable is a dummy variable that takes a value "1" if a firm reported a turnover increase in the last 12 months or "0" otherwise. Explanatory variables control for the introduction of any ICT-enabled innovations in the same time period, firm size, age and country of origin. All independent variables are dummy variables, taking a value of "1" if a specific characteristic is identified, and "0" otherwise. To analyse the relationship between a firm's turnover change and ICT-enabled innovation activity, a probit regression was run.

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

Exhibit 4.2-4 shows the results of the regression. An analysis of the results leads to the following conclusions:

- *ICT-enabled output is 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 a sales growth. Although turnover increase was used as dependant variable, this should not be read as a simple formula for success ("the more ICT-enabled innovation, the more turnover a firm will have"), as there are possible confounding factors[122] such as growth of a company in general. A similar result might also have been obtained by exchanging the dependent and independent variables, in the sense that successful companies (i.e. firms experiencing turnover growth) are more innovative. In any case, the results indicate that the dynamics of business growth and innovativeness are strongly linked, possibly reinforcing each other.

[122] Regression analysis is a technique used for the modelling and analysis of 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 for the modelling of causal relationships, one must be very 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).

Exhibit 4.2-4: Effect of ICT-enabled innovation activity on turnover increase

Independent variable [a]	Coefficient	Standard Error
ICT enabled innovation (D2, D4)	0.300***	0.095
Less than 249 employees (Z2b)	-0.128	0.184
Firm founded before 1998 (G2)	0.007	0.093
Model diagnostics		
N = 932		
R-squared = 0.07		
Note: Probit estimates. The table does not report the country coefficients.		
Base: Firms with >250 employees, founded after 1998 and based in the USA		
[a] Questionnaire reference. Dependent variable: G9		
* Significance 90%, ** Significance 95%, *** Significance 99%		

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

ICT diffusion and 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 email, knowledge management systems, wikis or instant messaging, considerably improve the process of innovation in knowledge-intensive and service-oriented sectors with informal, unstructured and spontaneous type of work, such as banking (McAfee, 2006). ICT facilitates firms' innovativeness by propagating innovations that are less structured than business processes. This leads to the following hypothesis:

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

The hypothesis is tested on the basis of data from the e-Business Survey 2007. The dependent variable controlling for organisational changes is based on companies' answers to the questions of whether they introduced changes in corporate strategy, management techniques, organisational structure and marketing concepts. 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.

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.[123] Exhibit 4.2-5 reports the results of the regression.

Exhibit 4.2-5: ICT use and organisational change

Independent variable [a]	**Coefficient**	**Standard Error**
Infrastructure index (A2, A3, A4)	0.000	0.002
Software index (A6, A7, B1, B3)	0.362***	0.060
IT practitioners (E1)	0.571***	0.195
% of employees with higher university degree (G11)	0.003	0.004
Less than 249 employees (G2)	-0.312	0.338
Firm founded before 1998 (Z2b)	-0.071	0.174
Model diagnostics		
N = 651		
R-squared = 0.05		
Note: Ordered logit estimates. The table does not report the country coefficients. Base: Firms with >250 employees, founded after 1998 and based in the USA [a] Questionnaire reference. Dependent variable: D5 * Significance 90%, ** Significance 95%, *** Significance 99%		

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

These results lead to the following conclusions:

- *ICT hardware of little importance for organisational changes:* Hardware endowment, measured in terms of network infrastructure usage and internet access, does not increase the likelihood of introducing organisational changes.
- *Software use and IT practitioners drive organisational changes:* The intensity of ICT applications and in particular IT-skilled employees are the major drivers of organisational changes. This together with the previous result indicates that ICT skills, 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. These are rather human

[123] 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.

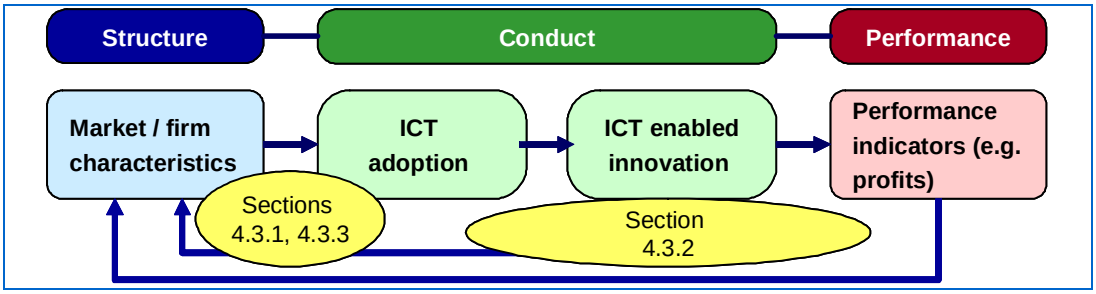
skills combined with innovative software that enable firms to rearrange their operations, functions and workflows, i.e. find innovative ways of doing business. Hardware infrastructure, in contrast, is already a commodity that does not offer companies any potential to create a competitive advantage.

4.3 ICT, rivalry in the market and outsourcing

This section explores to what extent the deployment of ICT is linked with competition in the market, the development of a company's share in this market, and firms' propensity towards outsourcing . More specifically, the following questions are studied:

1. How do companies perceive the impact of ICT on competition?
2. Does the intensity of competition, notably a perceived increase in the market rivalry, constitute an incentive to adopt ICT (as a tool to withstand competitive pressure, e.g. by cutting costs)?
3. Are companies that use ICT more intensively also more likely to experience market share?
4. Does a higher level of ICT endowment have an impact on a firm's "make or buy" decisions by facilitating the outsourcing of business processes?

In the SCP framework, these questions concern the relationship between market structure (market rivalry) and ICT adoption, as well as possible links between ICT adoption and performance, if market share is taken as a measure of performance.



4.3.1 Market structure and ICT diffusion

Increasing rivalry in the market might be another important factor that drives the adoption of new technologies and innovation, as companies search for new opportunities to cut costs by improving process efficiency or develop new products. Firms want to escape competition by innovating. This can be done by securing a monopoly position, which might stem from a successful innovation protected from imitating by means of a patent, a trademark, or a copyright. Furthermore, just by being the first in the market, a firm may secure an unchallenged position by building up the necessary capacity to enjoy substantial economies of scale, or strategic know-how. This leads to the following hypothesis:

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

The hypothesis is tested on the basis of data from the e-Business Survey 2007. The dependent variable accounting for the intensity of the ICT usage is a sum of answers to the questions regarding the internet connection type (score between 1 and 4), the use of LAN, WLAN, WWW, Intranet, Extranet, ERM, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners (one score for each positive answer). Thus, the variable can take values between "0" and "14". The independent variable indicates whether the rivalry in a firm's market increased in the last 12 months or not and takes a value "1" or "0" respectively. In addition, the regression includes dummy variables controlling for firm size, age and country of origin. To analyse the relationship between market rivalry and ICT adoption intensity, an ordinary least-squares regression was run.

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

- *Increasing market rivalry drives ICT usage:* The hypothesised relevance of increasing market competition for the intensity of ICT adoption was confirmed. In other words, more intense competition forces companies to use innovative technologies to cut costs and look for more innovative ways of conducting business.
- *Firm size is an advantage:* Firm size appears to have a considerably strong effect on the adoption of ICT.

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

Independent variable [a]	**Coefficient**	**Standard Error**
Increasing rivalry (G8a)	0.633**	0.257
Less than 249 employees (G2)	-3.637***	0.471
Firm founded before 1998 (Z2b)	-0.148	0.239
Model diagnostics		
N = 932		
R-squared = 0.10		
Note: OLS regression. The table does not report the country coefficients. [a] Questionnaire reference. Dependent variable: A2, A3, A4, A6, A7, B1 and B3 * Significance 90%, ** Significance 95%, *** Significance 99%		

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 market 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. These firms use ICT to surpass the whole retailing sector and to sell their goods directly to customers instead of depending on a network of retailers. This leads to the following hypothesis:

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

The hypothesis is tested on the basis of data from the e-Business Survey 2007. The dependent variable accounting for the change of a firm's market share can take one out of three values: "0", if the market share decreased, "1" if the market share stayed the same or "2" 0", if the market share increased in the last 12 months. 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 (score between 1 and 4), the use of LAN, WLAN, WWW, Intranet, Extranet, ERM, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners (one score for each positive answer). Thus, the variable can take values between "0" and "14". In addition, the regression includes also dummy variables controlling for firm size, age and country of origin. To analyse the relationship between the change in market share and ICT endowment, an ordered logit regression was run.

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

- *ICT enables firms to expand:* The hypothesis that ICT enables firms to extend their operations was confirmed. Companies that intensively use ICT applications are likely to take advantage of their potential to increase their market reach and relative position to the competitors.
- *Firm age relevant for the positive development of market share:* Firm age negatively affects a firm's chances to increase its market share. This might indicate that younger firms tend to grow at the expense of their older competitors.

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)	0.070***	0.020
Firm founded before 1998 (Z2b)	-0.306**	0.149
Less than 249 employees (G2)	-0.073	0.315
Model diagnostics		
N = 872		
R-squared = 0.02		
Note: Ordered logit estimates. The table does not report the country coefficients. Base: Firms with >250 employees, founded after 1998 and based in the USA [a] Questionnaire reference. Dependent variable: G7 * Significance 90%, ** Significance 95%, *** Significance 99%		

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

4.3.3 ICT deployment and outsourcing

Following 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. The following hypothesis is formulated:

Hypothesis V.2: ICT endowment is positively correlated with outsourcing.

The hypothesis is tested on the basis of data from the e-Business Survey 2007. The dependent variable can take a value "1" if a company outsourced any of its business activities in the last 12 months, or "0" if it did not. The explanatory variable controlling for a company's ICT endowment level is an index composed of answers to the questions regarding the internet connection type (score between 1 and 4), the use of LAN, WLAN, WWW, Intranet, Extranet, ERM, SCM, CRM, the use of the internet to sell and buy goods and employing IT practitioners (one score for each positive answer). Thus, the variable can take values between "0" and "14". In addition, the regression includes dummy variables controlling for firm size, age and country of origin. To analyse the relationship between the change in market share and ICT endowment, a probit regression was applied. Exhibit 4.3-3 reports the results of the regression.

Exhibit 4.3-3: The intensity of ICT use and outsourcing

Independent variable [a]	Coefficient	Standard Error
ICT endowment (A2, A3, A4, A6, A7, B1, B3)	0.059***	0.017
Less than 249 employees (G2)	0.050	0.237
Firm founded before 1998 (Z2b)	0.211*	0.125
Model diagnostics		
N = 932		
R-squared = 0.051		
Note: Probit estimates. The table does not report the country coefficients. Base: Firms with >250 employees, founded after 1998 and based in the USA [a] Questionnaire reference. Dependent variable: G22 * Significance 90%, ** Significance 95%, *** Significance 99%		

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

These results lead to the following conclusions:

- *The ICT intensity increases the propensity to outsource 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 12 months. This provides support to the hypothesis that ICT enables companies to redefine their make-or-buy decisions and to outsource business activities that were previously done in-house.

- *Firm age relevant for outsourcing decisions:* Firm age positively affects the chances of a firm outsourcing some business activities that were previously done in-house. In other words, young firms already use state-of-the art technologies and organisational structures, whereas older companies might need to adapt to new market conditions.

4.4 Summary of impact analysis

Productivity and employment

Regarding the role of ICT capital in the transport and logistics sector, the economic analysis found the following evidence:

- Little evidence for a significant role of ICT capital in terms of gross value added growth;
- Little evidence for a significant role of (and neither for significant correlation between) ICT capital in terms of boosting labour productivity growth;
- Little evidence for convergence of the EU Member Countries in terms of common patterns regarding GVA and labour productivity growth.

With regard to the hypothesis formulated, we can make the following two conclusions: First, the growth accounting decomposition confirms that ICT capital played an important role for the majority of the countries studied (albeit not for all). Second, our stochastic production possibility frontier approach, which enabled both the decomposition of the labour input by skill class and the inclusion of intermediate inputs, revealed that the direct linkage between ICT investment and labour productivity may actually be much weaker than the evidence from more aggregate studies suggests. Instead of pure ICT capital growth, an adequate use of human capital and strong total productivity growth, as well as the outsourcing of non-core activities may actually play a more important role.

Finally, there seems to be some (preliminary) evidence regarding the time structure of TFP growth accelerations. In the standard growth accounting literature, TFP growth instantaneously rises with increased investment in ICT capital. This is in contrast to case studies, which indicate that often there are significant lag times in reaping the benefits that can be reaped from adopting new technologies and organisational change (see e.g. Aral et al., 2006, p.4). Such time lags might explain the mixed results from evaluating the EU KLEMS database when comparing the changes between ICT capital stock growth and TFP growth across the sample of EU member countries used in our analysis for the three time periods 1980-1995, 1995-2000 and 2000-2004, respectively (see Annex III). The results from our empirical analysis indicate that an instantaneous impact of ICT capital investment on total factor productivity growth does not take place, so that this hypothesis has to be rejected.

Innovation, market structure, value chain

The analysis based on the e-Business Survey 2007 data allows identifying the driving forces of ICT and its impact on selected business dimensions. On the driver's side, there are three points that are worth mentioning. First, increasing market competition is one of the driving forces behind ICT usage. In other words, more intense competition make

companies use innovative technologies in order to cut costs and look for more innovative ways of conducting business. This, in turn, enables them to withstand the effect of increasing rivalry. Second, the relationships of companies interacting with each other play an important role in the diffusion of ICT applications supporting inter-firm collaboration. Close relationships facilitate investments in specific technologies. Third, the success of the ICT-driven innovative process depends on the availability and quality of complementary assets such as employee skills and IT know-how.

On the impacts' side, the following issues draw one's attention: First, companies advanced in terms of ICT usage are more likely to have outsourced business activities. This provides support to the hypothesis that ICT enables companies to redefine their make-or-buy decisions. However, a detailed analysis shows that the intensity of ICT applications and IT-skilled employees are the major drivers of organisational changes. Hardware infrastructure, in contrast, offer companies less potential to create a competitive advantage compared to software applications and skilled employees. Second, ICT usage has a positive impact on company performance, i.e. firms that introduced ICT-enabled innovations were more likely to have experienced a sales growth and increase market share.

5 Case studies

Overview

Case studies and business examples presented in this chapter should be regarded as illustrative examples for the issues that are discussed in this study. Cases are by definition individual manifestations of e-business practice and are not necessarily representative for the industry as a whole. Nevertheless, some observations and conclusions on current e-business activity in the transport and logistics industry can be drawn from the cases. The selected case studies are briefly introduced in the table below.

Case studies / business examples	Case illustrates issues discussed in section(s)
Case study 1: e-Business systems of AISA, Spain. AISA is Spanish road passenger transport company that operates lines of regular and discretionary road passenger transport in some regions of Spain like Madrid and Castilla-La Mancha. This case study summarises how the implementation of a centralised information system can help a passenger transport company like AISA to reduce its planning and decision times, making the organisation more reactive to early changes in demand, markets and internal issues and also analyses the impacts of the system in this bus transport company	**3.6 Improving Customer Service: e-Marketing** 3.6.2 e-ticketing: a commitment towards innovative retailing and ticket solutions
Case study 2: Optimising the transport and logistics management for SME at AIT, France. Being faced to intense competition, structural changes of the market and resulting declining revenues, AIT, a supplier of transport and logistic services located in France near Lyon, decided to implement a new transport and warehouse management solution. The objective of the solution implementation was double: on the one hand the objective was to support the company in organising the multimodal transport for their customers and in managing its warehouse activities and on the other hand to provide the company with detailed data analysis on the whole company activity.	**3.4 Internal process integration** 3.4.2 e-Integrated supply chains: SCM, WMS and ICT links with suppliers
Case study 3: e-Business systems of ALSA, Spain. The implemented ICT solution and e-business systems have brought ALSA, a Spanish road passenger transport company, a lot of benefits and positive impacts including the opening of new sales channels, intelligent bus seat management, cost advantages and increase in the global competitiveness of the company.	**3.6 Improving Customer Service: e-Marketing** 3.6.2 e-ticketing: a commitment towards innovative retailing and ticket solutions
Case study 4: Improving terminal operations through an Electronic Document Solution at CEMAT, Italy. Discussion of challenges and success factors for implementing an e-solution for the operation of transport terminals, secure the transport delivery process and improve the transport document management for CEMAT and its customers.	**3.4 Internal Process Integration** 3.4.1 Use of software systems for internal process integration

Case study 5: "xSell" – e-ticketing & e-reservation at CFR Călători, the national Company for Passenger Railways Transportation, Romania. As part of the modernisation programme and to be more competitive, an e-ticketing/e-reservation system has been implemented all over Romania. This case study demonstrates the importance of e- business solutions for the modernisation of the public rail transport sector in Romania. **Business example: National e-ticketing system in the Netherlands** The new payment system for the Dutch public transport system in travelling either by train, metro, tram or bus. The OV-chipkaart system ensures that all transactions generated by the use of the public transport smart card are processed.	3.6.2 e-ticketing: a commitment towards innovative retailing and ticket solutions
Case study 6: Clic Services Fret SNCF: Improving customer service through the deployment of an e-service portal at Fret SNCF, France. This case study demonstrates how a company with a comparatively low Information and Communication Technology (ICT) culture managed to implement a successful and innovative e-business solution in a relatively short time.	**3.5 e-Procurement and Supply Chain Integration** 3.5.1 B2B online trading: companies placing orders online
Case study 7: Automated Warehouse Management at Geodis, Belgium. This Case study represents a typical example for automated warehouse management as it is used in the logistic sector. It demonstrates the benefits and requirements for a successful implementation of such a solution.	3.5.2 e-Integrated supply chains: SCM, WMS and ICT links with suppliers
Case study 8: Integrated software management with GPS train control at Hupac, Switzerland. Discussion of challenges and success of the application of an innovative IT solution that manages transport information in real time and coordinates all phases of intermodal traffic from departure to arrival, implemented by Hupac of Switzerland.	**3.6 Improving Customer Service: e-Marketing** 3.6.1 Companies receiving orders from customers online
Case study 9: 'Truck Business' at N.C. Cammack & Son, United Kingdom. From its base in Colchester, UK, N.C. Cammack & Son provides transport, distribution and warehousing services to the UK and Europe. The key features of the ICT solution are the automation of transport, warehousing, and workshop tasks; stock control; and online access for both, clients and employees. The main benefit of this solution is a superb 'just-in-time' performance at the firm allowing customers to online view and monitor stock levels, keep pace with demand and check the order shipment status.	3.5.2 e-Integrated supply chains: SCM, WMS and ICT links with suppliers

Case study 10: Cargo Tracing at Saima Avandero, Italy. Saima Avandero is a logistics and international freight forwarding company. The headquarters is located in Milan. This case study analyses the benefits of a track and trace solution, the different obstacles that Saima Avandero had to overcome to implement this solution as well as current issues faced for the operational solution. It particularly points out the difficulties of guaranteeing a good quality of information in an environment of multiple and small supplier, as it is the case for Saima Avandero in Italy.	3.5.2 e-Integrated supply chains: SCM, WMS and ICT links with suppliers 3.4.1 Use of software systems for internal process integration
Case study 11: Real-time passenger information system at Trafikanten, Norway. Trafikanten is the joint information provider for the two public transport authorities (PTA) in the Oslo region of Norway. Trafikanten deployed an innovative real-time passenger information system providing travellers with reliable information on real-time departure times of public transport vehicles. Real-time vehicle departure information is calculated with the help of a combination of location positioning systems, distance measuring devices, travel planning information and other parameters.	**3.6 Improving Customer Service: e-Marketing** 3.6.2 e-ticketing: a commitment towards innovative retailing and ticket solutions 3.4.1 Use of software systems for internal process integration
Case study 12: Improving public transport management through vehicle monitoring solution at Värmlandstrafik AB, Sweden. Värmlandstrafik is a public owned local transport company in one of Sweden's regions called Värmland. In order to improve the management of contracts with the different transport operators and providing a better service to the public in its region, Värmlandstrafik implemented a vehicle monitoring solution in 2004 enabling the company to have clear visibility on operation of the transport vehicles. Key information provided by the system about functional disabilities, safety/security issues and environmental information allows the company to draw important conclusions when making decisions.	**3.4 Internal process integration** **3.6 Improving Customer Service: e-Marketing**

5.1 e-Business systems of AISA, Spain

Abstract

AISA is Spanish road passenger transport company that operates lines of regular and discretionary road passenger transport in some regions of Spain like Madrid and Castilla-La Mancha. The company is now involved in a process of implementation of an e-business project related to the centralisation of all the business information related processes of the 11 different company centres. This project has a very positive impact on the planning and operations times, thanks to the optimisation of the internal information flow in the company that is one of the main objectives of the system.

This case study summarises how the implementation of a centralised information system can help a passenger transport company like AISA to reduce its planning and decision times, making the organisation more reactive to early changes in demand, markets and internal issues and also analyses the impacts of the system in this bus transport company.

Case study fact sheet

■ *Full name of the company:*	*AISA (AutoMNIBUS Interubanos, S.A.)*
■ *Location (headquarters / main branches):*	*Valdemoro (Madrid), Spain*
■ *No. of employees:*	*388*
■ *Sector:*	*Transport*
■ *Main business activity:*	*Road Passenger Transport. Regular. Urban and Interurban*
■ *Primary customers:*	*Public Administrations and final users*
■ *Year of foundation:*	*1942*
■ *Turnover in last financial year (€):*	*28 € million*
■ *Most significant market area:*	*Spain (Madrid and Castilla-La Mancha regions)*
■ *Main e-business applications studied:*	*Centralised information system, RFID*

5.1.1 Background and objectives

The goal of this case study is to demonstrate an example of the adoption and usage of e-business systems in AISA, a Spanish road passenger transport company with regional market focus, analysing the major business impacts and results on the company. AISA is a road passenger transport company that operates in Spain and mainly in interurban regular bus lines, with a total of 388 employees. The vehicle fleet of AISA consist of 192 buses, operating in 170 different passenger transport lines. AISA operates in different areas of the road passenger transport services including:

- regular road passenger transport, interurban
- regular road passenger transport, urban
- school bus services.

One of the main aspects of the market in which AISA operates is that in Spain the operation of regular public passenger transport services by road is regulated by

administrative transport concessions, controlled by the public authorities. Normally the companies compete to obtain these long term transport concessions presenting their service proposals when a public bidding process is open (normally each four years). In the evaluation process to obtain new line concessions there have been traditionally some important factors like the vehicles characteristics, additional services, transport security, etc. However future concessions are probably going to take into account also new ICT implementation aspects, like internet sales, web page, centralised information systems, etc.

Some of the administration clients of AISA, like the regional transport consortium of Madrid region (Consorcio Regional de Transportes de la Comunidad de Madrid), one of the main clients of AISA, require monthly statistics and data on passengers, sales figures, etc. for consolidation, settlement and result evaluation of services and operations. Without an automated and computerised information system it would be impossible to generate this type of operation data to satisfy these client demands. AISA innovates to be prepared for these processes with suitable e-business solutions like the new centralised information system.

An example of the computerisation of the different process is the ticketing system. The company buses now have onboard electronic ticketing generation and validation systems, approved by the public administration client. These ticket machines enables AISA to use the information generated in every bus of the company to generate useful information and statistics on the operations, using the information downloaded from the machines and consolidated in the computers of the company, with a centralised analysis of the relevant information.

5.1.2 e-Business activities

The new centralised information system implemented by AISA enables the company to integrate and consolidate its different business centres.

AISA is now in a process of ICT adoption with some major e-business projects in preparation or implementation phase to increase the control of the operations and optimise the processes minimising operation times and improving reaction times to the market changes or probable future scenarios in the market. he first steps prior the implementation of the centralised information system of AISA started with the introduction of computers in the year 2000. In this year the company had four computers operating. The computerisation of the main business processes of the company started in the year 2000 and now, in 2008 the company has more than 50 computers.

The big change in the computer adoption in the last has eight years has been the computerisation of all the processes. This long and complex process has replaced previous manual processes with automated processes using computer systems and applications. The computerisation of processes has represented a major operational change for the company.

This centralised information system started as an e-business system project in the third quarter of 2007. The main objective was to integrate information flows of the different company facilities, including the offices, buses, lines and garages. This should enable the company to speed up information processing, planning, reporting and daily operation control tasks. The technical backbone of this centralised information system are two high

capacity computer servers (from Hewlett Packard) in the central company office. They are connected with all computers in centres with offices and ticketing offices.

This way, AISA collects and aggregates data from its various facilities, for example bus information form the ticket machines, ticket systems onboard the busses and ticket offices, and can then process and analyse the data in real-time to support the management of its daily operations. The system has different application modules for different operations and type of centres. Data flows are integrated with the accounting, analysis, planning and control systems of the company. The accounting information from the different company centres are integrated in the central servers.

The company has designed this proprietary system in conjunction with its ICT provider and a specialised consulting company. AISA uses a service provided by its telecommunications provider (Telefonica) to run a company network (standard VPN – Virtual Private Network). The systems can be expanded in the future with more modules or applications. Data are transmitted via regular broadband network connections (ADSL) with a download speed of 8Mbit/s in the central offices and 3Mbit/s in the rest of the centres.

System applications have been created by different ICT providers. The main applications of the centralised information system are interconnected. Some examples of important applications integrated in the system are:

- vehicle operation and management;
- accounting and payroll software;
- panning;
- garage software for management.

A practical example of applications enabled by the company-wide integration of data flows is a new timetable which manages the timetables of all individual workers and automatically links these data to the payroll application. The system combines some features typical form systems like ERM and ERP. It enables AISA to improve the planning and control of:

- Operations
- Human resources
- Vehicles
- Services
- Cash management
- Accounting systems
- Reporting systems
- Ticketing systems (sales)

The system has been customised to the company needs for reporting, accounting, controlling sales, information analysis and operations areas. Moreover, the design of the applications takes into account the requirements and information needs of the major clients (public administration). The applications can be adapted to specific needs.

An example of another innovative e-business system is the Telemat systems (provided by Repsol). This system consists of the implementation of RFID chips in the fuel tank area of the buses that to control the fuel consumption of the bus and opt to a professional fuel subsidy from the Spanish Government. The chip is read in a computerised petrol pump (with a reader chip) when the vehicle is filling up. The chip has information on the

numbers of vehicle and driver, the time of filling up and the number of kilometres done. This system has led to significant cost reductions due to the fuel subsidy save.

The company also innovates in some different areas like contact less cards, using magnetic technology. The company has future project for the implementation of GPS systems and WiFi implementation onboard the buses for data transfers in the garages. However the main e-business priority is the accomplishment and finalisation of the information centralised system.

5.1.3 Impact

Although the integrated information management system is a major enabler for process innovation at AISA, it has not caused any radical or disruptive organisational changes. The main changes concern tasks and responsibilities of the personnel, internal work processes, and some personnel changes. The centralised information system has had a positive impact on the company and its business.

In particular, reporting, planning and controlling processes have been significantly improved. These processes can be accomplished much faster and based on much more accurate data, which facilitates decision making in operational management. This time reduction also implies a cost optimisation due to the improved control of operations and the reduced reaction times to unforeseen events and problems.

AISA plans to measure the time reductions achieved with the system when it will be fully integrated (with the new software version operating).

The centralised information system has also a positive impact on data security. It is now possible to make back-up copies of all the relevant data from the central servers, avoiding duplicating task and minimising the risk of losing important data. The system allows eliminating existing duplicated processes and reducing errors in the information process, reducing the costs of information processing for the company.

The system has had some implications for the company's office workers (about 50 employees). As processes and applications are now running in remote mode (and no longer in local mode), files have to be saved on the server and not in the local hard drive. Employees have been trained to use the new system properly.

The Telemat system of RFID chip for fuel subsidy has very positive impacts in the cost reduction thanks to the fuel subsidy save. It allows has a poimpacts on fuel consumption efficiency and energy sustainability (climate change positive effects), with detailed consumption information by lines, vehicles, etc. This is important for the company as AISA is certified with ISO 14001 standard (environmental certification) and ISO 9001.

Due to these improvements in work flows and information management, and the resulting improvements in cost efficiency, the system contributes to the competitiveness of AISA and leads to better customer satisfaction.

AISA says that the system is highly profitable (investment vs. results). The total estimated cost of the system was about €100,000. However the preparation process and design of the applications has been a challenge.

5.1.4 Lessons learned

This case is an example of an effective and profitable ICT project in the road passenger transport sector. However, the complexity of the implementation of a centralised information management system must not be underestimated. One of the main challenges was actually the adoption process by the users. Once the information system was internally accepted and users were accustomed to work with it, the positive effects became visible almost immediately. The information system led to reduced human errors in information processing, as former manual processes could be automated. It also reduced the response times to internal and external changes that affect the company services and operations.

The elimination of manual processes and duplications of work has greatly improved company operations, planning and decision making. The remote information access is an interesting feature of the system and contributes to the efficiency of the internal business processes.

The project is currently in the implementation stage. There are continuous changes and improvements in the process of implementing the different parts of the system, in order to maximise the results of the tools for the company.

5.1.5 References

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

- Interview(s) with AISA Quality Manager and responsible of the centralised information project (Madrid, 2008)
- Websites: AISA (www.aisa-grupo.com)

5.2 AIT, France

Abstract

AIT is a supplier of transport and logistic services located in France near Lyon with 60% of its turnover generated on the international market. The company employing 42 people provides Euro-national transport services with pick-up trucks and distribution partners throughout Southern Europe including Italy, Spain, Portugal, Belgium, Switzerland and France. It owns a 6000 square metre warehouse located at its headquarters in Genas.

Being faced to intense competition, structural changes of the market and resulting declining revenues, AIT decided to implement a new transport and warehouse management solution in 2003. The objective of the solution implementation was double: on the one hand the objective was to support the company in organising the multimodal transport for their customers and in managing its warehouse activities and on the other hand to provide the company with detailed data analysis on the whole company activity.

This case study case demonstrates the benefits of such a solution and analyses the success factors of this e-business project.

Case study fact sheet

■ *Full name of the company:*	*AIT*
■ *Location (headquarters / main branches):*	*Genas, France*
■ *No. of employees:*	*42*
■ *Main business activity:*	*Transport and logistics*
■ *Primary customers:*	*Companies*
■ *Year of foundation:*	*1998*
■ *Turnover in last financial year (€):*	***8 398 000 €***
■ *Most significant market area:*	*France, Spain, Italy, Portugal*
■ *Main e-business applications studied:*	*Information systems*
■ *Case contact**	*Françoise Arnaud, Director of Information Technology AIT*

5.2.1 Background and objectives

AIT is a supplier of complete logistics services for all kind of goods with its headquarters located in Genas in France. It provides the organisation of Euro-national transport services with pick-up trucks and distribution partners throughout Southern Europe including Italy, Spain, Portugal, Belgium, Switzerland and France. 60% of the annual turnover is generated on the international market. AIT has generated a turnover of about 8 398 000 € in 2006.

The competition is very aggressive in this market. AIT is facing huge competitors like Geodis or Schenker as well as very small companies. To differentiate the company on the market, AIT offers tailor-made and high quality solutions with the following engagements:

- Deep understanding of specific customer's needs.

- Responding in real time with tailor-made solutions.
- Continuously training of its staff to keep abreast of new information technologies and logistics management.
- Offering innovative solutions based on know-how, pro-activity and dynamism.

Information technology is key to support AIT in this market positioning. According to Françoise Arnaud, Information Technology Director at AIT, the main role of Information Technology for the company is to automate business and data transmission processes, to eliminate errors, to save time and to allow AIT having visibility on the whole activity through the availability of complete data. Current ICT solutions implemented are a company web site, a Sage software solution for the accounting, as well as a global transport management solution.

AIT implemented a first transport and warehouse management solution in 2000. The solution developed by an external provider was composed of a core programme with specific developments to match AITs specific needs. Over the years this solution became more and more difficult to manage due to the accumulation of specific developments performed for AIT and the overall complexity of the solution.

After a period of growth from 1998 to 2003, AIT saw its revenues declining due to a structural change of the market (the regional activities in import & export of textile declined, increased competition etc) and the loss of some key customers. To face this situation AIT had a growing need to analyse its Business activity in details in order to better understand how to optimise its profitability.

When AIT requested a new functionality to the service provider in order to get detailed data on their traffic and activity from the current system in 2003, the solution provider could not match their requirements with the existing solution. Therefore AIT decided to search for another solution on the market.

The overall objective of implementing a new transport management solution was double. On the one hand the objective was to organize the multimodal transport for their 30 customers taking into account the whole transport process. On the other hand AIT looked for a solution with a flexible and ergonomic interface to manage its warehouse activities.

Another important objective of the new solution was to optimise the different processes like the customer billing, purchasing, business operations and to provide detailed data analysis on the whole activity.

5.2.2 e-Business activities

Beginning of 2004 the Information Technology Director and the General Manager of AIT, both leading the project, defined the functional specifications for the new solution. Among the range of solution providers on the market, AIT chose a young company that was at this time developing a new solution for the transport sector. The company proposed AIT to be the first pilot of the solution. Even if this supplier (Solulog) had no success stories to prove the effectiveness of its solution, AIT trust this company it for its deep knowledge of the transport and logistics business as well as for its capabilities in project management. Keeping the time schedule was an important criterion for AIT. From mars to august the solution provider worked with AIT on the development, testing and training of the solution. The training deployed to the 32 users of the solution lasted two days and was performed by Solulog. Due to the crash of the old programme in October 2004, the new solution needed to be deployed very rapidly at this time.

The solution that has been developed is modular software composed of the core Solulog solution and some specific developments to meet the needs of AIT. The programme has been developed with VBA code on Access and uses a SQL database. The Solulog solution is hosted internally at AIT. The overall budget for the solution is about 110 000€.

The solution supports AIT throughout the whole transport and logistic process and provides the following functionalities:

Data entry of a transport file: At the beginning of the transport process a specific transport file is created directly in the system including all information related to the transport order.

- **Automated rating:** Once all elements of transport information are entered into the system, the solution automatically attributes the correct rate and the transport tariff is calculated and displayed.
- **Management of correspondents:** This functionality allows the creation of agreement protocols for the transport partners, specific account management calculations for billing etc.
- **Purchase of transport and billing:** Depending on the data that is entered at the beginning, transport purchase orders are created automatically. This is possible through the interconnection of the system with the global e commerce shipping platform INTTRA, allowing companies to automate the shipping instructions.
- **Edit the transport documents:** According to the type of transportation, AIT does not create the same transport documents. The solution allows AIT to define the format of the documents to be created according to the type of transport.

Two specific interfaces where users enter with a login and passwords exist: one interface for the warehouse and another one for the transportation, logistics, commercial activities, statistics, billing and procurement of transport.

The transport process supported by the solution is described hereunder.

The AIT operators enter the information about the transport at the beginning of the process into the system. They are in direct contact with the customers and the transport companies that will be selected for the transport. Then the transport documents are created automatically, printed and sent by fax to the involved partners (customer, transport company, AIT internal).

If the merchandise is stored in the warehouse of AIT, the process starts with the check of the availability of stock in a specific module of the solution. The merchandise to be sent is selected on the interface and the list of selected goods printed on paper and given to the persons working in the warehouse. The transport file is then created in the system, the transport documents created, printed and sent.

The warehouse employees are in charge of loading the truck (or register the truck that will unload the goods). Warehouse employees performing these tasks are still very paper oriented at AIT; therefore the list of goods is transmitted on paper to them. They sign the list and return the document if all is fine.

The commercial activities supported by the system consist in managing information about AIT prospects, including customer information, sales actions (customer visits, telemarketing) and quotations made for customers. This module also allows preparing all the elements of a future transport file (data directly usable if the customer accepts the proposal) and analysing the overall salesmen activity.

The statistic module of the system (called infocentre) allows analysing the entire transport activity, like for example the volume of transports by month and by road (Lyon-Madrid), by type of transport etc. The information is used by the general management, accounting and the commercial services.

Future developments planned for the solution are to automate the integration of tracing information provided by the shipping companies affiliated to INTTRA allowing AIT to provide track and trace services to its customers in the future.

5.2.3 Impact

AIT is very satisfied with the implementation of the solution. The functionalities of the solution cover exactly AITs initial requirements and needs. The maintenance is scalable and takes into account the specific needs and feedback of the users. The integrated design tool allows AIT to define tailored document formats which improves the quality of documentation and service provided to the customers.

The statistic module allows AIT to get all necessary information for the analysis of its business. The integration of the solution with accounting ensures consistency between Business operations information and accounting and financial information (thanks to the interface with the Sage accounting solution).

The interconnection with the global e commerce shipping platform (INTTRA) has enabled AIT to automate the shipping instructions. It will enable AIT in the future to provide track and trace information to its customers after the completion of automated integration of tracing information provided from the shipping companies affiliated to INTTRA.

The solution also fits AIT business needs and enables the operation services to manage files with precision, while generating information that allow a clear analysis of the transportation process.

The most important benefit is probably achieved through the availability of detailed data of the activity allowing AIT today to have clear visibility on profitability of the different transports. Before the system implementation the follow up of the activity was very difficult and very basic. Profitability losses of some transports could be easily hidden. The system allows today to follow up the activity in details and to know the profitability of each contract signed with the different transport companies. This enables AIT to better adapt the agreement with transport companies according to the analysis of the traffic.

The control of tariffs applied to the different transports which is done automatically by the system is also an important tool for the management to control the correct application of the sales strategy.

Today it is difficult to measure the achieved benefits since the efficiency of the Business was not measured before the implementation of the new solution and no data is available for the period before the solution implementation. There is no doubt that the solution allows AIT today to save time, to harmonise and control some Business practices through the automation of processes and to support the company in taking the right decisions thanks to the availability of detailed Business activity reporting.

It is important to highlight that the adoption of the new solution by the different users happened in a very smooth way. This might be due to different factors. First of all, all persons were used to work with a transport management system for several years. For some users, the new solution added lots of value. This is the case for the operators, who previously had to re-enter all the transport files that were initially created on paper. The

purchasing and financial department was also very positively impacted by the new system allowing them to have clear visibility and control on the activity.

Another reason for the good user adoption of the solution might also be the fact that the former transport management solution crashed just before the deployment of the new solution. Therefore employees had no choice and even perceived the new solution as a kind of rescue.

5.2.4 Lessons learned

The implementation of the new transport management solution at AIT allowed the company to achieve great benefits. Several factors have contributed to the success of this e-Business project. An important point is that the solution is really adapted to the specific needs of the company. In the case of AIT, the choice of a small company as solution provider allowed AIT to work very closely with the development pole. This close cooperation facilitated the tailoring of the solution. Another advantage was that the solution was not really finalised when AIT started the project, so the inputs of AIT were taken into account in the finalisation of the Solulog standard product.

The maintenance of database is also an important point to consider when implementing such a solution. The former transport management solution used by AIT was based on a unique database, which with the time grew and, crashed in the end. The new solution is composed of three databases. There is one operating database, where the data for one year is stored to optimise the respond times of the system. Another database contains all data elder than one year and a third database contains all information for the “infocentre”, allowing providing the Business figures and analysis. It is very important to consider the correct maintenance of the databases including cleaning the data, extracting the data from the operating database to keep the response time of the system optimised. The outsourcing of the solution to a data-centre may represent a major advantage for SMEs since the solution is managed by specialists in a controlled technical environment.

Another point that AIT would like to improve in the future is the creation of Business processes together with the deployment of IT solutions. AIT did not create any processes when implementing the system. A first step towards process creation was engaged in 2003 with an audit performed on the company. The results were impressive but AIT did not engage any concrete actions to improve the situation. Only since August 2007, AIT got engaged in an ISO 9001 certification process; therefore the company is currently working on creating Business processes. To be able to completely take advantage of the solutions It is important to associate the creation of new Business processes to IT solution deployments. In AITs case the solution that is used by a relative small number of persons has been successfully implemented without the creation of new processes, but other cases have shown that IT solution implementations should generally go along with adapted business processes deployment to take full advantage of the solutions.

5.2.5 References

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

- Interview(s) with Françoise Arnaud, Director of Information Technology AIT, 05/02/08, Genas, France
- Websites:

  AIT (http://www.aitlogistique.com/info.htm)

  SOLULOG (http://www.solulog.fr/)

5.3 e-Business Systems of ALSA, Spain

Abstract

ALSA is a Spanish road passenger transport company with more than 100 years of experience. Its main operational areas are regular and discretionary road passenger transport. Since the 1980s, with the introduction of the first computers in the ticket sales area, ALSA has been developing its current modern e-business and ICT systems. Now the online e-ticketing system is fully integrated in the company, with complete Java internal support and external web interfacing for the e-ticket sales via Internet and mobile phone.

The implemented new ICT and e-business systems have brought ALSA a lot of benefits and positive impacts, including the opening of new sales channels (mobile and internet sales) which increase the customer satisfaction, intelligent bus seat management, cost advantages and increase in the global competitiveness of the company thanks to the different e-business tools. One of the main systems developed and implemented in ALSA is the Resource Planning system that has optimized considerably the management of operations.

This case explains the advantages and challenges of some of the main e-business solutions implemented by ALSA and analyses the success factors common for this kind of large European bus transport companies.

Case study fact sheet

■ *Full name of the company:*	*ALSA*
■ *Location (headquarters / main branches):*	*Madrid, Spain*
■ *No. of employees:*	*3,633*
■ *Sector:*	*Transport*
■ *Main business activity:*	*Road passenger transport*
■ *Primary customers:*	*Administration, final users and companies*
■ *Year of foundation:*	*1728*
■ *Turnover in last financial year (€):*	*365 € million*
■ *Most significant market area:*	*Spain, Portugal, Switzerland, Belgium, Germany and Morocco*
■ *Main e-business applications studied:*	*Electronic sales systems, Internal Resource Planning System, other ICT systems*

5.3.1 Background and objectives

This case study describes the e-business activities of ALSA, as an example of ICT adoption and usage in a large European road passenger transport company, taking into account the relevant impacts and results of this ICT systems on the company. ALSA is currently one of the leading road passenger transport companies in Spain and also is one of the largest ones in Spain, with a total of 3.633 employees. ALSA operates in different areas of the road passenger transport services, like:

- regular road passenger transport

- discretionary road passenger transport
- regular special road passenger transport services.

ALSA also operates in urban and interurban passenger transport routes. The main market in which ALSA operates is Spain, in which competes with more than 4,000 companies of various sizes and in different market segments. ALSA is present all over Spain, operating in all regions, in urban and/or interurban bus transport. The sector is currently experiencing a business concentration process in Spain via company merger and acquisition operations. These acquisition processes make necessary to modify the e-business systems and processes related to reporting, planning and finance areas in the affected companies, as in the case of ALSA. Since the year 2005 ALSA is part of the British transport group National Express. This recent acquisition has had some effects on the e-business reporting and accounting systems due to the integration of the company in the National Express group, making necessary certain modifications and updates in the processes and company e-business reporting systems.

The regular passenger transport services in Spain are normally regulated by public authorities, so in this area the competition is for the market not in the market. The main activity of ALSA is the operation of regular road passenger transport services (bus), this type of operation normally in Spain requires administrative passenger transport concessions. In its different markets in Spain, ALSA has an approximate market share of:

- 10% of the total market of regular interurban road passenger transport
- 4% of discretionary road passenger transport market
- 3% of urban road passenger transport market.

Regarding other international markets, ALSA operates also in countries like Portugal, Switzerland, Belgium, Germany and Morocco. The National Express group operates in UK and USA, among other countries.

The regular road passenger transport market, main market for ALSA in Spain, is a highly regulated market. Companies have to compete in order to obtain public transport concessions. Normally the public regulator imposes some systems and applications, for example in the ticketing process, and the company has to adapt to these specifications. Sometimes this aspect represents technical challenges for the companies to adapt to the variety of technical specifications its systems.

5.3.2 e-Business activities

This case study focuses on the following ICT and e-business systems for passenger transport which are used by ALSA:

- Integrated sales system
- Resource planning system (internal tool)
- Intelligent Transport Systems (ITS) and other e-business tools.

One of the main areas of e-business implementation in ALSA is the Integrated Sales system. The design and implementation of the e-business solution for sales area and the e-ticketing systems is one of the major ICT implementation projects of ALSA in terms of calendar and resources. The company introduced the first computers in the sales area in the 1980s. These computers were mainly dedicated to the ticket selling systems, the first

implementation of ICT technology in the company in this department. Since the year 2000 ALSA started the ticket sales system via internet (based on a B2C platform).

The current Integrated Sales system of ALSA is now designed and implemented in Java programming language, including an integrated operations platform that manages the base and intermediate layers of the system in order to control each of the different sales channels. This enables ALSA to change only the final interface layer of the system to the different sales channels when they add a new channel to sell the tickets (internet, mobile phone, travel agency, ticket offices, etc.). The entire sales system is implemented online and it is designed to adapt its different interfaces to all front-end applications of the system. The integration of the systems enables the centralisation and optimisation of all the data and operations of the sales area.

The Integrated Sales system is in its majority an internal development of the IT department of ALSA, with a total budget of €300.000 (€100.000 corresponding to hardware and licences and €200.000 to development). The technical department (IT department) in charge of the project, and other e-business systems, has a total of 20 persons; 10 of them internal IT workers and 10 external workers. The project is very profitable, and a proof of this is that ALSA is going to create the 4th generation website, including Web 2.0 technologies, a content manager and external web features. The internet sales currently represent 20% of total ticket sales (final users and travel agencies), and the mobile phone sales represent 1% of ticket sales.

One example of the advantages of the integrated sales system of ALSA is the integration of all the relevant information of the sales process into one single system. For example, one of the key benefits of having an online interlinked e-business sales system with these kind of features is the implementation of an intelligent seat management application (Plaza Inteligente). This system enables ALSA to add and additional value to the clients giving them the choice to select their seats in the bus when buying a ticket online. Other important benefits of this application is the exploitation of the intelligent seat system that allows ALSA to maximize efficiency of the seat management in each bus, for example with this system it is possible to improve the bus occupation to 180 passengers in a bus with 48 seats, in different travel segments. This strategy enables ALSA to reduce costs and increase its competitiveness, maximising customer satisfaction at the same time.

The second type of e-business system implemented by ALSA is a resource planning system (internal tool). This resource planning system is similar to an ERP (Enterprise Resource Planning) system, but including resource planning as well as incidence management functions especially suited to the road passenger transport operations of the company.

One of the main functions of the system is the resource optimisation to accomplish the daily objectives in operations, maximising the efficiency and usage of the available resources. The system includes features that allow naming the different services, controlling de execution of tasks and managing the possible incidences. The resource planning system is very useful, as it can also be used to dispose of the needed statistics and data for:

- activity and service management;
- payroll process;
- accounting;
- payments to transport service providers.

These statistics are used for the real system and operations analyses, and to check the correct performance of the system to ensure cost optimisation and savings. This resource planning system helps ALSA to reduce the operations personnel and minimize the operation errors, thanks to an alarm management function in which the system controls the operations that can be introduced in the system and the timings of the tasks. This system increases the security in the service, for example ensuring the fulfilment of the vehicle revision calendar. The alarm management is linked to the planning system, the control of processes and the reporting system. The resource planning system is also connected to the applications of the maintenance management.

The resource planning system is functional since the year 2003, and is helping ALSA to reduce the amount of processes on paper, for example daily bus driver reports. The initial implantation cost is calculated in 0.8 euro million, with an average use of 1.5 men/month in the development of the system.

The resource planning system includes different digital reporting interfaces (some of them onboard the vehicles and other like PDA for the bus traffic chiefs), database and analysis tools and it is designed to improve the planning and the optimisation of processes. It helps to ensure the correct the interconnection of different operation and processes, and also it gives real-time information to the drivers, coordinating the work with the traffic chiefs. The information for the drivers (planning, events, warnings, etc.) is transmitted and loaded automatically into the system onboard the vehicle via a WiFi system in the garage, the communication with the bus is bidirectional. All these functions provide a centralised and real-time knowledge of the different operations to improve them, enabling the cost and resources optimisation.

Other relevant e-business systems at ALSA include:

- A modern **data warehouse**, which is implemented with business objects to provide the necessary information for the integrated sales system and the resource planning system mentioned above. This system delivers information to all the organisation parts and helps in the reporting and analysis tasks, including the supply and demand analysis.
- Systems and online tools for **marketing**. This systems use the information of the data warehouse to perform special analyses and prognosis. They also include the Balance Scorecard system and the daily management. The sales department also uses PDA technology for the sales force.
- **Onboard bus entertainment** systems (in long haul buses) that can load media contents electronically to the buses.

ALSA is a company in a continuous innovative process to bring the latest facilities to improve its main business processes other examples of ICT use and innovation include Intelligent Transport Systems (ITS) like the vehicle management and security tools, implementing smart card and other types of ITS in their vehicle fleet and SAE system (Sistema de Ayuda a la Explotación or Operations Support Systems) which include modern fleet control systems, including GPS systems. Other innovations include the use of advanced digital tachographs systems in the fleet vehicles, intelligent proximity sensors onboard some of the vehicles or the use of integrated mobile data communications systems onboard the buses. Some of the high class buses (like the Supra class coach) have also implemented free WiFi Internet connection service for the clients.

5.3.3 Impact

The main impacts of the **Integrated Sales** system are in increased customer satisfaction, cost optimisation (through intelligent seat system and sales channels innovations) and the acquisition of competitive advantage to win more regular passenger transport concessions. The Integrated Sales systems is currently at the heart of the company systems, given its key role, helping the company to reduce ticketing process costs, centralise sales information and processes, increase the profitability of the company and improve the user experience with the transport services (convenience, comfort and economy).

The **resource planning system** has helped ALSA to reduce costs of € 4-5 million (estimate) due to improved control and planning of operations. This system has also increased the transport security and services productivity, using the alarm controls and the intelligent incidence management and real-time analysis tools. Other e-business systems, such as the integrated data warehouse, the ITS (Intelligent Transport System) and the fleet control system have also contributed to improving business processes which as led to a considerable increase in the profitability of some indicators such as the euro-per-kilometre revenue.

All these ICT solutions have been introduced with accompanying **training programmes** for employees to ensure the best possible use of the systems. This reflects that the way these complex systems are actually used in the daily work is more important than the mere adoption of the technology itself to achieve positive impacts.

ALSA managed to increase the **labour productivity** through the use of these ICT systems. The resource planning system in particular has led to a big resource optimisation and spectacular productivity increases, in specific work areas of 200% (i.e. one employee can now accomplish the work which required three employees before the system was introduced). This productivity gains translates into an increase in competitiveness. The reduction in the number of operation errors is another positive impact of this system, making production processes more reliable and effective.

The adoption and usage of the new ICT systems also have had important impacts on the **employment** side, requiring more specialised and professional workers who are capable of taking full advantage of the ICT systems. Sometimes this point is also a challenge for companies such as ALSA which operate in a traditionally low technology sector. ALSA was initially confronted with some resistance to the changes; it has responded by organising training programmes and defining adequate intermediate manager position profiles that help to tackle the organisational changes.

Some innovative tools, such as those offered by the ITS (e.g. GPS control, fleet management in real-time, intelligent sensors the onboard vehicles, WiFi bus communication systems or digital tachographs) have a double positive impact for the company, as they reduce costs (and help to a sustainable transport system) and also increase the **transport service security**, one of the key areas for a passenger transport company like ALSA.

In general, the solutions for the integrated sales system and the resource planning system also have boosted the **corporate image** of this leading transport company, and promoted the innovation inside the company, as the employees reckon the company efforts to improve the processes and competitiveness of the company via these innovations and take an active role to take advantage of them.

5.3.4 Lessons learned

This case demonstrates a successful e-business implementation and a profitable innovation process development in a large company of the road passenger transport sector. Each of the e-business systems has its special implementation process and challenges. For example, one of the main challenges of the Integrated Sales systems implementation was finding the right employees for the development and operation of the system. For this task, ALSA used both internal and external workers. The development and maintenance of certain parts of the system, like some final web interfaces have been outsourced, thus the company depends on the providers' response times (on average three to four months). The average learning time how to use the system is another four months.

Regarding the resource planning system, one of the key elements has been the involvement of the users, i.e. the workers. The planning tool is highly adopted in the company, and it has a lot of users. As the planning tool contains several possibilities and functions, it requires a trained and skilled worker to use it correctly. The training programs are crucial to prepare the users for the new tools.

The resource planning system also represents one of the big challenges in the process of integration with other new companies after the merger and acquisition processes of the sector. The correct system implantation is a critical point in the integration processes with new companies added to the National Express group in Spain. One example is the integration of Continental Auto in the transport group, former big company in the Spanish market acquired also by the National Express in 2007 and integrated in the ALSA organisational structure.

In general ALSA have succeeded in the adoption and usage of innovative e-business and ICT tools, but one of the most important challenges has been the high resistance to changes in the organisation of work by some employees (80% of the employees don't have high school studies). The tools require the feedback from users, and the intermediate managers need a more professional profile to forecast different scenarios and use the resource planning tool effectively.

The planning and training have helped to avoid the lack of training in the workforce. In the next implementation processes ALSA will give priority to the training aspects of the tools and will do a previous tool analysis to optimise the adoption and usage of the system by the employees, analysing the usefulness of the applications to ensure the most efficient and optimal adoption of the systems.

5.3.5 References

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

- Interview with ALSA Development Director and ALSA Central Services Director (Madrid, 2008)
- Websites: ALSA, http://www.alsa.es

5.4 CEMAT (Italy)

Abstract

CEMAT (Combined European Management and Transportation) specialises in combined transport of containers, trailers, swap bodies and vehicles on land and sea. The company, whose headquarter is located in Milan, was founded in 1953.

At the beginning of 2006, CEMAT launched a reorganisation programme of CEMAT information technology (IT) systems. The goal was to increase the performance of CEMAT IT systems and to support new innovative IT solutions that improve the company's operational efficiency as well as services delivered to the customer. As part of this programme, CEMAT implemented an IT solution in 2007 with the aim to enhance the check-in/check-out process efficiency at their terminals.

This case study demonstrates how an e-solution can significantly improve the operation of transport terminals, secure the transport delivery process and improve the transport document management for CEMAT and its customers. It also illustrates the difficulties end users faced during the adoption process.

Case study fact sheet

Full name of the company:	*CEMAT*
Location (HQ / main branches):	*Milan, Italy*
Main business activity:	*Combined transport on land and sea*
Year of foundation:	*1953*
Number of employees:	*270*
Turnover in last financial year:	*about € 230 million*
Primary customers:	*B2B (various sectors)*
Most significant geographic market:	*Italy, Germany, France, Benelux countries, Switzerland, Denmark*
Main e-business applications studied:	*Information systems*
Case contact person(s):	*Marco Cipelletti, IT manager at CEMAT*

5.4.1 Background and objectives

CEMAT is an Italian company providing combined transport on land and sea to its European customers. The European market (except Italy) represents 30% of CEMAT customers and 80% of the company's revenues. The most significant markets for CEMAT are Italy, Germany, France, Benelux, Switzerland and Denmark.

The competition in the combined market is very aggressive and a multitude of companies is competing on this market. Companies are usually quite small and own some terminals in their home countries. Inland terminals are strategic nodes essential for the functioning of combined road-rail transport: at this place, the cargo units change the transport mode. The difficulty consists in covering the terminals in the different countries to provide an international transport offering. CEMAT is using about 40 terminals in Italy and 150 terminals in other countries. The company owns 21 terminals in Italy. CEMAT covers the international market by contracting with partners or third partner companies and by having agreements with terminal gate companies.

5.4.2 e-Business activity

The role of information and communication technology in this market is very important. *'If you want to be present in the future in this market, the IT solution is the most important part of the service offering'*, admits Mr Cipelletti, IT director at CEMAT. The market is mature and most companies are investing in IT technology to get a competitive advantage.

As part of the company strategy, CEMAT launched a reorganisation programme of its IT systems two years ago. The first goal of this programme was to reorganise the IT systems in order to increase its performance and flexibility. The second objective was to create and to develop new innovative IT solutions to improve efficiency of processes, quality of services and communication with customers, suppliers and partners.

Following an analysis of existing systems and current processes in place, the IT department defined two priorities for 2007:

- Increase the performance of existing IT solutions to achieve better efficiency in operating the terminals.
- Identify an IT solution to improve the service rendered to customers at the terminals.

CEMAT owns 21 terminals where an average of 500 trucks load and unload goods every day (more than 1000 cargo units are moved per day in each terminal). The efficiency of terminal operations is very important for the correct organisation of this huge amount of cargo units being managed at the terminal. A check-in/check-out process is necessary to control the loading and unloading of the various units. This process, in which five copies of a transport document are exchanged, was very time consuming before the implementation of the e-solution. Drivers and customers had to wait until the end of the process before being able to leave the terminal. This relatively structured process, was organised as follows before the e-solution was adopted.

Check-in: once a customer sends a transport order over the Web-based ordering service to CEMAT, the data is directly integrated into the internal CEMAT transport management system. CEMAT sends a pre-filled “bill of lading” document to the customer and to the terminal where the goods will arrive. The customer manually completes the document, and he (or his driver) brings it with the goods to the terminal. The terminal employee manually enters the complementary information filled by the customer into the CEMAT transport management system. The completed “bill of lading” document is then printed 5 times, three hard copies are given to the customer (driver), one hard copy is stored by the terminal and one hard copy is sent to the CEMAT headquarter.

Check-out: Once the goods arrive at the terminal, the customer (or his driver) delivers the completed “bill of lading” document to the terminal. The terminal employee enters the data into the CEMAT transport management system and gives the signed paper to the customer (or his driver). A paper copy is stored in the terminal and another one is sent to CEMAT headquarters.

The following issues plague the process, consisting of a mix of automated, electronic and manual processes:

- The duration of the process is very long and it has a significant impact on the accessibility of the terminal: on average, customers have to wait one to two hours before they are able to unload or pick up their goods.

- The security for the check-out process is very low regarding the identification of the consignee (person receiving the goods) of a cargo unit.
- The procedure is complex due to a duplication of processes where paper documents are produced manually and data is re-keyed into the CEMAT transport management system.
- It is necessary that both, the customer and CEMAT, store paper documents.
- The system contains some manual processes that can lead to errors.
- Processes applied at the different CEMAT terminals are not the same.

In order to address these issues, the IT department developed a solution based on electronic document management and delivery, which significantly improves the check-in and check-out process at CEMAT terminals.

5.4.3 Impact

CEMAT employees and the majority of CEMAT customers are glad about the new process. The recent implementation of the solution and the progressive adoption of the new process (customers can use the old process until the end of October) does not yet allow measuring the benefits effectively achieved through the solution. Therefore, the benefits explained hereunder are only expected ones.

The expected customer benefits are the following:

- Decrease of the waiting time for customers (or their drivers) at the terminals thanks to the reduced check-in/check-out process (the objective is to reduce the process to 3 minutes).
- Increased security due to the attribution of a pick up code for the delivery of transport goods.
- Simplified management of their transport documentation.

The expected benefits for CEMAT are the following:

- Increased customer satisfaction, thanks to the benefits they achieve through the solution.
- Increased efficiency, due to the elimination of data duplication, the electronic management of the transport documents and the automatic delivery of documents.
- Future elimination of paper archiving.
- Higher speed in transmission of data to the customer.
- Improved production mode in the terminals, with the elimination of manual processes leading to less errors and simplifying the process for employees.
- Standardisation of the check-in/check-out process for all CEMAT terminals.

CEMAT estimates that the break-even point for the solution will be reached by the end of this year and that the savings for 2008 will be about 50 000 Euros owing to the

- Elimination of the carrier cost to send the documents to the customers representing the average annual cost of 20 000 Euros,
- Reduction of paper representing an annual cost saving of about 50 000 Euros

A customer survey is planned for next year to get detailed customer feedback. The most important issue that CEMAT faces today is to change the customer culture and process.

A key success factor of the solution is the correct usage of the process. CEMAT employees have adapted well to the new process and IT solution. CEMAT has the full support of the terminal directors who were the key persons to introduce the new processes in their terminals. Terminal employees were already used to use information technology and the new process has simplified their working tasks. Therefore, the adoption of the solution was very good in the terminals.

It is more difficult to change the working processes of the customers who have very different cultural backgrounds. For some customers the usage of the new process is very easy since they have an IT culture and are used to applying these type of working processes. Others, often very small companies, have IT solutions but do not know how to use them and do not understand the importance of processes.

5.4.4 Lessons learned

CEMAT estimates that the solution impact on the customer was underestimated. Even if customers were involved in the project from the starting point, CEMAT today faces a cultural barrier to the adoption of the solution by some of their customers.

Even if all customers generally have IT tools, they do not necessarily have the experience to use them. Sending a fax to communicate an e-mail address to CEMAT illustrates quite well the IT approach of a company. However, this is not the most important reason why the solution has an important impact on some customers: the efficiency of the solution directly depends on the correct application of the process.

The main issue faced by CEMAT today is that some of their customers have a very low culture of processes and do not understand the importance and necessity of following a process.

CEMAT still spends a lot of time explaining the new process several times to some customers.

Therefore, CEMAT will put in place a dedicated team to prepare and support the customer in a better way for similar future projects. This team will train the customers and support them in the usage of the new solution. Another important point is to involve a representative panel of customers in the pilot phase. CEMAT has only involved its biggest customer in the pilot phase. This customer has a dedicated IT department and the process deployment in this company was very easy. Unfortunately, this experience was not representative for all CEMAT customers. It is therefore important to cover the diversity of customers when testing such a solution with customers.

The main lesson learned from this case is probably the need to carefully measure the impact on the customer before implementing such a solution and to provide adapted support to its customers.

The benefits targeted by CEMAT are significant. They will enable the company to realise cost savings, improve the quality of production and customer service, as well as optimise the efficiency of overall terminal operations.

5.4.5 References

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

- Interview(s) with Marco Cipelletti, IT director at CEMAT, 16/10/07 and 17/10/07
- Internal presentations about the solution
- Website of Cemat, http://www.cemat.it/

5.5 CFR Călători (Romania)

Abstract

The national company for passenger railways in Romania, CFR Călători, is a public company operating the 4th biggest railway in Europe and providing rail transport to public passengers in Romania. CFR Călători is one of the four independent companies which emerged from the split of CFR after the liberalisation of the railway in 1998. As part of the modernisation programme and to be more competitive, an e-ticketing/e-reservation system has been implemented all over Romania.

This enables the company to provide better customer services and to get detailed market and financial data. Analysis of this data allows the company to take efficient decisions for the continuous modernisation of the railways. This case study demonstrates the importance of e- business solutions for the modernisation of the public rail transport sector in Romania.

Case study fact sheet

■ *Full name of the company:*	*CFR Călători SA*
■ *Location (HQ / main branches):*	*Bucharest, Romania*
■ *Main business activity:*	*Passenger rail transport*
■ *Year of foundation:*	*1998*
■ *Number of employees:*	*17,078*
■ *Turnover in last financial year:*	*about € 685 million*
■ *Primary customers:*	*Romanian rail passengers*
■ *Most significant geographic market:*	*Romania*
■ *Main e-business applications studied:*	*Information Systems (e-ticketing and e-reservation)*
■ *Case contact person(s):*	*Dorina Mironescu, CFR Information Technology Director*

5.5.1 Background and objectives

Ever since the liberalisation of the railway market in 1998, Romanian railway companies have been facing intense competition from road transport leading to a significant decrease in rail traffic. To remain competitive, CFR (Căile Ferate Române, Romanian Railways) aims to continuously improve its services by better adapting them to the needs of their customers. CFR manages the fourth-largest railway network in Europe, in terms of volume of passengers and freight. As an entity, CFR has been operating since 1880, even though the first railway on current Romanian territory was opened in 1854. Today, CFR is divided into four independent companies:

- CFR Călători, responsible for passenger services;
- CFR Marfă, responsible for freight transport;
- CFR Infrastructură, responsible for managing the infrastructure of the Romanian railway network; and
- Societatea Feroviară de Turism, or SFT, responsible for managing tourist railways.

In order to improve its image, which was internationally and domestically plagued by reports of poor service and outdated rolling stock, CFR started a modernisation programme at the end of the Nineties. It joined the modernisation policy in Europe with the introduction of high speed trains and high speed track infrastructure. This was and still is a quite difficult project to follow for CFR, as significant budgetary requirements are necessary. Other efforts like travel fleet renewal and introduction of passenger facilities followed to improve the position of CFR in the market. Despite these efforts, CFR lost 45% of its traffic to road and air transport over the past five years. Today, the two main strategic goals of the company are to modernise the rolling stock and to improve the service for the customer.

The e-ticketing/e-reservation project is part of the modernisation programme and fits perfectly with this strategy. Among its strategic priorities, CFR Călători (the passenger service division of CFR) has identified the need to have a national system for ticketing. The first stage of this complex and ambitious project covers the electronic ticket sales with the next stages focusing on electronic seat reservation and other facilities for passengers. The main driving forces for implementing such a solution are to better serve the customers by providing them with a consolidated system, to improve the sales process and to get relevant business and market data about the passenger railway activities.

5.5.2 e-Business activities

The decision to implement an e-business solution was taken in 1993. The solution, called “xSell” has been fully designed in house by a team from CFR Informatică Feroviară (since 2003 a subsidiary of CRF which is in charge of delivering all IT services to the railway companies). The main requirements for this solution defined by the passenger rail company CFR Călători were to have an electronic system with at least 3 functionalities: tickets sales, seat reservation and management reporting and statistics. A major condition for the implementation of the solution was to analyse the existing business processes and to fully redesign the whole selling and seat reservation processes. The “xSell” solution is composed of different subsystems: a central reservation system (“xSellCentralSeats”) linked to more than 200 local servers that host the ticket sales system, as well as a statistics/reporting system (“xSellData”) and a data maintenance warehouse (xSellWarehouse”).

For a nation-wide system, a unitary hardware and standard software architecture has been chosen to offer long-term benefits, like improved technical support, technical operating services and reduced TCO (Total Cost of Ownership). In this respect, the solution is based on Hewlett-Packard hardware, Oracle RDBMS software and Practical Automation thermal printers, verified for more than 7 years in real-time operation and being the architecture of an accepted system. The operating system is Microsoft Windows NT for PC’s & PC Net Servers and HP-UX for RISC machines. The solution has been implemented in over 245 railway stations where each selling point is equipped with a PC and a printer linked to the different systems.

When a customer goes to a selling point to buy a ticket, the sales system sends the inquiry (entered by a CFR employee into the computer) to the reservation system which checks if a seat is available. If so, it blocks the seat and sends seat number and price to the sales system which stores these elements, together with information such as about the destination and the type of traveller.

Once the ticket is paid, the sales system sends the information to the reservation system and the seat is marked as sold. The ticket is printed for the customer. The seat reservation is included in the price of the ticket. The accepted payment method at the selling points is cash. In some selling points payment with credit cards are accepted as well.

A first pilot of the overall solution was implemented in 1995 at two selling points in Bucharest and ran for over 7 years until the company accepted the rollout of a second release of the solution nationwide. By operating the pilot, the project team members gained good knowledge of specific business problems and practices. The pilot system validated the technical solution (hardware and software) as well as the design and provided real data to determine the transaction volumes needed to operate such a system.

From 2000 to 2004 a new version of the software solution was designed by the CFR information technology team and was rolled out between 2005 and 2007 in more than 245 railways stations.

The costs of this project (not including the first pilot) were about 25 million euros, 20 million euros for the hardware including the services and 5 million euros for the application software and deployment.

Future major developments that are foreseen are to open the system for the public on the Web allowing customers to make an online reservation, to design home printed tickets, as well as to equip train staff with mobile devices connected to the systems to sell and print tickets in the train. These projects are planned to be achieved by mid 2008.

Stakeholders of this project were the passenger railway company, the information technology company of CFR, CFR Infrastructură, (managing the infrastructure on the Romanian railway network) as well as the ministry of Romania. CFR Informatică Feroviară managed the software development, the infrastructure setup and the deployment of the solution. The passenger railway company established a new department for electronic selling who managed the project from the-business perspective and today operates the business. The commercial department was also involved in the project. 90 million tickets have been sold through the system and 23 millions passengers have been served between January 2007 and July 2007.

5.5.3 Impact

The main impact of the e-ticketing & e-reservation solution has been felt by CFR employees in charge of ticket selling. Since the working processes for ticket selling and reservation needed to be completely redesigned, approximately 5000 CFR employees working in this area have been heavily affected. Before the deployment of this solution, there was a manual system in place which was very complicated and time consuming. For example, employees working at the selling points had to spend a lot of time at the end of the day to count the tickets sold.

The change management was done at the same time as the deployment of the solution between 2005 and 2007. Key personnel from the passenger railway company was trained on the new processes over a six week period by the IT team in charge of the solution roll-out. These people were then in charge to train the respective CFR employees on the new business processes. The training sessions lasted between two to four weeks, depending on the job of the employee.

There was no resistance from employees towards the new e-ticketing & e-reservation system since they were very pleased with the new solution: it improved their working conditions and significantly reduced manual work. For example, all selling points have been equipped with new furniture and air condition. Before the solution deployment the sales people had to work overtime at the end of the day to count the tickets sold, a non paid task that is not required anymore. The fact that CFR did not reduce the number of employees following the implementation of the solution contributed to this good user adoption.

The feedback from CFR employees and CFR customers about the solution is very positive. The lack of data available before its implementation as well as its recent deployment does not allow the company to quantify the benefits achieved so far but the intangible benefits can be summarized as follows:

The implementation of the system allows CFR Călători to provide a better service to customers: before the system was implemented people spent an average of 10 minutes to get a ticket, now it is less than one minute. The overall service quality for passengers is improved thanks to the availability of clear information, of correct prices, of secure seat reservations and of additional services like the ability to reserve a journey and pay at a later time. Another benefit is the reduction of manual work and the optimisation of working process which leads to a more efficient production mode of the ticket selling.

A very important benefit is the effect on marketing of CFR: before implementing the system, all the information about passenger rail transport was manual, and it was impossible for the railway company to analyse the market situation and design market policies. Thanks to the availability of detailed data about destinations, passenger categories, distance choices etc. delivered by the system, the marketing department can better adapt future services to passenger needs. Thanks to the statistics provided by the data warehouse, the company is now able to estimate the flow of passengers, better plan its trains and better order routes from the infrastructure company.

This means better usage of their rolling stock fleet, cost reductions and a more efficient execution of the modernisation programme by being able to make the right decisions about closing non-efficient routes and modernising those which are heavily used by passengers. The implementation of this flexible solution also allows implementing a couple of future services, like the deployment of a Web service for ticket reservation and selling, that can be connected to international travel agencies.

5.5.4 Lessons learned

The project is considered a major success at CFR Călători as its objectives have been achieved and all the people involved and affected are satisfied. A major difficulty to achieve this success was to implement a mix of old and new processes since the team first designed the solution and then adapted the business processes to the system.' We should have done the reverse', explains Dorina Mironescu of Informatică Feroviară, 'first analyse the processes, redesign them and then build the IT system which fits the new processes'. The organisation reckons that it might have been beneficial to hire an external consultant to analyse the existing process model and the to-be model together with the developer team and assist in the change management process.

Comprehensive knowledge of all aspects of railway business including knowledge of interactions between train operators, infrastructure managers and other companies in the supply chain is fundamental for a successful IT solution in this sector. Therefore, at least

one member of the project team should be an accomplished expert for this type of business. For this project the expertise was provided by Informatică Feroviară, with specialised railway competencies applied in the sector for over 40 years in several large-scale implementations and continuous service engagements with actors in the sector.

Even if the "xSell" solution remains a bit outdated compared to the solutions used in other European countries, (still using cardboard tokens instead of electronic tickets) this solution implementation represents an important step for the Romanian railways company towards the European standards. Future e-services can be deployed progressively with this platform to provide more and more advanced solutions to railway passengers.

5.5.5 References

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

- Interviews with Dorina Mironescu, CFR IT manager 18/09/07 and 04/10/07
- CFR Călători annual report 2006
- Website of CFR Călători: www.cfr.ro/calatori/engleza/index_eng.html

5.6 Fret SNCF (France)

Abstract

Fret SNCF, the second largest rail-freight carrier in Europe, provides rail transport of goods, container and lorry transport on trains to business customers. In the context of increased competition due to the liberalisation of the rail freight market in 2003 in France, FRET SNCF is mobilising the whole organisation to become more competitive and productive. One of the main strategic goals is to transform Fret SNCF into a customer-oriented organisation.

In order to improve customer service and communication, Fret SNCF has recently implemented an electronic (e-) portal ("Clic Services Fret SNCF"). This solution allows customers to track orders, follow transport progression in real time, transmit their transport documents and consult their invoices.

This case study demonstrates how a company with a comparatively low ICT culture managed to implement a successful and innovative e-business solution in a relatively short time. It analyses the major problems faced during the implementation as well as the benefits achieved.

Case study fact sheet

■ *Full name of the company:*	*Fret SNCF*
■ *Location (HQ / main branches):*	*SNCF Direction Générale Déléguée Fret* *10 place de Budapest, 75009 Paris*
■ *Main business activity:*	*Rail transport (transport of goods, container transport and lorry transport)*
■ *Year of foundation:*	*1938*
■ *Number of employees:*	*166,000 (SNCF)*
■ *Turnover in last financial year:*	*6,595 million euros*
■ *Primary customers:*	*Fret SNCF serves only business clients, main sectors are chemistry, agriculture, combined transport, large retail, automotive industry, iron and steel industry*
■ *Most significant geographic market:*	*about 50 % France, about 50 % international*
■ *Main e-business applications studied:*	*e-Communication with customers*
■ *Case contact person(s):*	*Fabienne Girard and François Rannoux: Responsible for Service Offering and E Services at Fret SNCF*

5.6.1 Background and objectives

Fret SNCF handles freight carriage for SNCF (*Société Nationale des Chemins de Fer*, French railways). It provides three general types of service, which are merchandise transport, container transport and lorry transport. Since the liberalisation of the rail market in 2003, the century-old established system of national railway traffic in France has

gradually been breaking up. The traditional market model is changing and for the railway companies, new opportunities and challenges are surfacing, driving them to lower cost and to increase their competitiveness.

Fret SNCF launched a major transformation programme some years ago to realise its ambitions against this market background as well as stagnating turnover and increasing losses. The company mobilised the whole organisation to come up with solutions that make them more competitive, and improve production efficiency and quality of customer service.

Production costs in railway companies depend heavily on efficient rotation of wagons: the higher the average speed of the trains, the fewer wagons, locomotives and staff are needed. Equally important is the customer service: poor quality can undermine customer trust, and may lead to a return of traffic to the roads. By placing the customer at the centre of its business strategy, Fret SNCF is making a transition from a production-oriented approach to an approach emphasising services and results. This transition should be achieved through a reorganisation of the production mode, working processes and customer relation ship management to better match customer needs and increase customer satisfaction and ICT will support part of these objectives.

The e-services project, launched by Fret SNCF in 2006 is part of this new strategy and aims to provide customer services over the Internet for a simpler, faster and more reliable exchange of information with the customer.

The major driving forces for this project are to:

1. Catch up with competitors who offer e-services and additionally provide a couple of free services through an e-portal.
2. Get a competitive advantage by providing innovative value adding services to match specific needs of specific customer segments (customers will have to pay for these services)
3. Increase productivity and turnover through automating internal business processes and getting accurate and correct information about transports.

5.6.2 e-Business activities

Providing accurate information to customers is fundamental in the transport sector. Fret SNCF therefore considered an investment in e-services to be of strategic importance. While the company started some isolated e-services initiatives in 2005, it decided to launch a 4-year programme for e-service development and deployment at the beginning of 2006.

The first phase of this programme was aimed at deploying a couple of “basic services” allowing customers to track orders, follow up their transports in real time, transfer their transport documents and consult their invoices. Here ICT is essential because it gives customers anytime and in a convenient way through a Web interface the possibility to get clear visibility on their transport status and provides a non stop shop for transport orders. For Fret SNCF ICT allows to more efficiently manage customer transport orders and requests.

The project team was composed of SNCF employees from the customer service, marketing and IT departments. Sales and invoicing were also involved. The project

started with a detailed customer needs analysis. The outcome of this market analysis was a roadmap for future services to be developed before the end of 2009. The management accepted this roadmap in November 2006. The development, testing and deployment of the portal and the first bundle of services took seven months. The "Clic Services Fret SNCF" portal went live in July 2007, providing four major e- services to customers allowing them to track orders, follow transport progression in real time, transmit their transport documents and consult their invoices.

SNCF Fret invested approximately one million Euros in this first phase of the project. This covered system development, as well as hardware and software for the four deployed e-services. Maintenance cost for the portal is about 11000 Euros per month.

A big implementation challenge was to deal with the heterogeneous information systems infrastructure at Fret SNCF, which is composed of SAP modules and proprietary information systems. The "Clic Services Fret SNCF" portal was developed using PHP and Dot Net languages. Security is guaranteed via SSL encryption of information and via a dedicated login and password for each user.

SNCF Fret customers can now log on to a Web platform that allows them to access the four different services that carry the following functionalities.

- "*Commande@RESAFRET"* enables the customer to directly order transport services on the internet. Each customer possesses a personalised online catalogue that details the respective transport terms negotiated. This service allows an easy data entry for the customer and a better order planning and management for Fret SNCF.
- "*Info@RESAFRET"*, allows to follow up orders in real-time and alerts customers and SNCF Fret if there are transport difficulties.
- "*e-LV"*, manages and transfers transport documentation.
- *"Info Facture",* handles all elements related to invoicing.

The web platform communicates with the internal SNCF information systems for the ordering and invoicing processes. Once an invoice is entered into the invoice management system (SAP), the data is sent to the Web platform where it is available to customers.

For the ordering process, the customer consults the transport catalogue on the portal and enters the transport order directly on the Web interface. The Web platform automatically sends the data to the internal order management system. The ordering process is composed of a couple of events like reservation of resources, departure of wagons, delivery, incident etc., which are again processed automatically. The order management platform communicates data for each transport phase to the Web platform allowing the customer to follow up on the order.

One weakness of the e-services solution is that the information provided to customers is captured manually by a multitude of persons at all stages of the transport process and errors are still too frequent. The quality of the e-service solution is directly linked to the quality of information fed into the system. The main requirement therefore was to mobilise the whole company making different actors responsible for the quality of information they put into the system. Quality of information in the given context means that the information is available, complete and correct. *'The development of these services highlighted the poor quality of information available at Fret SNCF'* explains François Rannoux, responsible for the development of e-services at Fret SNCF. The production mode

needed to be adapted by deploying processes that allow the improvement of data quality and that are adapted to the necessary information provided through the e-services.

The development of e-services accompanies the reorganisation of the SNCF Fret and is a driving force for improving data entry quality.

Today, the e-services portal is operational and the project team is working on the future developments planned. The main deliverables planned for 2008 are as follows:

- enlarge the portal to European customers by providing a multilingual portal with an international service offering,
- provide a GPS tracking solution for dangerous goods,
- manage complaints,
- provide a solution for detecting transport CO_2 emissions and publish the data on the website.

5.6.3 Impact

The e-services solution affects the whole company and its working processes: it requires a major transformation of processes and of working culture.

Most importantly, quality of information is key and this issue needs to be respected by all employees. Before the implementation of the solution, the majority of employees had to concentrate their efforts on the correct operation of the transport. With e-services, the management and correctness of the information is as important as the rail service itself. It is quite difficult to change the mindset of employees who have worked in a specific way for years and years and to modify their working priorities. Thanks to internal communication and change management, good results have been achieved but it will take time until the new working modes will be fully adopted by the majority of employees.

The service has been a success on the customer side as the number of connections is continuously growing since the launch of the service. There is an increasing number of connections to the portal and customer feedback gathered to date is very positive. A detailed customer satisfaction survey planned for October 2007 will bring more information on the customer adoption rate of these new services.

5.6.4 Lessons learned from case study Fret SNCF

The implementation of this e-business project has shown that it is particularly important to consider the quality of information provided through e-services. In summary, this project illustrates that three important points should be taken into account when planning to implement an e-business solution. The first point is to carefully analyse customer needs before the implementation of such a solution. Compliance of e-services to target customer needs is a key success factor and an investment in market analyses and customer surveys of the solution is very important. The second point is that the quality of information used by the information system is key for the quality of the service delivered. A company investing in such a system should analyse precisely the different data creation processes and the quality of data produced. If data quality is not adapted to the level required, the processes should be adapted, the employees trained and the quality of information improved.

The final key point is to consider the sales channel of e-services when planning such a project. The sales persons at Fret SNCF manage the promotion of e-services. If they do not believe in the solution, they will not promote it amongst their customers. Therefore, it is particularly important to completely involve the sales force in the project from the beginning and to get their sponsorship.

5.6.5 References

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

- Interview(s) with Fabienne Girard, responsible for service offering and François Rannoux, responsible for e- services, 24/07/07 and 15/09/07 by phone
- Company internal newsletters and brochures
- Website of Fret SNCF, http://fret.sncf.com

5.7 Geodis (Belgium)

Abstract

This case study represents a typical example for automated warehouse management as it is used in the logistics sector. It demonstrates the benefits and requirements for a successful implementation of such a solution.

As a global logistics provider, Geodis is a European group with a worldwide scope, ranking among the top four companies in its field in Europe. The Group's ability to coordinate all or part of the logistics chain (air and sea freight forwarding, groupage / express, contract logistics, transport of part and full truck loads, reverse logistics) enables it to support its customers in their strategic, geographic, and technological developments, providing them with solutions tailored to optimising their physical and information flows. Geodis offers a range of logistics services, adapted to the specific needs of a sector. The group operates in 120 countries and has about 26,000 employees. Geodis posted nearly €3.8 billion in net sales in 2006. It is listed on Euronext Paris (Eurolist compartment B).

To support its warehouse management services, Geodis operates an integrated warehouse managing system for its overall 3,000,000 m² of warehouse space. This case study demonstrates the benefits and requirements for a successful implementation of such a solution.

Case study fact sheet

■ *Full name of the company:*	*Geodis Group*
■ *Location (HQ / main branches):*	*France*
■ *Main business activity:*	*Coordination of all or parts of the logistics chain (air and sea freight forwarding, groupage/express, contract logistics, transport of part and full truck loads, reverse logistics)*
■ *Year of foundation:*	*1995*
■ *Number of employees:*	*26,000*
■ *Turnover in last financial year:*	*about € 3,785 million (revenues)*
■ *Primary customers:*	*Companies in the Automotive, FMCG, Healthcare, High Tech, Industry, Luxury, Retail sectors*
■ *Most significant geographic market:*	*worldwide*
■ *Main e-business applications studied:*	*Supply chain management*
■ *Case contact person(s):*	*Philippe Baetens, Managing Director GEODIS Logistics Belgium*

5.7.1 Background and objectives

Geodis is a global logistics player and present in all segments of the transport and logistics market (apart from single parcel delivery). The Geodis group is organised in 4 operational divisions: Geodis Wilson (freight forwarding), Geodis Logistics (contract logistics), Geodis Calberson (groupage express), Geodis BM (full truck load) and Geodis Global Solutions (an integrated team at corporate level, able to combine all activities

within the group to respond to the requirements of world wide operating key accounts). The company has a significant presence in the main countries of Western Europe and is continuing to expand into Eastern Europe to partner their customers in these markets. In addition, they have a strong presence in Southeast Asia and operate or are creating subsidiaries in Africa and China.

Geodis operates in the transport and logistics market. The market comprises several segments, including groupage, express deliveries, warehousing, full and part truckload, air and sea freight forwarding and reverse logistics. Despite the high level of mergers and acquisitions activity in recent years, the transport and logistics market is still fragmented and shaped by rampant competition. Recent years have seen a number of major acquisitions leading to the creation of global groups. For instance Geodis has acquired TFM, the freight forwarding division of TNT, in February 2007 and is actually in the process of taking over the German service provider Rohde & Liesenfeld. In that respect Geodis is continuously reinforcing its position as important operator of the global supply chain.

Many companies operating in the market generally focus on one or more segments or sub-segments, for example air freight, shipping or warehousing, and it is therefore difficult to make comparisons, particularly as they often don't serve the same geographic markets. The majority only operate in their domestic market or in the domestic market and countries with shared borders. Few of them operate in all market segments or are truly global; in particular, they are generally absent from the fastest growing markets (Central and Eastern Europe, China, India and Brazil). Many transport and logistics groups operate in one or several market segments that are also served by Geodis. Their main competitors include, but are not limited to, DHL (Deutsche Post), Kühne & Nagel, Schenker, DSV, Panalpina and UPS.

Transport and logistics are service businesses in which the quality of customer care and the level of technological innovation make a world of difference. At Geodis, information systems are fully integrated into transportation and logistics plans. The information is used to promote productivity and customer satisfaction by favouring reliable communication that is quick and always available thanks to a wide range of tools and services.

The Geodis systems management department acts at all levels of its organisation and is involved at the early stages of project management: from analysis of the technical specifications to implementation, through operational follow-up, while guaranteeing optimal quality service to the customer. To do this, the department relies on "high-availability" technical infrastructures that allow for operation seven days a week, 24 hours a day.

Geodis has implemented warehouse management systems since the beginning of its logistic operations more than 20 years ago. The driving forces of implementing an automated warehousing system, which will be detailed in this case study, were to have a tool for a more organised storage which can be integrated with other internal systems. Direct benefits expected from the implementation of such a solution were to increase accuracy, decrease cost and reduce cycle times through:

- Optimised management of incoming/outgoing stock;
- Visualisation of storage placement and automatic assignment of available space;
- Real-time knowledge of stock levels and the geographic location of merchandise.

5.7.2 e-Business activities

Geodis manages over 3,000,000 m² of warehouses. The primary purpose of the warehouse management system is to control the movement and storage of materials within an operation and process the associated transactions. Directed picking, directed replenishment, and directed put-away are some of the key functionalities of GEODIS warehouse management systems. The basic logic uses a combination of item, location, quantity, unit of measure, and order information to determine where to stock, where to pick, and in what sequence to perform these operations. The warehouse management solution is integrated with other information systems allowing therefore automatically integrating and exchanging information with customers and transporters. Today, the order is directly put into the customer system and taken into account by the Geodis warehouse management system. This avoids retyping the information and errors.

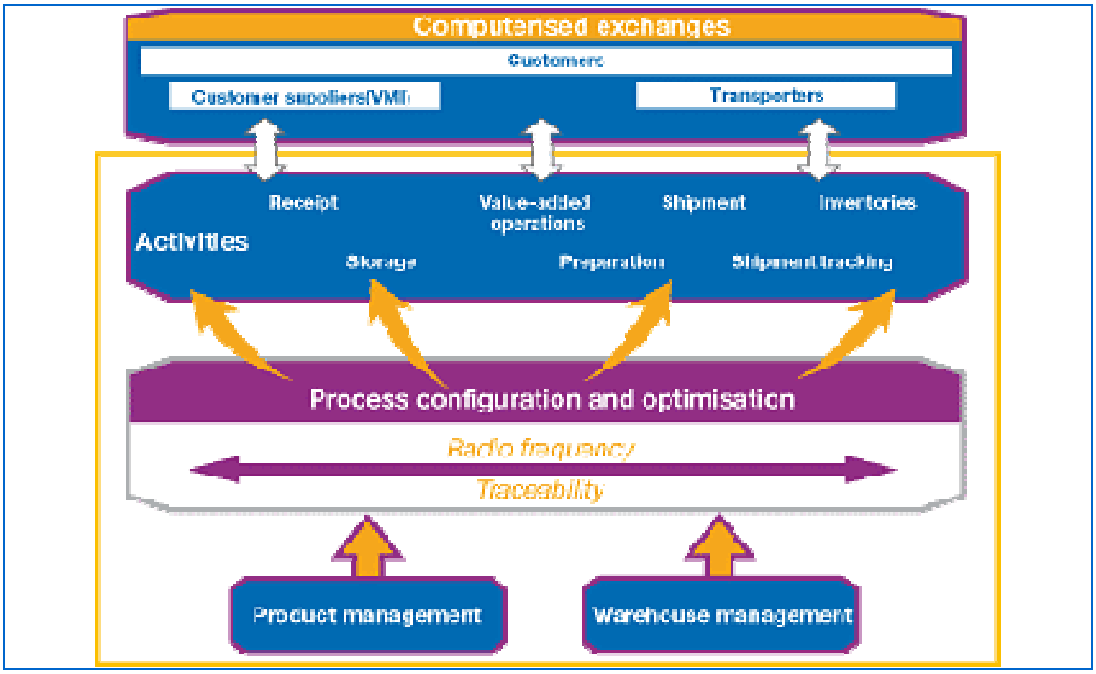
Warehouses have a critical part to play in the supply chain management and optimising the management of warehouse operations through ICT is critical to reduce costs and maximise their value.

The Geodis warehouse management system has been implemented on a world wide basis and is operational in the mean time for over 20 years. The implementation cost of a warehouse management system depends on the complexity: on the fact if a company can implement a standard solution or if they need a customized solution. Geodis uses its own warehouse management applications (Altesse, Geode) that allow easy connectivity with the customers' ERP systems. Mr Philippe Baetens, Managing Director at Geodis, points out that it is an *"important requirement before implementing such a warehouse management system is you need a detailed view and study on the existing processes.*"

The analysis phase is extremely important. Only once the company has analysed the internal processes and clearly identified the objective of what it wants to achieve, it can seek for the right solution. All departments are involved in such a project impacting logistics, customers and partners.

The warehouse management system of Geodis supports all the main processes of the warehouse. It handles the product architecture, multiple references (shipper, commercial, supplier, manufacturer) and multiple packaging schemes. It manages series and batch numbers and different dates, thereby offering tracking options for the entire logistics chain.

A typical business process is triggered when a customer makes a sale. Geodis receives the information and the system checks if the product is available in stock. The message will be sent to the system, a picking order will be made to the operators in the warehouse, the operator will prepare the shipment, a transport order will then be sent to the transport department, and at the same time a message to the custom modules will be sent. When the shipment has left the warehouse, a confirmation is sent to the customers. The delivery is then checked and confirmed to the customer.



5.7.3 Impact

The warehouse management system provided Geodis with a couple of benefits resulting from the use of ICT that can be summarized in increased accuracy resulting from the availability of correct and updated data, improved inventory management thanks to the visibility of exact stock variations and logistics and in a greater ability to serve the customer by reducing cycle times. These benefits translate into direct costs savings like inventory cost reduction due to inventory visibility and accuracy; reduced paper handling through the automation of management of orders and priorities by the system; less personnel handling picking orders through automated Radio Frequency based picking or voice picking and reduction of personnel handling shipping documentation and confirmation.

In addition to the tangible costs and associated savings, there are a number of intangibles difficult to accurately quantify, but are nonetheless valuable as the result of implementing this solution:

- **Ability to receive orders and ship the same day without expediting**. This brings a higher level of service that helps differentiate you from your competitors.
- **Improved customer service levels**. A warehouse management system enhances the overall warehouse operation. Data accuracy and inventory accuracy both improve. Mistakes are pushed to an absolute minimum. Deliveries are timely, shipments are accurate and customers stay happy. This results in avoiding the very costly problem of losing existing customers to the competition. The cost of acquiring a new customer is up to five times greater than maintaining an existing customer.
- **Self-managed employees**. With system-directed operations available to the users, supervisory intervention is held to a minimum. Much of the decision making required in a typical warehouse is handled by the warehouse management system. Workers do not need to take the manager away from his/her primary job. Rather, the Warehouse management system directs the employee's actions based on the

user profile and location within the facility. Managers have more time to make higher level decisions.

5.7.4 Lessons learned

For global logistic service providers, warehouse management systems form the backbone of operations and represent a prerequisite to stay competitive, notably in providing optimal customer services. The latest generation of WMS employed by Geodis enable the logistics provider to offer its customers' maximum flexibility. To this end, it is important that WMS are fully compatible with common ERP applications of today and allow an easy set-up of connectivity with the customer's ERP system.

Warehouse management systems support a wide range of applications and processes such as first-in-first-out, cross-docking, automated pick replenishment, wave picking, lot tracking, yard management, automated data collection, automated material handling and equipment management. The resulting increase in process efficiency has translated into sizable labour efficiencies.

ICT has contributed in increasing the competitiveness of logistics companies in significantly reducing operational costs, optimising the efficiency of warehouse management and associated services and improving customer satisfaction.

5.7.5 References

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

- Interview(s) with Mr BAETENS , Managing Director Geodis Logistics Belgium, 20/07/07, per phone
- Company annual report 2006
- Website of Geodis: www.geodis.com

5.8 Hupac (Switzerland)

Abstract

Hupac is leader in combined transport across the Swiss Alps and number two in transport of containers, swap bodies, semi-trailers, and trucks by rail in Europe. It offers innovative combined transport solutions by road, rail and sea. Hupac operates a network with more than 100 trains a day between Europe's most important economic areas as well as between the major harbours and the European hinterlands. The company was founded in 1967 and the head office is located in Chiasso, Switzerland.

In order to manage its European transport activities and better control information about their trains, Hupac has implemented an innovative information technology solution that manages transport information in real time and coordinates all phases of intermodal traffic from departure to arrival. The information is provided by a GPS (Global Positioning System) train control system. This case study analyses the benefits of such a solution, the different obstacles that Hupac had to overcome to implement this solution as well as current issues faced for the operational solution.

Case study fact sheet

■ *Full name of the company:*	*Hupac Sa*
■ *Location (headquarters / main branches):*	*The Hupac Group consists of 10 companies based in Switzerland, Germany, Italy, Holland and Belgium. The head office is located at Chiasso, with subsidiary offices in Basle, Busto Arsizio, Oleggio, Singen, Mannheim, Cologne, Rotterdam, Taulov and Warsaw.*
■ *No. of employees:*	*396*
■ *Main business activity:*	*Independent intermodal transport operator*
■ *Primary customers:*	*Haulers, logistic companies, carriers*
■ *Year of foundation:*	*1967*
■ *Turnover in last financial year (€):*	*EUR 303.2 million*
■ *Most significant market area:*	*Switzerland, Denmark, Poland, Germany, Italy, Holland and Belgium*
■ *Main e-business applications studied:*	*Supply Chain Management*
■ *Case contact person:*	*Aldo Croci, Hupac Information Technology Director*

5.8.1 Background and objectives

The strategy of the Hupac Group has remained fundamentally unchanged for decades. It has proved to be equally successful in the last period which was characterised by a change of the market environment due to railway liberalisation. Following the liberalisation, the market situation of intermodal traffic has changed: many railway companies are getting into the intermodal traffic business either directly or via newly established subsidiaries. Today, national railway companies hold a majority stake in many of the older combined transport companies. This removes the basis of the free market, reinforces protectionism, and deters intermodal traffic developments. As one of

the few private combined transport companies, Hupac is a driving force in the current process of railway liberalisation.

Hupac prepared itself early on for fair competition: Ongoing extension of the network, independence from the railways as well as investment in its own assets such as rolling stock. Today, terminals and IT solutions remain the key success factors for the company's growth.

Information technology solutions are part of Hupac's strategy and Hupac ensures the efficient exchange of data with clients, terminals, service providers and other operators through several information technology tools. "Cesar" is an Information technology system for combined transport that enables customers to make reservations, track and trace goods, and verify traffic conditions. "E-booking" is a system which puts the customer's information system in contact with the Hupac system through standard XML technology, offering considerable advantages in terms of time, security, and operational efficiency. "E-billing" is a service allowing the customer to receive, verify, and integrate invoice information directly through its own accounting system, therefore reducing internal costs and potential errors.

The most innovative e-business solution that Hupac has implemented is "GOAL", an integrated software that manages transport data in real time, coordinating all phases of intermodal traffic. "GOAL" is connected to "e-train", an innovative GPS train control system. Together, "GOAL" and "e-train" allow a constant updating of the situation for each load so that customers can be kept precisely informed about their shipments.

Hupac is managing the transport of containers all over Europe by renting trains and drivers using 6 different rail companies (public and private). In order to guarantee the punctuality of transport to its customers, Hupac needs to be informed on how their trains run and where they are. It also needs to be informed about any incident that may impact the punctuality. In the past, Hupac was forced to search for information about its trains in the information systems of each railway company. This proved to be extremely difficult as these are very heterogeneous systems. In addition, the location of the trains was never communicated, and system searches often remained vain. The need to control train movements with railway partners that use different monitoring systems in a context of an ever enlarging network has led to the creation of an integrated software management system with GPS train control.

The main driving forces for implementing this combined solution ("GOAL" and "e-train") were to make Hupac independent of railway companies: it delivers information about how their trains run and allows them to be informed about any incident that may have an impact on the punctuality of their trains. This type of information is key for Hupac since the quality of transport service is very dependent on trains' punctuality and Hupac contractually pays penalties to its customers if the transport does not arrive on time at its destination.

5.8.2 e-Business activities

The idea of launching a project to implement a system that manages the information about the trains started in mid 2004. The project lasted 18 months and the solution is operational since January 2006.

The analysis phase has taken 6 months and consisted in the investigation of existing solutions on the market and to prepare a demonstration. The implementation phase has taken 8 months most of it being the software implementation, followed by a 4-months test phase.

The overall cost for the solution including software, hardware and implementation were approximately 100.000 Euros. The cost for one GPS unit is about 1200 euros and 60 units have been deployed so far. It is planned to cover the whole traffic of Hupac by buying another 50 GPS units in the future.

The solution was provided by a Swiss company, specialised in traffic system GPS (hardware and software) and intelligence traffic systems. This firm was in charge of the integration and implementation of the system, and worked closely with Hupac specialists.

The overall need for Hupac was to be able to know where and when a train was late in order to be able to inform its customers about any delay. Another need was to know what railway company causes the delay, allowing Hupac to negotiate better prices with them. Hupac needed to find a solution that was independent from the information systems of railway companies and which could run in all countries. The solution also had to run on Hupac timetables (definition of locations of each transport and the estimated time when the transport has to be at each location). A requirement for the localisation units was that they should run on their own, without any interaction with the driver. An automated integration of the information coming from the location system into the central information system was also required.

To locate trains it was decided to equip trains with a GPS system. However, Hupac needed to find a solution to get energy for the system since energy is not available on trains. It was decided to equip the units with long life batteries.

The solution implemented consists of two main components: “Goal” and “e-train”. ”Goal” (Global Oriented Application for Logistics) is an integrated software designed by Hupac that coordinates intermodal transport from booking to billing. In 2006 the project concerning the automatic integration within “Goal” of data originating from external systems such as clients, terminals and third party operators has been further developed. New applications with an XML interface have been implemented in 2007 making it possible to acquire and process data coming from peripheral terminals which do not use “Goal”. The second part of the solution is “e-train”, a new satellite-based train monitoring system that covers most of Hupac’s traffic network. The e-train system is capable of monitoring train progression thanks to a GPS unit installed on each train which signals possible time variations with respect to the theoretical preset traffic timetable. This information is then automatically integrated within the Goal software, providing a constantly updated situation of the progression of each train. The new system allows for time and cost savings since it abolishes the need for costly requests of information from each railway company and achieves a consistent and integrated feed-back.

The e-train solution is composed of units that are composed of a long life battery, a GPS card which can locate the train, and a GSM (Global System for Mobile communication) card that sends the information to the Goal system managing the information sent to and received from the units. The unit is configured to send 3 types of messages. A “delay message” is sent if there is a delay between the theoretical preset traffic timetable and the real one. A “confirmation message” is sent each time a train arrives or leaves a terminal. A “punctuality message is sent if a train arrives at a point on time. Delays can be tracked with their precise location.

The server where the Goal software is stored at is fully connected to the Hupac central system. The information of the "Goal" system is accessible for Hupac employees only, who then decide what information is provided to the customer.

With this solution, exact information about all train movements and whereabouts is readily available from departure to arrival; and it can be filtered and provided to the customer: the information is included in the transport management system (from booking to invoicing) and, depending on the configuration set by the customer, the information is provided in the format required by the customer.

5.8.3 Impact

Despite the fact that Hupac already has advanced internal information technology solutions in place, the impact of this solution on the employees previously in charge of searching information on the different railway information systems was significant. They completely changed their jobs as this task was no longer required. Their new responsibility is to ensure that the GPS units are operational and that each train running for Hupac is equipped with one GPS unit. One of the new tasks is to supervise and maintain batteries. For example, if a battery is low they have to replace it. Thanks to internal change management including involvement of employees in the project and communication and training, the transition happened in a smooth way.

Thanks to the implementation of this solution, Hupac is now independent from the railway information systems and can gather information on their trains. Whatever railway they use, and in whatever country, they get accurate information. The solution allows Hupac to realise a significant reduction of working load for researching information and to offer better customer services thanks to the visibility that customers have today on their transport.

To summarise, Hupac was able to get the following benefits from the implementation of the solution:

- Better quality of service thanks to visibility on incidents and better management of those. In case of delay, all involved partners are automatically informed about the delay. Once aware about an incident, Hupac can try to optimise the following stages of the shipment to catch up with the delay;
- Better customer service due to real time information available for the customer;
- Cost reduction as a result of a) better positions for price negotiations with the railway companies depending on the delays tracked and b) less penalties to pay to customers.

The quality of the system is high: 98 % of messages exchanged are received by the Hupac system from the GPS units (no reception in tunnels and mountains due to the absence of the GPS signal). The main contemporary downside of this solution is that telecommunication costs generated by the units are very high. At the moment, the solution runs with a Swiss communication card and as soon as the train is in a foreign country, roaming costs are generated to send information from the units. With the current solution in place, the Hupac system sends an SMS to the unit and gets a response half an hour later. When GPRS (Global Packet Radio System) is available the system is online the whole time and the user can know where the train is at any time. Another advantage with GPRS is that you are priced on the data volume and therefore this is less

expensive. On the other hand the battery consumption is higher and battery life decreases from 1.5 years to 1 year.

Hupac is currently negotiating a flat rate for GPRS and roaming costs with the telecom operator in order to address this cost issue.

5.8.4 Lessons learned

The implementation of the “Goal” / ”e-train” project was a real success and Hupac is very pleased about its realisation and results.

Nevertheless, even if the technical solution works well, it is important to outline that this solution is dependent on the availability of the GPS and network. For Hupac this means that about 2% of all messages exchanged between the system and the GPS are not received. This is an acceptable result for Hupac. However, the fact that the solution is not working in tunnels and higher mountains may be of high importance for other companies and a barrier for its implementation.

Another issue is roaming costs. Many Mobility solutions that depend on the tele-communication infrastructure and operating in an international environment face the same issue. These cost factors should be taken into account when planning the implementation of such a solution. For Hupac this is a big concern since they will expand their traffic to new regions not necessarily part of the European Union. For these countries the roaming costs will even be higher than in European countries. Depending on the number of GPS units deployed and number of messages exchanged, this point can be another barrier for companies who want to provide this solution or free for their customers.

Another aspect to be taken into account and which seems to be quite “basic” is the battery. The GPS solution is very battery dependant. However, it is still not as optimized as it should today.

In summary, this case study is an interesting example of a track and trace solution on the transport sector based on GPS. The advantage of this solution is the automated transmission of information (independent from suppliers) even if a little limited due to technical barriers, like the GPS availability.

An RFID solution would not have been a possible choice for Hupac. For an RFID solution the infrastructure must be put in place at the terminals to read the codes. Since Hupac only owns 40% of the terminals that it uses, the coverage of the solution would not have been acceptable.

5.8.5 References

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

- Telephone interview with Aldo Croci, Information Technology Director at Hupac, 26/07/07
- Company annual report and brochures
- Websites: Hupac (www.hupac.ch).

5.9 N.C. Cammack &Son, United Kingdom

Abstract

From its base in Colchester, UK, N.C. Cammack & Son provides transport, distribution and warehousing services to the UK and Europe. In 2002, competitive forces drove N.C. Cammack & Son to adopt a truck business management solution. This application is specifically designed to suit the needs of small transport businesses with a single depot. The key features of the application are the automation of transport, warehousing, and workshop tasks; stock control; and online access for both, clients and employees. The main benefit of this solution is a superb 'just-in-time' performance at the firm allowing customers to online view and monitor stock levels, keep pace with demand and check the order shipment status. Other effects acquired over the years include operational efficiency gains and improved profitability control.

Case study fact sheet

Full name of the company:	*N.C. Cammack and Son*
Location (headquarters / main branches):	*Colchester, UK*
No. of employees:	*50*
Sector:	*Transport & Logistics*
Main business activity:	*Transport, distribution, Warehousing*
Primary customers:	*All Business sectors (50% food sector)*
Year of foundation:	*1919*
Turnover in last financial year (€):	*6 million Euros*
Most significant market area:	*UK, Europe, and Eastern Europe*
*Main e-business applications studied: **	*Benefits of ICT*

5.9.1 Background and objectives

Founded in 1919, N.C. Cammack & Son is a transport, distribution and warehousing specialist offering its services across the United Kingdom, Europe, and Eastern Europe. Under family control, the company developed from a domestic coal delivery provider to offering services including transport, distribution, freight forwarding, express deliveries, warehousing and handling to its approximately 500 customers. Through careful investment and controlled growth, the company now has an annual turnover in excess of 6 million Euros. Assets include a property portfolio comprising of a 55,000 square feet operating facility, a 15,000 square feet warehouse and a heavy goods vehicle (HGV) maintenance area. It operates a fleet of 27 HGVs and trailers, plus a fleet of 5 non-HGV trucks and vans used for town centre and express deliveries.

N.C. Cammack & Son believes that one of the reasons for its success is its investment in a specific Information Technology (IT) solution called 'Truck Business'. This solution, designed by a company called Techwire in close cooperation with the Cammack Senior Management Team, automates transport, warehousing, and workshop tasks for the company. N.C. Cammack & Son is operating in a very competitive marketplace where a multitude of small companies compete with a small number of large logistic companies

like TNT and Geodis. While 15 years ago the business was fully managed with pencil and papers, today it is almost impossible to successfully operate in this market without the support of IT solutions for controlling and monitoring operations.

Initially, the main driver to adopt the 'Truck Business' application was to allow the company to improve traffic plan management and increase the speed at which jobs can be assigned to loads (trucks). This should allow using the trucks more efficiently and eliminate the amount of paper used for this task. The definition of a daily traffic plan represents an important operational task at N.C. Cammack & Son, yet, it is a difficult and time consuming activity when managed on paper. Traffic planners are in charge of collecting the different jobs sent by fax from the customers, putting them together into a load by taking into account all different factors and constraints and entering the whole data into the computer.

An IT solution, implemented in 1990 for managing accounts, invoices, sales and purchases, was not able to match the needs for improved traffic planning. N.C. Cammack & Son therefore decided to search for an application tailored to its specific needs.

5.9.2 e-Business activities

The 'Truck Business' project was initiated in November 2001 and it took about 22 months until the application was deployed in 2002. The project team consisted of Cammack senior management and consultants of the supplier company which was developing the software.

The project commenced with a 6-months analysis phase for defining the application needs, followed by a 6-months development phase for the application. The testing of the solution took about 8 months. Installation of the solution happened over a 3-months period.

The budget included solution development costs of approximately 30.000 Euros and it also included time spent by the manager responsible for the project. The software developed is running on a Windows NT 2000 server that is managed in house. 15 terminals are connected to the system.

The most important technical challenge was to develop a standard solution based on windows which offers scope for new functionalities whenever these become necessary.

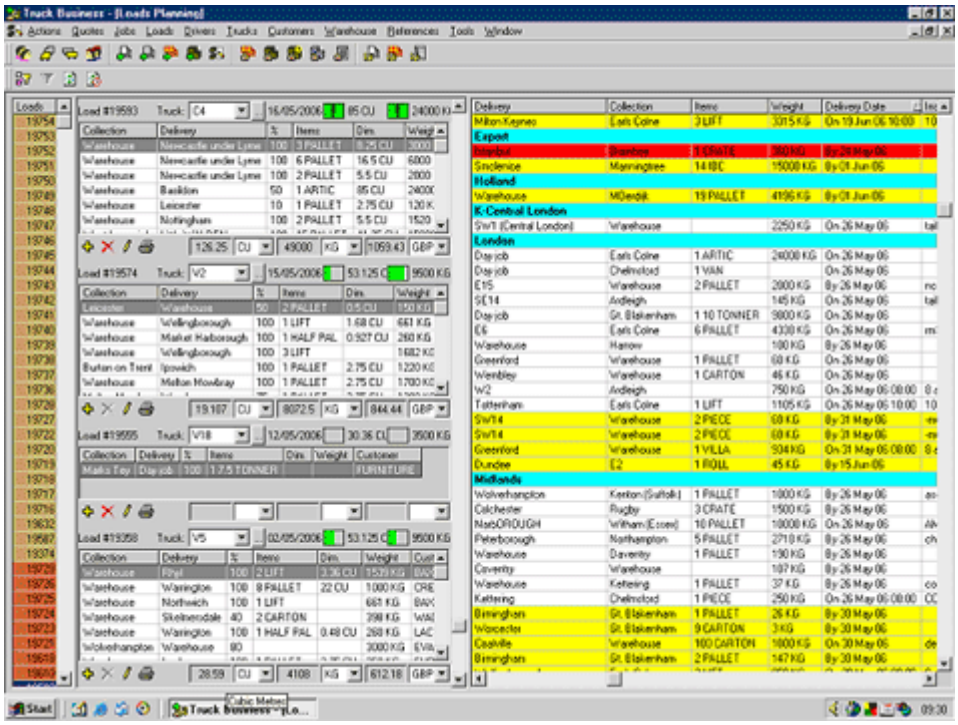
The main requirement for the system was to improve traffic plan management. The system should allow for collecting the different transport orders (either entered by the customer over the Web or entered into the system by the Cammack employee), putting them into a diary and allow the traffic planner to easily put the jobs together on the screen into a load. The system should automatically take into account the different factors like truck space and destinations.

Another system requirement is warehousing management, a functionality which was developed 3 years after the initial set-up of the solution when this activity became part of N.C. Cammack & Son's core activity. The third requirement was to give customers online access to the system allowing them to see their job status, history and invoices.

The application has been operational for more than 5 years and is enhanced on an ongoing basis. The main functionalities of the system are described hereunder.

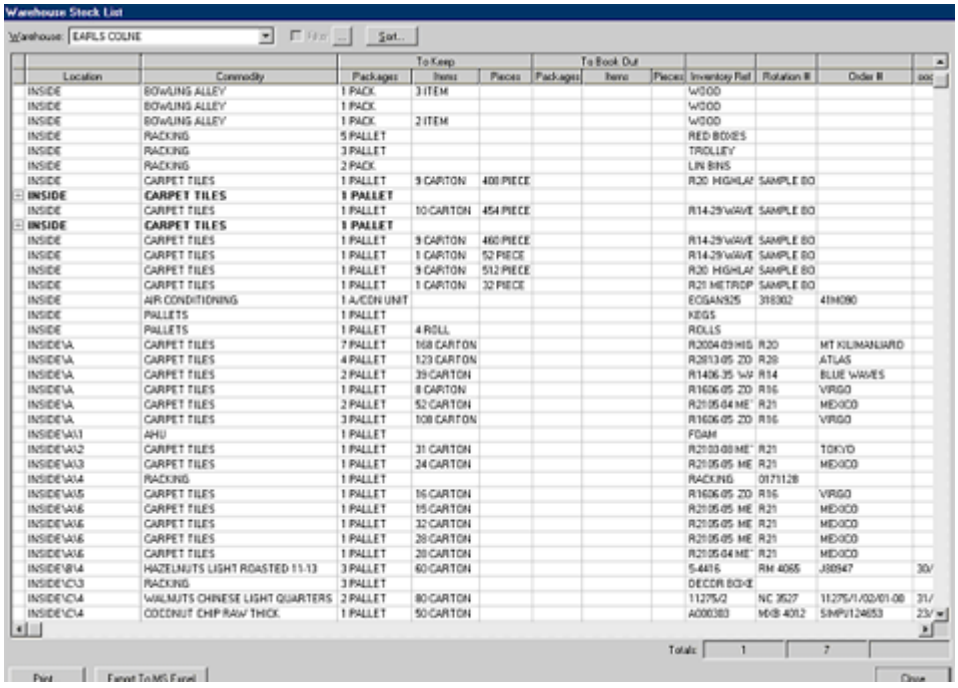
The traffic module allows to manage quotations, jobs, shipping and delivery notes, rate schedules for separate customers, loads with jobs for different truck types, invoices (per job or for a list of jobs) and credit notes (with history). A warning is displayed in case of overloads either by weight or by dimensions. It is then possible to split a job between several loads.

Exhibit 1: Loads Planning Page



Everything stored in the warehouse is monitored by a computerised stock control system which is particularly important when dealing with foodstuff and other perishable items.

Exhibit 2: Warehouse stock page



One important feature of the 'Truck Business' system is that it allows N.C. Cammack & Son's customers to view their own stock records, print reports, plus monitor incoming and outgoing goods, online. The system allows them to see the exact status of their job. It is also possible for clients to instruct N.C. Cammack & Son when and where to deliver/collect consignments. Another interesting feature is the cost and earnings by vehicle reporting where the profitability per truck is shown on a detailed table (see Exhibit 4).

Exhibit 3: Traffic Jobs List

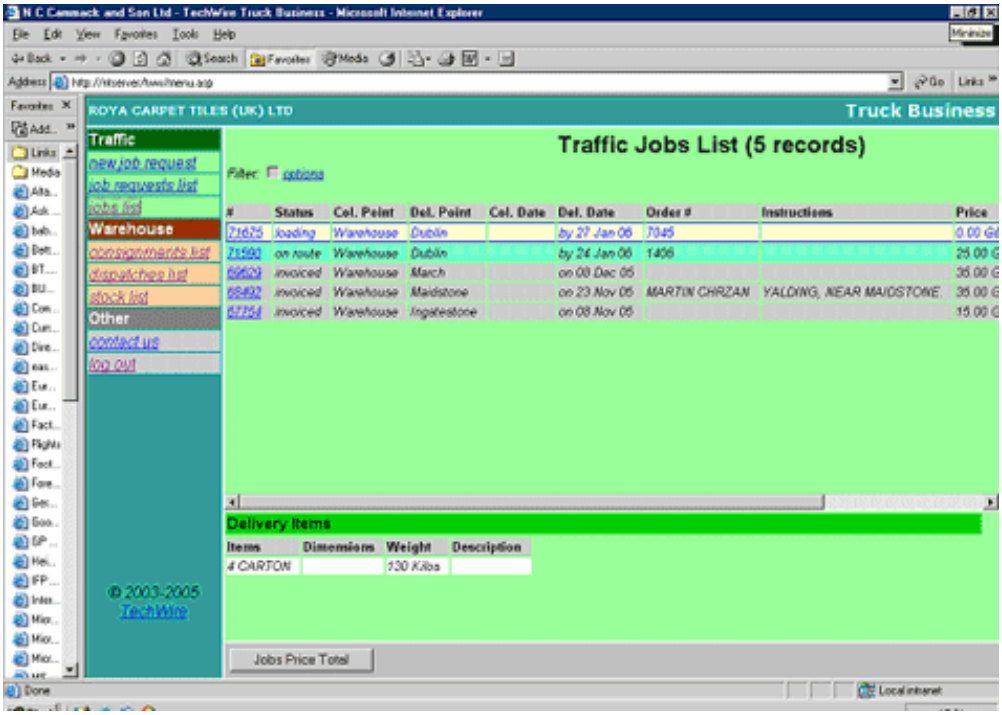
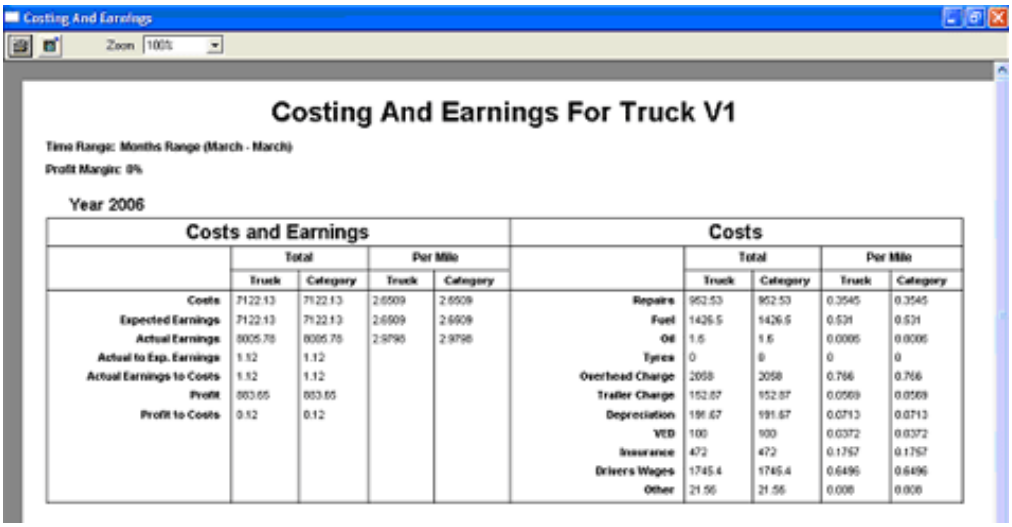


Exhibit 4: Cost and Earnings by Vehicle Page



The current process can be described as follows. A job that is entered into the system is loaded into the traffic job request list. An employee will monitor the job, accept it and send an acceptance receipt to the customers. Once the job is accepted, the information is automatically transferred into the job diary and can be used by the transport planning employees. The system automatically groups jobs together. It also gives the information

about the trucks available. Traffic planners can directly drag and drop jobs to load the trucks. All the information about the trucks like dimension and availability is available on the system and taken into account automatically. Once a truck is complete, an alert is created to inform the traffic planner that the truck is full. A load manifest is then created by the system including information like name of the driver, truck number and instructions for the driver.

Two copies of the load manifest are created by the system and printed. One is given to the warehouse to load the truck and one is for the driver, who receives the instructions for his job for the following day.

Once the driver has finished the job, the delivery and signature is checked against the job. Then the invoice is created automatically by the system and sent to the customer. All the financial information generated by the solution like customer details, invoice values, credit notes, truck costs, are transferred to an accounts package purchased from Access Accounting Ltd. N.C.Cammack & Son uses 'Access Horizons' and a product called 'Transaction Broker'. The sales and nominal ledger data is transferred from the 'Truck Business' solution by Transaction Broker automatically at the press of a button. The customer's payment record is monitored from Access Accounts. The accounts manager at N.C. Cammack & Son can place customers "on stop" in the 'Truck Business' solution, which disables users from carrying out work for customers who have a bad credit record.

5.9.3 Impact

The implementation of the 'Truck Business' solution required a significant change in working culture at N.C. Cammack & Son especially for employees in charge of managing the traffic plans. They were used to writing everything on paper and to moving around to see people in the different departments to plan the jobs. At the early stages of the system implementation a certain resistance to the new system among traffic planers was noted. Planners had concerns about the reliability of information available through the system. Following training sessions and change management mentoring by the senior management team all employees were quickly convinced about the benefits of the solution for their daily working process, mainly resulting in:

- speed at which jobs can be assigned to loads (trucks). The jobs can be moved quickly from one truck to another and all the important information of the job transfers to the donor load which utilises the trucks more efficiently.
- greater transparency. All users of 'Truck Business' can see the status of jobs, loads, trucks at any time allowing better communication and discussion for improving efficiency. Before the solution implementation everything was on one person's desk written on sheets of paper. It was also very laborious moving jobs between loads (trucks), and time consuming recalculating the new totals (weight, dimensions) for the affected loads.

Further benefits are described hereunder.

On the administration side, significant time saving can be noticed resulting from the automation of some processes like the invoicing as well as the simplification of the whole planning process. Thanks to the improvement of operational efficiency, N.C. Cammack & Son is able to perform more jobs today with the same number of employees. *'I would suggest that we would not be able to efficiently control the volume of business we handle*

now without the 'Truck Business' solution or a similar product', comments senior manager Nigel Monk.

The efficiency of trucks has increased due to better attribution of loads to each truck. The visibility of the profitability of each truck can be measured owing to the availability of detailed reporting on costs and earnings for each truck. This allows N.C. Cammack & Son to define best practices to improve the efficiency of vehicles running for them and to be in a better price and quality standards requirements negotiating position with truck companies.

Customer service has improved as well. N.C. Cammack & Son has increased its goods delivery performance since the system helps the company to do an efficient job. Customers are very satisfied with the services rendered. N.C. Cammack & Son is gathering new customers through word of mouth promotion done by their current clients. Customers are particularly impressed by the quality and detail of information they can access online regarding their stock levels or regarding the status of their jobs owing to the track and trace solution. The track and trace solution assigns a specific number to each job according to the current status of the transport from its assignment to the invoicing. The customer can access this information on the Web interface.

5.9.4 Lessons learned

N.C. Cammack & Son's 'Truck Business' solution shows how a small company can automate and improve the majority of their operational processes without making significant financial investments. Although N.C. Cammack & Son initially did face resistance from their employees, the company achieved great results with the implementation of the solution that can be summarised in a time saving and operation efficiency increase as well as improved customer service.

An important success factor for such a project is to choose a flexible solution that can evolve with the market needs and integrate new functionalities and features.

When N.C. Cammack & Son implemented the solution, the technology was not as mature as it is today. The products were very expensive and not exactly fitting the needs of the company. This is why N.C. Cammack & Son decided to develop a specific solution tailored to their needs. This is not the case anymore today. Standard solutions for small enterprises exist providing the same features as the 'Truck Business' solution.

Thanks to the usage of 'Truck Business', N.C. Cammack & Son remain competitive in its core markets trough improving operational performance while keeping the number of employees constant. Being able to monitor the costs of each truck and compare it with its earnings means N.C. Cammack & Son is far more aware of what it can or cannot do for each customer regarding its pricing structure. N.C Cammack & Son analyses this information monthly using the 'Truck Business' solution. Without this information at hand it would be difficult to keep in touch and over price itself out of the market or undervalue its services and end up running at a loss which ultimately would mean the closure of the company. Thus, by operating efficiently N.C. Cammack & Son can remain competitive in the market.

Keeping cost and prices under control is also important for N.C. Cammack & Son. The competitive threat for domestic UK firms such as N.C. Cammack & Son, for whom 98% of business is in the UK, is particularly significant: faced with high UK taxes not levied upon

European Economic Community (EEC) haulers, cost and prices are major survival and success factors. For N.C. Cammack & Son the 'Truck Business' solution is a key tool for keeping prices and cost at an adequate level.

5.9.5 References

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

- Interview(s) with Nigel Monk, General Manager at N.C. Cammack & Son's 19/12/2007
- Other sources: demonstration of the application
- Websites: Cammack (www.cammack.co.uk)

5.10 Cargo tracing at Saima Avandero, Italy

Abstract

Saima Avandero is a logistics and international freight forwarding company. The headquarters is located in Milan. Freight forwarding activities represent 80% of its activities in the market, which is worldwide.

In order to improve customer services, Saima Avandero implemented a track and trace solution in 2002 to allow their customers to follow up their transport activities on a Web interface. The company developed a solution in house. Even if track and trace solutions seem to increasingly become a "standard" customer service in the transport and logistic sector, Saima Avandero faced some important barriers to achieve the benefits they expected from this solution.

This case study analyses the benefits of a track and trace solution, the different obstacles that Saima Avandero had to overcome to implement this solution as well as current issues faced for the operational solution. It particularly points out the difficulties of guaranteeing a good quality of information in an environment of multiple and small supplier, as it is the case for Saima Avandero in Italy.

Case study fact sheet

Full name of the company:	*Saima Avandero S.p.A.*
Location (headquarters / main branches):	*Milan*
No. of employees:	*1400 employees*
Sector:	*Logistics*
Main business activity:	*Logistics and forwarding services*
Primary customers:	*All sectors*
Year of foundation:	*1993 (Saima bought Avandero)*
Turnover in last financial year (€):	*675 million*
Most significant market area:	*China, Hong Kong*
*Main e-business applications studied: **	*e-Communication with customers*

5.10.1 Background and objectives

Saima Avandero is one of the top five international freight-forwarding specialists on the Italian market. The company offers its customers an integrated logistic service including the delivery of tailor-made services that interconnect logistic and transport services. Saima Avandero's activities cover the management of all logistics aspects including the collection, storage and distribution of products supported by state of art computing technology and robotics. A solid network of transport suppliers ensures that Saima Avandero can offer freight services like bulking, combined transport and special transports all over Europe.

Saima Avandero faces intense competition on its market with the main competitors being TNT, DHL, Kuehne & Nagel and Schenker. To better face the growing demand of the market, Saima Avandero joined the Belgian group ABX LOGISTICS in 1999.

Information technology (IT) plays an important role in the international freight-forwarding marketplace where it is critical to improve the efficiency of operational processes and customer services on a continuous basis. An important customer requirement in the transport sector is to have clear visibility about the status of the transport orders.

'*In the past, to remain competitive, the transport company had to provide a good and price competitive transport service'*, recognises Mr Scotti, Information Technology Director at Saima Avandero. '*Today we still have to provide a good service but at the same time, we also have to provide an information service on the entire transport chain for our customers'*.

The idea for implementing a track and trace solution came about in 2002. The primary driving force to implement this service was to match the growing needs of its customers for traceability of their transports: some of Saima Avandero's most important customers wanted more visibility on their transports. This is why Saima Avandero decided to develop a solution. The objective for the solution was to provide the status of the transport over a Web interface to customers.

5.10.2 e-Business activities

The track and trace project, started in 2002, was managed in-house by Saima Avandero's information technology department. After a short analysis phase for the track and trace solution, a team of three employees of the IT department developed and deployed a flexible solution in a timeframe of about 6 months. A test solution deployed in one branch of Saima Avandero allowed to detect some issues and to adjust the final solution.

The main requirement for the solution was to give customers access to a database where information about their transports orders is stored. Customers should be able to access this information in different ways, according to the specifications they define. The different suppliers of Saima Avandero (the transport companies they are working with) should provide this information. Another requirement was that the system should be easily integrate-able with the existing information systems at Saima Avandero.

The budget for the track and trace solution includes the cost for three full time employees over 6 months for the development, deployment and training. The solution was developed on the IBM tool "Websphere". It is running on the company's main server (IBM AS 400). Security requirements include user identification and password.

The typical process is as follows: when a shipment is produced, it is assigned to the different suppliers. The supplier contacts are entered into the database. Suppliers are informed of their assignment. This is managed either directly through the system or through any other communication means like e-mail, fax or phone, in case the supplier is not directly connected to the Saima Avandero database. The supplier will then confirm the transport order (through the system or other communication tools). Once Saima Avandero has received confirmation from all suppliers, it will calculate the planned transportation time from the departure to the arrival and enter it into the system. The different suppliers involved in the transport are responsible for sending the information of any event of the shipment from its departure to the final arrival. This information is communicated to Saima Avandero via the system or through other communication channels and entered manually into the database. The customer can consult this information via the Web interface.

The main future developments planned is the connection of this solution to the ABX group's system. The ABX group has a standard track and trace solution with a central system connecting all local databases to the ABX central database. Saima Avandero will have to analyse the situation again in order to get the data from the suppliers according to the requirements defined by ABX group. Another future development planned is the extension of the existing solution through an SMS (Short Message Service) solution that should automate some of the information exchange with the suppliers and will allow Saima Avandero to automatically integrate data received into the database.

The solution has been operational for over 5 years and some of the customers are very satisfied with it while others complain about the low quality of information available for some transports. Seven suppliers are directly connected to the system representing 40% of the traffic. The remaining suppliers are mostly managed through an EDI interface flow or manually.

5.10.3 Impact

Even if some customers are very satisfied with this solution, overall Saima Avandero is not completely satisfied: the solution is completely dependent on the suppliers and the reliability of information provided by them. Although initially all suppliers were contacted during the solution deployment process to evaluate the best possible approach to this issue, the solution found is not satisfactory: for some suppliers the solution has been put in place and integrated into the supplier's information system. That means that the supplier has direct access to the solution interface. This is the case for seven suppliers today representing only 40% of the traffic. For the remaining 60% the information has to be collected manually by Saima Avandero through channels including e-mail, fax, and telephone. Once the information is collected, a Saima Avandero employee has to enter it into the central system. This creates a lot of additional work. One employee is assigned to manage the supplier relationships on a full-time basis.

The quality of data received from the suppliers is an important issue for Saima Avandero.. Sometimes the quality of data is poor and sometimes data is not even available at all. Since Saima Avandero works with a multitude of small suppliers (sometimes up to five suppliers for one single transport) it is very difficult to get them engaged to provide the requested data (either through the common system or in any other way).

The biggest issue faced by Saima Avandero, is to provide a homogenous level of data quality to the customers. For some transport, the quality of data is very good while for others it is inexistent.

Another important issue is the additional work generated by the solution. The manual work generated by the data collection from suppliers and entry into the system is costly and time consuming.

In conclusion, the impact of the solution implementation is not as well as expected and Saima Avandero receives complaints from their customers. Some strategic customers for whom the company puts many efforts in place to maintain the data quality at a high level are however satisfied with the solution.

5.10.4 Lessons learned

This case illustrates barriers that companies can face when implementing an e-business solution. It particularly highlights the importance of involving the respective parties in the project in order to agree on commitments and necessary involvements from those. This case represents an example of low adoption of an e-business solution resulting in poor benefits and even negative impacts. The negative impacts in this case can be summarised in additional manual work to comply with the poor quality of data generated by the overall solution as well as poor customer satisfaction. The efficiency of e-business solutions depends on the correct application of the functional processes.

Solutions that are aimed at providing data to customers encounter huge issues if the quality of information cannot be guaranteed in cases where a company depends on a third party to provide the data it is very important to get a clear commitment of this third party on the respect and correct application of processes deployed with the solution.

The case of Saima Avandero, cooperating with a multitude of small transport suppliers seems to represent a typical example of the Italian transport market where lot's of small transport companies are coexisting.

According to Mr. Scotti it is important to have a good presentation of the solution highlighting the advantages to convince the suppliers to adopt the solution. It might even have been important to involve the most important suppliers in the project from its early beginning. This would have allowed to take into account their comments and constraints and to agree on their involvements. Other cases have shown that providing information on a regular basis on the project and an intense training could also have eased the adoption of the solution by the suppliers.

Saima Avandero is currently testing a solution to collect information through SMS and try to push in this direction. The solution should allow sending an SMS in an automated way from the supplier's mobile phone and directly integrating it into Saima Avandero's database. Even if this solution should improve the current situation by reducing the manual data entry of information provided, it is still fully dependant on the different suppliers. The best would probably be to deploy a solution that works independently on the different suppliers, either through location positioning systems or through RFID technologies. Saima will investigate those solutions in the future.

5.10.5 References

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

- Interview with Mr Scotti, Information technology director at Saima Avandero, 19/02/08
- Websites: Saima Avandero (www.SaimaAvandero.it).

5.11 Trafikanten, Norway

Abstract

Trafikanten is the joint information provider for the two public transport authorities (PTA) in the Oslo region of Norway: AS Oslo Sporveier (PTA Oslo), Stor-Oslo Lokaltrafikk AS (PTA Akershus) and NSB AS (National State railways). Founded in 1986, the main objective is to provide services and information to travellers in order to ensure an easy access to the network of all public transport operators in this region.

In 2005, Trafikanten deployed an innovative real-time passenger information system providing travellers with reliable information on real-time departure times of public transport vehicles. Real-time vehicle departure information is calculated with the help of a combination of location positioning systems, distance measuring devices, travel planning information and other parameters. This information is displayed via wayside signs at the stops or provided through different channels like the Internet and mobile channels. It allows to better inform passengers regarding travels, either at home, at the office or at the stop. Planning trips and commutes have become much easier and unnecessary waiting times at the stops have been reduced with the help of this system.

This case demonstrates the benefits and barriers of such a solution and analyses the success factors of this challenging e-business project.

Case study fact sheet

■ *Full name of the company:*	*Trafikanten AS*
■ *Location (headquarters / main branches):*	*Oslo, Norway*
■ *No. of employees:*	*75*
■ *Sector:*	*Transport*
■ *Main business activity:*	*Information provider to public transport passengers*
■ *Primary customers:*	*Public transport authorities, Norway operators*
■ *Year of foundation:*	*1986*
■ *Turnover in last financial year (€):*	*n.a.*
■ *Most significant market area:*	*Oslo region of Norway*
■ *Main e-business applications studied: **	*Information systems*

5.11.1 Background and objectives

Trafikanten, founded in 1986, is the joint information provider for the two public transport authorities (PTA) in the Oslo region and the Norwegian state railways. It is organised as a limited company (ltd) and has been set up to brand a common public transport information and customer service in the central eastern region of Norway. In 2008 the ownership of Trafikanten was slightly changed as 6 new shareholders entered the company representing Norwegian PT operators, PT branch organisations and two airliners. The original 3 shareholders still have the majority of shares.

Trafikanten's main objective is to promote public transport and ensure easy access for passengers to the network of all public transport (PT) operators in the region, regardless

of transport mode or company. Information provided to travellers is free of charge and service costs are covered by the organising authorities, the state railways and the bus operators on a contractual basis. Information contracts for express busses and other commercially operated lines are negotiated on a cost-plus basis. Other incomes result from a commission taken on ticket sales and other Customer Service contracts with different operators in the region. Trafikanten operates on a non-profit basis.

Even if Trafikanten does not operate in a competitive marketplace due to their specific business model, they compete indirectly with operators providing information to travellers and do marketing and promotion for their companies. Trafikanten today is the dominating information service provider due to the fact that users can compare different transportation modes on Trafikantens Website.

Information and Communication Technology (ICT) is key for Trafikantens activities. The efficiency of the company is fully dependant on the development of those solutions. All future services planned are based on Information and Communication technologies.

The first information service provided by Trafikanten set up in 1988 was a centrally located service centre to manually sell tickets and provide information to customers. At the same time a call centre was opened for travellers. ICT at the time was used to give precise information and fast answers to travel enquiries. This step was the main driving force for the development of a travel planner in 1990.

The operators in the call centre checked timetables on different paper pages, which was a time consuming and error generating activity. With 3000 calls handled a day, there were long waiting times for customers until a call was treated. The objective of developing the traffic planner was to reduce the duration of each call and to be able to serve an increasing number of telephone customers.

In 1992 Trafikanten put the first travel planner in place [did they develop it?]. The travel planner achieved the expected results and reduced the speaking time of the average customer call by about 20%. In 1997 the travel planner was launched on the Internet for public use; www.trafikanten.no.

Before implementing the real-time information solution in 2005, Trafikanten enhanced its service offering through an online ticket selling service, and an SMS and WAP travel planner service.

The objective of the real-time information project is to provide travellers with the accurate vehicle arrival and departure time information via the Internet, mobile channels and through signs available at the stops.

5.11.2 e-Business activities

The real-time passenger information project started in 2004. Prior to the start of the project, a one-year planning phase took place where Trafikanten brought the stakeholders and project partners (including public transport authorities, the road authorities and operators) to agree on the organisation of the project and on the commitments of each partner. Achieving a good adoption of the final solution by the operators required the full support of all partners involved. A complete and comprehensive functional requirement specification was finished by mid 2004.

The next step was a tendering phase to acquire the technical solution. From a functional point of view the solution should allow to provide information on punctuality of all

transport vehicles to the public over different channels including the Internet, mobile channels and signs at stops. It should be based on timetable data from the existing travel planner tool. Another important requirement was that the suppliers could meet time and budget constraints. After 9 months, a main supplier in Germany (INIT) was chosen to provide the technical solution, and some supporting supplier contracts were signed in parallel.

The project responsibilities were shared between the suppliers and Trafikanten. Suppliers were asked to provide an all-in-one solution. Trafikanten managed the implementation of the solution for all operators.

The contract was signed in February 2004. A first pilot of the solution was deployed 8 months later. The pilot solution was running for 4 months on 52 vehicles (48 busses and 4 tramcars). It was based on a central system linked to local dispatch systems deployed in three different vehicle depots and six stops equipped with signs. The pilot was very successful and after some errors were corrected the “GO” for the overall deployment was given by Trafikanten.

The rollout started in January 2005 and will when finalised include the following equipment:

- 1050 vehicles with computers, GPS systems and meter measuring systems,
- 350 stops with signs,
- 12 depots with dispatch systems to upload and download data.

The rollout is still ongoing and 90% of targeted vehicles are equipped with the solution today. The deployment is planned to be completed by the end of 2008. Trafikanten is today the owner and operator of the system and has signed separate agreements with all involved partners.

The overall budget of the project is about 9,5 million Euros including external and internal costs.

The solution is a proprietary solution developed by INIT based on meter measuring, Global Positioning Systems and General Packet Radio Service (GPRS) technologies that have been tailored to the specific needs of Trafikanten.

5.11.3 Impact

Owing to the careful preparation of the project, the organisational part which was the most challenging part of the project was one of the key project success factors. The project team included up to 20 persons, 7 stakeholders and 3 full time project officers from Trafikanten assisted by an external consultant. Since the project had a big impact on all operators it needed a great involvement of all stakeholders and partners from the very beginning. Trafikanten put a very flexible project organisation in place and organised working groups that involved people from different partners for each specific project topic: technical groups, training groups, data capture/testing groups, evaluation groups. Once a specific task for which the group was set up was finished the group was dissolved and another group was set up. Thanks to the good knowledge of all their partners by Trafikanten and their habit to work with them, the project went very smoothly.

The project is considered to be a great success and the citation of this case in the media testifies the good e-business practice.

Significant benefits resulting from the system implementation are summarised hereunder.

Passenger satisfaction and the attractiveness of public transport services can increase considerably if reliable and clear passenger information is available before a journey is planned and is available at the vehicle stop.

Trafikanten has achieved its main goal of providing this real-time information on the punctuality of all targeted transport modes through the internet, mobile channels and signs to the public. Passengers can now conveniently access the website from their home or office and conveniently gain information about the real departure times they need for planning their trip. And even better, someone that is already on the move always has up-to-date information. Passenger information data can be accessed using a dialogue-oriented user menu on a WAP-compatible mobile phone (Wireless Application Protocol).

Another important benefit results from the traffic signal priority system allowing to improve the efficiency of priority (green light) given to the vehicles. Travel times can be considerably optimised with this system. The results are fewer vehicles being needed and therefore lower costs for transport companies. The average driving time of buses on some of the heaviest bus lines have been reduced by up to 20%.

Another important benefit results from the planning capabilities given through the data analysis provided by the system. The data administration and evaluation system is used for the evaluation and report generation of data recorded during operations. The operators are able to gain an overview of complex daily activities, evaluate these and respond when needed. Preparing and evaluating over long periods and in close correlation to practical activities allows them to draw up the bases for economic viability considerations or operational planning. Strengths and weaknesses can be detected, analysed and operating procedures corrected and optimised. The analysis of historical data is of great interest for Trafikanten and allows them to provide detailed reporting on all activities to the Public transport authorities.

5.11.4 Lessons learned

This case demonstrates a successful solution implementation in the public transport area that allowed achieving significant benefits in terms of passenger communication and service improvements, lower travel times and increased planning efficiency for the Public Transport Authorities and operators.

Some of those benefits were not expected from the beginning and were resulting from the multiple features offered by the system.

The expected benefits like increased customer satisfaction through reduced waiting times at the stops will be analysed in the coming months with specific customer surveys.

It is important to highlight that the most challenging part of this project was the organisation and management of the project and not the technical or financial parts of the project. Even if a one-year planning phase seems quite long for such a project, it was a prerequisite to agree with all involved partners on their involvement and on their commitments before starting the project. The success of such a solution is dependant on the correct application of the deployed solution and processes. Defining clearly the commitments avoids wasting time with solving conflict situations and disagreements.

The project being managed by a common organisation that is recognised by all involved stakeholders contributed to the success of the project.

The question of operational cost management should also be addressed in the planning phase. Such a solution has an important impact in terms of ongoing operational costs that needs to be considered. Trafikanten mentions that it could have spent even more time on the operational contracts to make sure that all obligations will be met in the future. Getting funding for operational costs can represent a difficult task in the public transport sector and should be addressed in the early beginning of the project.

5.11.5 References

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

- Interview with Jarl Eliassen, Managing Director Trafikanten, 03/01/08
- Presentation of Trafikanten and their services
- Websites: Trafikanten (www.trafikanten.no)

5.12 Värmlandstrafik AB, Sweden

Abstract

Värmlandstrafik is a public owned local transport company in one of Sweden's regions called Värmland. It is managing regional train and bus transportation. The company counts about 55 employees and its central office is located in Munkfors.

In order to include the planning of the traffic, improve the management of contracts with the different transport operators and providing a better service to the public in its region, Värmlandstrafik implemented a vehicle monitoring solution in 2004 enabling the company to have clear visibility on operation of the transport vehicles. Key information provided by the system about functional disabilities, safety/security issues and environmental information allows the company to draw important conclusions when making decisions.

This case demonstrates the benefits and barriers of such a solution and analyses the success factors of this e-business project.

Case study fact sheet

■ *Full name of the company:*	*Värmlandstrafik AB*
■ *Location (headquarters / main branches):*	*Munkfors, Sweden*
■ *No. of employees:*	*55*
■ *Main business activity:*	*Operation of public bus and train transport*
■ *Primary customers:*	*Passengers*
■ *Year of foundation:*	*1981*
■ *Turnover in last financial year (€):*	*n.a.*
■ *Most significant market area:*	*Sweden Värmland*
■ *Main e-business applications studied:*	*Information systems*
■ *Case contact:*	*Markus Bergman IT director at Värmlandstrafik AB*

5.12.1 Background and objectives

Värmlandstrafik is a public transport authority (PTA) responsible for providing public transport services to passengers in the Värmland region of Sweden with its central office located in Munkfors. Värmlandstrafik has been founded in 1981 following the adoption of a law in the late seventies, deciding that each region in Sweden should have its local authority for the public transport.

The main activities of the company include the planning of the traffic, the management of contracts with the different operators and the provision of a unique public transport interface to the public.

The company does not own any vehicles but works with different transport operators that own the vehicles. The operators are contracted by the regional PTA. Värmlandstrafik is working today with the public train operator and eight transport operators. The contract management is an important activity for the company, including choosing the adequate partners, defining the contracts, setting up requirements that concern the respect of

passenger comfort, security and environment and controlling the respect of the requirements and the activity of the operators.

Vehicles are of great importance for Värmlandstrafik since they play a crucial role to the total travel experience of the passenger. It is important that public transport vehicles are perceived being attractive. Comfort, security, safety and appearance are important aspects in the choice of means of transportation. The operation and maintenance of the vehicles in accordance with the requirements specified in the agreements are part of the responsibilities of the operator.

The traffic is financed at 60 percents by the revenues generated by tickets selling. The remaining budget is funded by the government and the shareholders, including the county council and the different municipalities.

IT solutions play an important role in supporting the company in achieving its objective of providing good transport services while keeping the costs at a low level, through:

- improving operational efficiency and lowering costs through internal IT solutions thanks to increased efficiency of Business processes;
- improving customer services and customer communication through Web based and mobile information services for passengers (Travel planner, Timetables etc), ticketing systems, etc

To improve the management of the operator contracts, Värmlandstrafik decided in 2004 to implement a solution that allows them to better control the activity of the operators. The company wanted to get clear visibility on the vehicle conditions and use and have a better control on the respect of agreed requirements by the operators in terms of comfort, quality, security and environment.

Another important driving force to implement a solution was that the PTAs in Sweden were under pressure from the Government to better control the pollution generated by the public transport. Therefore the solution should enable the Värmlandstrafik to measure the pollution generated by the public transport in Värmland.

To match these requirements Värmlandstrafik decided to implement an existing solution called FRIDA, a system allowing accessing all vehicle information including accessibility, security, quality, and environment.

5.12.2 e-Business activities

The solution chosen by Värmlandstrafik had been initially developed by Nordic Port and the Public Transport Authority (PTA) in West Sweden, called Västtrafik with the main objective to allow the region to measure the pollution of the vehicles managed by operators they have contracted. A first version of the solution has been deployed in 2000 for Västtrafik, after 2 years of development by Nordic Port.

From 2000 to 2004 further developments extended FRIDA to a solution matching perfectly the different needs of Värmlandstrafik AB, who implemented it in 2004.

The FRIDA solution is based on software, entirely developed by Nordic Port. It is a web based system, with a central database hosted by Nordic Port. The different users get an address and login and can access the solution via the Internet. The region pays a monthly fee (about 5000 crones). Developments to match specific requirements are done by Nordic Port and are paid by the region.

Nordic port is in charge of the maintenance and support of the solution and 2 employees are working fulltime on these tasks.

FRIDA allows collecting and understanding detailed information about the vehicles used for the public transport. It provides detailed information about functional disabilities, information about safety/security of transport such as bus, train and tram. The information is available for the PTA through a Web interface. Specific information such as environmental pollution is measured as well.

The information about the vehicles is entered by the operators. There is one person in charge of filling the data at each transport company working for the PTA. They enter the information over the Web interface, an XML file is sent to the system and FRIDA is fed automatically with the data. Every 6 months the operators send the data about miles ran and fuel used for each vehicle. The system calculates the pollution generated. Each time an operator buys a new vehicle the data is entered into the system. The information is stored centrally in the system and organising authorities have full access to the information as well the operators.

New functionalities that have been developed are the connection to the FRIDA system via mobile devices (through offline data synchronisation), to ease the process of data collection. Värmlandstrafik checks the vehicles on a regular basis to make sure that they are in good condition. The person in charge of the bus control is equipped with a handheld PC and directly enters the information about the vehicle in the mobile device. Once the bus check is finished, the handheld PC is connected to the PC at the office and the data directly fed into the system.

The solution allows today counting any vehicle that runs in Sweden whatever kind of vehicle is used: busses, trains, boats and even cars. When more organising authorities became customers in the system, a user society was formed, @FRIDA, which now manages the development of the system. Members of the group jointly decide about new developments necessary for the FRIDA system. In addition, a close cooperation takes place with SLTF (Swedish Public Transport Association) concerning development and marketing of FRIDA. SLTF has the role as administrator of the user society @FRIDA. FRIDA is used by the greater part of the organising authorities in Sweden today and the user society @FRIDA has prepared a standard for vehicle information, which is being used in a way that makes it possible for SLTF to compile national data about the vehicles concerning environmental discharges, increased accessibility for disabled persons etc.

The total costs of the solution reach today about 3 million Swedish crones, a budget that has been funded by different regions.

All regions of Sweden use the FRIDA system today. About 100 users are connected per region to the system. Since all regions use the system in Sweden comparisons between regions can be made and each region can measure its performance against the others.

Future developments that are planned for FRIDA are to extend the system to other Nordic countries like Norway and Denmark.

5.12.3 Impact

The implementation of the FRIDA system has generated great benefits for Värmlandstrafik resulting in a better control of the operator's activities and the

environmental impacts, in providing better security and comfort to transport passengers, and in a better standard of the overall transport service.

The most important benefit achieved through the implementation of this solution is a greater control of the transport operations. Transport operators have agreements to respect in terms of bus equipment, quality, security and traffic. The bus operator put the information about its vehicles and equipments into the system. It also feed the system with the distances that a vehicle has run.

If operators do not follow the agreements, the solution will automatically display these “anomalies” on the user interface. This allows the region to directly get in contact with the operator. The solution allows to insure better follow up of vehicle quality and security and to provide a better service level to the passengers.

Another benefit is resulting from the reporting capabilities provided by the solution. The regional authority can provide concrete figures on the operations of the region and compare it against other regions.

Before the system implementation Värmlandstrafik had manual processes in place to follow up the operators and to perform the reporting to the authorities. These processes were very time consuming and the information was not reliable. It was very difficult to have any control on the activities of the operators. The only information provided by the operators was a copy of the quality check of the busses that was done once per year and sent to Värmlandstrafik by mail and fax.

In order to plan the traffic and get figures on the bus operation, Värmlandstrafik met the operator once a year and tried to find out the figures which were very time consuming. This information is today provided in a reliable way by the system.

The operators are also positively impacted by the solution. FRIDA allows them to manage their vehicle park and to follow up on their activity. Thanks to this “win-win” situation and the complete transparency of information for all partners, the overall relationship with the operator has been improved and a real dialogue and cooperation between those partners exist today.

Värmlandstrafik can make use of the analyses generated by FRIDA to sign new contracts. It allows the company to improve the contracts and to set up more precise agreements and objectives with the operators according to its key priorities.

5.12.4 Lessons learned

The example of FRIDA enabling today the different regions of Sweden to control the national transport operation and its environmental impact is an example of a successful e-Business solution implementation.

The reasons for the success of this solution can be summarised in technical flexibility of the solution as well as in depth user involvement during the whole development of the system.

The FRIDA tool is very flexible and modular allowing being extended to match the growing needs of the local Public Transport Authorities in Sweden for more than 10 years.

To build up such a tool on a national basis it is very important to involve all the regions. This is why a specific user group has been set up for FRIDA called @FRIDA, composed

of one or several representatives of each region, where the different needs and requirements of all regions are discussed and decisions about future developments taken.

The data provided by FRIDA supports the Swedish PTAs today in achieving an important objective which is the reduction of the pollution generated by the public transport. Before the FRIDA system implementation, no measurement at all was possible.

Thanks to the solution implementation, Värmlandstrafik can exactly measure the pollution generated by the public transport in its region and compare the results against other regions. In order to improve the environmental impacts of the public transport, the local PTA can set up detailed requirements in terms of use of specific vehicles, filters or fuel to achieve its goals. If a region is better than the defined goal, it gets a fee from the government.

The deployment of the FRIDA system allows the Swedish authority today not only to measure the pollution generated by the public transport all over Sweden but also to set up concrete and achievable goals for the environment for the different regional authorities.

5.12.5 References

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

- Interviews with Markus Bergman, IT coordinator at Värmlandstrafik AB, 30/11/08 and Mr. Fredin, Company owner Nordic Port 27/11/07.
- FRIDA demo presentation
- Websites:

  Värmlandstrafik (http://www.kollplatsen.com/index.html)

  Nordic Port (http://web.port.se/).

6 Conclusions: outlook and policy implications

Due to the high turnover and number of jobs in the European TLS industry and its interrelation with almost all other European economy sectors, any improvements to the competitiveness and effectiveness of European transport and logistics enterprises will have a positive impact on other industries and, undoubtedly, will also have an impact on the European economy as a whole. Based on the results of the e-Business Survey presented in Chapter 3, the impact of ICT on companies' performance that have been drawn in Chapter 4 and the results from case studies analysis (Chapter 5), some conclusions regarding the e-business usage in the TLS sector can be identified. First, the most relevant key findings will be presented. Then, taking into account the expectations of the surveyed firms, an assessment of possible further development of e-business in the sector will be made. Lastly, policy implications will be suggested.

6.1 Key findings

***Saturation point*.** Nearly all TLS companies (97%) which use computers in the TLS sector are connected to Internet. A tendency of the firms to have a higher broadband connection is also observed. One third of the firms have a bandwidth connection of more than 2Mbit/s.

Perceived importance of e-business is clear for large-size companies, but not for micro and small companies. The TLS sector is characterised by a pronounced digital divide between small and large companies. In general, the ICT systems of large companies obviously tend to be more powerful and sophisticated than those of small firms. This translates into more intensive and advanced electronic business practices, and a greater potential for exploiting cost-saving opportunities. For micro and small companies the feelings that the "company is too small" or that "business technologies are too expensive" act as barriers to further ICT adoption and have to bee eliminated.

The deployment of Enterprise Resource Planning (ERP) systems is a good indicator of the overall e-business maturity in many sectors. ERP is the technical backbone for various e-business applications, including systems for product planning, purchasing, inventory management, order tracking and finance. In the TLS sector there is still a considerable gap in ERP adoption between small firms on the one hand and the medium-sized and large firms on the other.

International comparison: In international comparisons, EU TLS enterprises are – on average – level with their counterparts in USA in their use of ICT. TLS companies from France, Italy, the UK, Sweden, Germany and Spain are very similar in their use of ICT, particularly if emphasis is laid on the larger firms. Firms from the only participating new Member State in this study – Poland - took the lowest rank in this benchmarking exercise, although, Polish enterprises are not far behind in its use of some ICT technologies.

Sectoral comparison: The sub-sectors comparison shows a higher development of ICT adoption in logistics than in the other two analysed sub-sectors (passenger and freight transport).

ICT role in innovation processes: The econometric analysis carried out in the present report has proved, among others, the following hypotheses:

- ICT-enabled innovations positively correlate with firm's turnover.
- A positive correlation between collaboration between business partners and the introduction of ICT-enabled innovations.

TFP growth. It has been observed that ICT together with high and medium-skilled labour has a positive impact on TFP growth. ICT usage and high levels of employee's skills complement each other, leading to skill-biased technological change and an advantage of firms with highly skilled employees in adopting and using ICT.

Therefore, ***investments in training and skill-formation*** are at least equally important as investments in ICT capital itself in order to attain optimal benefits. In other words, in a knowledge economy driven by rapid technical change, the ability to empower the work force is a necessary complementary measure to ICT adoption. Without having the right skills in place, costly investments bear the risk of becoming ineffective.

IT practitioners. Interviewed SMEs often lack a coherent ICT investment strategy or the related skills - partly because most SMEs cannot afford to employ ICT practitioners. According to the present report, only about 9% of small firms and 33% of medium-sized firms employ ICT practitioners i.e. have their own ICT department. It has also been seen that employing IT practitioners positively affects the likelihood of ICT-enabled innovations.

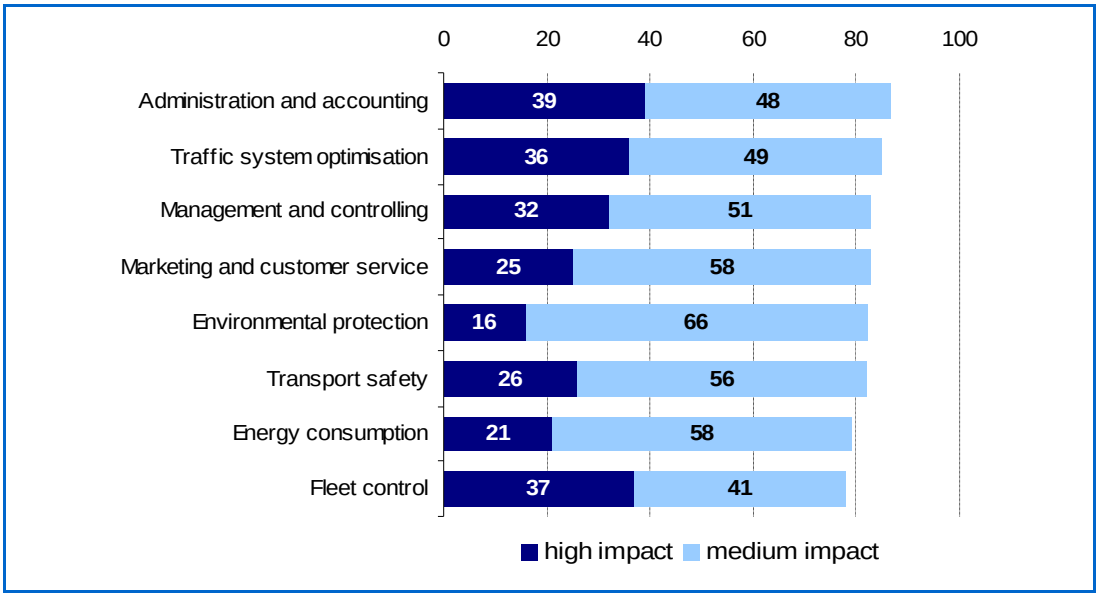
*There is still only a very **limited use of RFID technologies** in the TLS industry.* Only 2% of firms (23 from a total of 1097 surveyed firms) have declared that they do use this technology, these were mainly large-sized firms.

6.2 Possible further developments of e-business

Companies interviewed in the e-Business Survey 2007 were asked to indicate in which areas they foresee an important impact of ICT in the future. According to the results, companies in the TLS sector do not expect that neither the role of ICT nor its impact on the way these companies operate will lose any momentum (Exhibit 6.2-1).

In particular, firms from the sector expect that ICT will have a **high impact** on support functions such as administration, management and controlling, and on primary operational functions such as fleet control and traffic system optimisation (30-40% each). Adding those companies that expect ICT to have a "medium impact", figures are nearly the same for all areas asked: companies representing about 80% of employment in the sector expect ICT to matter in all these fields in the future (see Exhibit 6.2-2).

Exhibit 6.2-1: % of firms* expecting that ICT will have a high / medium impact on …

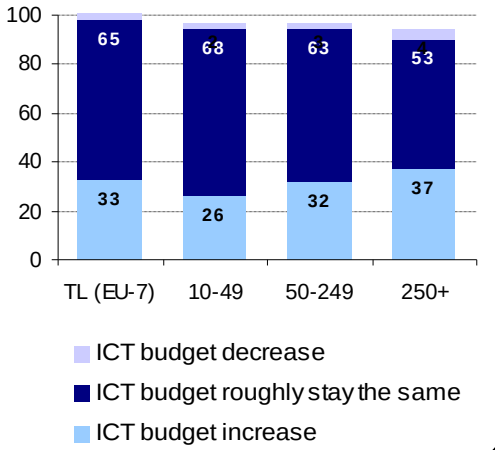


* Data weighted by employment ("firms representing …% of employment in the sector expect that ICT will have a high / medium impact on …

Source: Sectoral e-Business Watch (Survey 2007)

Companies were asked then about their expectations with regards to the estimated budget for ICT technologies that the company will assign for the next year. As shown in Exhibit 6.2-2, one third of the sector's companies expect that ICT budget will increase. This is another element which supports the expected further developments of e-business in the TLS sector. However, according to the findings reported in Chapter 4, investments in training and skill-formation are at least equally important as investments in ICT capital themselves in order to realise the optimal benefits. Using the key findings and the companies' subjective feelings, the specific fields to be developed in the future are described below in the policy implications section.

Exhibit 6.2-2: Expected development of ICT budget: % of companies saying that their ICT budget will increase / decrease / stay the same in the forthcoming financial year



Source: Sectoral e-Business Watch (Survey 2007)

6.3 Policy implications

The preceding chapters and sections revealed some important issues related to e-business in the TLS sector, as well as several areas where e-business developments may have implications for policy. This section highlights those policy implications arising from the survey, the qualitative analysis and the case studies presented in the previous chapters of this study.

Exhibit 6.3-1 below illustrates the possible implications arising from an increase in e-business activity in the TLS industry. However before going deeper in the analysis of policy implications, it's necessary to outline some important facts related to the construction of a policy framework for ICT adoption in all sectors in Europe, especially in the TLS sector.

1. Looking at the e-Business Watch Sectoral reports carried out in the last few years, and notwithstanding sectoral differences, there are some common characteristics across sectors with regard to ICT adoption, such as the lower ICT adoption by SMEs, problems with ICT skills development, standardisation and interoperability issues, a lack of awareness of ICT benefits and potentials.

2. The European Commission have been working to tackle this situation and a vast number of studies, reports, working groups, researches programmes have been produced,, –all of which are supported by the EU. They deal with those problems mentioned in which a very clear policy framework has also been developed. Quoting only from some of them:

- In February 2005, the European Commission proposed a new start for the Lisbon Strategy. Some of the policy areas of this renewed Lisbon objectives address ICT-related issues. Central Policy Area No. 6 deals with facilitating ICT uptake across the European economy.
- The eBSN (European e-Business Support Network for SMEs) is an e-business policy coordination platform, bringing together decision-makers in the field of e-business to share information and discuss strategic policy direction. It involves about 200 public policies or public-private partnerships from 30 countries in Europe. eBSN supports policy analysis and benchmarking, generates positive synergies between national policies, and inspires new e-business policies and the exchange of good practice.
- INTEROP FP6 Network of Excellence and ATHENA FP6 Integrated are projects that have been initiated in Europe which focus on methods to encourage and enable implementation of e-business standards and interoperability for SMEs.
- e-Business W@tch Special Study on "e-Business Interoperability and Standards" (September 2005). The study's recommendations focused on medium term actions which could directly contribute to implementation of common standards based solutions in all sectors. For long term value, the study's proposed actions suggest focussing primarily at the sectoral, cross-sectoral, and standards policy levels.
- COM (2007)96 final. Radio Frequency Identification (RFID) in Europe: steps towards a policy framework; e-Business Watch 2007 study on RFID adoption and implications; EPCglobal: industry-driven standards for the Electronic Product Code (EPC) to support the use of RFID.

- e-Skills for Europe: Towards 2010 and Beyond (2004); the European e-Skills Forum and the ICT Task Force provided at the end of 2006 a set of recommendations contributing to the preparation of a long-term and consistent e-skills agenda to ensure that the EU has the necessary e-skills in the future. Following-up on these recommendations, the European Commission adopted a policy Communication on "e-Skills for the 21st Century: Fostering Competitiveness, Jobs and Growth" on the 7th September 2007 presenting a long term e-skills agenda for Europe and five action lines at the EU level. The Council of Ministers adopted Conclusions on a long term e-skills strategy at the meeting of the Competitiveness Council on 22-23 November 2007. All the actions in support of the long term e-skills agenda will be implemented before the end of 2010.

3. Specifically for the TLS sector, the following actions to counteract the problems of ICT adoption in the sector have been developed:

- COM (2006) 314 final - Communication: Keep Europe moving - Sustainable mobility for our continent: Mid-term review of the European Commission's 2001 Transport White Paper (Energy and Transport DG).
- European Commission (2007). Information Society and Transport: Linking European Policies.
- E-Safety Forum: ICT for Clean & Efficient Mobility Working Group.
- COM (2007) 607 final. Freight Transport Logistics Action Plan. The Logistics Action Plan represents the first attempt by the European Commission to truly coordinate and combine freight transport policies that had previously been considered and developed separately and in isolation from each other. The approach of the Commission is to join the various policies covering individual modes into a single, cohesive and co-ordinate logistics and freight policy
- Technical Committee 278 (2007) Road Transport and Traffic Telematics.
- Towards an RFID Policy for Europe (2007), RFID in Transport and Logistics, RFID Consultation; COM (2007)96 final: Radio Frequency Identification (RFID) in Europe: steps towards a policy framework. Realising the potential of RFID technology, this report addressed a number of interrelated issues pertaining to security and privacy, governance, radio spectrum and standards and called for an RFID Stakeholder Group to provide an open platform allowing a dialogue between consumer organisations, market actors, and national and European authorities.

Those studies, reports and working groups, have developed a great number of policy recommendations. Furthermore, some of those groups are working hard to realize the suggested actions derived from those policies. Having said that, the policies' implications derived from the present report are similar in many occasions and hence ratify those policy recommendations derived from other sectoral or transversal studies carried out by the European Commission or by e-Business Watch sectoral studies. For example, in the 2006 e-Business Report, two objectives were seen as particularly important: the improvement of e-skills among smaller companies, and the advancement of interoperability and standards. This assessment remains valid for 2007, in full recognition of the many efforts that have been started at regional, national and European levels to address these goals. Nevertheless, this report aims to summarise current knowledge and understanding, as well as identify future information requirements of ICT and e-business adoption in the TLS industry, useful to the policy-making process.

Exhibit 6.3-1 summarises policy implications from e-business developments that have been identified in this TLS sector study.

Exhibit 6.3.1 Policy implications arising from e-business activity in the TLS sector

Policy issues	Suggested actions	Possible initiators
Promoting ICT solutions for SMEs, especially the development of affordable ERP systems for SMEs	• Improve dialogue and cooperation with software providers. • Encourage initiatives for networking and cooperation. • Stimulate the participation of SMEs in business networks and clusters. • Develop mechanisms to help SMEs set challenging and realistic targets for their B2B implementations. • Improve access to finance and risk capital for SMEs. • Provide the resources to educate, coach and integrate the SMEs relying on IT-SMEs and local support centres. This can help to get the applications adapted to their particular needs and business models	Sector associations Business intermediaries Competence centres
Improving ICT skills and managerial understanding and skills for e-business	• Facilitate knowledge transfer between research centres and enterprises. • Counteract e-business skill-shortages in the market, e.g. by promoting multi-stakeholder partnerships in ICT training programmes. • Provide incentives for ICT training of employees. • Improve skills related to the reorganisation of working processes and procedures, helping SMEs managers to better understand organisational aspects of e-business. • Create opportunities for dialogue between SMEs and ICT service providers.	European Commission National Governments Regional Governments Competence centres Chambers of commerce Member States (via their e-business programmes) Other intermediaries
Developing standards for e-business, facilitating the process of interoperability	• Support projects to improve standards for e-business (like INTEROP FP6 Network of Excellence and ATHENA FP6 Integrated project). • Promote relevant industry initiatives. • Encourage adequate representation of SMEs in standardisation processes. • Policy can act as a neutral coordinator and promoter of standardisation initiatives.	Standardisation bodies European Commission National Governments Innovation centres Industry associations
Promoting efforts towards innovation	• Create incentives for innovation, recognising the specific role of ICT in this context. • Improve skills related the implementation of innovative technologies. • Improving the framework conditions for innovation in general; this includes education, R&D and market regulation. • Create a level playing field for cooperation between large companies and SMEs	European Commission Innovation centres Regional Governments Industry federations Business support networks

Promoting ICT Solutions for SMEs, especially the development of affordable ERP systems for SMEs

Although ICT uptake has certainly increased among SMEs in the sector, small businesses are slower than large ones to adopt new ICT as is the case with other sectors. According to the Sectoral e-Business Watch Survey results, three third of small firms (67%) have adopted e-business in some more or less significant way, while 74% of medium-sized firms and 82% of large firms did the same. Principal reasons for non-adoption are not yet so clear. In some cases it is associated with a lack of applicability and little incentive to change business models when returns are unclear. In a nutshell SMEs' ICT requirements are that they support their core business, work well, are user-

friendly, easy to upgrade and at as low a cost as possible. In this case, financial support in the form of tax deductions, subsidised grants, or free consultancy and training programmes might help. On the other hand, some firms claim that their reluctance to engage in e-business is due to the fact that they cannot see how this could be implemented in their company (a clear awareness problem). Against this background, policy could consider initiatives to accelerate the adoption of ICT systems among smaller companies.

Moderate financial support can be given in the form of prizes for competitions featuring innovative e-business applications.[124] Potential small business benefits and firm and sector-specific strategies drive the adoption and use of ICT. Large companies are maturing in the TLS industry. They understand the benefits and are steadily improving ICT tools to their own advantage. There is a big distance to go to create a level playing field for cooperation between large companies and SMEs. Many of the small firms still cannot cope with system requirements, and they risk exclusion from the value network. Policy and industry initiatives have to address this issue. Change management should be actively promoted, especially as a tool to help SMEs take up the new e-business solutions. It is also important that the financial failure of new business ideas is made less punitive.

There is still a considerable gap, for instance, in ERP adoption between small firms on the one hand (14%) and the medium-sized (23%) and large firms (41%) on the other, based on the Sectoral e-Business Watch Survey results (see section 3.4.1). A faster deployment of an ERP systems among medium-sized and small enterprises would create a much broader base for sectoral e-business and this could drive process efficiency and productivity gains in European enterprises. Now there is a positive market environment to attain this goal: driven by market requirements, and enabled by technological advances, ICT companies are increasingly addressing the SME market. They are developing affordable, smaller-sized solutions (e.g. ERP and CRM suites) that can be connected with the more powerful systems of large firms. Policy makers could, in fact, use some of their instruments to give this trend additional momentum.

The limited degree of B2B integration between large firms and their smaller business partners is one of the principal bottlenecks to a better exploitation of the potential of e-business in terms of process efficiency and cost savings. Indicative evidence is the low percentage of small firms (8%) that have linked their ICT systems with suppliers (see Sections 3.5.2 on "e-Integrated supply chains"). The use of SCM software is also very limited among smaller companies (6%). Against this background, mechanisms to enhance and accelerate this development should be considered.

As e-collaboration increases innovative output (see section 4.3.1), initiatives have to be developed to encourage cooperation among SMEs and the formation of networks and clusters. If smaller TLS providers and operators cooperate and combine their efforts and resources, they indeed are able to successfully operate in an increasingly competitive market.

A specific element of promoting the adoption of ICT by SMEs, as was outlined by the Lisbon agenda of the European Union, is to improve access to finance and risk capital for SMEs. In this context, the European Commission, the European Investment Bank and the European Investment Fund launched, in May 2006 the *Joint European Resources for*

[124] Other possible tools could include microcredits, strengthening equity capital, mezzanine financing, securisation of loans, etc.

Micro to Medium Enterprises (JEREMIE) initiative, which allows European Member States and Regions to use a part of their structural funds to obtain a set of financial instruments that are specifically designed to financially support micro, small and medium enterprises.

Improving ICT skills and managerial understanding and skills for e-business

Skills requirements arise as an important issue whenever e-business is implemented. Smaller companies are obviously less equipped in terms of ICT skills (see Section 3.2) and tend to be less receptive towards sophisticated solutions. The results of the Sectoral e-Business Watch Survey show that two of three large companies employ ICT practitioners, whereas fewer than 10% of micro- and small-sized firms employ ICT practitioners. ICT usage and high levels of employee's skills complement each other, leading to skill-biased technological change and an advantage of firms with highly skilled employees in adopting and using ICT.

The European e-Skills Forum, established by the European Commission and the CEN Workshop Agreement (CWA) could be appropriate forums to discuss the issue of ICT skills development in the TLS sector. A product of such discussion could be an assessment of required skills for enterprises in the TLS. The required skills can be provided at a general level, such as public education, or it can be about more specific ICT skills which could be provided by vocational and higher education institutions or professional educational programme vendors (private operators).

The picture that emerges from the survey is that ICT skills are a decisive issue, especially among SMEs, notably at the managerial level, i.e. how to use e-business to support a company's strategy. In micro and small companies in particular, the usage of ICT equipment and the access to the internet are often limited to the owner and a few key people. Training programmes need to be more focused on managerial understanding and skills for e-business, such as how to effectively integrate e-business processes into existing business models and strategies to change organisational structures.

As has been pointed out in Chapter 4, investments in training and skill-formation are at least equally important as investments in ICT capital themselves in order to realise the optimal benefits. Thus investments in e-skill formation and training have to be prioritised. This is also in line with the recommendations made in the recent "Small Business Act" for Europe, where one of the 10 action lines focuses on upgrading the skills in SMEs.[125]

Developing standards for e-business, facilitating the process of interoperability

Setting standards and promoting interoperability is another important policy implication that has been identified by the analysis in this sector study. In particular, large companies that were interviewed claimed that systems' incompatibility constitutes an important barrier to e-business diffusion. The Sectoral e-Business Watch Survey results reveal that the most important reason for not using e-business more intensively in the TLS sector is

[125] European Commission (2008): "Think Small First". A "Small Business Act" for Europe. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the regions. COM(2008) 394 final. Brussels, 25.6.2008.

that most of the companies feel that their customers/suppliers are not prepared (65% of the firms, 76% of the larger firms). Thus, despite the wide diffusion of ICT applications in this sector there is still potential for further productivity increases through supply chain integration but that remains under-utilised due to interoperability problems. The importance of standards as a means of reducing transaction costs and increasing competitiveness has fortunately been recognised by policy makers. Policy measures should allow for temporal and business considerations in a competitive marketplace and could include, as appropriate, active dialogue with industry on the challenges of forming value networks and other potential barriers to implementation of interoperability. Other considerations could be the maintenance of an agenda with priority identification, target-setting and the monitored progress of interoperability. This agenda could be based on an evolving priority list created by functional digital enablers of ICT innovation and uptake.

European standards have to be developed in line with existing legislation, international conventions and international standards, in order to facilitate the secure integration of transport modes in the logistic chain. The European Commission is supporting the work on ICT standards and interoperability, including the interoperability of networks, which is performed by the European Committee for Standardisation (CEN). Although the process of standardisation is not the responsibility of public bodies, the policy challenge is to encourage the cooperation between private companies. In particular, support for developing uniform standards might help to overcome the market failure resulting from coordination problems. Furthermore, as large companies pursue their own interests, standards multiply and companies at lower levels of the supply chain need to adopt various standards required by their customers. This increases the overall cost of integration and weakens the incentives to use ICT.

While large dominant organisations can implement information systems using their own proprietary solutions, it is important to ensure that the requirements of small firms are properly advocated, since the sector comprises mainly of small companies which typically do not have the knowledge or resources to get involved in these activities. Supporting standardisation initiatives and programmes that encourage SMEs to participate in the standardisation process can mitigate this problem. Furthermore, it is important that during this process the interests and needs of SMEs are taken into account. Since SMEs often lack the necessary negotiation power, public bodies can ensure that the voice of SMEs will be taken into consideration.

Promoting efforts towards ICT-enabled innovation

The implementation of new ICT and complementary investments can lead to innovations, and innovations are positively associated with turnover growth. Innovative firms are more likely to grow. The empirical evidence presented in this study confirm the widespread that ICT and innovation are positively associated with turnover and productivity growth at the firm level (see Section 4.2). This holds for ICT- and for non-ICT-related innovations, for process and product innovations. There is no direct link, however, between ICT capital and economic variables such as productivity and employment dynamics. Instead, ICT has indirect effects that occur via innovations that are carried out and triggered by the adoption of new ICT.

Therefore, innovation activities should be fostered, with a particular emphasis on SMEs. The European Commission has taken an active role in this respect. Programmes which are of particular importance in this respect are the '*Competitiveness and Innovation Framework Programme'* and the '*7th EU Framework Programme for Research*

Technological Development and Demonstration'.[126] Moreover, the recent "Small Business Act" for Europe emphasises the importance of SME participation in research and development programmes to foster innovation.[127]

Finally, as the EU ICT Uptake Working Group has recommended:[128] EU policy makers should envisage the creation of lead programmes in fields of excellence such as, among others, logistics and transport.

[126] See http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm and http://cordis.europa.eu/fp7/home.html, respectively.

[127] European Commission (2008): "Think Small First". A "Small Business Act" for Europe. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the regions. COM(2008) 394 final. Brussels, 25.6.2008.

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Annex I: The e-Business Survey 2007 – methodological notes

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 A1-1). This document contains methodological notes for Projects 1 and 2, which accounted for 4,369 of all interviews conducted.

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 A1.2). 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.[129] 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 A1-3).

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%

* depending on sector

[129] 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.

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.[130]

- 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[131] 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

[130] 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.

[131] 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.

schemes). Confidence intervals for employment-weighted data are highest for the steel industry, due to the small number of observations and because this sector's structure makes it more sensitive to data weighting (i.e. large firms dominate in a comparatively small population). Employment-weighted data for this industry therefore have lower statistical accuracy than for the other sectors.

The calculation of confidence intervals is based on the assumption of (quasi-) infinite population universes. In practice, however, in some industries and in some countries the complete population of businesses consists of only several hundred or even a few dozen enterprises. In some cases, every enterprise within a country-industry and size-band cell was contacted and asked to participate in the survey. This means that it is practically impossible to achieve a higher confidence interval through representative enterprise surveys in which participation is not obligatory. This should be taken into account when comparing the confidence intervals of e-Business Watch surveys to those commonly found in general population surveys.

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%**

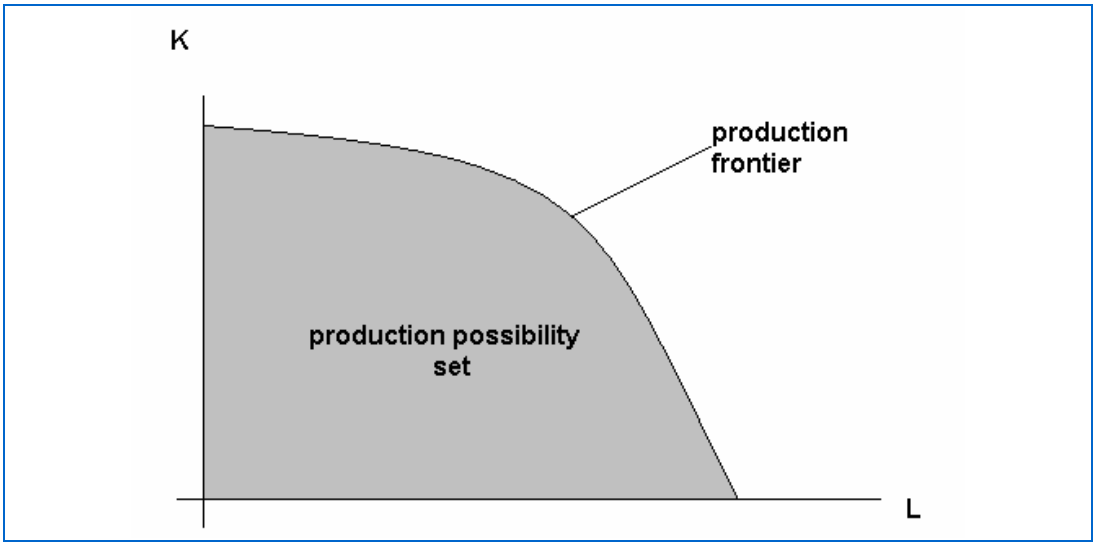
confidence intervals at α=.90

Annex II: Econometric methodology

Common stochastic possibility frontiers approach

A production frontier indicates the maximum possible production in a given period of time, using a given amount of production factors. The frontier may for example refer to a particular country or industry. The production possibility frontier approach, in contrast to the more traditional production function approach, allows to disentangle the overall productivity growth[132] into two components: first, the rate of technological progress expanding the frontier, and second, the movements of decision-making units (e.g. firms and, on an aggregate level, industries and countries) towards the frontier, i.e. towards optimal usage of production factors (see Exhibit A-II-1).

Exhibit A.II-1 Production possibility set and frontier



The stochastic production possibility approach is not a method for directly estimating impact factors on labour productivity. However, through modifying the variables, i.e. through dividing them by total working hours (TWH), a constellation can be created that allows to draw conclusions about the contribution of single variables on labour productivity.

If, given the factor input set, the produced output level stays below the potential maximum level, then the respective inefficient use of resources indicates indirectly that the whole production system or, at the micro level the single producer, faces an inability to match the best available practice. Farrell (1957) was the first to distinguish between technical and allocative efficiency. Technical efficiency reflects the ability of a firm to obtain maximal output from a given set of inputs. Allocative efficiency is used for the ability of a firm to use the inputs in optimal proportions, given their respective prices. The combination of both gives a measure of the total economic efficiency.

[132] Measured as changes in the ratio of total output produced over all inputs used in the production process.

Assuming log-linear production function where i countries produce their output given the technological parameter b , the stochastic production possibility frontier is now determined by two types of random errors. The always positive inefficiency random variable u_i **,** and the new random error term v_i, which has the usual properties of identical independent normally distributed errors with a mean value of zero and a constant variance, s_v^2 .

$$\ln(y_i) = b_0 + \sum_{j=1}^{m} x_{ij} \cdot b_j + v_i - u_i \qquad \text{for} \qquad i = 1,...,N$$

The production frontier is therefore determined by the deterministic part plus a stochastic part consisting of a mixture of two probability distributions: a non-negative one, for instance a positive truncated normal distribution, and the usual normal distribution of the error term. Estimating a stochastic production possibility frontier therefore involves estimating the parameters of the two probability distributions simultaneously.

The stochastic frontier function is accordingly bounded from above by

$$\ln(y_i) = b_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot b_j + v_i \qquad \text{for} \qquad i = 1,...,N \ .$$

The model equation can be estimated by using standard maximum-likelihood methods. This approach requires explicit assumptions on the underlying probability distributions of the two random variables. However, the estimation function cannot be derived explicitly, so the maximum likelihood (ML) function has to be optimised numerically. This is achieved here by the Frontier 4.1 programme (see Coelli, 1996). For the exact specification of the ML-function see Battese and Corra (1977). They showed that the ML-estimators are consistent and asymptotically efficient (Aigner, Lovell, Schmidt, 1977).

The model is not limited to a Cobb-Douglas function estimation; it could easily be adjusted to a more flexible functional form of a translog production function.[133]

$$\ln(y_i) = b_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot b_j + \sum_{j=1}^{m} \sum_{k=1}^{m} b_{juk} \cdot \ln x_{ik} \cdot \ln x_{jk} + v_i - u_i \qquad \text{for} \qquad i = 1,...,N$$

One-sided generalised likelihood-ratio-tests for such estimators were derived in later research (Coelli, 1995).

In this study, the stochastic production possibility frontier approach was used **to measure the degree of inefficiency of factor inputs** between industries in different countries. Since we do not estimate a single frontier for each country's industry separately but instead assume a common production possibility frontier, this approach is referred to as a common stochastic production possibility frontiers approach (see e.g. Berger, Humphrey 1997). The production possibility frontier approach does not explain the causes of the inefficiencies studied. It only indicates that a certain combination of factors is used

[133] In our econometric analysis translog specification were estimated but the results are not included in this report due to limited space. They will be published separately in a forthcoming working paper. By incorporating the cross-terms of a translog function or other flexible functional form one is able to determine variable substitutions elasticities between the different factor inputs. Assuming a Cobb-Douglas specification one assumes constant unity substitution elasticities between all different factor inputs.

inefficiently. Organisational or institutional failures are not revealed as they are not explicitly included in the estimation of the stochastic production possibility frontiers.

For this analysis a panel-data approach was used because of the low number of countries sampled. The only way a cross-section approach could be used would be by pooling industry and country data. Further trends can be drawn from the stochastic production possibility frontier model although a complete analysis is beyond the scope of this study.

To incorporate intermediate inputs in the analysis, the gross production value was used, gpv of the respective industry instead of the gross value added, gva, as the output variable. This enables us to estimate the output elasticities[134] for intermediate inputs.

$$\ln(gpv_i) = b_0 + \sum_{j=1}^{m} \ln x_{ij} \cdot b_j + v_i - u_i \qquad \text{for} \qquad i = 1,...,6$$

$$\text{with} \quad x_{j.} \in \{imi, ict, nict, hswh, mswh, lswh\}^{135}$$

Combining the industries production possibility frontiers for each country to one common production possibility frontier for an industry across all countries, we obtain a multi-country data panel with a common stochastic production possibility frontier.

$$\ln(gpv_{j,i}) = b_0 + \sum_{j=1}^{m} \ln x_{ijj} \cdot b_j + v_i - u_{j,i} \qquad \text{for} \qquad i = 1,...,6 \qquad \text{and} \quad j = 1,...,12$$

To impose constant returns to scale we normalised the production possibility frontier by subtracting the natural logarithm of total working hours from both sides of the equation. This normalised common production possibility frontier equates the gross production value labour productivity in working hours on the left hand side with respective factor intensities such as ICT-capital intensity on the right hand side.

$$\ln(gpv^*_{j,t}) = b^* + \sum_{j=1}^{m} \ln x^*_{ij,t} \cdot b^*_j + v_i - u_{j,i} \qquad \text{for} \qquad i = 1,...,6 \qquad \text{and} \quad j = 1,...,12$$

To include Harrod-neutral technical change in the multi-country industry common production possibility frontier a time trend variable is also included. The respective parameter value b_7 measures the average TFP-growth rate. The long-term rate of Harrod-neutral technological progress therefore determines the outward shift attributed to a steady technical change in the common production possibility frontier.

$$\ln(gpv^*_{j,t}) = b^* + \sum_{j=1}^{m^*} \ln x^*_{ij,t} \cdot b^*_j + b^*_7 \cdot t + v_i - u_{j,i} \qquad \text{for} \qquad i = 1,...,6 \qquad \text{and} \quad j = 1,...,12$$

[134] An output elasticity is a dimensionless measure for the ratio of marginal percentage changes of output with regard to a particular input variable, i.e. a 1% increase in the input variable changes the output variable by x%.

$$e_{o,x} = \frac{\partial \ln o_t}{\partial \ln x_t} = \frac{\partial o_t}{o_t} \Big/ \frac{\partial x_t}{x_t} = \lim_{\Delta \to 0} \frac{\Delta o_t}{o_t} \Big/ \frac{\Delta x_t}{x_t}.$$

[135] The symbols used denote the following: imi - intermediate inputs, ict – ICT-capital stock, nict – Non-ICT-capital stock, hswh – high-skilled total working hours, mswh – medium-skilled total working hours, lswh - low-skilled total working hours.

Annex III – Additional tables

Table A.III-1: Gross Value Added, Labour Input and Labour Productivity in the transport and logistics sector (1980-1995, 1995-2000 and 2000-2004)

	Gross Value Added (GVA) (1) = (2) + (3)	GVA per hour worked (2)	Total hours worked (3) = (4) + (5)	Total persons engaged (4)	Average working hours (5)
			(annual average volume growth rates, in %)		
1980-1995					
Austria	2.5	1.8	0.7	1.1	-0.4
Belgium	3.6	4.3	-0.7	-0.6	-0.1
Denmark	2.8	3.1	-0.3	0.5	-0.7
Spain	3.1	3.6	-0.4	0.2	-0.6
Finland	2.4	2.9	-0.4	-0.5	0.1
France	1.9	1.9	0.0	0.4	-0.4
Germany	3.1	3.6	-0.4	0.4	-0.9
Greece	3.6	4.9	-1.3	-1.3	0.0
Ireland	-	-	-	-	-
Italy	3.6	2.8	0.8	0.0	0.8
Luxembourg	10.8	8.3	2.5	2.6	0.0
Netherlands	2.9	1.6	1.3	1.4	-0.1
Portugal	2.5	4.5	-2.0	-1.6	-0.4
Sweden	1.8	1.2	0.6	0.0	0.6
United Kingdom	2.5	3.1	-0.7	-0.6	-0.1
1995-2000					
Austria	3.1	2.3	0.8	0.6	0.2
Belgium	1.2	-1.1	2.2	1.7	0.5
Denmark	5.5	3.2	2.4	0.7	1.6
Spain	4.4	0.8	3.5	3.3	0.2
Finland	3.9	2.3	1.6	1.9	-0.2
France	4.6	2.5	2.1	2.1	0.0
Germany	3.2	3.3	-0.1	0.7	-0.7
Greece	10.2	10.3	-0.1	-0.4	0.3
Ireland	10.3	0.5	9.8	10.8	-1.1
Italy	3.1	1.8	1.3	3.5	-2.2
Luxembourg	6.1	-0.5	6.7	5.9	0.8
Netherlands	4.7	2.9	1.8	2.4	-0.6
Portugal	3.1	2.2	0.9	1.7	-0.7
Sweden	2.5	1.7	0.8	1.1	-0.4
United Kingdom	4.4	3.7	0.7	1.7	-1.0
2000-2004					
Austria	-1.0	-1.5	0.5	0.8	-0.3
Belgium	-0.6	0.0	-0.6	0.3	-0.9
Denmark	-0.9	-0.2	-0.6	-0.2	-0.4
Spain	3.4	0.6	2.8	3.3	-0.5
Finland	1.2	0.3	0.9	0.7	0.2
France	1.6	0.3	1.3	1.2	0.1
Germany	1.8	2.8	-1.0	0.0	-1.1
Greece	7.1	6.0	1.1	1.1	0.0
Ireland	-0.6	-3.2	2.6	2.7	-0.1
Italy	0.4	-1.8	2.2	0.1	2.2
Luxembourg	2.6	-0.9	3.5	3.4	0.1
Netherlands	1.0	1.3	-0.3	0.8	-1.0
Portugal	2.1	1.9	0.2	0.3	-0.1
Sweden	-0.1	2.4	-2.4	-1.2	-1.3
United Kingdom	2.0	1.0	1.0	1.4	-0.4

Table A.III-2: Total Hours, skills, age and gender in the transport and logistics sector (1980-1995, 1995-2000 and 2000-2004)

	annual average volume growth rates, in %								
	Total Hours	H_29	H_49	H_50PLUS	H_F	H_M	H_LS	H_MS	H_HS
1980-1995									
Austria	0.7	0.2	0.3	-1.0	0.9	-0.2	-2.5	1.2	1.8
Denmark	-0.3	-0.6	0.5	-0.5	1.4	-0.3	-2.3	2.5	5.8
Spain	-0.4	1.1	0.3	-1.1	4.8	-0.4	-1.7	8.7	5.5
France	0.0	-2.5	1.2	-1.0	1.0	-0.2	-2.7	1.7	2.2
Germany	-0.4	0.1	0.0	0.0	0.8	-0.3	-1.6	0.6	3.2
Italy	0.8	-0.6	-0.1	1.6	3.8	-0.5	-10.2	0.2	4.3
Netherlands	1.3	-1.4	0.9	-0.8	3.2	-0.5	-5.8	1.2	3.9
United Kingdom	-0.7	-0.9	1.2	-1.3	2.8	-0.6	-7.6	2.5	3.0
1995-2000									
Austria	0.8	-2.1	1.2	-1.6	3.3	-0.9	-0.5	-0.2	9.1
Denmark	2.4	-4.2	0.1	3.4	0.8	-0.2	-1.5	1.0	3.3
Spain	3.5	1.1	0.7	-2.3	3.4	-0.5	-2.6	4.6	6.3
France	2.1	-0.6	-0.6	2.9	1.9	-0.4	-3.4	1.1	5.2
Germany	-0.1	-0.1	0.0	0.0	-0.4	0.2	1.8	-0.7	0.0
Italy	1.3	-1.3	0.5	-1.3	5.6	-1.1	-13.3	0.0	5.4
Netherlands	1.8	-3.1	-0.4	5.7	3.7	-0.8	-0.7	-0.1	1.2
United Kingdom	0.7	-2.9	0.2	2.6	2.9	-0.8	-1.3	0.0	3.0
2000-2004									
Austria	0.5	-1.3	-0.1	1.6	0.6	-0.2	-2.0	1.1	-9.1
Denmark	-0.6	-3.6	0.2	1.9	-0.1	0.0	-1.3	0.7	3.2
Spain	2.8	-3.3	2.1	-2.4	3.5	-0.6	-2.6	3.6	4.1
France	1.3	-1.0	0.0	1.0	2.7	-0.6	-3.6	0.7	6.9
Germany	-1.0	-5.5	0.0	5.4	-0.3	0.1	0.6	-0.6	5.4
Italy	2.2	-2.1	0.7	-1.6	5.4	-1.4	-14.0	-0.1	5.8
Netherlands	-0.3	0.0	-0.7	2.0	0.7	-0.2	-6.6	0.2	4.0
United Kingdom	1.0	-3.2	-0.1	2.9	-2.5	0.7	1.9	-0.6	3.2