Sector Report No. 10/2006

ICT and e-Business in

Hospital Activities

ICT adoption and e-business activity in 2006

e-business w@tch

European Commission

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

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

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

Disclaimer

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List of abbreviations

BCCA	British Columbia Cancer Agency
BGN	Bulgarian Leva
CAP	College of American Pathologists
CATI	Computer-assisted telephone interview
CD	Compact disc
CEN	Comité Européen de Normalisation
CEO	Chief Executive Officer
CIO	Chief Information Officer
CIP	Competition and Innovation Programme
CPOE	Computerised Physician Order Entry
CRM	Customer Relationship Management
C&W	Chelsea and Westminster Hospital
DICOM	Digital Image and Communications in Medicine
DRG	Diagnosis Related Group
eBSN	e-Business Support Network
EC	European Commission
ECG	Electro cardiogram
EDI	Electronic Data Interchange
EEA	European Economic Area
EHR	Electronic Health Record
EMR	Electronic Medical Record
EPR	Electronic Patient Record
ERP	Enterprise Resource Planning
EU	European Union
GDP	Gross Domestic Product
GP	General Practitioner
HINE	Hospital Information Network Europe
HIS	Hospital Information System
HL7	Health Level 7
HOPE	European Hospital and Healthcare Federation
HP	Hewlett Packard
ICD-10	International Statistical Classification of Diseases and Related Health Problems
IEC	International Electrotechnical Commission
ICT	Information and Communication Technology
IHE	Integrating the Healthcare Enterprise
IOM	American Institute of Medicine

IS	Information system
ISO	International Organisation of Standardisation
LAN	Local Area Network
MPI	Master Patient Index
MRO	Maintenance, repair and operation
NACE	General Industrial Classification of Economic Activities within the European Communities
NHH	National Heart Hospital
NHS	National Health Service
OECD	Organisation of Economic Co-operation and Development
PACS	Picture Archiving and Communication System
PC	Personal Computer
PDA	Personal digital assistant
R&D	Research and development
RFID	Radio Frequency Identification
RIS	Radiology Information System
SATS	Study on the use of advanced telecommunications services by health care establishments and possible implications for telecommunications regulatory policy of the European Union
SCM	Supply Chain Management
SHA	System of Health Accounts
SMEs	Small- and medium-sized enterprises
SMS	Short Message Service
TC	Technical Committee
UK	United Kingdom
US	United States
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
WHO	World Health Organisation
WLAN	Wireless Local Area Network
XML	Extended mark-up language

Executive Summary

Objectives and scope of the study

This document is a sector study by *e-Business W@tch*, focusing on Hospital Activities (see section 2 for an introduction to this sector). It describes how hospitals use information and communication technologies (ICT) for conducting business, assesses the impact of this development for hospitals and the health sector as a whole, and indicates possible implications for policy. Analysis is based on literature, interviews, case studies and a survey among decision-makers in European hospitals about the ICT use of their hospital.

The sector covers the business activities specified in NACE Rev. 1.1 Division 85.11 and focuses on acute care hospitals. In 2005, the number of acute care hospitals in the European Union Member States was around 13,000. They are typically large or medium-sized units in terms of employment and serve patients mainly from the city or region they are located in. Around 50% are public, 40% private for-profit and 10% private non-profit.

e-Business in hospitals: findings from the e-Business Survey 2006

The e-Business Survey 2006 shows that the hospital activities sector is one of the sectors with the highest ICT and e-business use. This is however partly due to the fact that hospitals tend to be larger organisations with more than 250 employees:

- **Sector differences:** In comparison with the other nine sectors considered in the e-Business Survey 2006, hospitals are quite advanced in ICT and e-business use (see summary in section 3.11). For example, as regards ICT networks, hospitals were found to be above the all-sectors average in internet access, broadband access and remote access to the hospital's computer network (section 3.2). Hospitals also reported higher levels for internal and external e-collaboration (section 3.6) as well as e-procurement (section 3.7). However, hospitals were found to be well behind other sectors in e-business solutions facing patients, notably online booking of services and e-marketing (section 3.8). This indicates opportunities for improvement in this respect.
- **Size class differences:** According to the survey results, small hospitals generally lag behind medium-sized and large ones in ICT and e-business use. This applies, for example, for internet, broadband and remote network access as well as for internal and external e-collaboration. However, small hospitals reported higher shares of employees that have internet access and internet telephony use (section 3.2) as well as for online service booking (section 3.8).
- **Drivers and barriers of e-business:** Expectations from health insurance funds were mentioned as the most important driver among the items asked (section 3.10). "*Gaining competitive advantage*" and the fact that "*competitors do it*" was also reported to be important, which confirmed that there is considerable competition among hospitals. Security concerns and expensive technology were mentioned as the most important barriers. The other barriers asked in the survey

followed well behind: "*hospital is too small*", "*legal issues*", "*lack of reliable ICT providers*", and "*systems not compatible*".

- **Standards and interoperability:** Currently there is a large number of ICT standards for the health sector in use. Commitment to European and international standards is generally weak, and there is a tendency for Member States to create national ICT standards for the health sector. Only 26% of the hospitals of the survey said they use the health-specific HL7 standard (section 3.4). In four of seven categories asked in the survey, the share of hospitals reporting difficulties due to a lack of interoperability was larger than the all-sectors average: invoicing, payments, technical aspects, and regulatory aspects.
- **Data security:** Hospitals face a dilemma: on the one hand patient data need to be readily available; on the other hand, information needs to be protected from unauthorised use and against loss or modification. Hospitals were found to respond to this challenge: The reported levels of use of secure server technology and digital signature or public key infrastructure in the hospital sector were twice as high as in all sectors. The level of use of a firewall was also reported to be much higher in the other sectors studied by *e-Business W@tch* in 2006 (section 3.5).

Implementation and integration of separate information systems

Hospital Information Systems (HIS) are the core means of e-business in hospitals. Two types of systems are of particular importance: firstly, e-prescribing and medication management systems as prescriptions are a core means of treatment, and, secondly, imaging systems because imaging is a core means of diagnosis. Integration of separate systems is a further important issue:

- **HIS benefits and implementation.** HIS can help to cope with the huge amount of data a hospital has to deal with, they can enhance communication among professionals and bring useful knowledge to them, and they can make processes more efficient. Almost all European hospitals have at least an electronic system for patient data and financial administration. However, only a minority uses more sophisticated systems for computerised pharmacy services, imaging and medication (section 4.2.1).
- **e-Prescribing and medication management**. When supporting medical decisions, e-prescribing and electronic medication management systems can reduce medical errors and, ultimately, save lives. However, less than 20% of hospitals surveyed this year by *e-Business W*@tch reported practicing some form of e-prescribing, and only around 2% said that they use "knowledgeable" systems (see section 4.2.2). This makes the introduction of systems for Computerised Physician Order Entry (CPOE) a political and economic issue. However, CPOE systems may not be appropriate in medical units with frequent need of emergency medication because CPOE may delay therapy and diagnostic testing.
- **Radiology Information Systems**. Electronic imaging offers improved visualising, archiving and communication methods. It can thus improve diagnosis and quality of care as well as reduce administration costs (section 4.2.3). However, the survey found that only around a quarter of the hospitals apply such systems.

- **HIS integration**. As hospital services may require the interaction of different departments, separate HIS need to be integrated to open up all potential benefits. However, often this is not the case inside the same hospital. Findings suggest that there are three principal reasons: firstly, a lack of ICT planning which may be caused by a complex hospital organisation; secondly, difficulties with ICT suppliers, and, thirdly, a lack of commonly used industry standards (section 4.2.4).

Impacts of ICT use in hospitals on the wider health system

ICT investment in hospitals impacts not only on the hospitals themselves but also on the wider health care system. Related issues include, firstly, the continuity of care across hospital borders and, secondly, the question whether the role of hospitals is changing with regard to relationships towards patients and the division of labour with different hospitals and other health care providers (see section 4.3).

- **ICT supporting continuity of care**. Since healthcare is increasingly specialised and tasks are distributed across a large number of health professionals, there is a need for ensuring continuity of care across departmental and extra-mural interfaces. ICT can support structured communication among clinicians to achieve appropriate health care provision. Electronic patient records and web services are two means of improving continuity of care which are currently on the deployment agenda of many European hospitals. However, there is hardly any evidence of actual implementation of comprehensive electronic health records (section 4.3.1).
- **Changing role of hospitals**. The role of acute care hospitals is to provide in-house, comprehensive, specific and round-the-clock care. Some hospitals also have the role of professional and student education and academic research. In the course of increasing investment in ICT, the role of hospitals may change. The analysis for this report suggests that ICT impacts mainly on the relationship towards patients and the need for in-patient care. Most importantly, electronic communication between hospitals and general practitioners or the patients themselves may make a patient's visit at the hospital unnecessary. The hospitals' boundaries potentially become more permeable; the role of hospitals may slowly shift from an in-house care provider to an outbound communicator (section 4.3.2).

Business impacts

The analysis of the e-Business Survey 2006 as well as of main topics of e-business in hospitals showed that ICT and e-business has enormous impact on hospitals. The core impacts are in workflows and business process efficiency (section 5.1.1). Workflows are likely to become more streamlined and efficient because patient data are available much quicker when they are accessible from any workstation in the hospital at any time.

Although the majority of European hospitals are public, there is considerable competition in the sector – among the hospitals and between hospitals and primary care providers. ICT influences this competition. For example, more than half of the hospitals in the e-Business Survey 2006 stated that competition in the sector increased due to ICT (section 5.1.2). 40% said that the fact that "competitors do it" is a driver of ICT use (section 3.10). In many European countries it may be politically desirable that the number of beds per inhabitant, the number of employees and wards per hospital or even the number of hospitals diminishes in order to contain costs while improving the quality of care.

Policy implications

The following policy implications (see section 5.2) are directed primarily to e-business and health policy makers. Health policy makers may have direct or indirect influence on investment decisions in hospitals, and public hospitals in particular. Therefore some of the implications directly affect hospital management.

- **Fostering interoperability.** In order to facilitate the integration of separate information systems in hospitals, health policy makers should increase awareness about interoperability issues in e-health. They should actively promote and facilitate interoperability by appropriate investments in the work of standardisation organisations and their standardisation efforts. Voluntary use of standards by hospitals and other health service providers could contribute significantly to interoperability.
- **Enhancing ICT investment.** Improvements in ICT applications in hospitals can come about only if the hospitals invest adequately in these technologies. Hospitals should carefully plan ICT spending within the near future and also develop a long-term strategic ICT plan. They should not necessarily expect quick returns of ICT investment. Many hospitals lack the investment capabilities as well as human resources for a "great thrust" towards implementation of comprehensive ICT applications. A step-by-step investment approach however appears to be appropriate.
- **Improving education and training in health ICT.** Effective use of ICT in hospitals requires adequate education of the users, e.g. physicians, nurses, and pharmacists as well as administrative staff. In particular, there appears to be a need for training of hospital Chief Information Officers and Chief Executive Officers, as the e-Business Survey 2006 found that ICT is expected to heavily impact on hospital management in the future (see section 5.1.1). Thus, policy makers should strive for providing adequate education and training opportunities for hospital managers.
- **Ensuring data security.** Hospitals need to be aware that security issues cannot be solved by purely technical means but that a broad approach needs to be applied, including a security policy and provisions such as security training.
- **Monitoring role changes.** Health policy makers should thoroughly monitor the changing role of hospitals in order to drive wanted developments and to react to unwanted developments if need be. Relevant indicators to be monitored include, e.g., shifts in size classes, in different locations, and public or private ownership. The relationships of hospitals towards patients, other hospitals, and primary health service providers should also be monitored.
- **Inform the public about ICT in hospitals.** Research for this report has not revealed any signs that patients and citizens are requiring more ICT use in hospitals. Thus, a potentially important driver of ICT use in hospital appears to be missing. Therefore, patients and citizens in Europe should be better informed about the benefits of ICT use in hospitals. Such information could be provided by public authorities in the field of health and ICT on European, national and regional levels.

1 Introduction

1.1 About *e-Business W@tch*

Policy background

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

The initiative is rooted in the **eEurope Action Plans** of 2002 and 2005. The eEurope 2005 Action Plan defined the goal "*to promote take-up of e-business with the aim of increasing the competitiveness of European enterprises and raising productivity and growth through investment in information and communication technologies, human resources (notably e-skills) and new business models*".[1] *e-Business W@tch* has been an important instrument for the European Commission to assess the developments and progress in this field.

The **i2010** policy[2], a follow-up to eEurope, also stresses the critical role of ICT for productivity and innovation, stating that "*… the adoption and skilful application of ICT is one of the largest contributors to productivity and growth throughout the economy, leading to business innovations in key sectors*" (p. 6). The Communication anticipates "*a new era of e-business solutions*", based on integrated ICT systems and tools, which will lead to an increased business use of ICT. However, it also warns that businesses "*still face a lack of interoperability, reliability and security*", which could hamper the realisation of productivity gains (p. 7).

In 2005, in consideration of globalisation and intense international competition, the European Commission launched a **new industrial policy**[3] to create better framework conditions for manufacturing industries in the coming years. Some of the policy strands described have direct links to ICT and e-business developments. One of the new sector-specific initiatives covered by the policy is the taskforce on information and communication technologies (ICT) competitiveness. The taskforce with stakeholders representatives focuses on identifying and proposing measures to remove obstacles that inhibit ICT take-up among enterprises. Another initiative is to conduct a series of competitiveness studies, to include for ICT, food, and fashion and design industries, in order to analyse trends affecting the competitiveness of these industrial sectors.

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

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

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

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

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

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

- the e-Business Support Network (**eBSN** – a European network of e-business policy makers and business support organisations),
- the **eSkills Forum** (a task force established in 2003 to assess the demand and supply of ICT and e-business skills and to develop policy recommendations),
- the **ICT Task Force**, a group whose work is to draw together and integrate various activities aiming to strengthen Europe's ICT sector, and
- activities in the areas of **ICT standardisation**, as part of the general standardisation activities of the Commission.[4]

Focus and scope

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

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

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

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

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

Methodology

e-Business W@tch combines quantitative and qualitative research elements. The quantitative analysis of ICT and e-business adoption by firms is based to a large extent on representative **surveys** among decision-makers in European enterprises ("e-Business Survey"). Interviews are conducted by telephone, based on a standardised and computer supported questionnaire (CATI[5] method). In total, more than 25,000 enterprises were interviewed in the surveys of 2002, 2003 and 2005. The most recent survey (conducted in April/May 2006) covered more than 14,000 enterprises from 10 sectors in all EU Member States and most EEA and Candidate Countries.[6]

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

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

The importance of networking and debate

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

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

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

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

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

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

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

The definition of sectors and the adequate level of aggregation

Economic sectors constitute the main level of analysis for *e-Business W@tch*. The 2006 studies cover sub-sets of **ten different sectors** whose configuration and definition are based on the NACE Rev. 1.1 classification of business activities.[7]

Over the years since its initial implementation in late 2001, *e-Business W@tch* followed a roll-out plan in the coverage of different sectors.[8] In each new period, some new sectors (not covered in previous years) were added.

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

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

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

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

[7] NACE Rev. 1.1 is a 4-digit classification of business activities. It is a revision of the 'General Industrial Classification of Economic Activities within the European Communities', known by the acronym NACE and originally published by Eurostat in 1970.

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

The 10 sectors studied in 2006

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

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

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

1.2 "e-Business" – the conceptual framework

Fresh momentum after the 2001 odyssey

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

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

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

From e-Commerce to e-Business

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

The term **'transactions'** refers to exchanges between a company and its suppliers or customers. These can be other companies ("B2B" – business-to-business), consumers ("B2C" – business-to-consumers), or governments ("B2G" – business-to-government). In the broad sense, transactions include commercial as well as other exchanges, such as sending tax return forms to the tax authorities. In the context of this study on e-business, transactions are predominantly commercial business transactions (see boxes for definitions).

Glossary

Definitions by standardisation groups (ISO, ebXML)

The term "business transaction" is a key concept underlying the development of e-standards for B2B exchanges. Therefore, definitions have been developed by the various standards communities as an underpinning for their practical work. Examples are:

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

If transactions are conducted electronically ('**e-transactions**'), this constitutes e-Commerce. Transactions can be broken down into **different phases** and related **business processes**, each of which can be relevant for e-Commerce. The pre-sale (or pre-purchase) phase includes the presentation of (or request for) information about the offer, and the negotiation about the price. The sale / purchase phase covers the ordering, invoicing, payment and delivery processes. Finally, the after sale / purchase phase covers all processes after the product or service has been delivered to the buyer, such as after sales customer services (e.g. repair, updates).

Exhibit 1-2: Process components of transactions

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

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

In this context, during 2000 the OECD proposed broad and narrow definitions of electronic commerce both of which are still valid and useful:[9] While the narrow definition focuses on 'internet transactions' only, the broad definition defines e-Commerce as "*the sale or purchase of goods or services, whether between businesses, house-holds, individuals, governments, and other public or private organisations, conducted over* ***computer-mediated networks***. *The goods and services are ordered over those networks, but the payment and the ultimate delivery of the goods or service may be conducted on- or offline"* (OECD, 2001).

Glossary

Definition of key terms for this study

- ***e-Transactions****: Commercial exchanges between a company and its suppliers or customers which are conducted electronically. Participants can be other companies ("B2B" – business-to-business), consumers ("B2C"), or governments ("B2G"). This includes processes during the pre-sale or pre-purchase phase, the sale or purchase phase, and the after-sale / purchase phase.*
- ***e-Commerce****: Electronic Commerce. The sale or purchase of goods or services, whether between businesses, house-holds, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. (OECD)*
- ***e-Business****: Electronic Business. Automated business processes (both intra- and inter-firm) over computer mediated networks. (OECD)*
- ***e-Interactions****: Electronic Interactions include the full range of e-Transactions, and in addition collaborative business processes (e.g. collaborative design) which are not directly transaction focused.*

The addendum regarding payment and delivery is an important part of the definition, but can be debated. The difficult question is which processes along the different transaction phases constitute e-Commerce and which do not (see Exhibit 1-2). The OECD definition

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

excludes the pre-sale or purchase phase and focuses on a specific part of the sale / purchase phase, namely the ordering process. *e-Business W@tch* follows the OECD position on this issue.[10]

e-Commerce, defined in this way, is a key component of **e-business**, but not the only one. In recent years, it has been increasingly acknowledged among policy and research communities that the focus on e-commerce transactions may be too narrow to capture the full implications of e-business. A wider, business process oriented focus has been widely recognised. Reflecting this development, the OECD WPIIS[11] proposed a (broader) definition of 'e-business' as "*automated business processes (both intra-and inter-firm) over computer mediated networks*" (OECD, 2004, p. 6). In addition, the OECD proposed that e-business processes should integrate tasks and extend beyond a stand-alone or individual application.

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

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

e-Business and the company's value chain

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

A **value chain** logically presents the main functional areas ('value activities') of a company and differentiates between primary and support activities. However, these are "*not a collection of independent activities but a system of interdependent activities*", which are "*related by linkages within the value chain*" (p. 48). These linkages can lead to competitive advantage through optimisation and coordination. In fact, it is exactly here that ICT

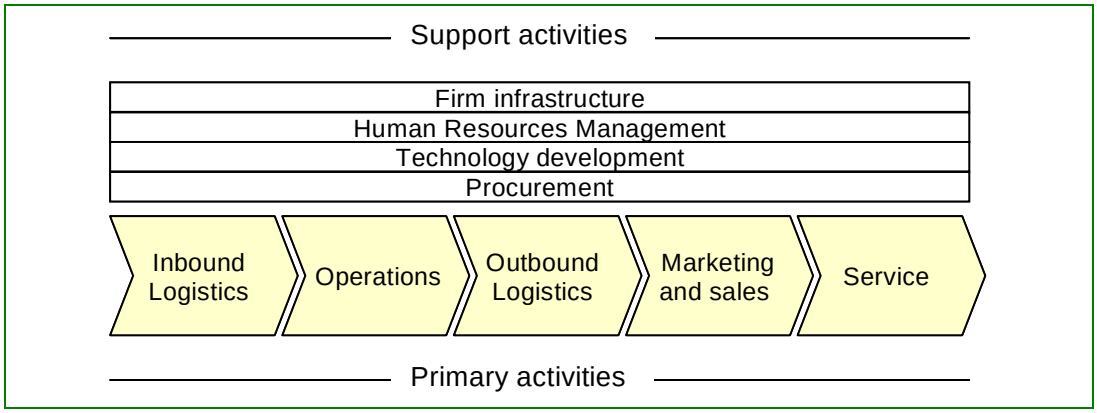
[10] This is reflected in the updated wording of the respective survey questions in 2006, when for "placing / accepting online orders" was asked instead for "purchasing / selling online".

[11] Working Party on Indicators for the Information Society

have a major impact, as they are a key instrument to **optimise linkages** and thus increase the efficiency of processes.

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

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



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

Key dimensions of this framework (notably inbound and outbound logistics, operations, and the value system) are reflected in the **Supply Chain Management** (SCM) concept. Here, the focus is on optimising the procurement-production-delivery processes, not only between a company and its direct suppliers and customers, but also aiming at a full vertical integration of the entire supply chain (Tier 1, Tier 2, Tier n suppliers). In this concept, each basic supply chain is a chain of sourcing, production, and delivery processes with the respective process interfaces within and between companies.[12] The analysis of the digital integration of supply chains in various industries has been an important theme in sectors studies previously prepared by *e-Business W@tch*.

e-Business and innovation

A very important aspect for *e-Business W@tch* studies is the link between ICT and innovation. The European Commission places great emphasis on the **critical role of innovation** for European businesses in order to stay competitive in the global economy.[13] On the other hand, a strong competitive pressure provides powerful incentives for companies to continuously engage in innovation and R&D. Thus, innovation, competition and competitiveness are closely intertwined.

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

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

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

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

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

However, as more companies strive to exploit the innovation potential of ICT, it becomes more difficult for the individual company to directly gain competitive advantage from this technology. e-Business is becoming a necessity rather than a means to differentiate from competitors.[14] In addition, the introduction of innovation can cause **substantial costs** in the short and medium term, as it may take time before the investments pay off. This causes challenges in particular for small and medium-sized companies. It is one of the reasons why *e-Business W@tch* focuses on such challenges in its sector studies (see also 'Policy Background' in chapter 1.1).

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

2 Context and Background

2.1 Hospital sector definition – scope of the study

Hospital sector definition and focus

Hospital activities, as defined in class 85.11 of NACE Rev. 1.1, are a sub-section of human health activities (division 85.1) which comprise medical, surgical technical and other related on-site care activities. Hospital activities include short- or long-term hospital activities of general and specialised acute care hospitals as well as related organisations such as psychiatric hospitals, sanatoria, medical nursing homes, including prison and military hospitals. The notion "acute" refers to the fact that the hospitals are predominantly serving patients in immediate need of health care, as opposed to long-term care. The activities of NACE class 85.11 are chiefly directed to so-called in-patients staying over night, as opposed to health care for out-patients who are treated ambulatory. Exhibit 2-1 shows how hospital activities fit in NACE 85.1.

Exhibit 2-1: Business activities covered by hospital activities (NACE Rev. 1.1)[15]

NACE Rev. 1.1			Business activities
Division	**Group**	**Class**	
N 85			Health and social work
	85.1		Human health activities
		85.11	Hospital activities

The focus on hospital activities was chosen, first, to have a closer look at a sector that is experiencing increasing pressure to modernise by using ICT. Second, hospitals were selected to increase interpretability of data facing the fact that the health sector as such is very diverse, its structural characteristics much depending on the national health system. For example, primary care (that does not require an overnight stay) can be delivered, depending on the Member State, by huge health trusts with many thousands of staff, by community centres or by physicians in solo practice. In 2002 and 2003, the whole division 85.1 was analysed by the *e-Business W@tch*; an effort that turned out to be very valuable but difficult in terms of data interpretation.

In this report the hospital sector is defined even more narrowly: only acute care hospitals are considered. The reason is that health processes, business activity and ICT use in acute care hospitals is quite different from other types of hospitals and for this report more relevant. For example, in psychiatric hospitals and also rehabilitation centres the amount and scope of diagnostic methods applied is not as large, reducing the need for implementing and integrating comprehensive information systems such as radiology information systems and medication management systems which form a major part of this report (see section 4.2).

[15] NACE Rev. 1.1 is a 4-digit classification of business activities. It is a revision of the 'General Industrial Classification of Economic Activities within the European Communities', known by the acronym NACE and originally published by Eurostat in 1970.

A note on terminology: e-business and e-health

In the health sector, the term e-health is normally preferred to e-business. However, "e-health" is a more comprehensive term than "e-business in the health field". e-Health can be defined as "ICT applications across the full range of functions that affect the health sector".[16] e-Health includes computerised processes – i.e. e-business – as well as health services themselves – i.e. the production of the services –, whereas e-business is solely about the *processes* related to service provision.[17] Thus, every e-business application in the health field can be considered as e-health, but e-health applications can only be considered as e-business to the extent that they are related to the processing of health service data. For example, transferring a patient's electrocardiogram (ECG) from the patient's home to a hospital via computer networks is an e-health service but not an e-business application.[18] On the other hand, processing the ECG data in a hospital's information system can be considered both as e-health and as e-business.

The uncommon use of the term e-business in the health sector reflects the fact that health professionals do not generally explicitly consider a health service as a business or a patient as a customer. The provision of health services usually does not involve a direct sales relationship between the patient and the personnel treating him or her. As a matter of professional ethos, the commitment to help people in need is always present for a medical practitioner. However, health services are in an indirect manner "sold" to the patient, and there are numerous electronic processes in hospitals that take place in similar form in manufacturing or service companies. Therefore it is appropriate to use the term e-business for hospitals' health processes. The term "e-business" is used overall in this report which analyses hospital activities from a business viewpoint.

Hospital definition and hospital business

In terms of business services, according to the System of Health Accounts (SHA) definition, "*a hospital comprises licensed establishments primarily engaged in providing medical, diagnostic, and treatment services that include physician, nursing, and other health services to inpatients and the specialised accommodation services required by inpatients*".[19] Hospitals may also provide outpatient services, i.e. ambulatory care, as a secondary activity.

Many health services in hospitals can only be provided using specialised facilities and equipment that form an integral part of the production process. On the input side, hospitals need a large variety of inputs from suppliers in order to provide their services, including food and beverages, garments and bed textiles, stationery products, drugs and medical technologies and many more products and services. On the output side, hospitals are integrated in a network of health service providers with particular roles, including other hospitals as well as ambulatory care services offered by general and specialised practitioners. Furthermore, hospitals deal with non-medical organisations for

[16] Definition used in the European Commission's e-Health Action Plan, see Commission of the European Communities (2004), p. 4.

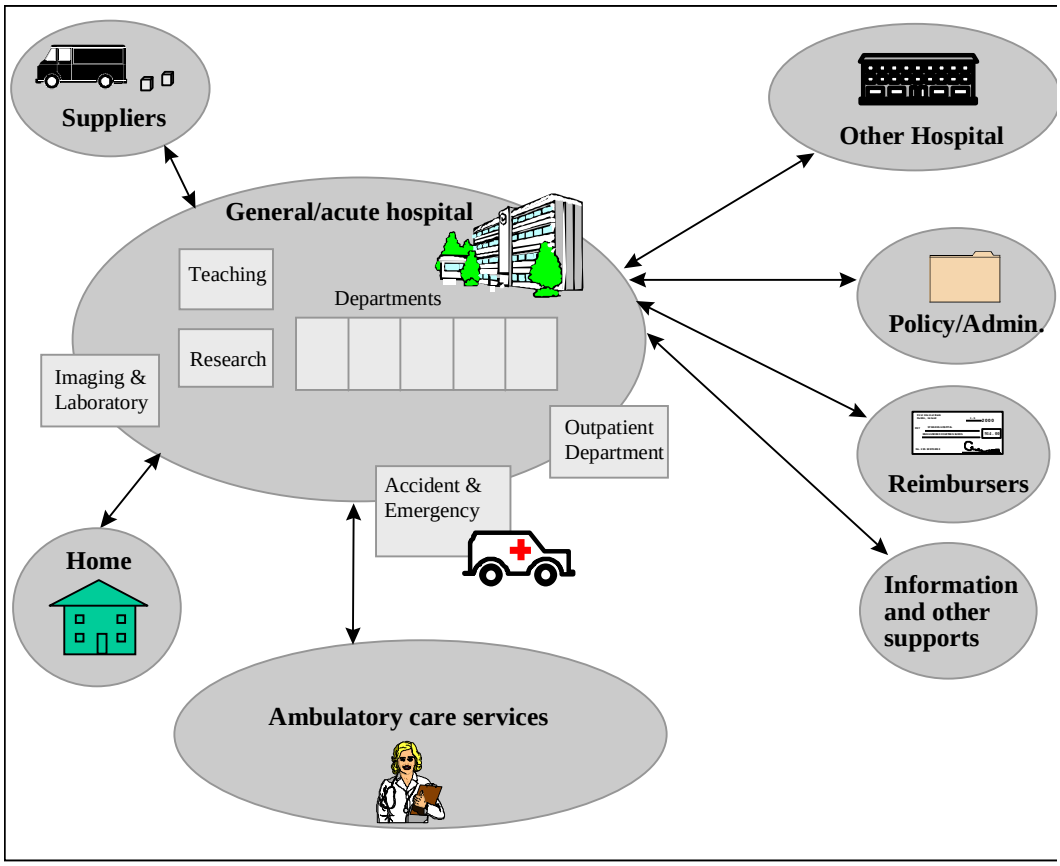
[17] See the definition of e-business in the introductory chapter above.

[18] Similarly, in a manufacturing sector one would consider a computerised machine that, for example, assembles a car as a production facility, not as an e-business application.

[19] Eurostat (2002), p. 303.

purposes of administration, reimbursement, and information. Exhibit 2-2 shows a scheme of generic health service providers with which hospitals communicate.

Exhibit 2-2: Hospitals in the scheme of health service providers



Source: SATS study, Stroetmann/Cullen/Duff et al. (2000)

A certain terminology has become common in the health service sector, distinguishing between primary, secondary and tertiary care facilities:

- **Primary care** comprises ambulatory care services by health professionals who normally have the first contact to a patient.
- **Secondary care** comprises health services in hospitals. The term "secondary" refers to the fact that hospital professionals generally do not have the first contact to a patient in the sequence of health care.
- **Tertiary care** refers to hospitals with academic research and teaching functions, i.e. university hospitals.

The terminology of primary, secondary and tertiary care is also used in this report. "Acute care" hospitals which are focused in this report – see sector definition and focus above – can be secondary or tertiary care facilities.

2.2 Hospital sector background

2.2.1. Size of the European Union hospital sector

Key economic figures of the hospital sector

Hospitals are a large service sector both in terms of employment and value added. However, there are no solid European-wide data about the number of hospitals, number of hospitals by type – i.e. general or specialised acute care hospital or other type –, number of hospitals by size class, number of employees in hospitals and Gross Domestic Product (GDP) produced by hospitals.

According to data from national statistical sources provided by the company that conducted the *e-Business W@tch* Survey 2006, the number of hospitals in the EU in 2005 was about 13,000. Hospitals vary widely in size. In contrast to many other sectors of the economy, the majority of hospitals is large or medium-sized in terms of number of employees. In 2005, 32% of hospitals in EU Member States had more than 250 employees, 30% had 50 – 250 employees, 20% had 10 – 49 employees, and a minority of 18% had 1 – 9 employees.

In a previous study covering, among other health care actors, also hospitals in EU-15, the number of employees in hospitals was estimated at approximately 2.5 million.[20] The majority of hospitals is publicly owned or publicly financed, with a growing minority of private hospitals. There is also a minority of private non-profit hospitals. The SATS study estimated the following shares of hospital ownership in EU-15: public 50%, private for-profit 40% and private non-profit 10%.

In the next sections, the number of countries varies by availability. Iceland and Switzerland are also included when data are available.

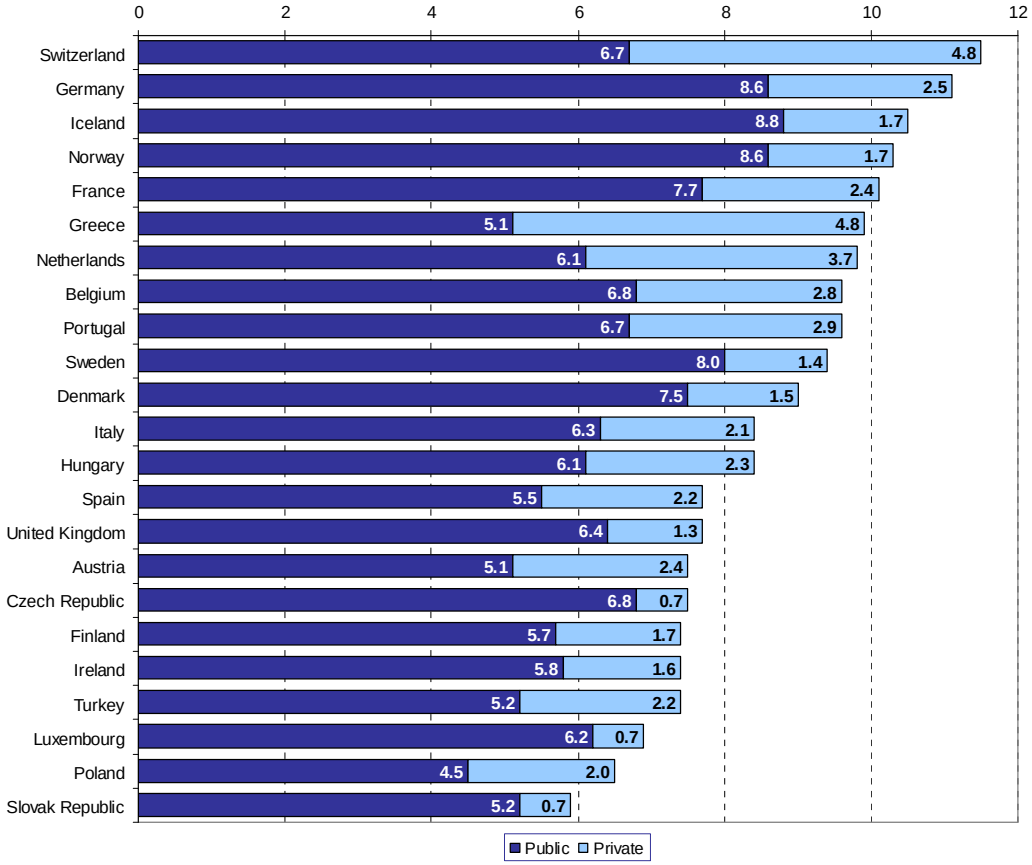
Health expenditure as a share of GDP

Health expenditure as a share of GDP can be a measure of the relative importance a society attributes to health; it may also reflect efficiency of a health system and price levels in the health sector. The proportion varies widely between European countries – see Exhibit 2-3. Taking both public and private expenditure together, the share in 2003 was highest in Switzerland (6.7% public / 4.8% private), Germany (8.6% / 2.5%), and Iceland (8.8% / 1.7%) and lowest in the Slovak Republic (5.2% / 0.7%), Poland (4.5% / 2.0%) and Luxembourg (6.2% / 0.7%).[21]

[20] According to findings of the "Study on the use of advanced telecommunications services by health care establishments and possible implications for telecommunications regulatory policy of the European Union" - SATS , see Stroetmann/Cullen/Duff et al. (2000).

[21] The low value for Luxembourg may be most striking. It does not reflect low expenditures – this Member State has the highest per capita expenditure – but rather the very high GDP per capita, due to the dominance of the finance sector.

Exhibit 2-3: Health expenditure in % of GDP in European countries (2003)



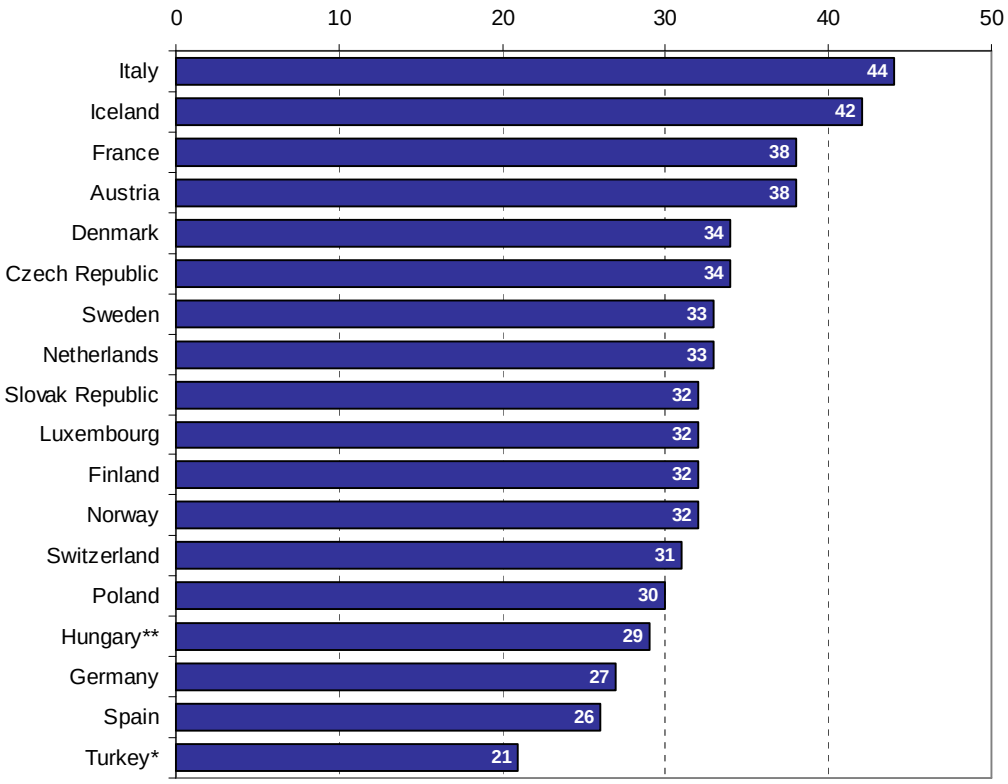
Source: OECD (2005), p. 71.

Hospital expenditure as a share of total health expenditure

Hospital expenditure as a share of total health expenditure may be a measure of the importance a country's health system attributes towards hospital care in contrast to primary care. It also reflects structural differences and the efficiency of ambulatory and social (residential and home) care and other characteristics of services like the relative share expended on drugs. The levels of hospital expenditure in percent of total health expenditure differs widely between European countries, see Exhibit 2-4. The levels are highest in Italy (44%), Iceland (42%), France (38%) and Austria (38%) and lowest in Turkey (21%), Spain (26%), and Germany (27%). There is a strong clustering around the 30% to 35% range.

Other types of expenditure not shown in the exhibit include in-patient long term care, ambulatory care, medical drugs and goods, collective services, and other expenditures.

Exhibit 2-4: Hospital expenditure as a share of total health expenditure in Europe (2003)



Source: OECD (2005), p. 73. ** data for 2002, * data for 2000.

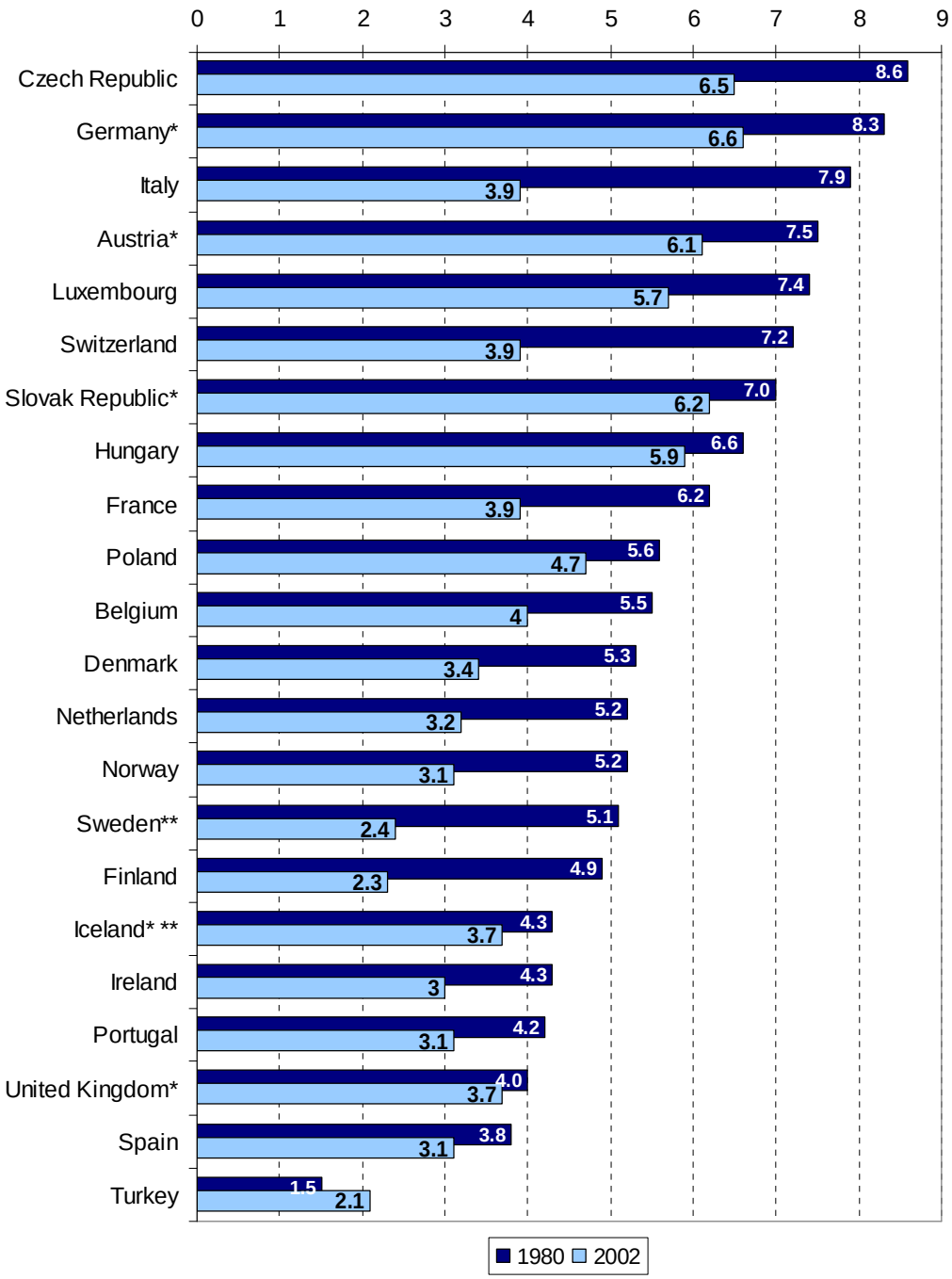
Number of hospital beds

Hospital size and quantitative service potential of hospitals is usually represented by number of beds. Official statistics distinguish between acute care beds in acute care hospitals and beds for long-term care in, e.g. old peoples' residences. The number of acute care beds per 1,000 inhabitants differs widely in Europe. According to OECD data for 2002 which are the most recent data available, the share was highest in Germany (6.6), the Czech Republic (6.5) and the Slovak Republic (6.2) and lowest in Finland (2.3), Sweden (2.4) and Ireland (3.0) – see Exhibit 2-5. The figures for Finland and Sweden may be surprisingly low but they point to a system directed towards outpatient and home care and to particularly efficient use of hospital beds. Differences in national statistics may also play a role.

In almost all European countries the share of acute care hospital beds per population decreased from 1980 (or from the earliest year for which data are available) to 2002 (or the most recent year for which data are available). This development is due to efforts to use hospital resources more efficiently and to increasingly focus on ambulatory care, for example "day surgery", and long-term residential or home care. Countries with the most noteworthy reductions include Italy (from 7.9 to 3.9), Switzerland (from 7.2 to 3.9), Sweden (from 5.1 to 2.4) and Finland (from 4.9 to 2.3). Turkey is the only exception; the number of acute care beds per 1,000 population increased from 1.5 in 1980 to 2.1 in 2002. Since Turkey is also the country with the lowest provision of hospital beds, the

reason for the increase may be that hospital care provision is relatively underdeveloped in Turkey.

Exhibit 2-5: Acute care hospital beds per 1,000 population in Europe (1980 and 2002)



* Replacements of 1980 data by earliest year for which data are available:
Germany: 1991, UK: 1995, Slovak Republic: 1996, Austria: 1985, Iceland 1990.

** Replacements of 2002 data by latest year for which data are available:
Iceland 1995, Sweden 2000.

Source: OECD (2005), p. 45, p. 130.

2.2.2. Trends and challenges

Constraints of financing health systems and hospitals

In all European countries the health systems are under funding pressure. On the input side, political willingness or ability to increase taxes or social insurance contributions to fund the health system is limited, and patients' ability or willingness to pay for health services is also limited.

On the output side, health care costs are increasing or sought to be contained for several reasons: medical interventions, technology and drugs are increasingly sophisticated, the European population is ageing at an accelerating rate, and the share of people with chronic diseases such as chronic cardiac or respiratory diseases is increasing. An ageing population is a challenge for cost containment in European health systems based on public contributions because the Effective Economic Dependency Ratio[22] is increasing dramatically, because the share of people with a disease is larger among old people than among young people, because older people tend to have more serious diseases than younger people, and because older people tend to have multiple diseases. The challenges of an aging population and chronic diseases are closely interrelated because the prevalence of chronic diseases grows with increasing age. However, chronic diseases do not only affect older people. The rapidly growing prevalence of obese children foreshadows a considerable increase in relatively young, chronically ill people with huge increases in health care costs to be expected because obesity will cause the onset of various chronic diseases such as diabetes much earlier in life.[23]

These developments of course also affect hospitals. Governments increasingly encourage or force hospitals to adopt more cost-effective procedures. One method is the implementation of diagnosis related groups (DRGs) that strictly define the amount of money a hospital can claim for the treatment of a certain disease instance. DRGs are in place or being introduced, for example, in Belgium, France, Germany, Hungary, Italy, Poland, Spain, the UK and the Scandinavian countries.

Ensuring quality of health care

Quality of health care is, similar to finance, an issue that affects the health system in general but also hospitals in particular. Achieving a high level of quality is a particularly difficult challenge due to the funding constraints noted above. It has always been an issue, but since publication of the US Institute of Medicine (IoM) report "To err is human - Building a safer health system" it has gained global attention.[24] Issues affecting quality of care include medication errors, diagnosis failures, negligent supervision, delayed treatment, failure to obtain consent, and lack of technical skill.[25] There is still a certain degree of suboptimal health care practice in various hospitals that can put patients' health

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[22] The Effective Economic Dependency Ratio is defined as = (Population under 15 or above 64) / (Employment). For details see Kubitschke et al. (2002).

[23] See also the obesity consultation and communication of the European Commission's Health and Consumer Protection General Directorate. Key documents are available at http://ec.europa.eu/health/ph_determinants/life_style/nutrition/keydocs_nutrition_en.htm.

[24] See Kohn/Corrigan/Donaldson (2000).

[25] See HOPE (2005), p. M7.

at risk and cause unnecessary costs. Quality of care is an issue with numerous facets. ICT-related tools to increase quality of care inside hospitals include electronic medical records (EMR), computerised physician order entry (CPOE) to improve medication logistics, barcoding of pharmaceuticals to prevent confusion, or computerised failure mode effects analysis[26] which is a method of predicting unwanted outcome of medication and other types of therapy. As regards links with healthcare providers outside the hospital, ICT can improve access and exchange of medical data, thereby also improving quality of care.[27]

Advancing and integrating health information systems

As a key means to cope with mounting health care costs and to improve the quality of care, health information systems have recently become an increasingly important issue at the European level. Currently, legacy systems, stand-alone systems for different tasks, and mainframe computers rather than client-server platforms prevail inside and outside hospitals. In this way, information systems cannot contribute to solving funding and quality issues in health services. Both at the national and at the European Union level various activities are planned or underway in order to tackle this problem. For example, the European Commission's e-Health Action Plan includes the objective of implementing health information networks linking hospitals, laboratories, pharmacies, primary care and social service centres.[28] The implementation of advanced health information systems is meant to develop national health systems, the creation of a seamless pan-European healthcare market, the further growth of the European health ICT industry, and the sustainability of its international competitive advantage.

Implementing Electronic Health Records

The Electronic Health Record (EHR)[29] that integrates all relevant, life-long information about a patient from all health service providers is meant to be a core component of a European e-health infrastructure.[30] As formulated by the Brookings Institute: "*The holy grail of connectivity is the transformation of the current paper-based medical record into an electronic medical record that is accessible to all necessary providers and possibly to the patient. Web-enabling the EHR expands the potential users and uses.*"[31] In principle, the benefits can be great. However, the organisational, legal, technical, and semantic complexity is overwhelming, and it remains to be seen whether all citizens and patients across the Union, wherever they live or whatever their social status is, can benefit from this development.

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[26] See for example Apkon/Leonard/Probst et al. (2004) and Cohen/Senders/Davis (1994).

[27] The issue of external links will be discussed in the chapter about continuity of care below in this report.

[28] See European Commission (2004), p. 20, chapter 4.3.2.

[29] Alternatively named Electronic Medical Record or Electronic Patient Record.

[30] See the objective of achieving interoperability of electronic health records in the European Commission's e-Health Action Plan in Commission of the European Communities (2004), p. 17.

[31] Danzon/Furukawa (2001), p. 208.

Public and private hospitals

As noted above in the report section 2.2.1 about secondary statistics, there are three different types of hospital ownership: public, private for-profit and private non-profit. Public hospitals may be owned by municipalities or other regional and governmental bodies. Private non-profit ones may be owned by charities or other non-governmental organisations. Private commercial hospitals play an increasingly important role. There is a number of private, national and increasingly European hospital chains that take over public hospitals or put them under considerable economic pressure because the private hospitals operate more efficiently and have easier access to investment funds.[32] In the same context, recently *DG Competition* started an inquiry into unfair competitive practices by publicly funded, presumably subsidised, hospitals in Germany.[33]

2.3 Review of earlier sector studies

Importance of e-business areas

In two earlier *e-Business W@tch* surveys in 2002 and 2003, the Health and Social Services sector in total was included, i.e. not only hospitals as in 2006 but also primary care facilities and other social services. The Health and Social Services sector in total showed the lowest summary scores of all sectors as measured by the *e-Business W@tch* indicators in 2002 and 2003.[34]

In the following summary of *e-Business W@tch* results from the 2003 survey, reference will be made to health service organisations in general because the earlier investigations did not allow a distinction between different types of providers such as hospitals, general practitioners and community care centres. The gap between small and large organisations concerning their perceptions of relevance and importance as well as with respect to applications and usage was very high. The same held for differences across Member States, which reflected different national health and social care system structures, their impact on the size structure of relevant organisations, and of priorities set by health and social policies. As regards specific fields of applications, the observations which were then made are summarised in the following paragraph.

Core findings of the *e-Business W@tch* 2003 for Health and Social Services

- **ICT infrastructure:** Hidden behind average values for the health services sector, in 2003 huge differences existed with respect to ICT and network infrastructure not only across size classes of organisations but also across Member States. There were many large organisations and also a few small ones with complex and

[32] See Murzin (2006) or Sleegers (2006). The issue of public versus private hospitals will be followed up in more detail in chapter 4.3.2 on a potentially changing role of hospitals.

[33] See Hagelüken (2006).

[34] The survey results of 2002 and 2003 are not fully comparable to those of 2006. Figures for 2002 are based on a sample of the four largest EU countries (France, Germany, Italy, UK), figures for 2003 on the five largest countries (EU-4 plus Spain), and figures for 2006 on 10 EU countries ("EU-10"). See methodology reports at www.ebusiness-watch.org ('about' > 'methodology').

advanced ICT architectures on the one hand, and a lot of smaller companies and hospitals equipped with very basic, frugal ICT on the other.

- **Internal business processes:** According to the *e-Business W@tch* Survey 2003, large organisations in the Health and Social Services sector were most likely to make use of internal ICT applications – such as online sharing of documents to perform collaborative work or online tracking or working hours – as the efficiency gains from them tend to increase with company size. For all applications, diffusion increased by size-class. However, even in large organisations intranets had not yet become a commonplace – only 63% had one.
- **Electronic procurement:** Next to personnel costs, healthcare supplies were the second largest cost factor for all medical and care service providers in 2003. In light of this key importance, it was not surprising that the Health and Social Services sector was, with 34%, at least somewhat close to the European overall average (46%) with respect to online procurement. Health service organisations that had experience with e-procurement reported that reductions in procurement costs were the dominant effect of this method: altogether 68% said that the perceived effects were fairly positive (51%) or even very positive (17%).
- **Customer oriented processes:** The Health and Social Services sector was very specific as far as marketing and sales activities were concerned. The data for online sales and more advanced interactive applications in the Health and Social Services sector were very low in 2003. The UK was an exception, where the National Health Service (NHS) was investing heavily into expanding client-facing e-business applications beyond a mere web presence. In the human health sub-sector, more advanced e-commerce activities in the sense of "selling" health and well-being were predicted to remain limited to niche applications for both ethical reasons and rules of professional codes of conduct.
- **Functions of the extended healthcare enterprise:** In the Health and Social Services sector the relationships and concerns differed basically from those in most other industrial and service sectors of the economy in 2003. Connectivity among the various participants was found to be of utmost importance for the further development of e-health applications. However, the use of online technologies other than free text e-mail for service cooperation was found to be very low (10% employment-weighted). Countries such as Denmark with 27%, the UK with 22% and Austria with 18% were leading the way.

All in all, the analysis of specific fields of application by *e-Business W@tch* in 2003 showed that the Health and Social Services sector lagged considerably behind other economic sectors in almost all categories considered. Online procurement was found to be an exception from this rule. In this 2006 report, internal business processes – in the form of hospital information systems – as well as functions of the extended healthcare enterprise – in the form of ICT links between hospitals and other healthcare providers – will be the principal topics analysed in chapter 4.

3 Adoption of ICT and e-Business in 2006

3.1 Methodological notes

Background information about the e-Business Survey 2006

e-Business W@tch collects data on the use of ICT and e-business in European enterprises by means of representative telephone surveys. The e-Business Survey 2006 was the fourth survey after those of 2002, 2003 and 2005. It had a scope of **14,081 interviews** with decision-makers in enterprises from 29 European countries.[35]

Most of the tables in this report feature a breakdown of the population of enterprises based on the aggregate of 10 EU countries – **the "EU-10"**.[36] In these countries the survey covered all 10 sectors (at least to some extent) and therefore comparability of the sample across sectors is given. The EU-10 represent more than 80% of the total GDP and inhabitants of the EU-25 and are thus to a large extent representative for the whole EU.

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

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

Characteristics of the hospital sample in the e-Business Survey 2006

Exhibit 3-1 shows the hospital sample in the e-Business Survey 2006 by countries and number of beds. These characteristics are important for interpreting the data in chapter 3. Altogether 834 interviews were conducted, 539 of them in EU-10 countries. In chapter 3, only data for the EU-10 countries are presented and used for interpretation.

The number of interviews per country differs largely between 8 in the Netherlands and 101 in Germany. Countries with fewer than 50 interviews are not listed in the country result tables. The majority of hospitals interviewed had fewer than 100 beds (344 hospitals); 226 hospitals have between 101 and 250 beds, 155 have between 251 and

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

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

750 beds and 49 hospitals have more than 750 beds. As regards hospital size classes by number of employees, 26% of the hospitals had 1 – 49 employees, 40% had 50 – 250 employees, and 34% had more than 250 employees (not shown in Exhibit 3-1).

Exhibit 3-1: e-Business Survey 2006 hospital dataset by country and number of beds

	Number of beds					
	1 - 100	**101 - 250**	**251 - 750**	**> 750**	**DK/no answer**	**Total**
Hospitals (EU-10)	**205**	**162**	**103**	**38**	**31**	**539**
Belgium	1	9	10	1	1	22
Czech Republic	10	19	15	2	4	50
Germany	48	23	22	7	1	101
Greece	11	2	2	1	0	16
Spain	15	11	4	1	6	37
France	42	30	4	1	3	80
Italy	22	6	6	4	2	40
Latvia	20	14	5	4	12	55
Lithuania	29	15	10	2	2	58
Hungary	2	15	21	16	6	60
Netherlands	3	0	5	0	0	8
Poland	30	48	15	3	1	97
Portugal	25	9	14	1	1	50
Finland	18	7	5	1	1	32
Sweden	5	1	3	0	1	10
United Kingdom	15	3	6	3	7	34
Turkey	45	13	4	1	12	75
Norway	3	1	4	1	0	9
Total (all countries)	**344**	**226**	**155**	**49**	**60**	**834**
Questionnaire reference	U7/8	U7/8	U7/8	U7/8	U7/8	U7/8

Countries with less than 50 interviews, i.e. Belgium, Greece, Spain, Italy, Netherlands, Sweden, UK and Norway, will not be listed separately in the following tables because the number of interviews is too small to allow for a meaningful interpretation of data.

Source: e-Business Survey 2006

Exhibit 3-2 shows the composition of the hospital sample in the e-Business Survey 2006 by hospital ownership and country. An almost equal number of interviews was conducted with public hospitals (361) and private for-profit hospitals (359). The other 101 hospitals are private non-profit. For 13 hospitals no ownership classification is available.

Exhibit 3-2: e-Business Survey 2006 hospital dataset by country and ownership

	Hospital ownership				
	public	private non-profit	private for-profit	DK/refused/ not applicable	TOTAL
Hospitals (EU-10)	**233**	**65**	**233**	**8**	**539**
Belgium	6	8	8	0	22
Czech Republic	27	12	9	2	50
Germany	19	32	48	2	101
Greece	1	0	15	0	16
Spain	12	1	23	1	37
France	2	0	78	0	80
Italy	10	0	30	0	40
Latvia	36	5	14	0	55
Lithuania	37	4	13	4	58
Hungary	49	3	7	1	60
Netherlands	3	3	2	0	8
Poland	79	4	12	2	97
Portugal	27	13	10	0	50
Finland	16	3	13	0	32
Sweden	4	0	5	1	10
United Kingdom	16	7	11	0	34
Turkey	12	5	58	0	75
Norway	5	1	3	0	9
Total (all countries)	**361**	**101**	**359**	**13**	**834**
Questionnaire reference	U10	U10	U10	U10	U10

Source: e-Business Survey 2006

An alternative view: findings from HINE

One of the best empirical sources about ICT use in hospitals are the Hospital Information Network Europe (HINE) surveys, the eHospital Census, comprising 1,250 hospital interviews in 19 European countries.[37] The survey used representative stratified samples for the 19 countries using three sets of criteria: size (beds), ownership and regional split. The survey was commissioned with support from nine leading ICT companies.[38] Meeting the business interests of these companies, HINE targets hospitals with more than 100 beds. Thus, in contrast to *e-Business W@tch*, HINE does not have a representative sample in terms of size classes, and HINE overestimates ICT use across hospitals of *all* sizes. HINE indicators include, among others, ICT implementation level, barriers, infrastructure, and ICT expenditure. Thus, HINE and *e-Business W@tch* have some but

[37] See the HINE website at http://www.hineurope.com. HINE reports are not available to the public for free. See also a presentation of HINE findings by Dave Garets at the World of Health IT Conference 2006, downloadable at http://www.worldofhealthit.org.

[38] The HINE findings referred to in this report were provided by Véronique Lessens, Member of the *e-Business W@tch* Advisory Board, Agfa, a HINE member. See also a summary of a HINE presentation at the *e-Business W@tch* hospital activities workshop at the High Level eHealth Conference in Malaga, 10 May 2006 (workshop conclusions available at http://www.ebusiness-watch.org/events/hospital_activities.htm).

not all indicators in common. References to HINE findings from a hospital survey in 2004 will be made at various sections of the report.

3.2 Use of ICT networks

Internet access and remote network access

Internet access is essential for the successful supply of hospital services. Medical staff may use the internet simply for searching medical information, for example in journal publications, or they may use the internet for more advanced processes described in this report. Broadband is important to ensure adequate speed of internet use, and remote access to the hospital's computer network is important to, for example, access patient data from outside the hospital's premises. The share of employees that are granted internet access indicates the importance hospitals attribute to internet use in everyday work.

Overall findings: According to the 2006 survey results, 98% of the hospitals, which is hospitals representing nearly 100% of employment in the sector, reported having internet access – see Exhibit 3-3. 78% hospitals (85% weighted by employment) said that they have broadband internet access. The average share of employees with internet access was reported to be 41%. 34% of the hospitals (39% weighted by employment) said they offer the opportunity of remote access to the hospital's computer network.

Findings by sector: In comparison with the other nine sectors under consideration, hospitals were above average in internet access, broadband access and remote access. The identified difference for remote access to the computer network was most distinct. While 34% of the hospitals said they allow remote access, only 16% of firms in other sectors reported this opportunity. Hospitals were on a similar level as firms in the consumer electronics (32%) and ICT manufacturing industries (35%). The share of employees with internet access was found to be about average: 43% of firms in other sectors compared to 41% in hospitals; employment weighted 40% in all sectors versus 41% for hospitals.

Findings by size class: While all hospitals with more than 49 employees reported internet access, 93% of small hospitals said they have internet access. Equipment with broadband access was reported to be similar in medium-sized (84%) and large hospitals (86%), while small hospitals appeared to lag behind (64%). Large hospitals had a reported lead in remote access (41%), medium-sized hospitals (34%) and small ones (38%) followed behind. However, the share of employees with internet access was reported to be largest in small hospitals (46%), compared to 39% in medium-size hospitals and 42% in large hospitals surveyed by *e-Business W@tch* in 2006.

Exhibit 3-3: Internet access and remote access to hospital network

	Hospitals with internet access		Hospitals with broadband internet access		Average share of employees with internet access *		Remote access to hospital network	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**100**	**98**	**85**	**78**	**n.a.**	**41**	**39**	**34**
Micro/small (1-49 empl.)		93		64		46		28
Medium (50-249 empl.)		100		84		39		34
Large (250+ empl.)		100		86		42		41
All 10 sectors (EU-10)	**95**	**93**	**76**	**69**	**n.a.**	**43**	**35**	**16**
Micro (1-9 empl.)		89		62		51		12
Small (10-49 empl.)		98		75		29		22
Medium (50-249 empl.)		99		83		33		43
Large (250+ empl.)		99		84		44		60
Food & beverages	95	88	72	64		25	35	14
Footwear	96	89	75	62		28	17	10
Pulp & paper	99	94	80	68		40	56	21
ICT manufacturing	100	99	84	79		74	69	35
Consumer electronics	98	97	87	74		80	51	32
Shipbuilding & repair	100	100	87	86		30	41	27
Construction	95	90	72	64		47	25	13
Tourism	93	90	72	68		53	38	13
Telecommunication	100	99	88	85		90	74	46
Hospitals activities	100	98	85	78		41	39	34
Base (100%)	hospitals using computers		hospitals using computers		hospitals with internet access		hospitals using computers	
N (for sector, EU-10)	539		539		539		539	
Questionnaire reference	A1		A3		A2		A5	

* Read: "The average share of employees with internet access in hospitals is 41%."

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

Networks and protocols used

The level of use of networks and protocols further indicates hospitals' sophistication in ICT infrastructure. Local Area Networks (LANs) and Wireless Local Area Networks (W-LANs) connect the computers and digital devices in a hospital and facilitate data exchange between them. Internet based telephony has gained momentum throughout the economy in recent years because it allows companies to save costs. This type of telephone is commonly referred to as "Voice-over-IP" (VoIP), because it uses the Internet Protocol (IP) as the means to transfer voice calls. The use of Virtual Private Networks (VPNs) for remote network access indicates how serious hospitals take data security issues.

Overall findings: As Exhibit 3-4 shows, 84% of the hospitals surveyed this year by the *e-Business W@tch*, which is hospitals representing 96% of employment in the sector, reported to have a LAN. Compared with results from they HINE survey which found that about 40% of the hospitals have a LAN, this figure is quite high. In any case, in the e-

Business Survey 2006, W-LAN was reported to be much less common, with only 26% (32% employment-weighted). Only a minority of 8% stated to use Voice over Internet Protocol (VoIP). A Virtual Private Network (VPN) for remote access to the computer network was reported to be used in 63% of the hospitals (71% employment-weighted).

Findings by sector: The share of hospitals with a LAN was found to be much higher than in the other sectors (46%). The same applies to W-LAN (16% in all sectors) and VPN for remote access (26% in all sectors). VoIP appeared to be more common in all sectors (13%).

Findings by size class: The share of small hospitals using a LAN (63%) was reported to be much smaller than in medium-sized (89%) and large hospitals (99%). The same sequence applied for W-LAN and VPN for remote access. However, the share of VoIP users was reported to be largest among small hospitals (11%), followed by large (9%) and medium-sized hospitals (5%). It may be that VoIP requires organisational changes so that small, flexible hospitals have an advantage over larger ones.

Exhibit 3-4: Networks and protocols used

	LAN		W-LAN		Use Voice-over-IP		Use VPN for remote access	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**96**	**84**	**32**	**26**	**8**	**8**	**71**	**63**
Micro/small (1-49 empl.)		63		20		11		49
Medium (50-249 empl.)		89		26		5		64
Large (250+ empl.)		99		34		9		74
All 10 sectors (EU-10)	**65**	**46**	**32**	**16**	**16**	**13**	**57**	**26**
Micro (1-9 empl.)		35		12		14		20
Small (10-49 empl.)		59		21		11		32
Medium (50-249 empl.)		84		37		13		57
Large (250+ empl.)		96		47		22		79
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers		Hospitals enabling remote access	
N (for sector, EU-10)	539		539		539		194	
Questionnaire reference	A4a		A4b		A4c		A6d	

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

3.3 Resources: ICT skills, outsourcing and budgets

ICT skills

An appropriate skills base is a critical factor for increasing health service quality and reducing costs after relevant ICT investments in hospitals. The supply and use of ICT skills has been monitored by *e-Business W@tch* since its inception.

Overall findings: As Exhibit 3-5 shows, 39% of the surveyed hospitals (i.e. hospitals representing 57% of employment in the sector) stated they employ ICT practitioners. 34% (39% weighted by employment) said they offer regular ICT training for employees. A

small share of only 3% (5% weighted by employment) reported hard-to-fill vacancies for ICT jobs in 2005. This figure may be surprisingly low because finding and also retaining the right ICT experts is, according to e-Business Advisory Board member Véronique Lessens, more difficult than in other sectors studied this year by *e-Business W@tch*. e-Learning was reported to be used in 22% of the hospitals (26% weighted by employment). HINE found that there is generally a lack of in-house ICT skills and that hospital management is reluctant to search for external ICT skills.

Findings by sector: Compared to the other sectors studied this year by *e-Business W@tch*, the shares of hospitals employing ICT practitioners (39% versus 14% in all sectors), offering regular ICT training of employees (34% versus 13% in all sectors) and using e-learning (22% versus 11% in all sectors) was found to be quite large. The dominance of large organisations in the hospital sector is no explanation for these findings: For all indicators except job vacancies, even the shares of small hospitals were larger than the average of all size-classes in the other sectors. The share of companies with hard-to-fill vacancies for ICT jobs was also reported to be small in other sectors (1%).

Findings by size class: For all four ICT skills indicators discussed here, small hospitals reported to have the lowest shares. Large hospitals stated to have the largest shares except regular ICT training of employees, for which the levels of medium-sized (41%) and large hospitals (39%) were similar.

Exhibit 3-5: Demand for ICT skills and skills development

	Hospitals employing ICT practitioners		**Regular ICT training of employees**		**Hospitals with hard-to-fill vacancies for ICT jobs in 2005**		**Hospitals using e-learning**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**57**	**39**	**39**	**34**	**5**	**3**	**26**	**22**
Micro/small (1-49 empl.)		16		20		1		16
Medium (50-249 empl.)		42		41		2		22
Large (250+ empl.)		62		39		6		28
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Micro (1-9 empl.)		12		9		2		12
Small (10-49 empl.)		15		16		0		11
Medium (50-249 empl.)		29		28		2		19
Large (250+ empl.)		59		41		6		35
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539		539	
Questionnaire reference	B1		B4		B2		B5	

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

Outsourcing of ICT services

Overall findings: The hospitals were asked whether they had outsourced any of their ICT services to external service providers in 2005 which had previously been conducted in-house. 30% of the hospitals (23% weighted by employment) reported to have outsourced ICT services in 2005 – see Exhibit 3-6.

Findings by sector: Compared to the other nine sectors studied this year by *e-Business W@tch*, the level of outsourcing ICT services was quite high (20% versus 14% in all sectors). However, when comparing only large organisations, hospitals were behind organisations of other sectors.

Findings by size class: According to the 2006 survey results, outsourcing of ICT services was apparently more common in large hospitals (24%) than in medium-sized (21%) and small hospitals (13%).

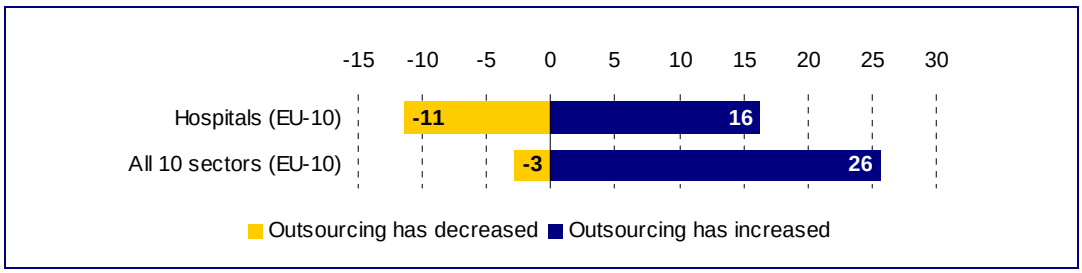
Exhibit 3-6: Outsourcing and spending on ICT

	Have outsourced ICT services in 2005		**Share of ICT budget as % of total costs**		**Have made ICT investments in 2005**		**Difficulty to draw funds for investments**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**23**	**20**	**5**	**8**	**87**	**79**	**36**	**23**
Micro/small (1-49 empl.)		13		7		59		n.a.
Medium (50-249 empl.)		21		10		87		n.a.
Large (250+ empl.)		24		4		89		n.a.
All 10 sectors (EU-10)	**19**	**14**	**6**	**5**	**65**	**50**	**19**	**15**
Micro (1-9 empl.)		8		5		39		25
Small (10-49 empl.)		21		5		60		3
Medium (50-249 empl.)		21		6		78		6
Large (250+ empl.)		31		6		86		29
Base (100%)	hospitals using computers		all hospitals (excl. "don't know")		hospitals using computers		Hospitals with external funding sources for their ICT investments	
N (for sector, EU-10)	539		266		539		81	
Questionnaire reference	B6		C1		C3		C5	

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

Exhibit 3-7 shows that the outsourcing trend in hospitals appears to be different from the other sectors. While outsourcing was reported to increase in 26% of the firms in all sectors and to decrease in only 3% of them, the level of outsourcing was said to increase in 16% of the hospitals and to decrease in 11%. This may show that hospitals are relatively reluctant to make use of external ICT expertise. Some hospitals may have outsourced ICT services but then realised that they became too dependent on their external ICT providers in functions vital for the hospital's operation.

Exhibit 3-7: Outsourcing trend: percentage of hospitals that have increased / decreased their outsourcing activities in 2005



Base (100%): Hospitals that have outsourced ICT services. N (for sector, EU-10) = 103.
Weighting: % of employment. Questionnaire reference: C2

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

ICT investments

In the e-Business Survey 2006, the hospitals were asked about the share of their ICT budget and whether they invested in ICT in 2005. Those hospitals that reported such investments were asked whether it was difficult to draw the investment funds.

Overall findings: According to the 2006 survey results, the share of ICT budget in percent of total cost was reported to be 8% on average – see Exhibit 3-6. This share appears to be very high and is not consistent with other sources. It may be that some interviewees – who were mainly ICT managers but not necessarily familiar with budget issues – guessed the figure and estimated it to be higher than it actually was. HINE revealed a relatively low level of hospital ICT expenditure: In Europe, 70% of the hospitals included in the HINE survey spent less than 2% of their total budget on ICT in 2006, while 70% of the US hospitals were spending more than 2% already in 2004. In the e-Business Survey 2006, 79% of the hospitals (87% weighted by employment) reported to having made ICT investments in 2005. 23% (36% weighted by employment) reported difficulties to draw funds for investments.

Findings by sector: The share of firms that stated ICT investments in 2005 (79% versus 50% in all sectors) and difficulties to draw investment funds (23% versus 15% in all sectors) was higher in hospitals. However, the percentage of hospitals investing in ICT were similar to the all-sector average when comparing size classes.

Findings by size class: The reported share of ICT budget was 7% in small hospitals, 10% in medium-sized and 4% in large hospitals. The percentage of medium-sized (87%) and large hospitals (89%) reporting ICT investments in 2005 was quite similar.

Major investment sources

In the e-Business Survey 2006, the hospitals were further asked about the major sources for investment in ICT and offered four answer options: cash-flow financing, bank loans, venture capital, as well as public funds and other sources.

Overall findings: Cash-flow financing was reported to be the most common source of ICT investment in hospitals, as Exhibit 3-8 shows. 56% of the hospitals reported this source. 26% of the hospitals stated they received public funds. Public funding of course

depends largely on the ownership status of the hospital. Bank loans were reported to be uncommon (5%) and venture capital funding was stated to be very rare (close to 0%).

Findings by sector: Compared to other sectors included this year in the *e-Business W@tch*, the percentage of hospitals investing in ICT from the cash flow was found to be lower (56% versus 82% in all sectors) and the level of public funding was found to be much larger (26% versus 7% in all sectors). Both may be due to the considerable share of public hospitals in the sample.

Findings by size class: Cash-flow financing of ICT investments was found to be more common in small hospitals (66%) than in medium-sized (56%) and large hospitals (50%). The same sequence applies to bank loans. The level of public funding was quite similar.

Exhibit 3-8: Major source for investments in ICT

	Cash-flow financing		Bank loans		Venture capital		Public funds and other	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**51**	**56**	**2**	**5**	**0**	**0**	**26**	**26**
Micro/small (1-49 empl.)		66		8		0		22
Medium (50-249 empl.)		56		6		1		27
Large (250+ empl.)		50		2		0		26
All 10 sectors (EU-10)	**74**	**82**	**5**	**7**	**1**	**1**	**9**	**7**
Micro (1-9 empl.)		82		8		1		2
Small (10-49 empl.)		81		6		1		2
Medium (50-249 empl.)		70		8		1		2
Large (250+ empl.)		67		2		1		8
Base (100%)	firms that have made investments in ICT							
N (for sector, EU-10)	438		438		438		438	
Questionnaire reference	C4		C4		C4		C4	

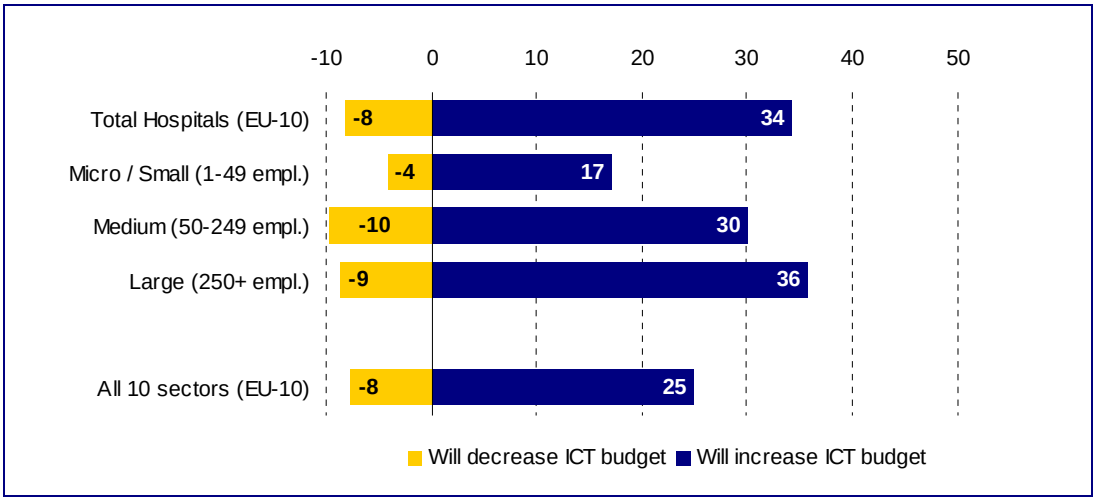
Source: *e-Business W@tch* (Survey 2006)

Budget trends

According to the e-Business Survey 2006 results, 34% of the hospitals said they plan to increase their ICT budget within the next 12 months. Only 8% said they plan to decrease their ICT budget. The share of hospitals that reported to plan to increase the ICT budget was largest among large hospitals (36%), followed by medium-sized (30%) and small hospitals (17%) – see Exhibit 3-9. The percentage of hospitals that reported to intend to increase the ICT budget was larger than in other sectors (25%).

In the HINE survey of 2004 the share of hospitals intending to increase their ICT budget was found to be larger, around 50%. This difference between *e-Business W@tch* and HINE findings can be explained by two facts: Firstly, HINE only included hospitals with more than 100 beds which have a higher inclination to invest in ICT. Secondly, HINE asked for investment increase in the next three years, not in the next twelve months as *e-Business W@tch*. HINE also found that ICT is not yet a strategic board-level issue in most hospitals but that hospitals generally recognise the e-business challenge.

Exhibit 3-9: ICT budget trend: percentage of hospitals that plan to increase / decrease their ICT budgets in 2006/07



Base (100%): Hospitals using computers (excl. "don't know"). N (for sector, EU-10) = 494.
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: C2

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

3.4 Standards and interoperability

Importance of e-business standards and interoperability for hospitals

Interoperability can be defined as "the ability of ICT systems and of the business processes they support, to exchange data and to enable the sharing of information and knowledge"[39]. However, interoperability is a serious challenge, as ICT from different health service providers, from different manufacturers, from different technology generations, from different administrative backgrounds and, in a European context, from countries with different health systems, different languages and stakeholders with different objectives is used. [40] Hospitals are challenged by interoperability issues because they often use a wide variety of information systems from different providers. The challenge is not only interoperability between the hospital and other organisations, but even within a single hospital.

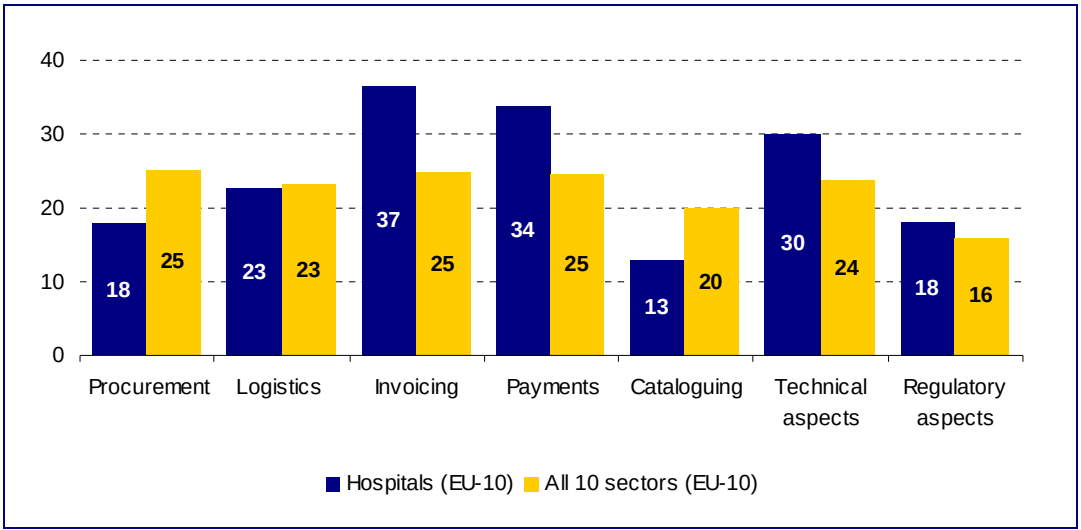
In the e-Business Survey 2006, hospitals were asked whether they experience problems due to a lack of interoperability with regard to seven items: procurement, logistics, invoicing, payments, cataloguing, technical aspects, and regulatory aspects. The results are shown in Exhibit 3-10. In three of the seven categories, the share of hospitals reporting difficulties due to a lack of interoperability was larger than the all-sectors average: invoicing (37% in hospitals versus 25% in all ten sectors), payments (34%

[39] Definition by Interoperable Delivery of European eGovernment Services to Public Administrations, Businesses and Citizens - European Interoperability Framework (IDABC-EIF), see IDABC (2004), p. 5.

[40] See European Commission (2005), "e-Business Interoperability and Standards: A Cross-Sector Perspective and Outlook", for current background information on the subject.

versus 25 %), and technical aspects (30% versus 24%). The shares were similar in regulatory aspects (18% versus 16 %) and logistics (23% both). Only in procurement (18% versus 25%) and cataloguing (13% versus 20%), the difficulties in the hospital sector were reported to be lower than in all ten sectors. It is striking that difficulties were reported to be relatively low for the procurement function in which hospitals are traditionally quite advanced.

Exhibit 3-10: Problems due to a lack of interoperability: hospitals experiencing difficulties in ...



Base (100%): Hospitals that say that interoperability is critical for their e-business. N (for sector, EU-10) = 306.
Weighting: % of employment. Questionnaire reference: G6

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

Current situation and developments in ICT standards for the health sector

Standards and interoperability in e-health is not just a matter of technology. It is also a matter of organisational and semantic interoperability.[41] In this report, however, only technical standards are relevant. Technical interoperability relates to the hardware and software as well as the networks involved in e-health communication and data exchange. This includes issues such as open interfaces, middleware, accessibility and security services. Currently there is a large number of ICT standards in use in the health sector. Exhibit 3-11 lists the most important technical standards used in Europe and explains their background, domain and characteristics.

Among the most important technical ICT standards for the health sector are TC 251, Health Level 7 (HL7), Digital Image and Communications in Medicine (DICOM), and the specifications developed by Integrating the Healthcare Enterprise (IHE):

- **TC 251**. The Comité Européen de Normalisation (CEN) has a specific group developing European standards in health informatics, Technical Committee (TC) 251 "European Standardisation of Health Informatics".[42] The most important

[41] See European Commission, Information Society and Media Directorate General (2006), chapter 5, for explanations about the various types of interoperability in e-health. See also the publications of the European Commission's i2Health project at http://www.i2health.org.

[42] See http://www.centc251.org/.

standard under development is probably EN 13606 on electronic healthcare record communication. For this development CEN cooperates with the International Organisation of Standardisation (ISO) and initiatives like HL7.

- **HL7** is a standard for clinical documents that defines the contents of messages between applications, and it covers messages and requests or orders from an organisation (e.g. a hospital) transmitted to departmental applications from other medical facilities. Initially a USA standard, it is being further developed at the international level.
- **DICOM** is a standard for the exchange of digital images, e.g. for radiology images.
- **IHE** specifies pre-established dialogues between different applications for exchanging messages or documents. It is an initiative driven by industry and users.

In the future, the World Health Organisation's eHealth Standardization Coordination Group can also be expected to play a more prominent role in developing ICT standards for the health sector.[43]

There are a number of challenges related to many of these standards:[44] their existence is not always well known, interoperability between applications using different standards is often not proven, they rarely explicitly take account of whether their requirements are suitable for small enterprises, and some of them conflict. Even when two systems use the same standard, it may be that the specification is different and the systems cannot interoperate. Consequently, commitment to European and international ICT standards in the health sector is still weak and there is a tendency for Member States to create national standards.[45] This may also be due to the fact that national health systems are quite different from each other and that health policy is still a national responsibility. The European Commission has a supporting and facilitating role.[46] The European Commission services are currently preparing a draft standardisation mandate, addressed to European standardisation organisations and inviting them to prepare an integrated standardisation work programme in response to current e-health policy needs in the EU.

The market for interoperability standards is maturing, even though slowly. The third version of the HL7 standard is progressively being adopted by the health industry, and convergence with Europe's CEN/TC 251 standardisation work is under way. The IHE initiative is producing useful protocols that standardise communication between various health information system components.[47]

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43 See http://www.who.int/ehscg/en/.

44 See CEN/ISSS e-Health Standardisation Focus Group (2005), p. 5.

45 See CEN/ISSS e-Health Standardisation Focus Group (2005), p. 5.

46 The European Commission, Health and Consumer Protection Directorate General (DG SANCO), has opened a consultation for the future EU legislation on health care services. The deadline to respond is January 31, 2007. Following this consultation, the Commission intends to bring forward appropriate proposals in 2007. More information available at: http://ec.europa.eu/health/ph_overview/co_operation/mobility/patient_mobility_en.htm.

47 See Geissbuhler (2005), p. IT54.

Exhibit 3-11: Overview of most common ICT standards in the health sector

Standard name and abbreviation	Issuing organisation and background	Domain	Characteristics
European Norm EN 13606	Under development at CEN Technical Committee 251, an EU-supported standardisation organisation	Electronic Patient Record communication	CEN TC 251 is partner in some of the before mentioned activities and globally at ISO and WHO level
Integrating the Health Enterprise (IHE)	Non-for-profit global initiative founded 1998 by the Radiological Society of North America (RSNA) and Healthcare Information and Management Systems Society (HIMSS). Does not develop standards as such, rather it develops use cases and selects and develops appropriate detailed specifications based on a screening of potentially applicable standards	Radiology, cardiology, laboratory, document exchange; "IT Integration" (interdepartmental or inter-institutional system integration)	Strongly supported by many global as well as regional e-health industry players; mandatory involvement of clinical users; specifications recommended by IHE have high probability of quick uptake on the medical devices and systems market
Digital Image and Communications in Medicine (DICOM)	Administered by the (USA) National Electrical Manufacturers Association (NEMA) Diagnostic Imaging and Therapy Systems Division	Digital images and associated data	De facto international standard for medical image communication
Health Level 7 (HL7)	Not-for-profit volunteer organization of providers, vendors, payers, consultants, government groups and others	Clinical and administrative data	Originally a USA-based standards organisation, the decisions it makes are increasingly relevant outside the USA

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

Types of e-standards used

Overall findings: Since the e-Business Survey 2006 had common questions for all sectors, not all ICT standards for the health sector listed above were asked in the interviews. The survey focused on standards that apply to all industries such as electronic data interchange (EDI) and extended mark-up language (XML). The only hospital-specific standard that was included in the questionnaire was HL7. As Exhibit 3-12 shows, 26% of the EU-10 hospitals (which is hospitals representing 41% of employment in the sector) said they use the HL7 standard. Compared with findings from the HINE survey, which found that around 70% of the hospitals use HL7, this figure is quite low. The difference may partly be explained by the different samples.

In the e-Business Survey 2006, 19% of the hospitals (23% weighted by employment) stated they use EDI-based standards, 21% (28% weighted by employment) XML-based standards, 4% (6% weighted by employment) proprietary standards, and 30% (32% weighted by employment) other standards.

Findings by sector: In sector comparison, the use of standards in hospitals was found to be very high. Only 3% of firms in all sectors studied this year by the *e-Business W@tch*

reported to use EDI-based standards, only 5% reported to use XML-based standards, 12% proprietary standards and 2% other standards.

Findings by size class: The e-Business Survey 2006 found that the use of standards was more common in larger hospitals than in smaller ones. Large hospitals reported the highest share of standards use except for proprietary standards for which the percentage of medium-sized and large hospitals is the same (33%).

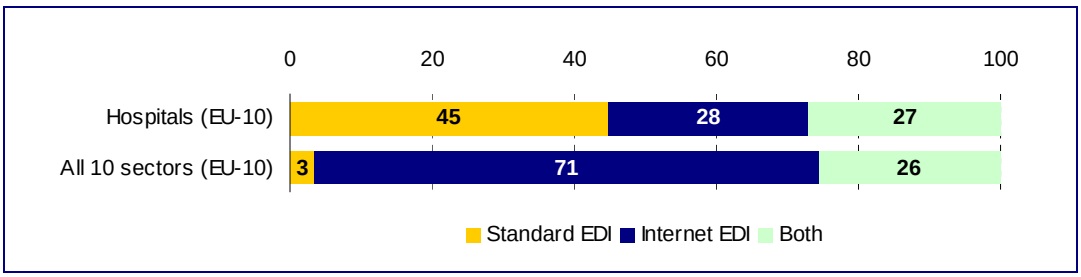
Exhibit 3-12: Use of e-standards

	EDI-based standards		XML-based standards		Proprietary standards		HL7		Other standards	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**23**	**19**	**28**	**21**	**32**	**30**	**41**	**26**	**6**	**4**
Micro/small (1-49 empl.)		13		10		23		6		0
Medium (50-249 empl.)		20		22		33		28		5
Large (250+ empl.)		25		30		33		46		7
All 10 sectors (EU-10)	**9**	**3**	**11**	**5**	**19**	**12**	**n.a.**	**n.a.**	**4**	**2**
Micro (1-9 empl.)		2		6		10		n.a.		1
Small (10-49 empl.)		4		5		13		n.a.		2
Medium (50-249 empl.)		10		10		24		n.a.		2
Large (250+ empl.)		29		27		31		n.a.		7
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539		539		539	
Questionnaire reference	G1a		G1b		G1c		G1e		G1d	

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

As regards EDI, hospitals in the EU-10 predominantly said they use standard EDI (45%), while the majority of firms in all sectors (71%) reported to use internet EDI. The share of organisations reporting to use both is the same for hospitals and all sectors. Exhibit 3-13 shows the related figures.

Exhibit 3-13: Types of EDI used

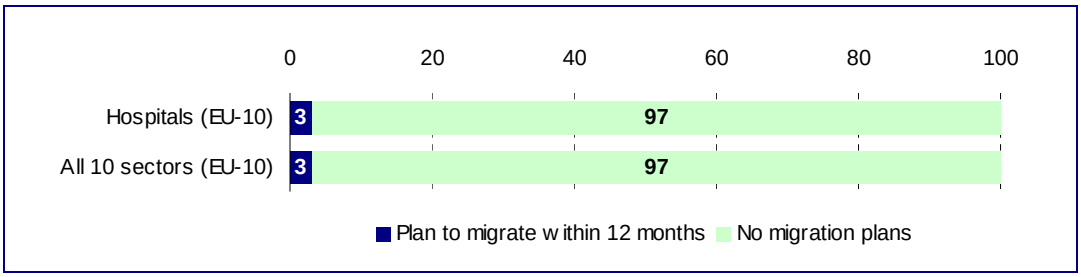


Base (100%): Hospitals using EDI. N (for sector, EU-10) = 62.
Weighting: % of employment. Questionnaire reference: G3

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

Migration from EDI to XML-based standards does not appear to be an important issue either in the hospital sector or in all other sectors studied this year by *e-Business W@tch*. The percentage of entities reporting plans to migrate is 3% in both cases (see Exhibit 3-14).

Exhibit 3-14: Firms planning to migrate from EDI to XML based standards



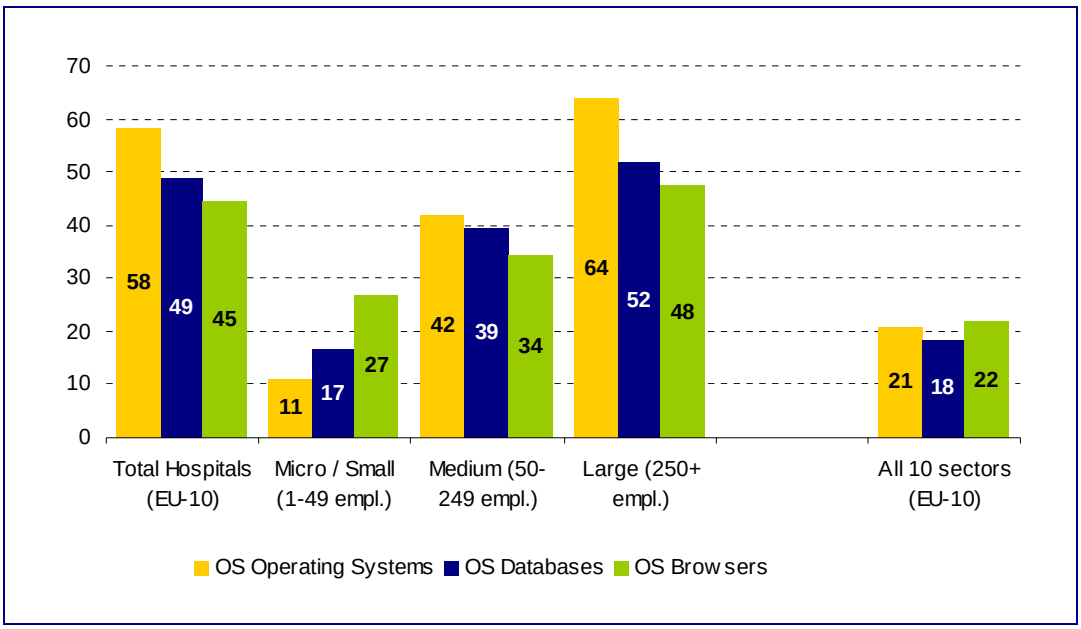
Base (100%): Hospitals using EDI. N (for sector, EU-10) = 63.
Weighting: % of employment. Questionnaire reference: G4

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

Use of Open Source Software

Overall findings: As Exhibit 3-15 shows, 58% of hospitals surveyed this year said they use open software operating systems, 49% said they use open software databases, and 45% stated they use open software browsers.

Exhibit 3-15: Hospitals using Open Source (OS) Software



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539. Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises. Questionnaire reference: G8

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

Findings by sector: In comparison to the other sectors studied this year by the *e-Business W@tch*, the use of open software was found to be particularly large. The average for all ten sectors was around 20% for the three open software categories considered here.

Findings by size class: The reason for the relatively high use of open source software in hospitals may again be the fact that hospitals tend to be relatively large organisations. As Exhibit 3-14 also shows, the use of open source software was found to be much more common in large hospitals than in medium-sized and small ones.

3.5 ICT security measures

The significance of data security in hospitals

In hospitals, large amounts of sensitive patient data are produced, stored and processed every day. Hence data security is of paramount importance for them. Hospitals face a dilemma: on the one hand patient data needs to be readily available for the hospital professionals in order to be able to treat a patient. At the same time, such data also needs to be protected from unauthorised use. There are four dimensions of data security in hospitals:[48] integrity (i.e. wholeness, completeness), confidentiality, availability and accountability of information.

Scenarios and challenges

Patient data are shared between numerous persons and organisations in a variety of different contexts and settings, each with its own security challenges and needs. Data exchange within the hospital, between the hospital and other medical entities, as well as between the hospital and non-medical entities can be distinguished.[49]

Within the hospital, data are transferred between different departments and clinicians. A first possible problem is data access by an unauthorised person. Health professional cards as well as electronic patient identifiers can be used to ensure proper identification of the person accessing – with appropriate patient consent, if and when required – the data. However, these cards can also be faked. Secondly, even properly authorised personnel can use data in an improper manner, for instance by modifying data to hush up mistakes.

As regards electronic communication with medical entities outside the hospital, [50] the risk of unauthorised persons gaining access is increased, for instance through Trojan software. A specific subset of challenges concern the confidentiality issues related to secondary use of medical data for research purposes.

In a broad non-medical setting, data are exchanged for administrative purposes, with health care providers, insurance companies or for legal purposes. Again, there is a risk of abuse, either through malicious actions or through neglect of security protocols.[51] In the hands of unauthorised people, confidential health information could be used to the patients' disadvantage. For example, employers may use health data of employees and applicants to sort out those who do not meet their fitness requirements, and insurance

[48] See Barber et al. (1998).

[49] See Blobel and Pommerening (1997).

[50] See NICTIZ Case Study (2005): The national e-medication record in practice. Case Study 2: information exchange between the GP, the hospital and the public pharmacist.

[51] See Blobel and Pommerening (1997).

companies may use health data of actual or potential clients to select people with so-called bad risks.

Trends

European hospitals take security issues seriously. According to HINE, the objective to "improve security and privacy provisions" was among the five most important drivers of ICT investments in hospitals.[52] Identification and authentication of health professionals, patients or administrative personnel accessing electronic health records is a topic that is currently among the priority e-health topics in many hospitals in Europe and at the EU level. Identification is the assignment of an unambiguous code to a certain person or organisation; authentication is a process to verify the claimed identity of a person. A trend towards authentication through two or three factors is developing: password or security code ("*something you know*"), token (e.g. a card, "*something you have*"), biometric identity ("*something you are*"), and even location ("*somewhere you are*").[53]

While authentication procedures may be relatively simple to implement within a certain hospital, difficulties increase when outside entities are to be granted access to electronic health records because the legal, organisational and technical issues involved become more complex. On a European level, there is no consensus on common principles and descriptors of electronic identification and authentication. Applicable laws may not match, identification and authentication procedures may differ, and technical facilities may not be compatible. Thus, cross-border authentication is a serious issue.

Findings from the e-Business Survey 2006

Overall findings: In the e-Business Survey 2006, 47% of hospitals using computers (63% weighted by employment) said they use secure server technology; 29% (40% weighted by employment) said they use digital signatures or public key infrastructure, and 90% (92% weighted by employment) said they use a firewall. These findings are shown in Exhibit 3-16.

Findings by sector: The levels of use of secure server technology and digital signature of public key infrastructure in the hospital sector are twice as high as in all sectors surveyed in 2006. The level of use of a firewall is also much higher (90% versus 62% in all sectors).

Findings by size class: According to the e-Business Survey 2006, the use of secure server technology and digital signature or public key infrastructure grows with hospital size: It is largest in large hospitals and smallest in small hospitals, while medium-sized hospitals have the highest level of firewall use.

[52] See Lessens (2006), with data from the HINE survey 2004 For example, according to the ICT investment index of the Federal Association of German Industry (Bundesverband der Deutschen Industrie), hospitals in Germany are currently heavily involved in security issues, investing 13% of their ICT budget in security technology.

[53] See MIS New Zealand (2006).

Exhibit 3-16: ICT security measures used by enterprises

	Secure Server Technology		Digital Signature or Public Key Infrastructure		Firewall	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**63**	**47**	**40**	**29**	**92**	**90**
Micro/small (1-49 empl.)		23		12		80
Medium (50-249 empl.)		51		33		95
Large (250+ empl.)		67		43		92
All 10 sectors (EU-10)	**36**	**20**	**21**	**15**	**78**	**62**
Micro (1-9 empl.)		16		13		56
Small (10-49 empl.)		23		17		73
Medium (50-249 empl.)		36		25		84
Large (250+ empl.)		64		39		94
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539	

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

3.6 Internal and external e-integration of processes

Introduction

The internal and external e-integration of processes is currently a very important issue in hospital activities. Process integration is necessary to realise efficiency gains and improve quality of health care. The integration issue is taken up in chapter 4 of this report in the discussion of hospital information systems integration and continuity of care.

Use of software systems for internal process integration

Overall findings: As Exhibit 3-17 shows, 55% of the hospitals surveyed (representing 75% of employment in the sector) said have an intranet. 77% (91% weighted by employment) said they use an accounting software, 21% (33% weighted by employment) said they use an Enterprise Resource Planning (ERP) system, and 59% (69% employment-weighted) stated they use electronic medical records management.

Findings by sector: Compared to the other sectors studied this year by the *e-Business W@tch*, the use of ICT systems for internal process integration appeared to be quite advanced which may be due to the dominance of large organisations in the hospital sector. Hospital use of intranets, accounting software, ERP systems and medical records management – and comparable solutions in other sectors – is much higher than in the all-sector average.

Findings by size class: The use of the systems under consideration here was found to be most common in large hospitals, followed by medium-sized hospitals and then small hospitals.

Exhibit 3-17: Use of ICT systems for internal process integration

	Intranet		Accounting software		ERP system		Medical Records Management	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**75**	**55**	**91**	**77**	**33**	**21**	**69**	**59**
Micro/small (10-49 empl.)		27		58		10		47
Medium (50-249 empl.)		60		85		20		61
Large (250+ empl.)		80		93		36		71
All 10 sectors (EU-10)	**42**	**23**	**70**	**57**	**19**	**11**	**19**	**13**
Micro (1-9 empl.)		19		50		7		11
Small (10-49 empl.)		28		70		16		13
Medium (50-249 empl.)		43		85		25		19
Large (250+ empl.)		76		88		45		42
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539		539	
Questionnaire reference	D1a		D1e		D1d		D1c	

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

Use of ICT for cooperative and collaborative business processes

Overall findings: In the e-Business Survey 2006, the hospitals were asked whether they "use online applications other than e-mail, for example special software", to support certain business functions. An example of such an application is the Medibridge system used in Belgium.[54] Exhibit 3-18 shows the results. The findings for communication with primary care clinicians is of highest interest here. 18% of the surveyed hospitals (representing 25% of employment in the sector) reported to communicate with primary care clinicians with online applications other than e-mail. These figures are similar to findings from HINE, according to which 31% of the hospitals have simple electronic links with general practitioners and 16% have links with document access. It seems that there is a largely unused potential for electronic communication between hospitals and general practitioners. The e-Business Survey 2006 furthermore found that 33% of the hospitals (37% weighted by employment) used online applications to share electronic documents between colleagues or to perform collaborative work in an online environment. 25% of the hospitals (35% employment-weighted) said they manage capacity or inventory online. 8% (11% weighted by employment) said they use collaborative design processes online.

Findings by sector: In comparison with the other sectors studied this year by the *e-Business W@tch*, the practice of sharing documents in a collaborative workspace (33% versus 14% in all sectors) as well as managing capacity or inventory online (25% versus 10% in all sectors) was found to be much larger in hospitals. The percentage is about the same for collaborative online design processes, a function that is more common in manufacturing industries and not so much related to the work processes in hospitals.

[54] See http://www.medibridge.be/en/.

Findings by size class: The sharing of documents in collaborative work spaces appeas to be most common in medium-sized hospitals (43%), followed by large hospitals (37%) and small ones (15%). Large hospitals have taken the lead in the other three items. The use of online collaborative design processes was found to be similarly large in small and medium-sized hospitals.

Exhibit 3-18: Online cooperation and collaboration within the value system

	Share documents in collaborative work space		Manage capacity / inventory online		Collaborative design processes		Communication with primary care clinicians	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**37**	**33**	**34**	**25**	**11**	**8**	**25**	**18**
Micro/small (1-49 empl.)		15		13		7		10
Medium (50-249 empl.)		43		26		6		20
Large (250+ empl.)		37		36		11		27
All 10 sectors (EU-10)	**27**	**14**	**22**	**10**	**15**	**7**	**n.a.**	**n.a.**
Micro (1-9 empl.)		10		8		5		n.a.
Small (10-49 empl.)		19		14		8		n.a.
Medium (50-249 empl.)		31		21		13		n.a.
Large (250+ empl.)		47		41		25		n.a.
Base (100%)	hospitals with internet access		hospitals with internet access		hospitals with internet access		hospitals with internet access	
N (for sector, EU-10)	533		533		533		533	
Questionnaire reference	D5a		D5e		D5d		D5c	

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

Deployment of e-invoicing

In the e-Business Survey 2006, special attention was paid to the issue of electronic invoicing (e-invoicing). e-Invoicing is a computer-mediated transaction between a seller and biller (invoicing entity) and a buyer and payer (receiving entity), which replaces traditional paper-based invoicing processes. In e-invoicing, the invoice is electronically generated and sent by the biller and electronically received, processed and archived by the payer. In practice, e-invoicing typically goes hand in hand with making payments electronically.[55]

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

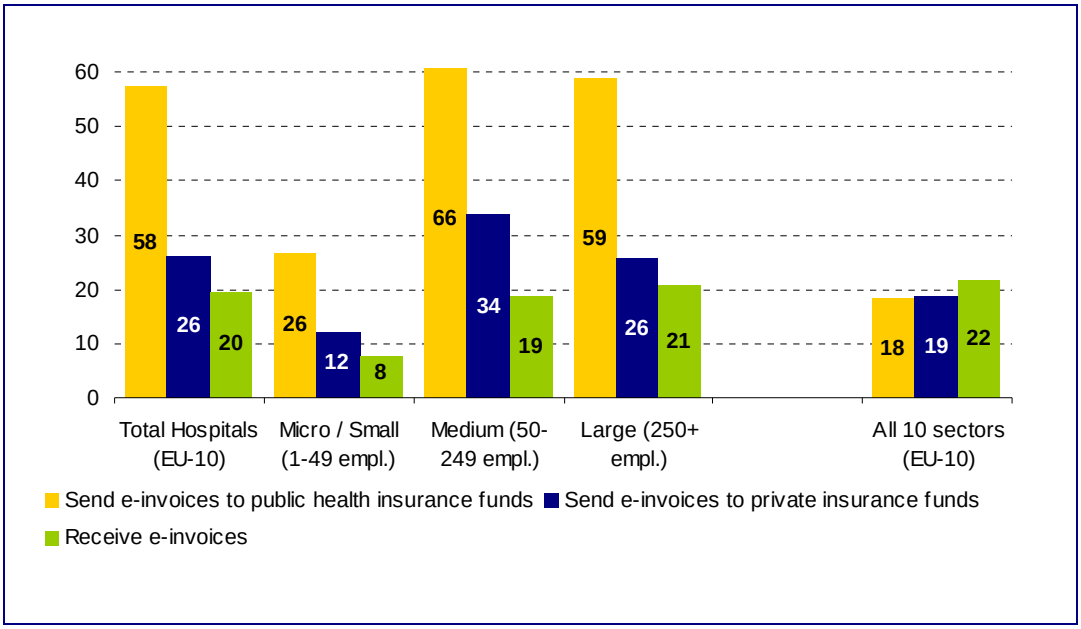
[55] For more background information on e-invoicing activities of enterprises, see *e-Business W@tch* Special Report "ICT Security, e-Invoicing and e-Payment Activities in European Enterprises" (September 2005). Available at www.ebusiness-watch.org ("resources").

Overall findings: Exhibit 3-19 presents findings about the adoption of electronic invoicing. 58% of EU-10 hospitals reported to send e-invoices to public health insurance funds, and 26% reported to send e-invoices to private insurance funds. 20% of the hospitals said they receive e-invoices.

Findings by sector: In the other sectors studied this year by the *e-Business W@tch*, the questions about sending e-invoices were formulated slightly differently; the companies were asked whether they send e-invoices to customers in the public or private sector. Sending e-invoices to public organisations appears to be much less common in the other sectors (58% versus 18% in all sectors). The level of e-invoice sending to private firms was also found to be higher among hospitals (26% versus 19% in all sectors.) The high figures for hospitals can be explained by standardised billing communication with a relatively small number of public and private insurance funds. Firms in other sector have a larger number of customers which makes standardised electronic billing more complicated. However, the all-sector average percentage of firms reporting to receive e-invoices was slightly larger than in hospitals (20% versus 22% in all sectors).

Findings by size class: The practice of sending e-invoices to public or private insurance funds as well as receiving e-invoices was found to be most common in large hospitals, followed by medium-sized and small hospitals.

Exhibit 3-19: Adoption of e-invoicing

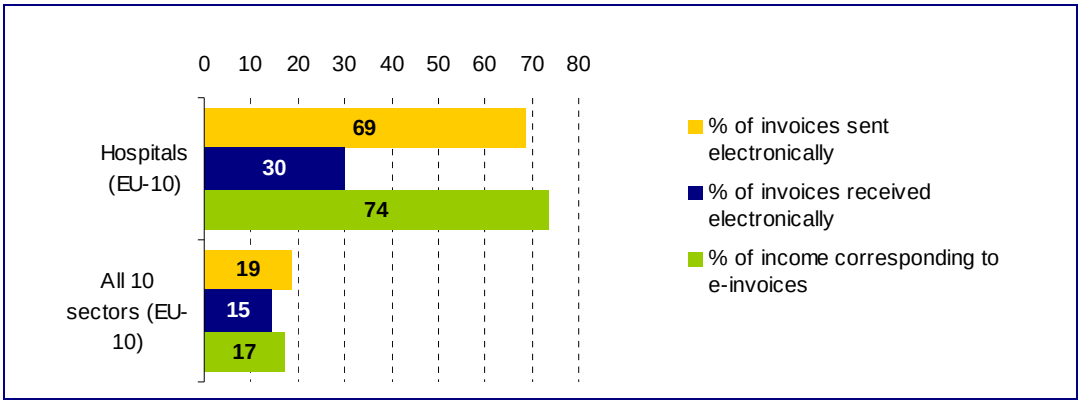


Base (100%): Companies with internet access. N (for sector, EU-10) = 533.
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: D5

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

The average percent of invoices hospitals reported to send electronically was 69% - see Exhibit 3-20. The percentage of invoices reported to be received electronically was much smaller (30%). On average, 74% of the hospital income were reported to correspond to e-invoices. The related shares in all ten sectors were smaller.

Exhibit 3-20: Share of e-invoices as % of total invoices



Base (100%): Companies sending/receiving e-invoices (without "don't know"). N (for sector, EU-10) = 185/69.
Weighting: % of employment. Questionnaire reference: D6, D7, D8

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

3.7 e-Procurement and Supply Chain Management

Introduction

Hospitals need to procure a large variety of goods and services in order to provide their services. These inputs include food and beverages, garments and bed textiles, stationery products, drugs, and medical technologies and many more products and services. Thus, procurement and supply chain management play an important role in hospital activities.

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

B2B online trading: hospitals placing orders online

Overall findings: According to the e-Business Survey 2006 results, 67% of hospitals (same figure in terms of employment-weighted data) said they place orders online – see Exhibit 3-21. Of these, 73% (71% weighted by employment) said they place more than 5% of their orders online and 27% (29% weighted by employment) said they place more than 25% of their orders online. 12% (19% weighted by employment) stated to use specific ICT solutions for e-sourcing.

Findings by sector: In comparison with the other sectors studied this year by *e-Business W@tch*, the reported share of placing orders online was very high in hospitals activities (67% versus 48% in all sectors). The percentages were higher only in the telecommunication (77%), consumer electronics (71%) and ICT manufacturing (69%) industries for which ICT is the core business. This underlines the importance of e-procurement for hospitals. The percentages for placing more than 5% or 25% of the

orders online were similar. The use of specific ICT solutions for e-sourcing was reported to be slightly higher in hospitals (12% versus 9% in all sectors).

Findings by size class: Placing orders online was found to be most common in medium-sized hospitals (75%), followed by large hospitals (66%) and small ones (55%). An explanation for the lead of medium-sized hospitals may be that they have more organisational flexibility for introducing e-procurement than large hospitals and at the same time more know-how for such practices than small hospitals. Of those hospitals that place orders online, the share of hospitals reporting to place 5% or 25% of their orders online was quite similar across the three size classes. Specific ICT solutions for e-sourcing were reported to be most common in large hospitals, followed by medium-sized and small ones.

Exhibit 3-21: Hospitals ordering supply goods online

	Place orders online		Place more than 5% of orders online		Place more than 25% of orders online		Use specific ICT solutions for e-sourcing	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**67**	**67**	**71**	**73**	**29**	**27**	**19**	**12**
Micro/small (10-49 empl.)		55		73		27		7
Medium (50-249 empl.)		75		74		26		11
Large (250+ empl.)		66		70		30		21
All 10 sectors (EU-10)	**57**	**48**	**74**	**75**	**26**	**25**	**16**	**9**
Micro (1-9 empl.)		44		73		27		7
Small (10-49 empl.)		54		80		20		10
Medium (50-249 empl.)		60		76		24		16
Large (250+ empl.)		68		75		25		29
Food & beverages	54	39	86	91	14	9	14	5
Footwear	35	29	83	87	17	13	9	5
Pulp & paper	59	49	81	75	19	25	14	8
ICT manufacturing	72	69	67	49	33	51	20	10
Consumer electronics	70	71	60	47	40	53	16	9
Shipbuilding & repair	62	53	78	69	22	31	18	12
Construction	53	51	74	72	26	28	12	6
Tourism	60	39	77	72	23	28	20	12
Telecommunication	78	77	54	49	46	51	26	12
Hospitals activities	67	67	71	73	29	27	19	12
Base (100%)	hospitals using computers		hospitals placing orders online		hospitals placing orders online		hospitals using computers	
N (for sector, EU-10)	539		300		300		539	
Questionnaire reference	E1		E3		E3		E7	

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

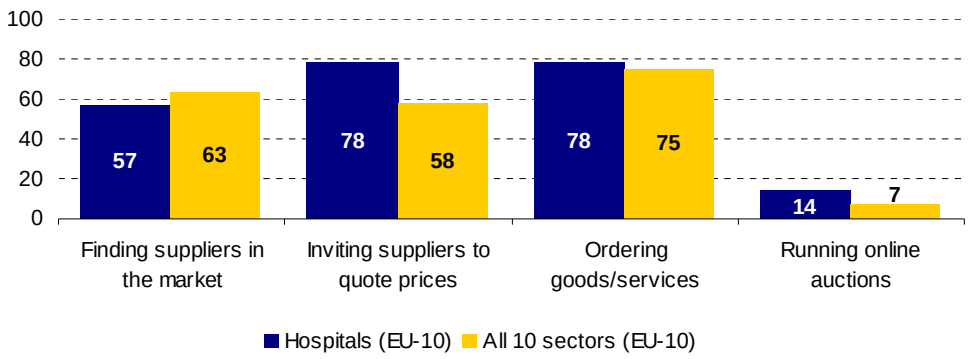
Use of ICT for e-procurement processes

As in 2005, *e-Business W@tch* asked hospitals whether they "*support the selection of suppliers or procurement processes by specific ICT solutions*." The rationale for this question is to further test whether e-procurement is in fact a systematic and digitally

integrated process, or an occasional business activity without much significance for the overall business.

Exhibit 3-22 shows findings for sourcing and procurement processes supported by specific ICT solutions. 57% of the EU-10 hospitals said they use specific ICT solutions for finding suppliers in the market, 78% said they use such solutions for inviting suppliers to quote prices and for ordering goods or services, and 14% said they use ICT solutions for running online auctions. For all items except finding suppliers in the market, the percentages for the hospital sector were slightly larger than for the all-sector average. It may be that hospitals 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 and services – is probably not in advanced state in these cases.

Exhibit 3-22: Sourcing and procurement processes supported by specific ICT solutions



Base (100%): Hospitals using specific ICT solutions for e-procurement. N (for sector, EU-10) = 85
Weighting: % of employment. Questionnaire reference: E8

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

Main location of suppliers in e-procurement

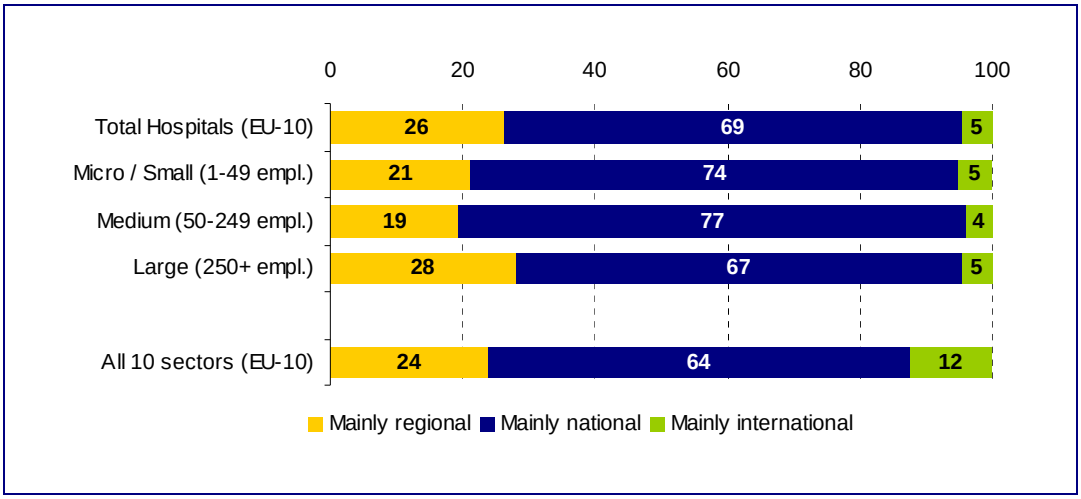
Overall findings: In the e-Business Survey 2006, the hospitals were asked whether their online orders are mainly from regional, national or international suppliers. As Exhibit 3-23 shows, most hospitals (69%) reported buying goods online mainly from national providers. 26% of the hospitals said they procure mainly regionally, 5% mainly internationally.

Findings by sector: The percentages of regional and national e-procurement in hospitals were slightly larger than in the ten sectors' average, and the share of firms procuring mainly internationally was smaller. The relatively large figure for regional e-procurement may reflect that many hospitals, particularly the public ones owned by municipalities, are firmly rooted in their local and regional environment. They may have strong traditional ties to regional providers, and the may to some extent have to buy from regional providers because it is politically desired in order to strengthen the regional economy. The relatively large share of e-procurement from national suppliers may reflect a need for specific products that are not available from regional providers. Finally, the

relatively small share of e-procurement from other countries may indicate that the are opportunities to exploit cost advantages of online business.

Findings by size class: The pattern of online procurement sources reported by large, medium-sized and small hospitals did not differ much. The share of large hospitals reporting to procure goods mainly from regional suppliers (28%) was larger than in medium-sized (19%) and small hospitals (21%).

Exhibit 3-23: Main location of suppliers in e-procurement



Base (100%): Hospitals placing orders online (without "don't know"). N (for sector, EU-10) = 310
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: E5

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

Main type of supply goods ordered online

Online sourcing and procurement can relate to different types of inputs. These include maintenance, repair and operation (MRO) goods,[56] raw materials, intermediary products and services. Interviewees were asked about their main type of goods procured online and they were also offered a category "*mixed or all*".

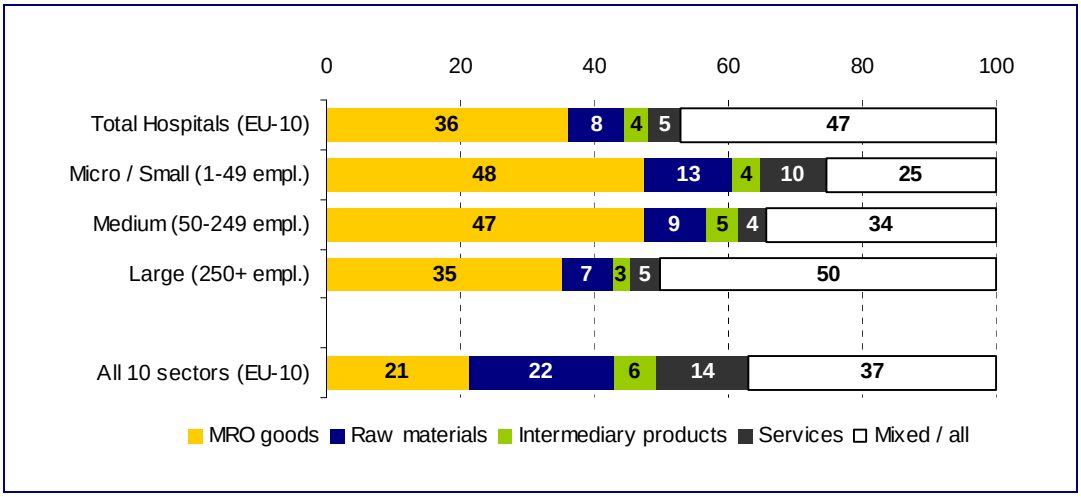
Overall findings: According to the 2006 e-Business Survey results, the main type of goods hospitals order online was "*mixed*" (see Exhibit 3-24). This may be due to the large variety of goods hospitals need to procure. The second largest share was reported to be MRO goods (36% of all goods ordered online). The other three categories – raw materials (8%), intermediary products (4%) and services (5%) – do not seem to play an important role.

Findings by sector: In comparison with the other sectors studied this year by the *e-Business W@tch*, the share of raw materials, MRO goods and services reported to be procured by hospitals was much smaller, while the share of mixed goods was larger. This may also reflect the particular goods needed to provide health services which could best be subsumed in the "mixed" category.

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

Findings by size class: The online procurement of MRO goods appeared to be more important in small (48%) and medium-sized hospitals (47%) than in large hospitals (35%). The share of mixed goods was reported to be largest in large hospitals (50%), followed by medium-sized (34%) and small hospitals (25%). It appears that small hospitals tend to mainly procure rather simple MRO goods through the internet, while large hospitals procure any kind of products online, including medical goods such as plasters and medicine.

Exhibit 3-24: Main type of supply goods ordered online



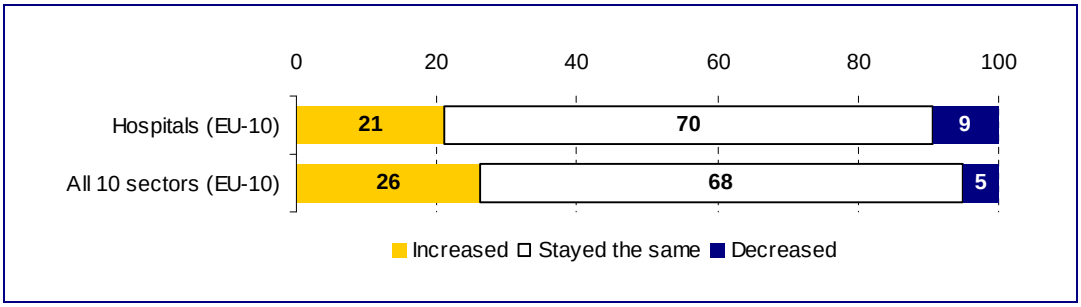
Base (100%): Hospitals placing orders online (without "don't know"). N (for sector, EU-10) = 317
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: E4

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

Impact of e-sourcing on supplier selection

As in previous years, *e-Business W@tch* asked companies that use e-procurement whether this has had an impact on the selection of suppliers, i.e. whether the number of suppliers has rather increased or decreased due to their e-procurement strategy, or whether this was without impact on the number of suppliers. According to e-Business Survey 2006 findings, e-sourcing and e-procurement did not have an effect on the number of suppliers in most hospitals, as Exhibit 3-25 shows. 70% of the hospitals reported that the number of suppliers stayed the same, 21% said that the number increased and 9% said that it decreased.

Exhibit 3-25: Impact of e-sourcing and e-procurement on the number of suppliers



Base (100%): Hospitals placing orders online (without "don't know"). N (for sector, EU-10) = 301
Weighting: % of employment. Questionnaire reference: E9

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

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

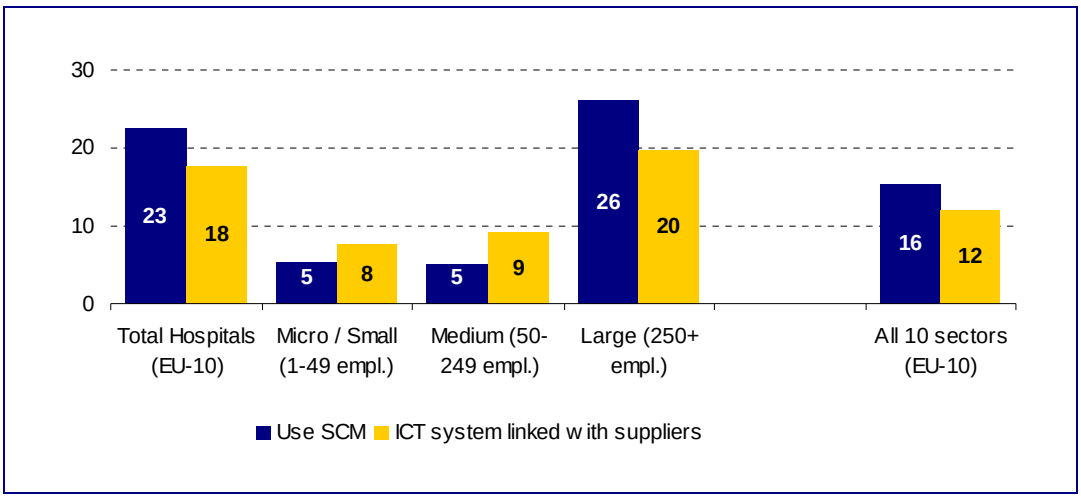
Supply chain management (SCM) software can help hospitals to match supply of and demand for health services through integrated and collaborative interaction tools. SCM provides an oversight of the flows of products and materials, information and finances, as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. SCM coordinates and integrates these flows both within and among companies or hospitals. One of the key objectives of any effective SCM system is to reduce inventory, with the assumption that products are available when needed.[57] *e-Business W@tch* also asked hospitals whether their ICT system was linked to that of suppliers.

Overall findings: As Exhibit 3-26 shows, 23% of the hospitals said they use a Supply Chain Management (SCM) system. In 18% of the hospitals surveyed this year, the ICT system was reported to be linked with that of suppliers.

Findings by sector: The percentage of hospitals with an SCM system was reported to be larger than in all ten sectors (23% versus 16% in all sectors) studied this year by the *e-Business W@tch*. The same applied to the share of hospitals whose ICT system is linked with the system of a supplier (18% versus 12%).

Findings by size class: SCM and systems links with suppliers were found to be domains of large hospitals: 26% of the large hospitals stated to use an SCM system, while only 5% of small and medium-sized hospitals said they use SCM. 20% of the large hospitals reported to have ICT system links with suppliers, while this was reported to be the case in only 9% of the medium-sized and 8% of the small hospitals.

Exhibit 3-26: Supply chain integration: use of SCM and ICT links with suppliers



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: D1f, F13a

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

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

Integration of financial processes in international trade

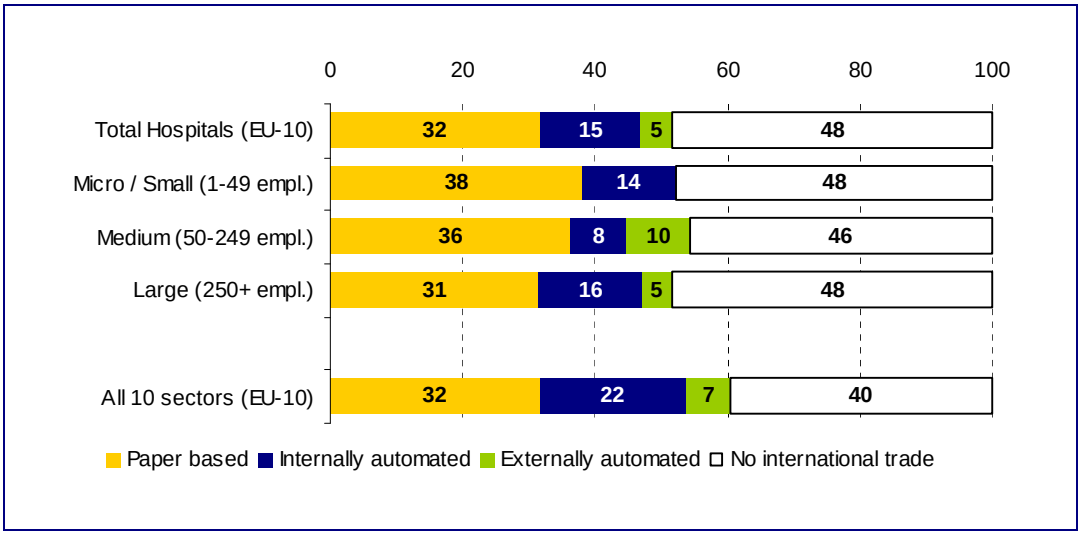
A new question in 2006 was whether the financial processes in trading with international suppliers were mainly paper based, internally automated or externally automated. It is acknowledged that this question remains a bit vague, as the difference between "internally integrated" and "externally integrated"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

Overall findings: According to the e-Business Survey 2006 results, 48% of the hospitals do not trade internationally – see Exhibit 3-27. In 32% of the hospitals, the international procurement relationships were reported to be paper-based, in 15% they were reported to be internally automated and in 5% they were reported to be externally automated.

Findings by sector: The findings do not differ much between the hospital sector and the all-sectors average. The most striking finding may be that internal automation was stated to be slightly more common in the other sectors (15% versus 22% in all ten sectors).

Findings by size class: The results do not differ much by size-class either. The most notable finding may be that there was no external automation reported from the small hospitals of the e-Business Survey 2006 sample.

Exhibit 3-27: Integration of financial processes in international e-trade



Base (100%): Hospitals placing orders online (without "don't know"). N (for sector, EU-10) = 293
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: E6

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

3.8 e-Marketing and sales

Introduction

Electronic marketing and sales do not appear to be well suited to hospitals because hospitals do not market and sell their services like firms in other sectors. Usually hospital services are required on either a local or regional level and there are only a few suppliers and many "customers", i.e. patients and citizens, in a certain region. In economic terms, hospitals are often part of a "close oligopoly" or even have a monopolist position. Patients are usually referred to hospitals by primary care clinicians or, particularly in case of emergency, they choose or are allotted to the hospital that is closest to their location. However, there may also be competition among hospitals, particularly in densely populated areas with numerous hospitals and particularly when there are public and private hospitals in close proximity. Thus there may also be an increased need for marketing activities. Furthermore, while hospitals do not directly sell their services, there is an opportunity for online booking for services. There is also an opportunity to provide publicly information about hospitals' performance that can implicitly alter a patient's choice. An example is the National Institute for Health and Clinical Excellence (NICE) in the UK.[58]

Hospitals receiving bookings from patients online

In the e-Business Survey 2006, hospitals were asked whether they "*allow customers to order goods or book services online from the website or through other computer-mediated networks*". This may, for example, include the booking of appointments for diagnosis or treatment in specialised outpatient or inpatient units.

Overall findings: 10% of the hospitals surveyed this year (representing 7% of this sector's employment) said they accept bookings from patients online – see Exhibit 3-28. Of these hospitals, 83% (93% weighted by employment) reported to receive between 1 and 25% of their bookings online, and further 17% (7% weighted by employment) said they receive more than 25% of the bookings online. 8% of the hospitals using computers said they use specific ICT solutions for online booking. Due to the low number of hospitals offering online booking in the sample (n = 39), a deeper analysis – for example with regard to the location of patients booking online services – is not meaningful.

Findings by sector: Compared to firms in other sectors included in the e-Business Survey 2006, the reported level of online booking in hospitals was much lower (10% versus 25% in all other sectors). There appears to be a lack in customer-facing, i.e. patient- and citizen-facing, online solutions in hospitals. The reported use of specific ICT solutions for e-sales was about the same level with regard to the percentage of firms but it is much lower with regard to the employment-weighted figures (8% versus 18% in all sectors).

Findings by size class: According to the e-Business Survey 2006 results, the share of hospitals that accept online bookings from patients was larger among micro and small hospitals (19%), while medium-sized (5%) and large hospitals (6%) followed well behind.

[58] See http://www.nice.org.uk.

It may be that small hospitals benefit from their organisational flexibility when introducing online booking opportunities.

Exhibit 3-28: Hospitals receiving bookings from patients online

	Accept bookings from patients online		Receive 1-25% of their bookings online		Receive more than 25% of their bookings online		Use specific ICT solutions for e-selling	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**7**	**10**	**93**	**83**	**7**	**17**	**8**	**8**
Micro/small (1-49 empl.)		19		-		-		10
Medium (50-249 empl.)		5		-		-		7
Large (250+ empl.)		6		-		-		8
All 10 sectors (EU-10)	**35**	**25**	**73**	**75**	**27**	**25**	**18**	**9**
Micro (1-9 empl.)		23		79		21		6
Small (10-49 empl.)		26		76		24		12
Medium (50-249 empl.)		29		75		25		16
Large (250+ empl.)		26		74		26		27
Base (100%)	Hospitals using computers		Hospitals accepting orders online		Hospitals accepting orders online		Hospitals using computers	
N (for sector, EU-10)	539		39		39		539	
Questionnaire reference	F4		F6		F6		F10	

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

e-Integration of marketing: CRM and ICT links with health insurance funds

One of the ICT applications that can help hospitals to improve the distribution of their services is Customer Relationship Management (CRM) for business intelligence purpose. CRM systems can help the hospital to systematically increase the knowledge about patients and their profitability, and to build and adapt marketing strategies on the basis of this intelligence. CRM refers to a broad range of methodologies and software applications that help an enterprise manage customer relationships, i.e. relationships to patients and citizens, in an organized way. Usually this will be based on some kind of database with systematic information about customers and the record the hospital has with them. Ideally, this information will support management, people providing service, and possibly the patients themselves in their tasks; for example by matching patient needs with service plans and offerings, and by reminding patients of service requirements. Three levels of application of CRM are commonly distinguished:[59]

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

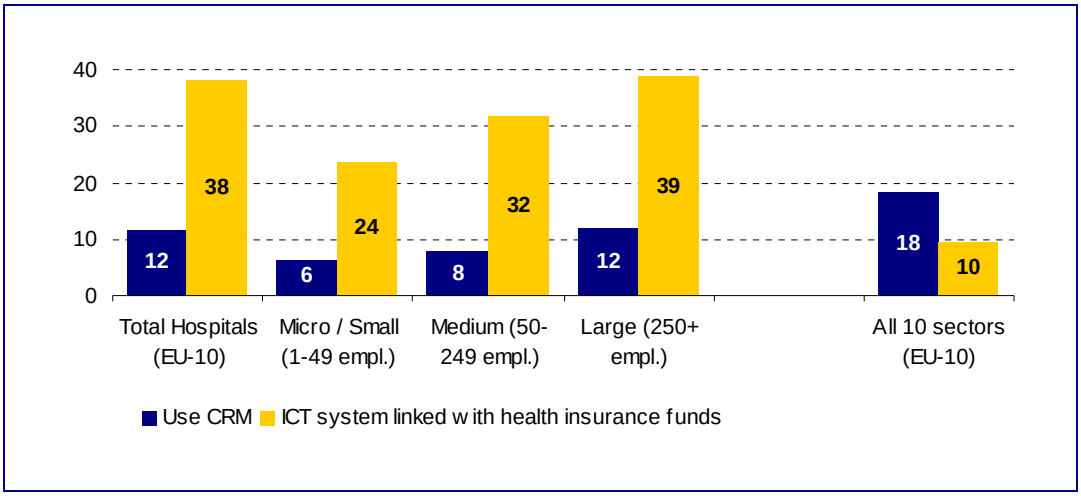
[59] Cf. www.mariosalexandrou.com/definition/crm.asp: "CRM Definition"

Overall findings: Customer Relationship Management (CRM) is an emerging system in hospitals. Hospitals may use it for example for links with general practitioners to attract patients.[60] As Exhibit 3-29 shows, 12% of the hospitals surveyed this year said they use a CRM system. In 38% of the hospitals, the ICT system was reported to be linked with the systems of health insurance funds.

Findings by sector: While the percentage of firms in all sectors using a CRM system was reported to be higher than in the hospital sector (12% versus 18% in all sectors), the percentage of firms that have their ICT system linked with that of customers is much lower (10% in all sectors versus 38% in hospitals). This may be due to the fact that hospitals have a relatively small number of insurance funds to deal with, compared to the number of customers of firms in other service sectors or in manufacturing sectors.

Findings by size class: According to the e-Business Survey 2006 results, for both CRM and ICT integration with insurance funds, the percentages are highest for large hospitals and lowest for small hospitals, with the medium-sized hospitals in between.

Exhibit 3-29: Use of CRM and integration of ICT systems with health insurance funds



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: F2, F13b

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

[60] Information from V. Lessens, member of the *e-Business W@tch* Advisory Board 2006, Agfa.

3.9 ICT and innovation

Introduction

The interviewees of the e-Business Survey 2006 were asked the following question: "*During the past 12 months, has your hospital launched any new or substantially improved products or services?*" If the question was unclear to the interviewee, they were told that "*we are interested in products or services new to your hospital – even if already on the market – as well as those that are new to your market.*" If the interviewees answered yes, they were further asked: "*Have any of these product or service innovations been directly related to or enabled by information or communication technology?*" In hospitals, this question sought to cover innovations such as online booking of appointments, online access to medical records and remote monitoring of vital data. In a similar manner, the interviewees were asked whether the hospital introduced "*new or significantly improved processes, for example for producing or supplying goods and services*".[61] This question related to all types of hospital information systems, whether for procurement, medication management, patient administration, communication with primary clinicians or other purposes.

e-Business Survey 2006 findings on innovation

Overall findings: According to the e-Business Survey 2006 results, 30% of the hospitals, which means hospitals representing 36% of employment in the sector, have made product or service innovations in 2005 – see Exhibit 3-30. Out of these, 55% (63% weighted by employment) said that the innovations were directly related to or enabled by ICT. The level of process innovation was higher: 44% of the hospitals (48% weighted by employment) said that they introduced new processes in 2005. The share of ICT-enabled process innovations was 77% (80% weighted by employment).

Findings by sector: The reported level of product or service innovation in the hospital sector was slightly higher than the all-sectors average (30% versus 24% in all sectors). The share of ICT-enabled product or service innovation was also higher (55% versus 45% in all sectors). The differences were even more distinct for process innovations in general (44% versus 20% in all sectors) and ICT-enabled process innovations (77% versus 63% in all sectors). However, when comparing only large enterprises, hospitals reported lower levels for product innovation (38% versus 48% in all sectors), and about the same levels for process innovation (49% versus 53% in all sectors) and ICT-related process innovation (80% versus 81% in all sectors). Only for ICT-related product or service innovation large hospitals reported a considerably higher level than large enterprises in the other sectors studied this year by *e-Business W@tch* (65% of hospitals versus 49% in all sectors).

Findings by size class: The picture for innovation by size-class was slightly fuzzy. Small hospitals were found to lag behind in all innovation categories discussed here except general product or service innovation. In this category, small hospitals appeared to having been slightly more active than medium-sized companies. Large hospitals reported

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

the largest shares of general and ICT-related product or service innovation but medium-sized hospitals were almost at the same level with regard to ICT-related product or service innovations. In general and ICT-related process innovation, medium-sized and large hospitals reported almost equal levels, too, with a small lead of medium-sized hospitals.

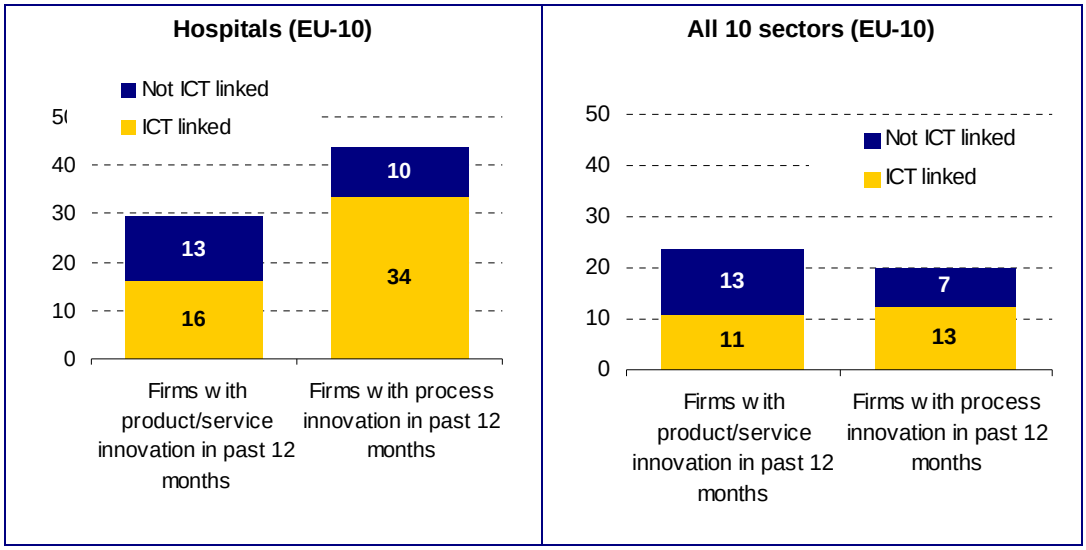
Exhibit 3-30: ICT and Innovation activity

	Firms with product or service innovation in 2005		**Share of ICT-enabled product or service innovations**		**Firms with process innovation in 2005**		**Share of ICT-enabled process innovations**	
Weighting:	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**36**	**30**	**63**	**55**	**48**	**44**	**80**	**77**
Micro/small (1-49 empl.)		29		34		28		43
Medium (50-249 empl.)		25		62		51		86
Large (250+ empl.)		38		65		49		80
All 10 sectors (EU-10)	**32**	**24**	**50**	**45**	**32**	**20**	**75**	**63**
Micro (1-9 empl.)		22		41		16		69
Small (10-49 empl.)		25		42		25		57
Medium (50-249 empl.)		33		45		38		71
Large (250+ empl.)		48		49		53		81
Base (100%)	hospitals using computers		hospitals with product or service innovation		hospitals using computers		hospitals with process innovation	
N (for sector, EU-10)	539		202		539		236	
Questionnaire reference	I1		I2		I3		I4	

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

Exhibit 3-31 illustrates the differences between the hospital sector and the all-sector average. It indicates in particular that the percentage of hospitals with ICT-linked process innovation is higher than in the other sectors surveyed.

Exhibit 3-31: The role of ICT for product and process innovation



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting: % of employment. Questionnaire reference: I1 – I4

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

3.10 Drivers and inhibitors for the uptake of e-business

About the importance of e-business drivers and barriers

A thorough understanding of the drivers and barriers of e-business in hospitals is important for all stakeholders in the field: for decision makers in hospitals, for ICT industry and for health policy makers. Hospitals need such an understanding in order to plan their investments and related managerial tasks. ICT industry needs to assess hospitals' requirements and constraints, market developments, trends and volumes in order to meet hospitals' needs. Health policy makers have to be able to assess whether there are activities necessary that benefit from particular e-business application support in hospitals. Other policy makers may perceive the hospital sector as an economic domain capable of supporting e-business growth or e-health industry expansion.

Types of e-business drivers

Possible drivers of e-business use in hospitals include potential for cost reduction, improvement of patient safety and health care quality, regulations, and requirements from business partners:

- **Cost reduction.** e-Business applications may potentially reduce the expenditures of hospitals. Such applications may improve workflows and increase process efficiency, allowing personnel to deal with more patients in a given time or treat a given number of patients with fewer personnel and fewer goods consumed. ICT applications may allow citizens and patients to be better informed, making them more aware of health issues, taking better care of their health and taking prescriptions more seriously; all of these benefits also potentially reduce care

costs. However, while costs may decrease due to ICT, there is also investment and maintenance costs of ICT. The outcome of cost-benefit analyses of ICT use in hospitals is not clear: whereas the "showcase" applications analysed in detail by the eHealth Impact study demonstrate very advantageous outcomes,[62] findings of case studies in the following chapter of this report provide a less clear picture.

- **Quality improvement.** e-Business can improve the quality of health care, e.g. by reducing medication errors caused by miscommunication between professionals,[63] and by making test results and treatment available more quickly and accessible more easily. e-Business also has the potential to involve patients more intensively in the health care process by empowering them with information about themselves, their health and the services they can expect.[64]
- **Regulation.** Regulations and reimbursement rules set by regional or national health (funding) bodies may set incentives for introducing e-business in hospitals. According to HINE, legal requirements emerge as top-ranking drivers of ICT investment in all countries.[65] The primary motivation of policy makers may be to reduce costs and improve quality of health care. For example, in some European countries, the introduction of DRGs stimulates hospitals to improve their electronic information systems in order to better understand and streamline workflow processes and to analyse the related costs in detail. Legislation promoting electronic applications in health care in general, such as the Health Care Modernisation Law in Germany that provided for the introduction of an electronic health card, set favourable framework conditions also for e-business in hospitals.[66]
- **Requirements from business partners.** It may also be that business partners such as health insurance companies require the implementation of ICT in order to streamline business processes.
- **Requirements from patients.** Theoretically, it may also be that patients demand for more intensive ICT use in hospitals in order to improve quality of care. However, in the course of research for this report no evidence of this has been found.

The following business example about *St. Josef Stift* in Sendenhorst, Germany, illustrates how governmental regulation in the form of DRGs can induce ICT investment in order to streamline workflows in hospitals.

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62 See http://www.ehealth-impact.org.

63 See more details below in section 4.2.2 about medication management.

64 See Major (2006), p. IT5.

65 See conclusions of the *e-Business W@tch* hospital activities workshop at the eHealth Conference in Malaga, 10 May 2006 at http://www.ebusiness-watch.org/events/hospital_activities.htm.

66 National legislation fostering ICT use in health will be described in country reports and factsheets in the context of the eHealth ERA project funded by the European Commission, to be soon available for download at http://www.ehealth-era.org.

Business example:

Cost-effective healthcare through Agfa's Orbis workflow system at St. Josef Stift, Germany

Agfa's Orbis information system led to more cost-effective healthcare at the St. Josef Stift in Sendenhorst, North-West Germany, a special clinic for orthopaedics and rheumatology. In Germany, a refined diagnosis-related group (DRG) system for calculating hospital reimbursement has been in effect since 1 January 2004. Germany's hospitals have to streamline their planning and control processes in order to operate effectively within this new legislative framework and also to cope with strong competitive pressure and a growing trend toward specialisation. Many hospitals and clinics, including St. Josef Stift, increased cost-effectiveness by implementing a comprehensive hospital information system and refining clinical treatment paths.

With Orbis, day-to-day procedures in St. Josef Stift have been simplified and standardised. The hospital's approach included all aspects of the medical, nursing and administrative service processes. "Clinical treatment paths are only promising when they can be integrated into the hospital information system. Day-to-day work must then be guided and facilitated by the imposed paths," says Ralf Heese, Deputy CEO at St. Josef Stift. "What is particularly important for us is that we are not creating an isolated stand-alone solution," Heese reports, and "data protection and data security are also safeguarded through the Orbis authorisation concept."

The system is flexible: users can adapt to exceptions, deviations in the path or unforeseen events and in this way avoid restricting the doctor's capacity to provide treatment. The path can be abandoned or continued at the user's choice, and process rules and plausibility checks can be applied.

Initial experience showed that the hospital's health professionals accept the treatment paths because an additional documentation burden is avoided, due to information systems integration. Furthermore, the hospital's health professionals expect that the concise and structured knowledge incorporated in the system will help to reduce the time for vocational adjustment of new employees.

Source:
http://www.agfa.com/en/he/knowledge_training/literature/customer_experiences/germany_stjosef_stift_sendenhorst.jsp. Edited by empirica.

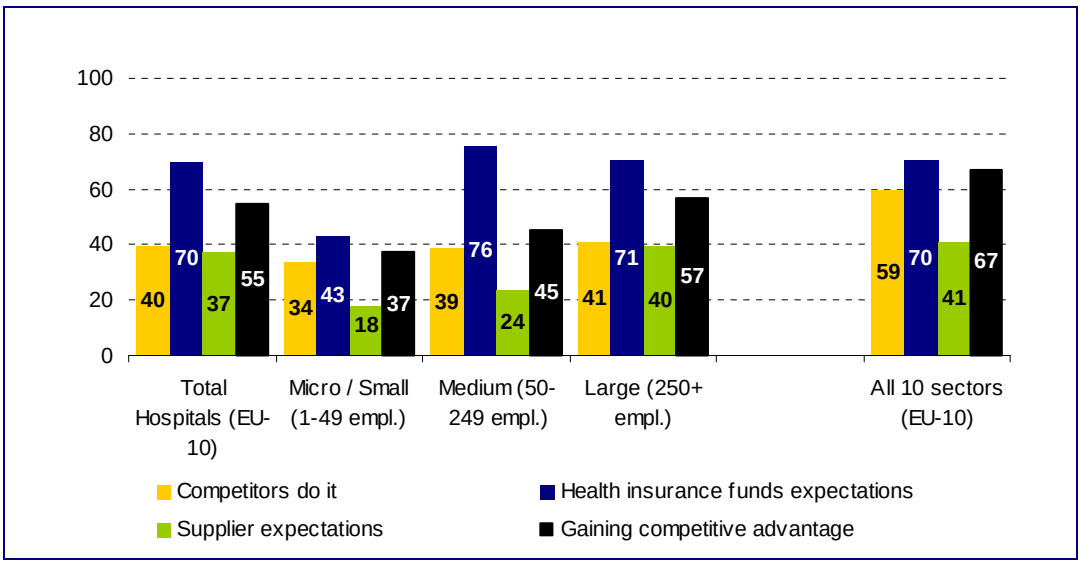
Findings from the e-Business Survey 2006

Overall findings: In the e-Business Survey 2006, hospitals were asked whether certain reasons were important for starting to use e-business. Expectations from health insurance funds appear to have been the most important driver among the items asked; 70% of the hospitals stated this – see Exhibit 3-32. For 55% of the hospitals, "*gaining competitive advantage*" was a driver and for 40% the fact that "*competitors do it*". This confirms that there is considerable competition among hospitals. Suppliers' expectations were stated as a driver by 37% of the hospitals.

Findings by sector: In the other sectors studied this year by the *e-Business W@tch*, firms were not asked about "*insurance funds expectations*" but "*customer expectations*". The all-sectors average and the level of agreement to this question in hospitals was the same (70% each). Gaining competitive advantage (67% versus 55% in hospitals) and the fact that competitors do it (59% versus 40% in hospitals) emerged as the prevailing drivers in all sectors.

Findings by size class: Expectations of health insurance funds were reported to be a much more important driver of e-business for large (71%) and medium-sized hospitals (76%) than for small ones (43%). Gaining competitive advantage was reported to be most important for large hospitals (57%), followed by medium-sized (45%) and small (37%) ones. The same sequence applied to "*supplier expectations*". The differences between size-classes were not so distinct with regard to "*competitors do it*".

Exhibit 3-32: Drivers of e-business adoption: hospitals saying that … was an important reason for starting e-business



Base (100%): Hospitals saying that e-business is a part of their operations. N (for sector, EU-10) = 372
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H2

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

Barriers to e-business adoption

There are numerous possible barriers of e-business use in hospitals, including that the technology is too expensive or too complicated, a lack of reliable ICT providers, legal issues, interoperability of systems, security concerns or that the hospital is too small. These possible barriers were included as pre-formulated questions in the e-Business Survey 2006.

A further barrier that may be specific to hospitals and that was not included in the survey may be shortcomings in ICT investment planning and implementation management. HINE found that many hospitals buy ICT as a need arises, without having a precise investment plan. Moreover, hospitals may not be able to manage effectively the complicated implementation and change processes that are implied in e-business applications. This applies particularly to large, complex hospitals with numerous departments and stakeholders with possibly diverging interests.[67] It may also apply particularly to public hospitals in which clinical directors are first of all physicians or scientists and not business executives.

Barriers to e-business adoption according to e-Business Survey 2006

Overall findings: In the e-Business Survey 2006, the hospitals were asked whether certain barriers to e-business adoption apply to them. Exhibit 3-33 shows the related findings. *Security concerns* were the most important barrier, reported by hospitals representing 59% of employment in the sector. "*Technology is too expensive*" was mentioned by an almost equally high share of hospitals (57%). The other pre-formulated barriers followed well behind: 37% for *"hospital is too small*" and "*legal issues*", 34% for "*lack of reliable ICT providers*", 30% for "*systems not compatible*". The item that was regarded as the smallest barrier was "*technology is too complicated*" (21%).

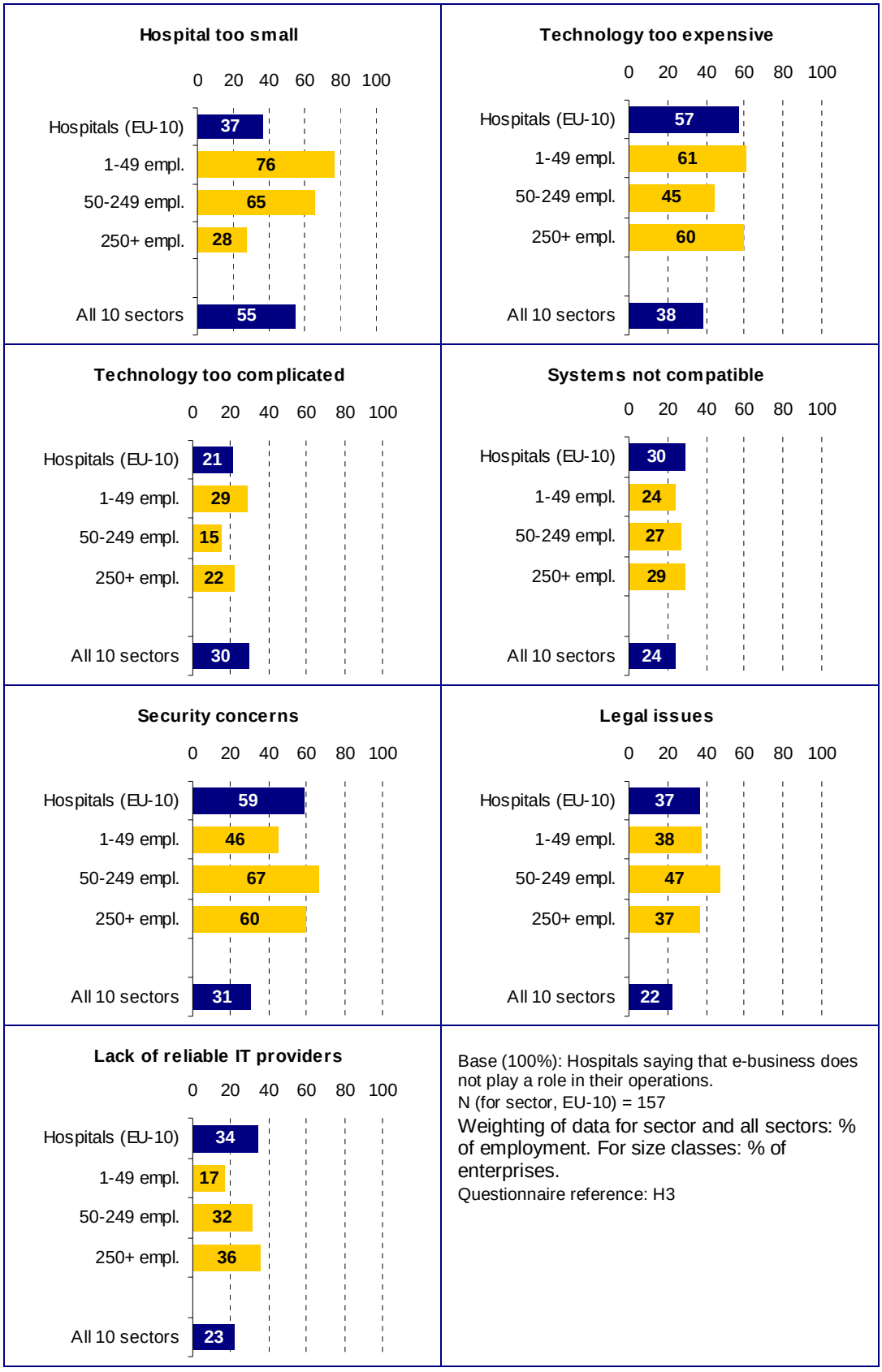
Findings by sector: Security concerns (59% versus 31% in all sectors studied this year by *e-Business W@tch*), expensive technology (57% versus 38% in all sectors) as well as legal issues (37% versus 22% in all sectors) appear to be much more important barriers than in the other sectors included in the e-Business Survey 2006. A lack of reliable ICT providers (34% versus 23% in all sectors) and incompatibility of systems (30% versus 24% in all sectors) were more important barriers in the hospital sector, too. This means that in most pre-formulated items – five out of seven –, the share of hospitals reporting a barrier was larger than in the other sectors. Only for "*hospital is too small*" (37% versus 55% in all sectors) and "*technology is too complicated*" (21% versus 30% in all sectors), the share of hospitals reporting to perceive a barrier was smaller.

Findings by size class: The assessments of barriers to e-business adoption differed in some way between the size classes. For small hospitals, the most important barrier reported was that the *"hospital is too small*" (76%); a reason that is also of particular relevance for medium-sized hospitals (65%). Even 28% of the interviewees in large hospitals said that their hospital is too small. Expensive technology was reported to be more important by large (60%) and small (61%) hospitals than by medium-sized ones (45%). Various reasons may explain the relatively high percentages for small and large hospitals (see also section 3.3): It may be that small hospitals face particular challenges in accessing investment funds, while large hospitals face substantial investment costs because they require comprehensive and complex systems.

[67] The importance of the ICT planning and management issue has been confirmed in an interview with the Chief Executive of the European Hospital and Healthcare Federation as well as in the *e-Business W@tch* hospital activities workshop at the eHealth Conference in Malaga, 10 May 2006 – see conclusions at http://www.ebusiness-watch.org/events/hospital_activities.htm.

The share of hospitals assessing complicated technology as a barrier was highest among small hospitals (29% versus 22% in large and 15% in medium-sized hospitals). A lack of systems compatibility was reported to be of almost the same importance for the three size classes. Security concerns appeared to be a more important barrier in large (60%) and medium-sized (67%) hospitals than in small ones (46%). Legal issues were reported to be a more important barrier for medium-sized hospitals (47%) than for large (37%) and small ones (38%) – a pattern that is difficult to interpret. For large hospitals, a lack of reliable ICT providers was reported to be more important for large hospitals (36%) than for medium-sized ones (32%), while small hospitals reported the lowest percentage in this respect (17%).

Exhibit 3-33: Barriers to e-business adoption as perceived by hospitals



Base (100%): Hospitals saying that e-business does not play a role in their operations.
N (for sector, EU-10) = 157
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H3

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

3.11 Summary

Overview of core e-Business Survey 2006 findings

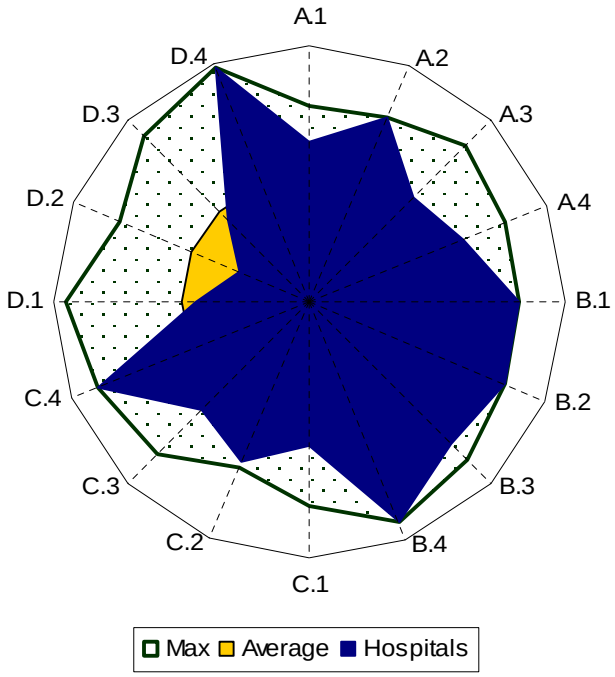
The e-Business Survey 2006 shows that hospitals in Europe are quite advanced in ICT and e-business use. The findings also show that many e-business practices, particularly with regard to customers, that is, patients, can still be improved.

- **Sector differences:** In comparison with the other nine sectors considered in the e-Business Survey 2006, hospitals were found to be quite advanced in ICT and e-business use. For example, as regards ICT networks, hospitals were above the all-sector average in internet access, broadband access and remote access. Hospitals also reported higher levels for e-procurement as well as internal and external e-collaboration. This is to some extent due to the fact that the share of medium-sized and large organisations in hospital activities is larger than in the other sectors. If only large organisations of each sector were considered, hospitals would not be in top rank. In any case, hospitals were found to be well behind other sectors in e-business solutions affecting customers, i.e. patients, directly. This applies notably to online booking of services by patients and e-marketing of services by hospitals.
- **Size class differences:** Small hospitals generally were found to lag behind large ones in ICT and e-business use. This applied, for example, for internet, broadband and remote network access as well as for internal and external e-collaboration. However, small hospitals reported higher shares of employees that have internet access. They also reported the highest levels of internet telephony use and for online service booking.
- **Drivers and barriers of e-business:** Expectations from health insurance funds were reported as the most important driver of e-business in hospitals among the items asked in the e-Business Survey 2006. The fact that "*gaining competitive advantage*" and that "*competitors do it*" were identified as important reasons by a substantial share of the surveyed hospitals confirms that there is considerable competition in this sector. *Security concerns* and *expensive technology* were the most important perceived barriers. The other barriers asked in the survey followed well behind, namely "*hospital is too small*", "*legal issues*", "*lack of reliable ICT providers*" and "*systems not compatible*".
- **Standards and interoperability**: Currently there are many standards for ICT used in the field of health. Hospitals' commitment to European and international e-health standards tends to be weak. There is a tendency for Member States to create national ICT standards for the health sector.
- **Data security**: Hospitals face a dilemma: on the one hand patient data need to be readily available; on the other hand, information needs to be protected from unauthorised use and against loss or modification. The levels of use of secure server technology and digital signature of public key infrastructure in the hospital sector were found to be twice as high as in all sectors. The level of use of a firewall was also reported to be much higher.

e-Business Index and Scoreboard 2006

The e-Business Scoreboard 2006 shows the relative position of the hospital activities sector against the other sectors considered.

e-Business Scoreboard 2006



Component indicators

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

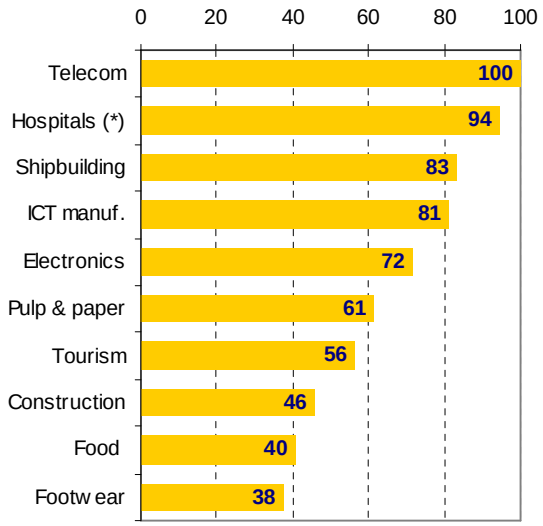
B. e-Integrated Business Processes
B.1 Intranet
B.2 ERP systems
B.3 Online tracking of production time
B.4 e-Invoicing

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

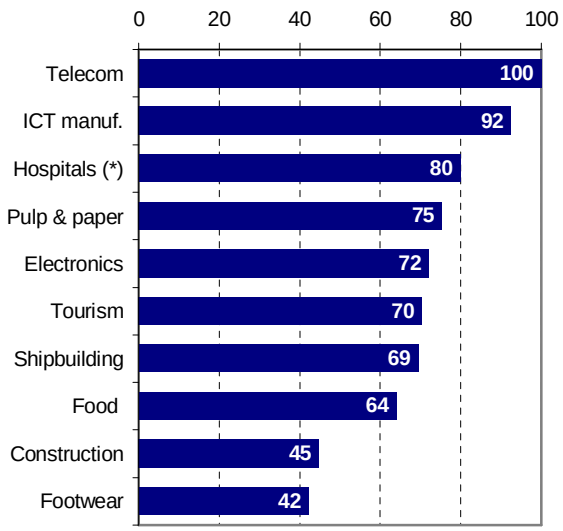
D. e-Marketing and Sales
D.1 CRM use
D.2 Firms accepting orders online
D.3 Use of ICT systems for marketing/sales
D.4 ICT system linked with customers

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

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



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



(*) Index for hospitals not fully comparable to other industries, as there are fewer micro and small organisations in this sector.

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

The scoreboard compares e-business activity in the ten sectors included in the e-Business Survey 2006 by using 16 indicators, with a set of four indicators related to each

of the following four categories: (A) ICT networks, (B) electronically integrated business processes, (C) e-sourcing and procurement, and (D) e-marketing and sales.[68] The thick outer line indicates the maximum value achieved by a sector, the yellow field indicates the all-sector average and the blue field indicates the values achieved by hospitals. The scoreboard shows that hospitals are particularly strong in electronically integrating their business processes in terms of using intranets, ERP, and e-invoicing as well as tracking production time online. They achieve the highest levels of all sectors in three of the four items in this category. Hospitals are also above average in e-sourcing and procurement as well as in ICT networks access. However, hospitals are below average in e-marketing and sales activities.

Based on the 16 indicators from the scoreboard, the e-Business Index 2006 shows a ranking of the ten sectors included in the survey. Hospitals are surpassed only be the telecommunications sector. However, the index for the hospital sector is not fully comparable to the other industries, as there are only few micro and small organisations in this sector. Thus, the apparently more intensive use of ICT is largely an artefact of the specific structure of the hospital sector. When comparing only the large enterprises and organisations, hospitals would not be within the top rank.

An alternative summary analysis: HINE levels of e-business sophistication

The Hospital Information Network Europe (HINE)[69] also offers a summary analysis of hospitals' e-business activities. While e-Business Watch compares economic sectors, HINE distinguishes four levels of e-business sophistication within the hospital sector:

- **Level 1:** implementation of an electronic patient administration system.
- **Level 2:** use of a common Master Patient Index, integration of departmental systems around a unified patient number.
- **Level 3:** ICT use for transmitting or processing clinical orders and results; use of an advanced medical library in the way that electronic patient records are linked to various functions such as archiving and managing patient data.
- **Level 4:** decision support through ICT by bringing knowledge to the point of care, e.g. through advice about drug dosage or contraindications; electronic transmission of prescriptions.

According to this classification, in 2004 almost all European hospitals had reached level 1 and close to 90% level 2. Then percentages drop significantly: around 10% of the hospitals had realised level 3 and only 2% level 4. HINE survey results indicated similar levels in US and European hospitals. However, US hospitals were far more advanced with regard to the number of workstations available per employee and use of mobile technologies such as notebooks and tablet PCs.

According to HINE, European hospitals plan to move towards fully integrated ICT systems and being externally connected as well as from one-way traffic to remote and interactive access to the hospitals' computer systems.

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

[69] See the notes on HINE in section 3.1.

4 Current e-Business Trends and Implications

4.1 Overview of topics in focus

Chapter objective

This chapter aims at providing insights into current ICT use and e-business activities which are specific to hospitals. The chapter does not claim to provide a comprehensive overview, as that would exceed the limits of this report. In fact, it would be difficult to achieve, as ICT and e-business are relevant for nearly all core business areas of a hospital. Therefore, the issues analysed, as well as the case studies presented, should rather be understood as examples of current practice and related opportunities and challenges.

These issues have been selected in coordination and agreement with DG Enterprise and Industry, and they were assessed by industry experts as particularly relevant and topical. They can be subdivided into, firstly, issues related to **Hospital Information Systems (HIS)** focussing on ICT applications inside hospitals, and, secondly, **impacts of hospitals' ICT investment** on the wider health service system. HIS were selected for discussion because they constitute the main means of e-business in hospitals. The issue of hospitals' ICT investment impacts on the wider health system is partly related to HIS. Both subjects are crucial for improving the quality and, at the same time, containing costs of health care (see Chapter 2). In contrast to the *e-Business W@tch* 2002 and 2003 studies on the health and social services sector in total, the study in this report can be more explicit and detailed about quality and cost benefits of e-business in hospitals as it focuses on this particular group of health service providers.

The subjects of HIS and wider health system impacts are related to but go beyond the issues included in the e-Business Survey 2006. Both subjects are related to the "internal and external e-integration of processes" as presented in section 3.6 above. A question about the use of certain HIS was included in the survey questionnaire. However, the survey did not go into further detail about the benefits and costs of these HIS. Such an analysis will be provided in section 4.2 for selected HIS. As regards hospitals and the wider health system, this issue was explicitly dealt with in the survey question about links between hospitals and primary care clinicians. The survey, however, did not provide further details about such relationships. In particular, it did not ask about electronic patient records which may be shared between various health care providers. Section 4.3 takes up on these issues. Some further findings from the e-Business Survey 2006 will be presented in sections 4.2 and 4.3.

Implementation and integration of Hospital Information Systems

Historically, hospitals have numerous information systems for specific functions or departments such as patient admission and discharge, material purchase, personnel, laboratory, radiology, or pharmacy. A key challenge to individual hospitals is the interoperability of these, often legacy, systems or their replacement by new and highly complex systems. Modern systems more and more cover clinical, administrative and

management aspects together. The *e-Business W@tch* 2006 is focused on the following subjects related to HIS:

- **Implementing HIS**. As an introduction, the different types of HIS and their opportunities are explained. The benefits of particular HIS are then analysed in more detail in the following sections.
- **Medication management systems**. Medication is the core means of health care. Therefore, medication systems require particular attention. The question is in what way the electronic transfer of prescriptions and medication management reduce administrative costs and allow more timely and safe medication.
- **Imaging systems**: Imaging is the most important diagnosis function in hospitals. The benefits of Picture Archiving and Communication Systems (PACS) and Radiology Information Management Systems (RIS) deserve a detailed discussion.
- **Information systems integration**. A single hospital often uses 50 to 100 stand-alone ICT systems. Their integration is a core challenge in order to improve quality of care and achieve efficiency gains. Major integration issues and barriers are analysed.

Impacts of hospitals' ICT investment on the wider health system

Hospitals' ICT investment, as analysed in section 3.3 of this report, does not only affect the hospitals themselves. As hospitals are service providers in a wider health care system, their ICT systems may support information exchange with other hospitals and with primary care facilities. ICT may support the continuity of care between different health providers, and they may change the role of hospitals within the health system:

- **ICT support of continuity of care**. ICT can support the structured communication among clinicians for improved health care provision which is currently a major issue in health system reform. The importance of continuity of care is explained and the role of electronic patient records and web-based services is discussed.
- **A possibly changing role for secondary care due to ICT.** Hospital services are provided by specialists who generally do not have the initial contact with their eventual patients. How is the role of secondary care changing or likely to change with an enlarged ICT support? Issues affecting the relationship with patients as well as the division of labour between different types of health care providers are considered because they may considerably impact on decisions about health care resource allocation by health policy makers.

Overview of case studies

Seven case studies were conducted for this report. Together with expert know-how, literature and survey findings, they support the basis for conclusions and policy implications presented in chapter 5 of this report. Each case study focuses on one of the core topics listed above but most of them also offer insights on several other subjects. Therefore, reference to the case studies is provided throughout the following sections as appropriate.

Most of these case studies represent large hospitals that have a leading position with regard to ICT use in their country. The only exception is *Ambroise Paré*, a mid-sized Belgian hospital that may provide an illustrative example particularly for smaller hospitals. All hospitals are public. Besides selecting cases supporting the subjects of this report, a balance between European regions and membership status (EU-15, New Member States, Acceding States) was sought. It was also sought to select cases in countries that were underrepresented in previous years of the *e-Business W@tch*. In this way, the report provides examples from a broad range of national contexts which may be of particular interest to e-health stakeholders at the European level. However, the experiences of the hospitals presented in the cases are not necessarily bound to certain national contexts. The hospitals may reflect developments that are prevalent in many European countries.

In addition to the seven case studies, three business examples were elaborated for this report. All case studies and business examples support the discussion in the respective chapters, as summarised in Exhibit 4-1.

Exhibit 4-1: Hospital case studies and business examples

Section	Hospital(s)	Country	Topic(s)
3.10	Business example: *St. Josef Stift*	Germany	**Cost containment** by using a computerised workflow management system
4.1	Case study: *Son Llàtzer Hospital*	Spain	Hospital Information Systems **integration** and benefits of e-business in hospitals.
4.2.1	Case study: *National Heart Hospital*	Bulgaria	Establishment of an integrated hospital information system in an **Acceding Country**
4.2.2	Business example: *Siemens Melior & Invision*	Sweden	Computerised **medication** management
4.2.2	Case study: *Chelsea and Westminster Hospital*	United Kingdom	**e-Prescribing** and medication management
4.2.3	Business example: *BC Cancer Agency*	Canada	Computerised medical **image archiving** and communication
4.2.3	Case study: *John Paul II Hospital*	Poland	**Imaging systems**: benefits and integration difficulties.
4.2.4	Case study: *CHU Ambroise Paré*	Belgium	**Integrating** separate hospital information systems
4.3.1	Case study: *Institut Curie*	France	Continuity of care supported by **Electronic Patient Records** and a medical search engine
4.3.2	Case study: *Hospital District of Helsinki and Uusimaa*	Finland	**Changing role** of hospitals due to ICT

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

The following case study is about an exemplary "electronic hospital", the *Son Llátzer Hospital* in Spain. It illustrates all main topics analysed in chapter 4 of this report. In particular, it offers insights about the benefits of HIS and their use for continuity of care in that region. It also shows in what respect the role of an "electronic" hospital may be different from a "paper-based" hospital. Since this case study will be used as a source of reference throughout chapter 4, it is presented before the analysis of the single topics.[70]

[70] See also the Good eHealth project at http://www.good-ehealth.org/index.html for further lighthouse examples.

CASE STUDY: PAPERLESS AND FILMLESS HEALTH CARE AT SON LLÀTZER HOSPITAL, SPAIN

Abstract

Son Llàtzer Hospital in Palma de Mallorca, Spain, is an example of a paperless and filmless hospital where almost all procedures are undertaken electronically. Online applications comprise all departments, professionals, processes and tasks. The hardware is rented, offering the opportunity of cost-effective replacement. The medical workstation is the core unit of the system architecture, allowing the health professionals to access the clinical history of a patient as well as related clinical and administrative data. Patient data can also be processed through wireless portable tablet computers and Personal Digital Assistants (PDAs). The complete computerisation has proved to be cost-effective – particularly with regard to the integration of other health service providers. However, the hospital's chief information officer (CIO) believes that the most important benefits in a fully electronic hospital are for quality of care rather than cost-effectiveness.

Case study fact sheet

Full name of the hospital:	*Son Llàtzer Hospital*
Location:	*Palma de Mallorca, Spain*
Main business activity:	*General acute care hospital*
Year of foundation:	*December 2001*
Number of beds:	*360*
Number of employees:	*1,500, of which 220 physicians*
Income in last financial year:	*Not available*
Area from which patients are drawn:	*Mainly South-West Mallorca*
Focus of case study:	*Ubiquitous electronic applications*
Key words:	*Paperless and filmless hospital*

Background and objectives

Son Llàtzer Hospital is a public hospital located in the East of Palma de Mallorca on the Ballearic isle of Mallorca, Spain.[71] It is managed as a foundation in order to allow it to proceed more autonomously than a state-owned entity. The legal form of a foundation allows flexibility in personnel management, purchasing facilities and developing projects. The hospital was constructed with funds from the Spanish government and inaugurated in December 2001. Today the hospital covers a population of around 250,000 people in the South-West of Mallorca, providing 360 beds and having 1,500 employees, 220 of them physicians. The hospital follows three main conceptual lines: clinical area directors are included in the management, orientation towards ambulatory processes, and automation of all clinical and administrative processes.

The hospital is equipped with recent generation ICT and a Hospital Information System that embraces all departments, professionals, processes and tasks. It is seeking workflow optimisation, fast access to information and decision support. Almost all processes in the

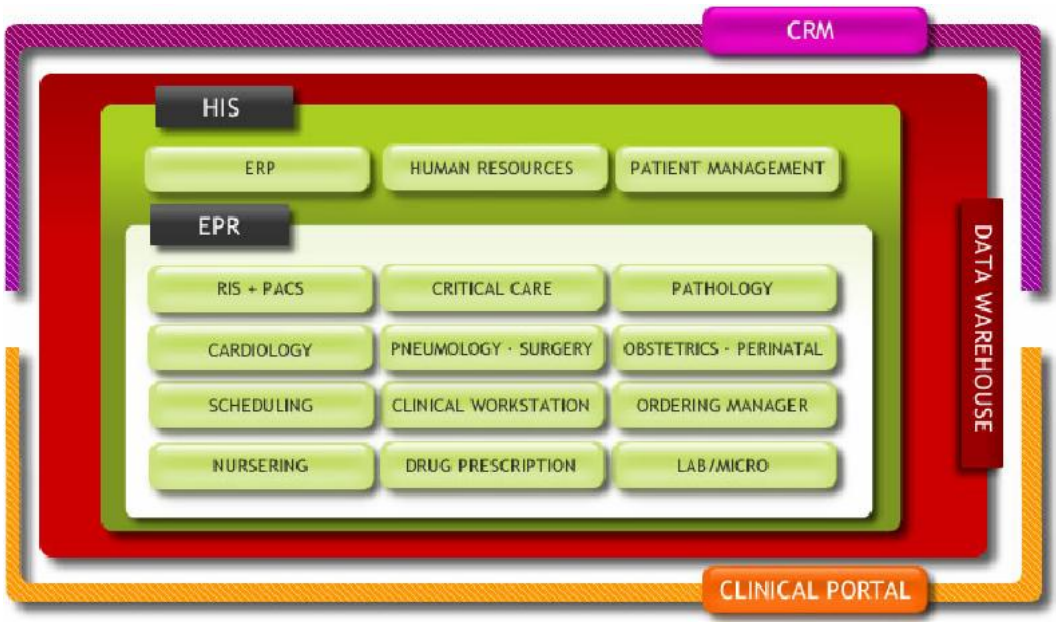
[71] "Son Llàtzer" is the name of the area where the hospital is located.

hospital are automated. The aim of Son Llàtzer is to be a paperless, filmless and to some extent even wireless hospital. As professionals in the hospital are mobile, it needs to be ensured that the professionals have access to the data they need wherever they are in the hospital. There is no other way to work in Son Llàtzer Hospital other than by logging into the electronic applications. No paper notes are made.

e-Business activities

Infrastructure

The information system of Son Llàtzer hospital comprises numerous modules, as shown in Exhibit 1.



Source: Son Llàtzer Hospital, Video Presentation
(Technology Project / Keys / Globalisation / Information System)

The Electronic Patient Record (EPR) includes data from all relevant departments and functions such as cardiology, radiology, drug prescriptions and scheduling administration. The Hospital Information System includes all the capabilities covered by the EPR plus an Enterprise Resource Management System, a Human Resource System and a Patient Management System. The combined data of the EPR and the HIS constitute the data warehouse. Overarching functions are the clinical portal and a Customer Relationship Management (CRM) system.

Information system integration

Son Llàtzer Hospital's chief information officer (CIO) considers the integration of the different systems as a separate, core project. The personnel in charge does not only need to have expertise about the technology but also about hospital workflows. The key is an integration tool, a software product called Enterprise Application Interface. Son Llàtzer Hospital had it created by a separate company, not by one of the system providers, in order to prevent conflicts of interest and ensure that the integration software really integrates all components. The hospital's CIO explains that systems integration is

an ongoing challenge because the workflow may change every day. An important characteristic of systems integration is that the applications communicate through standards: Health Level 7 (HL7), DICOM, and Integrating the Healthcare Enterprise (IHE). Using a DICOM converter developed by the hospital, any image generated by other units and from any device is converted to DICOM and stored in the Picture Archiving and Communication System (PACS).

Technical equipment and budget

Son Llàtzer uses recent generation technology, including 700 Personal Computers (PCs) that are installed inside the hospital as well as 298 printers, 10 scanners, 40 PDAs and 15 portable tablet PCs. The bulk of the hardware is from Hewlett-Packard (HP); it is rented which offers the opportunity of cost-effective replacement. Most of the hardware is updated every three years. The network has been implemented by Cisco and includes a fibre optics backbone and a Virtual Local Area Network (VLAN). The architecture is open for different kinds of devices. Support is offered by four technical professionals and coordinators, 14 application support, administration and help-desk professionals on site as well as by a round-the-clock remote service. 80% of the ICT budget is spent on outsourced ICT services. The hospital started with an ICT budget of 5% of the overall budget; currently, after major investments have been achieved, this share is at 3%. According to Son Llàtzer hospitals CIO, the average in Spain is around 1%.

The core unit of the system architecture is the medical workstation. From these stations, the health professionals can access the clinical history of a patient as well as related clinical and administrative data from a customised portal.

Security

Security against data loss is ensured by centralised backup of data. However, like any company relying on an ICT system, the hospital would stop if there was a system breakdown. There is a contingency plan for that case, recurring to making paper notes, but no previous medical records on paper would be available. The CIO argues that one should not only be anxious about ICT security but also about serious medical errors that could be prevented by more use of ICT. "*There is a risk – but there is more to win*", he says. In order to prevent unauthorised access to data, a sophisticated security system and encryption means is in force, including the following features:

1) Individual user profile for privileges and authorisations (depending on the profile, the user can either see, edit, delete, change or programme).

2) Identification code (ID) plus password to log-in.

3) Periodic change of ID plus code.

4) Automatic log-out after a period of inactivity.

5) Continuous tracing of users when they access the data, which can be easily checked: by clicking an icon, one can consult the last users who interacted with the patient.

6) Text data encrypting when exceptional security is needed.

A firewall is also implemented to ensure security. Both technical and functional levels have been carefully studied to avoid security gaps.

Innovative solutions and projects

The hospital offers various innovative solutions, including a platform for SMS messages to mobile phones, a data warehouse, e-mobility applications, and attendance continuity by primary care providers:

- The **mobile platform** offers a contact and information interchange system through SMS messages. Three SMS initiatives are underway: state of the hospital (e.g. beds occupation), clinical orders and results (e.g. information to a physician that a an order for a certain treatment of a patient has been carried out and that the results can be viewed in the HIS), as well as an appointment-reminding system for patients. The daily average of SMS sent is around 820.
- The **data warehouse** offers the opportunity to retrieve clinical and management data immediately. The contents of the data warehouse are huge: between April 2003 and April 2004, more than 810,000 electronic medical reports were written, and between December 2001 and April 2004 more than 3 million images were stored in the hospitals Picture Archiving System.
- **e-Mobility** applications include portable tablet PCs that are of particular use in the outpatient department, tablet PDAs offering access to the Electronic Patient Records (EPRs) from any point in the hospital, and wireless medical devices, for example for ECGs. A study prior to the introduction of the mobile system and a selection of appropriate devices ensured that there is no interference either with the hospital's telephone system or with medical equipment. Son Llàtzer Hospital also conducts a home care project visiting patients at home after surgery. Two physicians and five nurses included in this project can use their tablet PCs and any function available at the hospital at the patient's home, too.
- **Attendance continuity** ensures the integration of primary care providers in the health care process. All 35 primary care centres in the region are connected to the hospital. They can access Son Llàtzer's information system and check administrative patient data, waiting lists and pending data and EPR documents such as hospital discharge reports, radiology reports and images, laboratory results, and ECGs. They can also retrieve discharge reports, radiology information and laboratory results. The average number of accesses to Son Llàtzer EPRs by primary care professionals is around 50 per day.
- **e-Health services for patients** include interactive health information retrieval, interactive health administration (e.g. appointment booking with confirmation), and passive health administration information (e.g. directions to and opening hours of clinics). Web technology is planned to be refined. Currently parents can use the hospital's website to send a picture of their newly born child to friends.

Exporting the Son Llàtzer model

Son Llàtzer Hospital is an island of full computerisation within an ocean of non-electronic applications, outdated solutions, and other, smaller islands of computerisation in other parts of Mallorca. Son Llàtzer is trying to export its model into the region. According to the CIO, one of the regional projects is the definition and implementation of an electronic

patient summary. It is meant to be stored on a small file that can be carried by any citizen so that core patient data are available, e.g. in the event of an emergency.

Impacts

Increased effectiveness

After two years of implementation, the hospital started to evaluate the return on investment in internal studies and surveys. They led to basic conclusions in terms of quality healthcare assistance, efficiency, and material savings. For example, sending orders and results electronically takes seconds whereas it would take much more time to deliver them on paper. Films not produced save money; foreign patients can have the images on a Compact Disc if required. Concrete, measurable savings include the following:

- The function of reminding patients about appointments by SMS has significantly reduced the share of patients not showing up at fixed appointments; from 18 to 11%. This enabled the hospital to have 12,000 appointments more per year.
- The average stay at the hospital is one day less than the national average. According to Son Llàtzer Hospital, this allows it to treat 2,500 patients more per year and thus provides better quality of life to patients.
- The ratio of administrative personnel and physicians is 10% less than the Spanish national average.

The hospital observed that projects related to external healthcare institutions with the hospital platform and information system bring a quick return on investment. ICT made communication with General Practitioners and other hospitals more frequent, more intense and faster. According to the hospital's CIO, 20% of outpatient visits in "paper hospitals" would be unnecessary if the "paper hospital" had electronic access to prior diagnosis and tests done at other service providers.

All in all the hospital's CIO does not believe that a fully electronic hospital necessarily runs with lower costs than other hospitals because ICT is expensive. However, he assumes that cost reduction can be achieved within the network of health providers in a region. For example, he suggests that two hospitals could share resources, e.g. a laboratory, if test results were sent immediately through electronic networks. The cost effects of such external e-communication are under consideration by the Healthcare Department of the Balearic Regional Government. It is developing the regional Healthcare ICT strategy based on the Son Llàtzer experience and platform to build other healthcare organisations' information systems.

Increased quality of health care provision

The hospital's CIO thinks that the real benefits of ICT are on the side of service provision to patients. Patients confirm this opinion. They were asked about their opinion about Son Llàtzer being an "electronic hospital". Their assessments were generally positive, as the following Exhibit 3 shows. For example, 70% of all ambulatory patients answered "yes" when they were asked whether the Son Llàtzer EPRs improve health services.

The CIO said that ubiquitous computer use may also interfere with personal consultations between physicians and patients. In order to maintain a personal relationship between patient and physician, there is, e.g. no computer module for notifying patients about important issues such as a necessary operation.

Exhibit 2: Patients' assessment of electronic applications at Son Llàtzer Hospital

Question	Patients replying "yes" in % of all patients		
	Ambulatory patients	Replies by SMS	Replies through hospital website
Do you believe that the Son Llàtzer EPRs improve health services?	70	90	94
Would you like to participate in telemedicine programmes based on internet and mobile phone?	52	79	70
Would you like to access your Electronic Patient Record through the internet or mobile phone?	69	92	94

Source: Son Llàtzer Hospital, video presentation at http://www.hsll.es/docs/eng.zip

Technology acceptance and job satisfaction

The comprehensive ICT use at Son Llàtzer Hospital is widely accepted among the personnel, as demonstrated by internal surveys:

- Physician satisfaction: After two years of working with the EPR and automated processes, 91% of the physicians would not want to switch back to paper-based systems.[72]
- CPOE acceptance: 84% of the physicians consider the CPOE system as optimising clinical processes in general.[73]

According to the CIO the equipment with top-end ICT makes Son Llàtzer Hospital a very attractive work place and attracts highly qualified and highly motivated young professionals.

Lessons learned

The two lessons from the Son Llàtzer Hospital are that it is possible to conduct hospital health services that are almost completely computerised and that such a practice can have positive impacts on regional costs of healthcare, health service quality and job satisfaction. Based on its experiences, the hospital offers the following core conclusions and recommendations:

- **Seeking support from all stakeholders.** When deciding to implement such a solution, all target stakeholders – managers, hospital professionals, service partners – have to support the project. The solution has to be clinically-oriented, not manager-oriented. Otherwise the physicians and nurses will not collaborate.

[72] Survey from 10 to 17 March 2004, total number of 129 responses.

[73] Survey from 22 December 2004 to 12 January 2005 with 157 responses.

- **Integration and automation.** Integration is key to workflow optimisation. The most important impact factor is to automate orders and results.
- **Difficulties occurring in established hospitals.** It is difficult to implement a fully computerised system in an established hospital. Building new hospitals or renovations of older buildings provide opportunities to achieve a change towards e-business. If a hospital does not have the funds for a comprehensive solution with many different systems, it should focus on one system – e.g. for medical images – that is implemented hospital-wide.
- **Difficulty of evaluation.** The efficiency of the model is quite complicated to evaluate, since output indicators are based on improving health care quality. The system is expensive to start up and to maintain. It requires strong technical support.

References

Research for this case study was conducted by Stefan Lilischkis, empirica, on behalf of e-Business W@tch. Sources and references used:

- *Interview with Miguel Cabrer, IT Co-ordinator (Chief Information Officer), Balearic Regional Health Services, 25 April 2006.*
- *Hospital website, http://www.hsll.es.*
- *Hospital video presentation, available at http://www.hsll.es/docs/eng.zip.*
- *eEurope 2004 awards application paper of Son Llàtzer Hospital (internal).*

4.2 Implementing and integrating Hospital Information Systems

4.2.1. Implementing information systems in hospitals

Types of information systems

A Hospital Information System (HIS) can be defined as an "integrated, computer-assisted system designed to store, manipulate and retrieve information concerned with the administrative and clinical aspects of providing services within the hospital".[74] HIS are the core means of e-business in hospitals and thus indispensable for an analysis of e-business in this sector. There are numerous different systems hospitals can put in place which can be subdivided into systems for patient and financial administration, medical records, order communication, departmental systems, clinical infrastructure, knowledge support, procurement-related systems and marketing-related systems. Exhibit 4-2 presents an overview of HIS types and a brief description of their functions.

[74] Definition by CEN/TC 252, a European e-health standardisation organisation; see http://www.centc251.org/Ginfo/Glossary/tcglosh.htm.

Exhibit 4-2: Overview of common types of departmental Hospital Information Systems

Category / Function	Description
Administration and management	
Patient administration	Systems for patient admissions, discharges and transfers.
Hospital resource scheduling	Systems for scheduling of critical resources or facilities, e.g. outpatient appointments, operating theatre times, and beds.
Finance and reporting, management	Systems for collection and coding of information for financial and reporting purposes, and for controlling and planning.
Medical records	
Medical document management / Electronic patient record	Systems for archiving and retrieving medical documents from patients, including, e.g. diagnosis, care episodes, test results, and discharge letters.
Orders	
Clinical service order placement	Systems for placing orders for, e.g. laboratory, radiology or operating theatre; possibly automated feedback of results or booking confirmations.
Systems for specific medical departments	
Radiology Information Management Systems (RIS)	Systems for documentation and administration of radiology-related medical and administrative data; interface to PACS.
Picture Archiving and Communication Systems (PACS)	A system for archiving and transmitting medical pictures such as X-rays, Computer Tomography images, or ultrasound pictures.
Laboratory Information (Management) Systems (LIS, LIMS)	Systems that handle receiving, processing, storing and transmitting information generated by laboratory processes.
Pharmacy department management systems	System that handles pharmacy functions.
Computer-based Physician Order Entry systems (CPOE)	e-prescribing systems for prescriptions within the hospital with integrated logistics and sometimes decision support.
e-prescribing	e-prescribing systems for transmission of prescriptions to outside organisations.
Clinical infrastructure	
Clinical data warehouse	System overarching various departmental IS, allowing analysis of clinical and administrative data from different departments.
Digital dictation and transcription	Systems for automated digital dictation and transcription for reporting and distribution of results.
Knowledge management	
Knowledge Management (KM)	Systems for hospital-wide use of electronic formularies, guidelines, minutes, clinical pathways or clinical/medical decision support.
Procurement-related systems	
Electronic Resource Planning (ERP)	Software that helps to integrate all major business activities, including product planning, parts purchasing, inventory management, order tracking, human resources and finance.
Supply Chain Management (SCM)	Software that helps businesses to match supply and demand through integrated and collaborative planning tools.
Marketing-related systems	
Customer Relationship Management (CRM)	Systems for managing customer-related (i.e. patient-related) activities for attracting and retaining customers; using ICT for customer data processing, marketing, sales and services.

Sources: empirica, *e-Business W@tch*, HINE

Current situation of HIS prevalence in Europe

Overall findings: There are only few hospitals in Europe that do not at least have an electronic system for patient admission, discharges and transfer.[75] 83% of all hospitals and hospitals representing 90% of employees have a Patient Administration System. These findings conform with Hospital Information Network Europe (HINE) results. According to *e-Business W@tch* and HINE, advanced clinical support systems are not yet widely available.[76] Radiology Information Systems are in use in 27% of the hospitals (hospitals representing 45% of employment) and 25% of the hospitals (32% weighted by employment) are equipped with a PACS. Since RIS have been available since around 1995 and PACS are a more recent product, sold since around 2001, the figures for PACS appear to be quite high.[77] 42% (67% weighted by employment) have a pharmacy management system.

As regards electronic medication management, the e-Business Survey 2006 found that in 12% of the hospitals (21% weighted by employment) prescriptions are transferred electronically and 19% (29% weighted by employment) have a Computerised Physician Order Entry (CPOE) system. CPOE is a term introduced in the US and may not yet be common in Europe. Some interviewees in the e-Business Survey 2006 probably considered rather simple medication documentation in computers as e-prescribing or CPOE.[78] This may explain why the figures for CPOE use found in the e-Business Survey 2006 are exceptionally high. Recent surveys in the US showed that only around 2% of healthcare providers use a comprehensive CPOE system.[79] HINE estimates that the percentage of CPOE use is quite similar in European hospitals with more than 100 beds. This implies that the benefits of such a system are available to a small minority of hospitals.

Findings by size-class: The use of hospital information systems increases by size class for any single system. The percentages for small and medium-sized hospitals are similar for electronic transmission of prescriptions and CPOE.

[75] See HINE results above in chapter 3.2.1.

[76] See chapter 3 for other findings about ICT implementation in European hospitals. See also the conclusions of the *e-Business W@tch* hospital workshop at the High Level eHealth Conference in Malaga, 10 May 2006 at http://www.ebusiness-watch.org/events/hospital_activities.htm.

[77] Assessment from Véronique Lessens, member of the e-Business W@tch Advisory Board.

[78] Véronique Lessens, member of the *e-Business W@tch* Advisory Board, considers 19% CPOE use as realistic for non-intelligent prescribing systems in Europe.

[79] See Baldauf-Sobez (2003), p. 3.

Exhibit 4-3: Use of departmental information systems

	Patient Administration system		Radiology Information Systems (RIS)		Picture Archiving Systems (PACS) and medical image transmission	
Weighting:	% of empl.	% of hospitals	% of empl.	% of hospitals	% of empl.	% of hospitals
Hospitals (EU-10)	**90**	**83**	**45**	**27**	**32**	**25**
Small (1-49 empl.)		66		16		20
Medium (50-249 empl.)		89		22		24
Large (250+ empl.)		92		50		34
All 10 sectors (EU-10)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539	
Questionnaire reference	D2a		D2b		D2c	

	Pharmacy management system		Electronic transmission of prescriptions		Computerised Physician Order Entry (CPOE)	
Weighting:	% of empl.	% of hospitals	% of empl.	% of hospitals	% of empl.	% of hospitals
Hospitals (EU-10)	**67**	**42**	**21**	**12**	**29**	**19**
Small (1-49 empl.)		23		9		14
Medium (50-249 empl.)		39		9		15
Large (250+ empl.)		72		24		31
All 10 sectors (EU-10)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539	
Questionnaire reference	D2d		D2e		D2f	

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

Benefits and disadvantages of departmental information systems

HIS can serve various objectives that are very basic for hospitals. The word “can” is to be stressed because there may also be downsides to HIS use which are also outlined here:

- In **cost reduction** terms, HIS can help to cope with the huge amount of data a hospital and its staff have to deal with. HIS can make processes more efficient, thereby enabling the treatment of more patients in the same period of time, or with less personnel, and thus save costs. HIS also help to reduce medical errors. This is important to avoid high expenditures for litigation and professionals’ insurance. However, HIS require significant investment costs, related to initial purchase, maintenance, staff training, and exchange.
- As regards **quality of care**, HIS can enhance communication, bring useful knowledge and help to make medical decisions, reduce medical errors, and improve the continuity of care. From a knowledge management point of view, the amount of medical and scientific information has increased starkly in previous

years, making it very difficult for a health professional to keep up to date. As regards security, HIS enables tracking and tracing of who is doing what, and therefore contributes to risk management in hospitals. However, both personnel and technology may fail.[80] Furthermore, HIS are managed by human beings so that the possibility of medical errors cannot be eliminated by HIS. There may also be downsides of disturbing or replacing personal communication between doctors and patients by technical procedures because the "human touch" may be important for healing success.

- **Job satisfaction** may also increase due to HIS. While job satisfaction is a very complex construct that is difficult to measure, quick and comprehensive access to data allowing faster and better decisions as well as improved health care are likely to increase job satisfaction of health professionals. This assessment is supported by the experiences in the *Son Llàtzer Hospital* (see section 4.1) and the *National Heart Hospital* (see the following case study).

Case study findings

All case studies presented in this report demonstrate various benefits of HIS. In the following case study about the *National Heart Hospital* in Sofia, Bulgaria, HIS implementation is at the core of the analysis. It demonstrates the benefits of HIS implementation and offers some lessons for successful implementation and integration of different systems.

[80] See the example of CPOE in section 4.2.2 about e-prescribing and medication management.

CASE STUDY: AN INTEGRATED HIS AT THE NATIONAL HEART HOSPITAL, BULGARIA

ABSTRACT

The National Heart Hospital (NHH) in Sofia is the largest hospital in Bulgaria specialised in cardiology care. It is the only Bulgarian cardiology hospital that implemented and integrated comprehensive hospital information systems (HIS), including medical and administrative ICT applications. The main impacts of HIS integration were improved quality of patient care, improved inventory management and logistics, as well as improved job satisfaction of healthcare personnel. Costs were also reduced in many respects but there is no analysis yet stating whether the benefits of IT outweigh the costs. The main success factors of implementing the HIS were high motivation and involvement of the hospital management and staff, as well as co-ordination among the HIS developers. The NHH's integrated HIS may be considered as a good practice that could be taken over by other hospitals in the country and in the region.

Case study fact sheet

Full name of the hospital:	*National Heart Hospital*
Location:	*Sofia, Bulgaria*
Main business activity:	*Specialised hospital for cardiology and vascular surgery as well as paediatric cardiology*
Year of foundation:	*1962*
Number of beds:	*331*
Number of employees:	*920*
Income in last financial year:	*40 million BGN (20 million euro)*
Area from which patients are drawn:	*Throughout Bulgaria*
Focus of case study:	*Hospital Information Systems*
Key words:	*Benefits of medical and administrative ICT applications*

Background and objectives

The National Heart Hospital (NHH) was established in 1962; since 2000 it is acting as a national heart hospital. Providing 331 beds and employing 920 people, it is the biggest hospital in Bulgaria specialized in cardiology and the only one specialized in paediatric cardiac surgery. It also acts as a university hospital. Patients are drawn from the whole country. The hospital has 30 organisational units and two pharmacies – one for medicine and one for consumables – as well as a rehabilitation centre in a small town near Sofia. The main departments for adults include cardiology and emergency, heart surgery, vascular surgery, neurology, chemodialysis. For children there are departments of paediatric and intensive care, paediatric cardiology and post-surgery intensive care. The mission of the hospital is to develop cardiology science and practice as well as to train medical personnel.

Competition among the hospitals in Bulgaria is limited – the majority is still state owned. There is another hospital that provides cardiology care and surgery but for adults only. Other hospitals' cardiology services are more general.

e-Business activities

Electronic business is not yet widely implemented in Bulgarian hospitals. Hospitals commonly have only a few medical ICT applications with limited functions. Most hospital ICT systems are used for administrative purposes. According to the most recent healthcare strategy of April 2006,[81] the Bulgarian government seeks to implement e-health applications including HIS more widely in the next years.[82]

The NHH is a pioneer and leader in e-business in Bulgarian hospitals. The first ICT applications were introduced ten years ago but the active development of the hospital information infrastructure and systems began in 2003. The driving forces behind ICT implementation in the NHH were the high motivation of the hospital management and the personal involvement of the former hospital director, Assistant Professor Dr. Vladimir Pilossoff.

The main objectives of HIS implementation were to improve patient services, to establish an effective management system optimising resource use, and to upgrade the hospital information infrastructure. Today, e-business applications in the NHH support the following processes: patient admission, registration, primary care, hospitalisation and discharge, clinical pathways allocation, purchase and distribution of drugs and consumables, costs calculation, accounting and reporting, procurement management, personnel management, laboratories investigation, as well as general management and administration.

The Hospital Information System

HIS components

The overall system. The HIS is implemented as a three-tier client-server architecture. The infrastructure consists of 250 Personal Computers and ten servers connected to an intranet.[83] The main characteristics of the NHH's information system are the following:

- **Comprehensiveness.** The HIS supports the activities of all hospital units. It is designed for direct use by all hospital staff members, i.e. management, physicians, nurses, medical secretaries. Everyone may use the system directly with access to particular HIS functions and data. The system also provides full reporting capabilities for external entities such as the Ministry of Health and the National Health Insurance Fund.

[81] The strategy is currently under discussion with the National Council of Bulgarian Medical Association and patient organisations, see http://www.sofiaecho.com/article/bulgarias-health-ministry-approves-new-strategy/id_14711/catid_66.

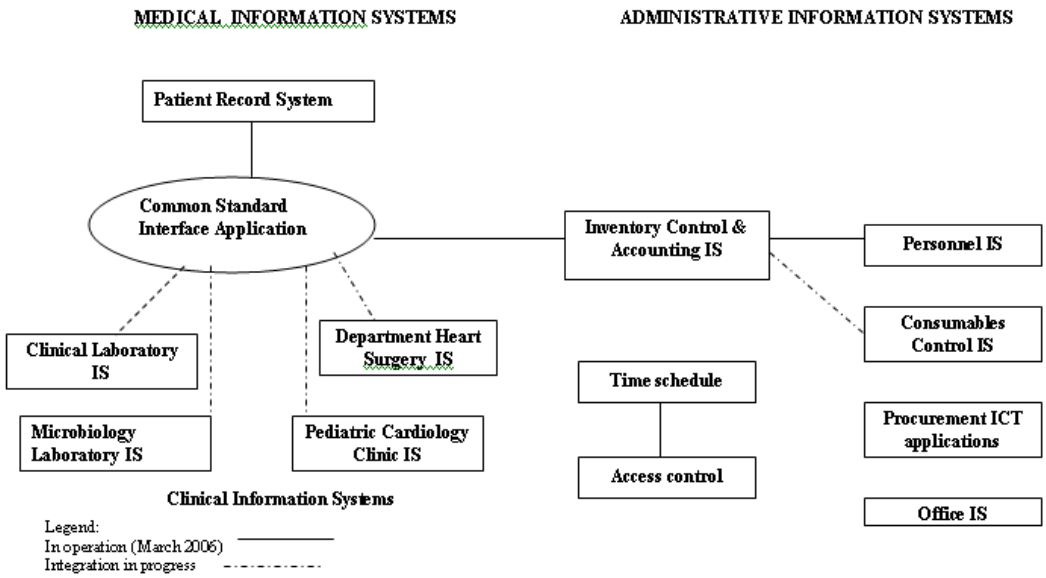
[82] See also the Bulgarian e-health strategy in Republic of Bulgaria (2005).

[83] Main software platforms are Windows 2000 Professional and Windows XP, Microsoft SQL, Microsoft Visual Basic Net, Oracle, Interbase. All application software is developed by Bulgarian ICT companies such as GAMA SOFIA (HIS), Bonev & Co (Inventory Control and Accounting IS), and Acsior (Office IS).

- **Patient-orientation.** The system includes an electronic medical record of each patient. Patient data in chronological order can easily be accessed. Patient flow in the hospital can be controlled.
- **Openness.** The HIS has a modular structure and is open for modifications and new applications.
- **Compliance with standards.** The system was developed according to the requirements of the ISO 9001:2000 standard. It supports the ICD-10 standard for medical diagnosis and includes technology for full integration with another systems based on XML standard.[84]
- **Security.** The system ensures data security and access control.

The overall HIS can be subdivided into a medical information system and an administrative information system, consisting of a number of elements that are depicted in Exhibit 1.

Exhibit 1: Information systems at the National Heart Hospital



Source: B. Dobrev on behalf of empirica 2006. IS = information system.

The medical information systems include the following:

- **Patient record system.** In this system, the NHH professionals create and maintain an electronic record for each patient. The database includes information about all the medical services a patient obtained during his or her stay at the hospital, including an individual cost calculation for each patient and for each hospital activity related to the patient. It automatically produces reports to external organisations such as private and public health insurance. Depending on the patients' situations, the professionals allocate clinical pathways to them. Today the HIS contains data about 45,000 patients..

[84] See chapter 3.4 on standards and interoperability.

- **Clinical Information Systems.** The integration of four clinical information systems into the overall system is in progress: an information system in the clinic for paediatric cardiology and surgery that has been in operation for five years, a Clinical Laboratory Information System that has been in operation for three years, an information system in the Heart Surgery Clinic, and a Microbiology Laboratory Information System.

The NHH's administrative information systems include the following:

- **Inventory Control and Accounting Information System.** This system performs all accounting operations in the hospital and transfers the data to the HIS. It provides data for the individual cost of each patient and each hospital unit as well as cost of medical healthcare per diagnosis. In particular, the accounting system provides information about input and output of the two pharmacies.
- **Consumables Control Information System.** The integration of this system into the inventory control and accounting system is in progress. It will control the usage of consumables in all hospital departments and link the pharmacy with several temporary stores.
- **Personnel Information System.** It supports all personnel management activities and produces the payroll.
- **Office Information System.** As a standalone system it supports administrative processes and controls the carrying out of decisions in all hospital departments.
- **Procurement ICT Applications.** Electronic tenders for drugs and consumables have been in operation for four years. They support request specifications for tenders as well as the evaluation and ranking of the vendors' proposals.
- **Time Schedule and Work Time Control.** This system produces and optimises the time schedule for the medical staff and supports the control of employees' work time.
- **Access Control.** It supports the activities related to control of employees' access to the hospital and related to their work time.
- **Internet Applications.** All professionals in the hospital have Internet access. An Internet Access Administration System controls the Internet usage. At present the Internet is used for checking the health insurance status of each patient at the National Insurance Institute, for information exchange with the health insurance fund, and for submitting tax declarations to the tax authorities. Applications such as Internet based e-procurement, patient application registration and e-payment are planned.

The HIS today and planned activities

All of the information systems and ICT applications presented above are in operation. The patient record system and the Inventory Control and Accounting Information System are fully integrated, the latter is integrated with the Personnel Information System. The integration of the other systems and ICT applications is in progress.

Planned activities include the implementation of new modules and functions to the HIS: In 2006, the information systems of the Heart Surgery Clinic and the Clinical Laboratory will

be integrated with the HIS, the rehabilitation centre will be linked to the HIS, and the Consumables Control Information System will be upgraded with medicines control features. In 2007, the Consumables Control Information System will be integrated into the Inventory and Accounting Information System. Information systems of other clinics will be linked to the HIS in 2007 and 2008.

Standards and Interoperability

Interoperability is achieved through the usage of a special interface application, the common standard for medical data exchange developed by the Gama Sofia company[85] that is based on XML and supports various software platforms such as Windows 2000, Oracle, and SQL. The common standard architecture is a Service Oriented Architecture and includes web services features as well a standardised interface. The links between the various information systems and ICT applications in the hospital are based on this common standard. The links describe the information objects and their presentation by using specific software components, namely adapters. The adapters translate the specific data of the information system into structures harmonised with the common standard in XML by reading and vice versa – translate the XML data structures in specific SQL instructions and commands by writing. According to the company that provided the integration application, the HIS can be further integrated with any other information system in any hospital and in any country if need be.

Security

Security of the HIS is achieved through organisational measures and common software solutions. There is no special software security tool in place. The NHH has a data security master plan determining, for instance, the creation of a weekly backup of the data base. The backup is produced in two copies, one of them stored outside the hospital. All legal requirements regarding the Bulgarian Data Protection Law are respected. The software tools used for ensuring data security are based on the open standard. Compulsory passwords for system access are in use and changed monthly by the system administrator. The Internet server is equipped with firewalls.

Impacts

Improved quality of patient care

The HIS improved the quality of health service in the NHH significantly. Since the HIS provides an easy, fast and 24-hour access to patient records, physicians receive all the necessary information in seconds, allowing them to treat the patient without delay. The daily information about any medical service provided to the patient enables the management to detect mistakes and to respond immediately. One of the main benefits of the HIS was enhanced routine in care provision. The discipline of the employees improved due to the permanent control based on the information about what was done, when it was done and by whom. Patients know that all medical services provided to them are entered in their record and supervised, which increases their trust and comfort.

[85] See the company's website at http://www.gama-sofia.bg/.

Furthermore, the HIS provides new opportunities to develop and implement standards for medical care according to the type of diseases and to forecast the expected demand for medical services, allowing to appropriately plan the efficient use of materials, staff and facilities.

Costs reduced in some respect – but no cost-benefit analysis yet

The HIS reduces costs in various ways. Since the HIS includes instruments for patient-flow control, planning for medical check-up, admission, operation and the like, workflows are streamlined and the time needed for patient service is reduced. Due to the fast access to the patient record with full medical information, many unnecessary tests and procedures are avoided. More patients can be treated in a given period of time. The costs for the patient stay in the hospital are reduced by 10 – 15 % due to the faster provision of medical services and the control over the delivery of medicines and consumables.

The time for producing reports decreased enormously. All reports for outside organisations such as insurance funds as well as government and tax authorities are prepared using the HIS, so that the hospital can receive payments in due time. Some reports are even produced automatically. The relations to suppliers improved due to an improved inventory control and electronic tenders. The time for preparing tender specifications was reduced from three months to one hour.

The cost calculation for every single patient, for type of medical service and for each department improved the hospital's financial management and cost control. However, there is not yet an analysis of ICT implications that could state whether the benefits of ICT outweigh the costs. Such an analysis is planned.

Improved job satisfaction

According to statements from hospital physicians and managers, the level of acceptance of the information systems by the hospitals' employees is very high. The HIS improved job satisfaction. Staff is convinced about the benefits from the HIS, uses the system and demands more functions and applications. As the system administrator, Vasil Kostadinov, says: *"If the HIS stops, the hospital stops because the medical staff is not willing to switch back to manual procedures."* This becomes a driver for the further development and improvement of the existing applications. It was also reported that shortly after the HIS implementation almost all medical employees purchased computers for their homes. A physician said that *"we can not imagine working without the HIS"*. The former hospital director summarised the employees opinion as follows: *"It was difficult to develop the HIS, easy to implement it and now we can not work without it."*

Improved inventory management and logistics

With the information base of the HIS, the hospital management can control resource use in an effective manner. Due to the Inventory Control Information System, inventory control is performed every day, and at every moment the management knows about the availability and the demand for drugs and consumables. This prevents shortages of goods, optimises the use of warehouse personnel and facilities, and speeds up the orders to suppliers. All this contributes to improved quality of care and cost reduction.

Lessons learned

The NHH case provides a number of lessons for the successful implementation and integration of Hospital Information Systems, including the following:

- The most important reason for the successful implementation of the HIS was the close day-to-day co-operation between the system developers and the medical and administrative staff of the hospital. The permanent support of the hospital management was considered as an important driver for the HIS development, implementation and on-going operation.
- The implementation of an integrated HIS is a comprehensive process and should be performed step by step based on common standards for data exchange.
- The integration of the medical and the administrative parts of the system is important because it allows cost calculation for each patient and for each hospital activity.

Medical staff and management benefit from receiving an abundance of information about the day-to-day hospital activities and from being able to produce reports automatically. However, the HIS provides more opportunities for analysis of the medical and financial issues than are currently used. According to the former hospital director and initiator of e-business development in the hospital, *"the system's use for forecasting costs and allocation of resources should be increased in the future"*.

References

Research for this case study was conducted by Bojil Dobrev, International University, Sofia, on behalf of e-Business W@tch. Sources and references used:

- *National Heart Hospital Information Structure (description in Bulgarian language), Internal paper, March 2006.*
- *Interviews with Mr. Vasil Kostadinov, NHH System Administrator, 17and 24 March 2006; 12 April 2006; 11 May 2006.*
- *Interviews with Mr. Orlin Gjurov, Manager Gama/Sofia, 11 April 2006; 9 May 2006.*
- *Interview with Ass. Professor Dr. Vladimir Pilossoff, Hospital Director 2002-2005, 12 April 2006.*
- *National Heart Hospital website: http://www.hearthospital.bg.*

4.2.2. e-Prescribing and medication management

Importance of e-prescribing and medication management

Prescriptions are a core means of conducting patient treatment. General practitioners, hospital doctors and some authorised clinical specialists may prescribe medications to initiate, continue or modify a treatment process. Prescriptions may rely on conventional media, such as prescription pads that are passed on to pharmacists or other healthcare professionals, but they can also be completed using computer systems, hence the term e-prescribing.

Two general concepts of e-prescribing can be distinguished: Firstly, e-prescribing within a hospital, where medications can be dispensed from stocks held on wards and units, or from a hospital pharmacy. Secondly, e-prescribing by sending a prescription to an outside agency, such as a pharmacy, where medications can be dispensed to the patient. An example of e-prescribing across organisational borders is the Swedish Apotheket system: electronic prescriptions, whether issued by a hospital or a primary care practitioners, are routed through a central, nationwide mailbox from where they can be retrieved from any pharmacy in the country. Apotheket owns almost all pharmacies in Sweden.[86] The focus here is on e-prescribing within the hospital.

e-Prescribing can be a separate e-health application. It can also be part of a computerised order entry system, or a computerised physician order entry (CPOE) system, where access is limited only to doctors. Whichever method is used, e-prescribing provides complete and accurate information, automatic dose calculations and clinical decision support at the point of care. This includes drug-drug interaction and allergy checking, as well as ordering supported by evidence-based best practices.[87] Usually they also include, or are connected to, a component which supports logistics and dispensing processes so that the patient receives the actual drugs prescribed for him or her, and in the exact quantities needed.

A potential for reducing medical errors

e-Prescribing can contribute directly to improved medication management, and so reduce medical and dispensing errors significantly which may occur when medication does not comply with the so-called “five rights”: right patient, right medication, right time, right dose and right route.[88] In 2000, the American Institute of Medicine (IOM) published “To err is human – building a safer health system”, estimating that in the US, between 44,000 and 98,000 people die in hospitals each year as a result of medical errors.[89] In a second report the IOM recommended a redesign of the American health system that is also built around “using information technology”.[90]

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[86] See findings from the eHealth Impact project at http://www.ehealth-impact.org, download at http://www.ehealth-impact.org/case_studies/index_en.htm.

[87] Definition according to Baldauf-Sobez et al. (2003), p. 3.

[88] Baldauf-Sobez et al. (2003), p. 4.

[89] See Kohn/Corrigan/Donaldson (2000), p. 26.

[90] See Committee on Quality of Health Care in America (2000), chapter 7, pp. 164 – 180. See also the most recent publication of the Committee on Identifying and Preventing Medication Errors in 2007 of which a summary is available at http://darwin.nap.edu/execsumm_pdf/11623.pdf.

Following the IOM publication, various studies verified the utility of CPOE. The medical benefits of CPOE have been confirmed in several empirical studies.[91] For example, in a study at a 700 bed academic medical centre in Chicago, US, it was found that of all verified prescribing errors, 64% were rated as likely to be prevented with a CPOE, including 43% of the potentially harmful errors. 13% were unlikely to be prevented with CPOE, and 22% could possibly be prevented with CPOE. The study covered 1,111 medical errors in 17,808 prescriptions[92], an error rate of about 6%.

The United States and other countries have started to analyse systematically the causes, and are seeking to implement measures to build a safer health system. Baldauf-Sobez et al. conclude that *"while there have not yet been comprehensive studies published substantiating differences and impacts, we believe that Europe experiences the same overall frequency of adverse medication events as the US"*.[93] Two of the key safety measures proposed for implementation are CPOE and medication management solutions. They cut down errors in the ordering process by eliminating mistakes, stemming mostly from manual processes.

However, CPOE may also result in increased medication error risks through "systems integration failure" or "human-machine interface flaws".[94] Recently, the case of the Intensive Care Unit of the Children's Hospital of Pittsburgh, US, has been reported where the implementation of a CPOE coincided with an increased level of mortality.[95] The core explanation may have been delays in administering therapy and diagnostic testing caused by the CPOE.

Such delays occurred for several reasons. First, it took one to two minutes to enter an electronic order, compared to a few seconds for the previously used written form. Second, nurses were denied access to critical medications from a dispenser close by, and instead, had to wait for dispensing and despatch by the pharmacy department. Third, pharmacists may access a patient file to process an order and thereby lock out physicians and nurses who would also like to access the same file.[96] Furthermore, bottlenecks in the hospital's wireless communication bandwidth slowed down order entry during peak operational periods. Computerised order entry and activation also diminished opportunities for face-to-face communication between physicians and nurses which previously fostered patient care and management. Whilst these downsides may not be critical in general medical wards, they may have significant consequences in intensive care units where *"multiple, rapid-fire interventions are regularly performed"*[97]. The assumption that CPOE success may depend on the circumstances of the medical unit is

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91 See Bates/Teich/Lee at al (1999), Mekhjian/Kumar/Kuehn et al (2002), Uppermann/Staley/ Friend et al (2005).

92 See Bobb, Gleason, Husch et al. (2004).

93 Baldauf-Sobez et al. (2003), p. 2.

94 See Koppel/Metlay/Cohen et al (2005).

95 See Han/Carcillo/Vekataraman et al (2005). The study included 1942 cases of children in an 18-month period, comprising 1394 admissions in the 13 months before implementing the CPOE and 548 admissions in the five months afterwards. The mortality rate increased from 2.8% (39 of 1394) to 6.6% (36 of 548). For another, more positive study in this field see Del Beccaro et al. (2006).

96 See Han/Carcillo/Vekataraman et al (2005), p. 1509.

97 Han/Carcillo/Vekataraman et al (2005), p. 1510.

supported by findings in the same hospital that show that harmful adverse drug affects declined significantly after implementing the CPOE.[98] It seems reasonable to assume that these findings about CPOE could also be expected in direct e-prescribing applications.

A potential for streamlining processes

Besides reducing medical errors, e-prescribing can also streamline medication management, improve hospital resource utilisation and save costs.[99] A study of electronic medication ordering, dispensing and administration at Helsingborg Lasarett, Sweden, concluded that time savings in the ward were 30 hours per week, while the time consumption at the pharmacy increased by 7.5 hours per week. The waste of drugs decreased from 4.8% to below 2%.[100] There may also be a reduced average length of stay for patients.

However, the CPOE study in the intensive care unit of the Children's Hospital of Pittsburgh, points to shortcomings also with regard to process efficiency. CPOE implementation often required one physician *"solely to enter orders into the computer during the first 15 minutes to one hour if a patient arrived in extremis"*.[101] It may be that the efficiency benefits of CPOE do not necessarily apply in wards with a frequent need for immediate, spontaneous emergency health care.

Case study findings

Several case studies in this report deal with medication management. The business example in the following summarises experiences from the *Siemens Melior and Invision Medication Management* systems, pointing out its benefits for medical error reduction, reporting times and cost reduction. Then follows a case study about electronic medication management at the *Chelsea and Westminster Hospital London*, UK. It shows the efficiency gains of e-prescribing, dispensing and pharmacy stock management, and shows that these can reduce medical and dispensing errors.

[98] See Upperman/Staley/Friend et al (2005).

[99] See Maekhjian/Kumar/Kuehn et al. (2002) and Han/Carcillo/Dragotta et al. (2003).

[100] See Baldauf/Sobez et al. (2003), p. 7.

[101] Han/Carcillo/Vekataraman et al (2005), p. 1509.

Business example:

Siemens Melior and Invision Medication Management

In a study in 2002 to evaluate the benefits of CPOE and electronic medication administration from the delivery of healthcare at the Ohio State University Health System, USA, Mekhjian et al. validated major benefits and outcomes of its implementation of Siemens' INVISION™ solution, which had been adapted by the health system, using vendor provided tools:

- *A statistically significant 64% reduction in medication turn-around times from ordering to actual administration.*
- *A statistically relevant 25% improvement in result reporting times.*
- *Physician Order Entry combined with electronic medication administration eliminated physician and nursing transcription errors.*
- *Although total cost per admission decreased significantly within selected services, it did not decrease significantly across the institution.*
- *The significant cultural and workflow changes that accompanied the implementation of CPOE did not affect the acuity-adjusted length of stay or total cost adversely.*

Mekhjian et al. concluded that the reduction in transcription errors, medication turnaround times, and timely reporting of results, supported the view that CPOE and electronic medication management provide a good return on investment.

Today, nine hospitals with approximately 2,000 physicians and nurses in Sweden use Siemens' Melior system for electronic medication ordering and medication administration. The number of hospitals and users continued to increase during 2003. A study performed in 2001 at Soedersjukhuset, Stockholm, Sweden before and after the implementation of CPOE and electronic medication management at the women's clinic, demonstrated a reduction of erroneous or incomplete medication orders of 73%, and an increase of signed orders from 37% to 98%, as the most prominent benefits.

Source: Baldauf-Sobez et al. (2003), pp. 3 – 4.

CASE STUDY: E-PHARMACY AT CHELSEA AND WESTMINSTER HOSPITAL, UK

Abstract

Chelsea and Westminster Healthcare Trust is an acute care hospital in West London. Its pharmacy department was modernised during 2002 and 2003, including the introduction of an electronic prescription system, a new dispensary, a computer-controlled dispensing robot and pneumatic tubes to distribute medications to the ward or unit where they are required. The new dispensary was designed to meet the needs of new pharmacy processes using electronic prescriptions. The electronic medication management system encompasses the whole chain of an electronic pharmacy system, that can be described as e-prescribing, e-dispensing, e-distribution, e-stock-management, and e-procurement. The new system led to more accurate prescriptions, more accurate dispensing, reduced stock holding, reduced waiting times for patients, reduced workload in the dispensary, and fewer visits to pharmacy by nursing staff, allowing more time to be spent with patients.

Case study fact sheet

Full name of the hospital:	*Chelsea and Westminster Healthcare NHS Trust*
Location:	*London, UK*
Type:	*Integrated acute care teaching hospital*
Year of foundation:	*1993*
Number of beds:	*522*
Number of employees:	*2,200*
Income in last financial year:	*£190 million (~280 million euros)(2004-2005)*
Area from which patients are drawn:	*Mainly central and West London*
Focus of case study:	*e-Pharmacy system*
Key words:	*Electronic prescribing, dispensing, distribution, stock management and procurement*

Background and objectives

Chelsea and Westminster Healthcare Trust (C&W) in London, UK, is an acute care hospital within the National Health Service (NHS). The hospital serves primarily the local population living in parts of Central and West London. People from a much wider area use the specialist services that include, among others, burns and plastics, HIV and sexual health, dermatology, endoscopy, neonatal care and paediatrics. The hospital opened in May 1993. It is part of the Imperial College School of Medicine and a teaching centre for Thames Valley University in Nursing.

In 1993, C&W started planning to introduce electronic patient records (EPRs). In 1999 the hospital introduced its EPR using a software system called Lastword. It was produced by the IDX Systems Corporation[102] to replace the old patient administration system. After a period of piloting and development, Lastword was also used from 2001 for e-prescribing for the hospital's outpatients and discharged inpatients. The general view was that e-

[102] See http://www.idx.com.

prescriptions were easier to read than hand written ones and the Lastword system provided useful electronic records of medication for particular patients. This reinforced a parallel development in the hospital pharmacy that aimed to modernise its services. A driving force was the long patient waiting times for both outpatients and discharged inpatients. There had been an increasing number of formal complaints regarding these waits. There was also a need to reduce the number of dispensing errors, increase the number of pharmacists working directly with patients as part of the healthcare professional teams, improve stock control, and improve the generally low staff morale caused mainly by hectic working days and late hours when on late duty.

e-Business activities

In 2001 e-prescribing was piloted and then rolled out sequentially, adding clinical directorates and the outpatient clinic. In 2003 the last directorate was equipped with the system. Throughout the roll-out period, training supported the proper use of the system.

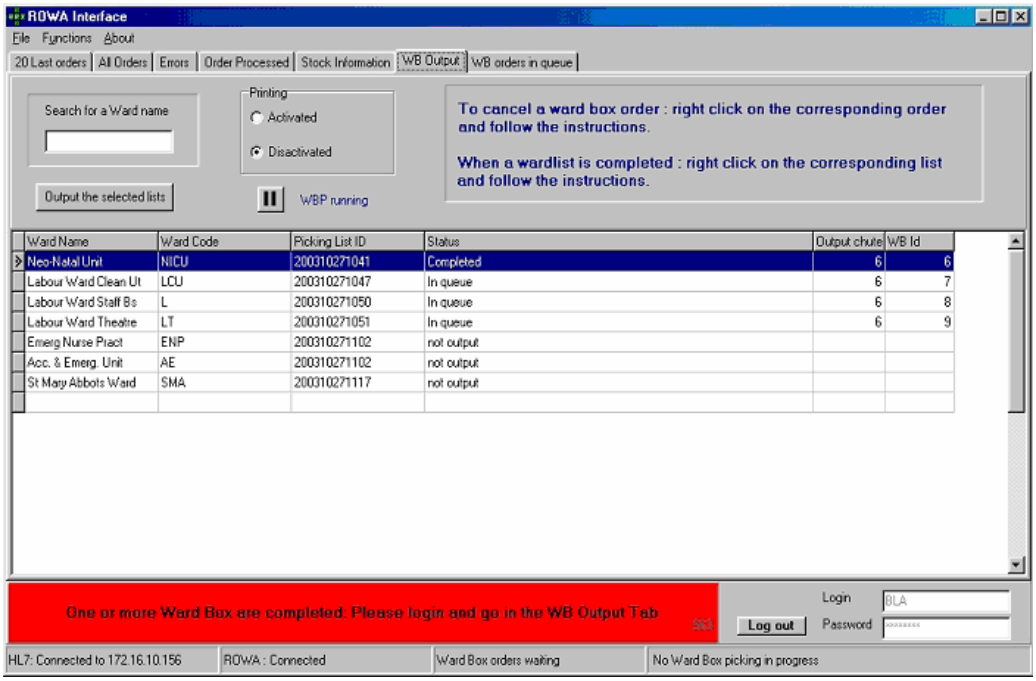
In May 2003, C&W installed the Rowa dispensing robot, constructed by ARX Ltd. In January 2004, a vacuum tube system for distributing items was installed. The robot is provided with the information on each prescription, picks the items from stocks, then transfers them to the dispensary staff for despatch to wards, or handed to the appropriate patients waiting at the dispensary. It also enables most stock items received from suppliers to be transferred into stock. In these respects, the dispensing robot operates to connect parts of the pharmacy chain from prescription to pharmacy stocks and dispensing to patients, and provides information to be transferred to the e-procurement process. The dispensing robot currently performs about 65% of all dispensary transactions. It does not deal with flammables, products without bar codes, intravenous fluid bags, controlled drugs, or products outside its height, width or weight limitations. The robot also has a limited fridge storage capacity.

The robot screens show stock orders from prescriptions that have been prepared by the robot, but not released by the pharmacy staff. This ensures that prescriptions can be prepared by the robot, but not executed until the system is explicitly told to do so by the pharmacy staff. This enables pharmacists to schedule the robot's outputs with each pharmacist's dispensing schedule, and so help to avoid errors. When pharmacy staff members need the dispensed items, they simply highlight the ward order on the screen and click on the "output the selected lists" button (see screen shot in Exhibit 1).

Distribution of medications follows a standard protocol, with outpatients and accident and emergency patients given the highest priority, followed by discharged inpatients. Access rights to the various functions of the robot are identified and assigned, based on the different job roles, such as pharmacists, pharmacy technicians and trainee pharmacists. A second server has been installed to ensure access to the medicines inside the robot in case the connection to the first server is lost. An intranet application monitors progress on dispensing of prescribed medications. It can be viewed by nurses on the wards.

Stock management and e-procurement are facilitated by information held in the JAC system, a proprietary pharmacy system for stock and medicines management. This is a routine e-health application found in several pharmacies and is provided by Mediware.

Exhibit 1: Giving the OK for execution of a ward order in Chelsea and Westminster hospital



"Completed" indicates the order has been output. "In queue" indicates the order is waiting for the previous order to be output before it will start to be outputted. "Not output" indicates that the order has been booked out on JAC but has not been requested to be outputted from the robot.

Source: Chelsea and Westminster Healthcare Trust 2006

Impacts

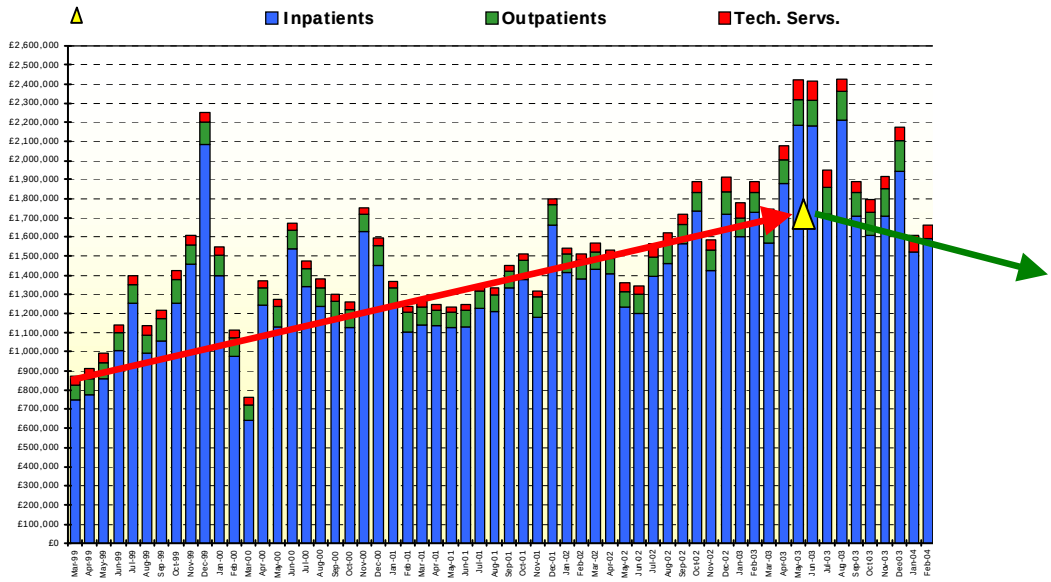
The new system improved dispensing accuracy, reduced stock holding, reduced waiting times for processing and dispensing outpatient and discharged inpatient prescriptions, enabled earlier finishing times for late duties, reduced workload in the dispensary, and reduced the number of visits to the pharmacy by nursing staff, allowing more time to be spent with patients on the ward. The impact has been evaluated using the methodology of the EU's eHealth Impact project.[103]

Reduced stock holding

The robotic dispensing system led to optimisation of stock management, with improved monitoring of stock levels, prompt timeliness of orders, centralisation of some stock, and eliminating situations where stock is ordered although it may already be available at a different location. The combined effect is a significant reduction in stock. Before implementation, there had been a marked trend for stock to increase, which was reversed. Exhibit 2 shows the Trust's stock position and indicates when the robot was installed.

[103] See eHealth Impact project website at http://www.ehealth-impact.org.

Exhibit 2: Development of pharmacy stock holding at Chelsea and Westminster hospital



Source: Chelsea and Westminster Healthcare Trust 2006

Before the robot, pharmacy stock levels had been climbing at an average rate of some £15,000 (22,137 euros) per month, peaking at £2,400,000 (3,542,000 euros) in May 2003. For the twelve month period after the robot installation, the rate reversed and the stock level decreased at a rate of about £28,000 (41,000 euros) per month, with a minimum level of £1,400,000 (2,066,000 euros) in early 2004. This reduction does not appear to have been driven in any way by a reduction in workload, and is attributed to the impact of robotic dispensing.

Reduced waiting time for prescriptions

Waiting times for outpatient prescriptions have been reduced significantly to about 30 minutes. Before ICT support and automation, outpatients had to wait 1 hour 45 minutes on average. Waiting times for prescriptions for discharged inpatients have been reduced by 41% for about 60 discharged inpatients each day. It has been attributed to improved workflow within the dispensary, and staff redeployed from the dispensary to undertake additional clinical activities, especially clinical screening on wards. More pharmacy staff members work on wards, checking patients' own drugs that they bring with them from home for re-use, and they also co-ordinate discharge prescriptions.[104] Before the implementation of the robot, no discharge prescriptions were written before the responsible physician actually decided to discharge a patient. After the implementation it was about 50%. In addition, the number of prescriptions dispensed before discharge has increased from 50% to 85% after the investment. Improved safety and quality of service is forecast to increase when e-prescribing is ex-tended to all inpatients in 2007.

Reduced dispensing errors

Since the introduction of automated dispensing, the number of errors in the dispensary has dropped by 29%, from 30 to 21 errors per 100,000 items. After the robot, errors fall

[104] This also implies an enhanced role of pharmacy staff in direct patient services.

into two categories: drugs dispensed manually because the robot cannot deal with them and incorrect labelling. For example, in the period of June to August 2003, there were eight dispensing errors. Five of these involved drugs that were not kept in the robot, such as fridge items. Of the other three errors, one involved dispensing the incorrect dose units from the shelf and the other two involved the labeller labelling an incorrect drug.

Reduced prescribing errors

The system significantly reduced the number of prescribing errors. This was due to two functions: Firstly, the system warns prescribers when they propose to prescribe a medicine that interacts negatively with another, or when the patient is allergic to a medicine, helping to minimise risk. Secondly, all information for safe dispensing, such as dose and frequency, is included in the e-prescribing system. According to an internal audit that was undertaken to compare the number and type of discrepancies on handwritten and electronic outpatient prescriptions, prescribing errors and discrepancies were down by 77% due to electronic prescribing.[105] Exhibit 3 shows the audit results.

Exhibit 3: Higher accuracy rates of electronic prescriptions in C&W

	Handwritten prescriptions	Electronic Prescriptions
Prescription writing process discrepancies	6.27%	0.17%
Clinical screening interventions	8.82%	3.81%

Source: Chelsea and Westminster Healthcare Trust 2006

More efficient workflows

Prescribers and screening pharmacists can view electronic medication histories, saving time in the process of prescribing new or updating old medication.

Earlier finish times for late duties

The pharmacy closes at 6 p.m. and pharmacists and technicians have to work a "late duty" in the dispensary and finish any work that the dispensary received before 6 p.m. The robot has enabled these late duty finish time to be reduced and concentrated mainly between 7 and 7.30 p.m. Previously, finish times were later, sometimes as late as 10 p.m. Earlier finishing times have a direct impact on costs, as overtime is reduced, and a positive impact on the morale and the working atmosphere at the pharmacy.

Reduced visits and calls to pharmacy by nursing staff

The automated system enabled the nursing staff to spend additional time on nursing duties and not waiting in the dispensary for prescriptions to be filled. In addition, it

[105] Prescriptions received in March 2004 and March 2005 were analysed, involving a total of 5,738 prescriptions and 9,266 individual medicines. Discrepancies were divided into two categories: Firstly, discrepancies relating to the prescription writing process, including compliance with legal and trust policy requirements, ensuring that prescriptions include the patient's name, their hospital number, the prescriber's name, the date and the requirements for prescribing controlled drugs. Secondly, discrepancies from a clinical perspective, requiring to intervene by obtaining further information before the dispensing medication, for example, by changing the dose and frequency, where the prescription may be incorrect or inappropriate.

reduced the amount of time dispensary staff spent answering telephone queries from the wards and units about dispensing status, and so alleviates work-related stress.

Lessons learned

C&W has the following lessons to offer by introducing ICT into its prescribing, dispensing and stock management chain:

- Investing in ICT across the whole chain from e-prescribing to e-procurement offers significant net benefits to patients, healthcare professionals and the organisation.[106]
- Access rights to robot programmes should be restricted according to job roles to prevent mis-coordination errors and misuse.
- Stock levels should be reduced several weeks before the system's "go live" date in order to facilitate the task of capturing all stock records in electronic form, as well as physically "feeding" the system with articles.
- At an early stage of planning, the managers involved should investigate existing solutions by visiting sites where similar systems are already running, as C&W managers did. Managers should seek support from people and teams who have experience in implementing such systems.
- Training curricula should be tailor-made to the needs of particular professionals, especially physicians, nurses and pharmacists. This is vital for motivating and ensuring the support of all staff members. The success of implementing a medication management system that requires a thorough re-organisation of workflows depends on the willingness of staff members to accept and use the system.

The C&W experience has already been successfully utilised by other NHS hospitals in the London area, with more sites in the process of implementing similar systems.

References

Research for this case study was conducted by Tom Jones, TanJent, and Alexander Dobrev, empirica, on behalf of e-Business W@tch. Sources and references used:

- *Interviews with Karen Robertson, Chief Pharmacist at Chelsea and Westminster Hospital, June 2006.*
- *Unpublished reports about the Chelsea and Westminster medication management system.*
- *C&W website at http://www.chelwest.nhs.uk/.*

[106] For more details see the eHealth Impact study at http://www.ehealth-impact.org.

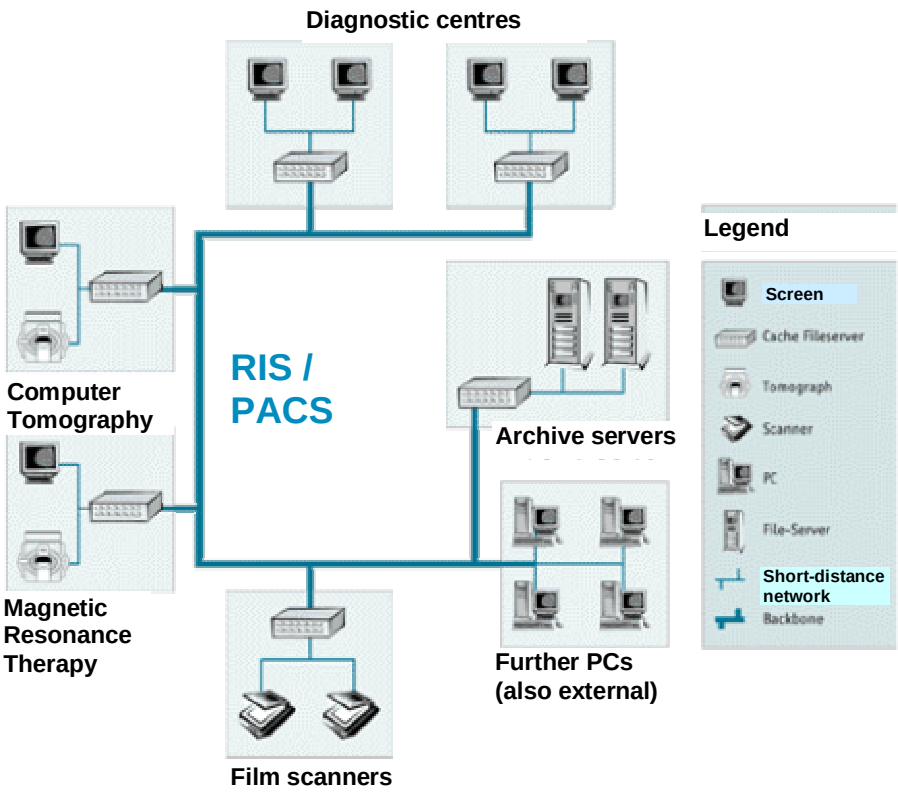
4.2.3. Computerised imaging systems

The role of RIS and PACS

Imaging technologies such as X-rays, computed tomography and ultrasound are among the most important diagnostic methods in hospitals. For the last 100 years, film has been the quasi-exclusive and relatively fixed medium for X-rays, with usually only one set of images available. Information produced via diagnostic imaging has always been difficult to acquire, handle and distribute.

Electronic imaging, supported by Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS), offer new opportunities of imaging for healthcare. The role of a RIS is mainly administration, meaning that the right picture has to be accessible at the right time to the right person. A RIS commonly offers the following functions: insertion, storage and administration of patient data, appointment planning, diagnosis documentation, archive administration and accounting. On the other hand, a PACS is, as the name indicates, mainly an archiving system with related viewing and communication functions. A common PACS includes a databank, workstations for monitoring and working on the images, as well as a network linking all imaging devices and workstations. Commonly the RIS steers the PACS. Exhibit 4-4 shows a common RIS/PACS system.

Exhibit 4-4: Basic architecture of a RIS/PACS system



Source: http://isis.de/RIS.301.0.html, 17 May 2006, with modifications by empirica

About the importance of RIS and PACS

Film- and paper-based image administration has a lot of shortcomings: limited opening hours of archives, long time between image order and actual delivery, decentralised archive locations, difficult research due to unregistered borrowing of images, erroneous storage or erroneous integration of supplements, high usage of storage space, no multiple use of the same image at the same time, and underutilised archive personnel.

Electronic imaging offers improved visualising, archiving and communication methods and can thus improve diagnosis and quality of care as well as reduce administration costs. RIS and PACS can allow immediate access to images from various locations inside and outside a hospital. For example, when a physiotherapist needs to have a look at an X-ray image, he or she may access the image immediately through a computer at the patient's bedside. Several health care professionals can access a particular image at the same time. If need be, multidisciplinary teams at various locations can convene to hold a telephone conference with the same images on their computer screens.

Case study findings

The following business example illustrates the use of image archiving and communication combined with grid technologies in a large region with dispersed medical centres. The case is from Canada but serves as an advanced example of the opportunities offered by ICT and illustrates opportunities which can also be achieved in Europe. Thereafter, a case study about the benefits and impacts of imaging systems at the John Paul II hospital in Poland substantiate some of the opportunities of electronic imaging.

Business example

Medical image archiving and communication at the BC Cancer Agency, Canada

The British Columbia Cancer Agency (BCCA) provides a cancer care programme for the people of the province of British Columbia in West Canada. The programme includes, among others, prevention, diagnosis and treatment services as well as support programmes. The BCCA operates four major regional cancer centres in Vancouver, Surrey, Victoria and Kelowna. With 30 hospitals and medical centres generating images and sending them to the BCCA every day – sometimes on film and also on CD – the need arose to store, back up and protect an immense volume of images and make them available instantly to authorised doctors and clinicians at multiple healthcare facilities. The BCCA implemented an HP Medical Archiving Solution. It enabled all images to be seen electronically and instantly from anywhere in the Province, eliminating the need for CDs and film altogether. Only authorised users can access the images. The solution's software maintains three copies of each image in different locations on the grid, eliminating the need for tape backup-and-restore procedures.

The system has been running since 2003. Today, BCCA's distributed storage grid provides a unified, fault-tolerant archive for all types of imaging studies, including computed tomography, magnetic resonance, computed radiography, nuclear medicine and ultrasound. Through the use of the system, many out-of-system referrals and ambulance transfers have been prevented. Some physicians became aware of procedures performed in a distant city, so that they did not need to repeat a procedure, preventing further patient discomfort and saving costs. The medical archiving system also permits collaborative activities, such as conferences between physicians. It also enables the practice of teleradiology by allowing a patient to have imaging work transferred from one location to another to the patient's physician or expert. This eliminates the need for the patient to travel and facilitates a remote consultation.

Source: HOPE (2005), p. IT11 – IT12.

CASE STUDY: BENEFITS OF IMAGING SYSTEMS AT JOHN PAUL II HOSPITAL, POLAND

Abstract

In the John Paul II Hospital in Cracow, Poland, the deployment of ICT systems for digital imaging improved quality of care and reduced cost. As regards quality of care, the Radiology Information System enables healthcare providers in the hospital to access critical information for diagnosis within significantly shorter time, compared to the traditional X-ray methods. By sharing images between different locations the hospital's staff can consult external specialists and provide diagnosis for patients from outside the clinic. As regards costs, shorter time for image delivery and also reduced material use imply considerable financial benefits for the hospital.

Case study fact sheet

Full name of the hospital:	*John Paul II Hospital*
Location:	*Cracow, Poland*
Main business activity:	*Cardiology and lung diseases diagnosis and treatment*
Number of beds	*520*
Year of foundation:	*1917*
Number of employees:	*1350*
Income in last financial year:	*33.9 million EUR*
Area from which patients are drawn:	*Poland, other EU countries*
Focus of case study:	*Electronic imaging systems*
Key words:	*RIS, PACS*

Background and objectives

The John Paul II Hospital in Cracow is a public hospital specialising in treatment of heart and lung diseases. Established in 1917, it is today one of the most modern hospitals in Poland. It has about 520 beds, 40 specialised laboratories as well as a Diagnostics Centre for Heart and Lung disease. The Centre conducts about 100,000 tests and consultations yearly, including 60,000 imaging examinations.

Due to constantly decreasing public health care expenditures, the hospital's management began to look for ways improving its operational efficiency. The implementation of appropriate ICT applications was meant to facilitate both administrative and health operations. However, the core driver of ICT implementation in the hospital was not cost containment but a better fulfilment of its objectives: *"It has always been believed that implementing IT solutions will improve the provision of patient care"*, said hospital Director Dr. Mieczysław Pasowicz, the founder and head of the diagnostics centre. The hospital's ICT strategy was established in 2002. Its aim was to become an "e-hospital", which would utilise integrated digital networks in all departments and integrating the hospital's network with external institutions.

e-Business activities

Core information system elements

Since 2002, all operational applications and systems have been modernised and integrated to create a digital platform for medical information exchange across the hospital. Most of the processes have been digitised through the following implementations:

- Picture Archive Communication System (PACS): A system for taking and processing digital diagnosis images.
- Network Radiology Acquisition, Access and Distribution (NetRAAD): A Radiology Information System (RIS).
- InfoMedica: An application whose primary use is detailed registry of health care services provision.
- Konsul: An application facilitating administrative tasks such as appointments and consultation management, an own development of the hospital.

The PACS and the RIS play a crucial role in the process of providing health care services, the InfoMedica and Konsul systems support the administrative and managerial activities. The NetRAAD and PACS systems were implemented between 2001 and 2005 and their initial cost was over 250,000 euros.

Digital imaging

Similar to other health care institutions, John Paul II Hospital has until recently used film for producing radiographic images. Due to the high importance of diagnostic imaging in patient care, especially in the specialist clinics, the managing directors decided to replace the expensive, time-consuming, manual film-based system with digital technology.

The PACS enables taking and processing digital images. It was deployed to provide a single tool for managing images and their associated data. It was supplied by University Health Care (UHC), a Polish specialist ICT provider for the health sector. Currently the system collects images from various devices including, among others, a Siemens Computed Tomography (CT) multi-row scanner, a General Electric (GE) Magnetic Resonance Imaging (MRI) scanner, and a GE rotational angiograph. Medical graphics workstations are provided by Siemens, GE, Marconi, and eFilm; thermal printers by Agfa.

The RIS, which has been tailored to the hospital's needs, links all specialised diagnostic imaging capabilities with the administrative systems and automates the daily operations of the radiology departments. It facilitates the document flow and patient records improving overall healthcare provision. The images and related information are stored in one repository. The RIS constitutes the backbone of the hospital's operations. The RIS is used by radiology departments to store, manipulate and distribute patient radiological data and imagery. This enables medical personnel to conduct, for example, collaborative diagnosis in the clinic and via Internet with professionals outside the campus. The system consists of three core modules: NetARCH supports the storage of images, WebRAAD enables the distribution to multiple image repositories and viewing of the images and their descriptions, and NetRIS manages the workflow of the radiology department including patient tracking and scheduling.

System integration

The integration of different systems within the clinic was a critical issue in order to enable a frictionless exchange of information. Common standards enabling system interoperability proved to be invaluable.

The smooth connection of the PACS system with devices from different vendors, thus reducing implementation costs was facilitated by the DICOM standard for handling, storing, printing, and transmitting information in medical imaging. For instance, the CT scanner, the MRI scanner, and other machines of different vendors all communicate within the PACS via the DICOM protocol. The images from all modalities can be displayed and interpreted at the same PACS workstation and then sent to the same archives from where they can be distributed over the network or sent outside the clinic.

Via HL-7 and DICOM protocols the RIS is operating in connection with the administrative systems, enabling the creation of digitised patient records and sharing of these files with satellite clinics. The connectivity and interoperability of the whole system was tested for one year to deliver an integrated system at the beginning of 2006.

Security issues

The hospital's internal computer network is equipped with advanced anti-virus control management systems and identification of users. In order to deal with security issues and unauthorised access, the NetRAAD system provides multilevel protection of patient, examination and image data using passwords and access rights. Each access is recorded and can be tracked easily by a system administrator. User accounts and user groups are defined and maintained by the hospital's system administrator. In general, all doctors in the hospital have full access that allows them to edit or view the data and images. Nurses and administrative personnel have limited access to the system with a view-only option. The program also provides a special educational user group setting, which allows access to medical information for instructional purposes, but restricts access to patients' personal information. Until now there was no unauthorised access or grave records misuse incidents noted in the hospital.

Impacts

Cost containment

Digital imaging brought considerable cost benefits to the hospital. An X-ray picture is costly, demands a certain processing time and storage solutions. The results are less detailed and complicated for reviewing during consultations than on a digitally viewed high-resolution picture. PACS technology offers the hospital a nearly filmless process.[107] It also removes all the costs associated with hard film. Furthermore, it takes only a few minutes to have a copy of the images burnt onto a CD or DVD while it may take up to two hours to have a hard copy on film.

Apart from material costs, the hospital achieved sustained savings on imaging operations. Today, only two people are involved in conducting and delivering the tests on CD, i.e. a doctor or technician taking the tests and a person at the reception desk to burn

[107] The traditional X-ray process is still at place due to legal provisions.

and hand over a CD or DVD copy to a patient. Previously at least three departments and several people were involved. Furthermore, the storage space for radiology film processing, administration and archives was reduced and the space is now used for consultation purposes, which increased the capacity of the hospital.

More efficient work processes and improved quality of care

The digital technology enables the integration of images into one care record, removing the inefficiency of keeping elaborations clipped to an X-ray picture and folded between the rest of patient health record written on paper. The electronic patient records provide a single source for on-demand clinical information.

The hospital also achieved considerable efficiency improvements in diagnosis. PACS and NetRAAD systems have brought changes to all departments of the hospital where medical images are used. The main benefits of digital imaging include:

- **Reduced delivery time**: Faster delivery of medical images to the clinicians that evaluate and report on them. The reduced waiting time for results and diagnosis can be crucial in many heart diseases.
- **Anytime access:** Clinicians can access images at any time, they are not bound to archive opening hours.
- **Better co-operation**, as images can be viewed from multiple terminals and locations by a range of clinicians, thus facilitating discussion about diagnoses. This also results in improved communication between radiologists and referring clinicians and also with primary care institutions.
- **Reduced number of lost or misplaced images**, which means fewer patients' consultations or operations being postponed or cancelled due to images not being available. This is particularly important considering that the common past practice was that patients keep their X-ray films with them and bring them to the appointment.
- **Improved flexibility of handling images:** Pictures can be viewed and manipulated on-screen, which means diagnoses can be more accurate. Flexibility is further improved by the possibility to display images in separate windows to allow for viewing multiple images and patient data simultaneously for making a comparison.
- **Better information availability:** The system allows an instant automated access to historic images and illness cases, laboratory data and other clinical information stored in one place.
- **Research and education support:** The option of categorising types of diagnosis into an educational and research database to help the John Paul II Hospital's research and educational function. Physicians can compare similar pictures for easier and more accurate diagnosis using past records.
- **More efficient time management:** The possibility of ordering tests from outside of the hospital allows better time and facilities management.

Benefits for patients

John Paul II hospital's patients also benefit from digital imaging. The greatest benefit for them is that images are no longer lost or misplaced, which might lead to postponed or cancelled appointments and repetitive X-ray exposure. Patients no longer have to bring their X-ray images with them for appointments in the hospital. The tests are engraved on the CD or DVD that are easier to handle and copy and more resistant to damage. On patient request, the hospital can also send the tests results instantaneously via email to a primary care institution. Patients also benefit from improvements in clinical procedures and quick information exchange between clinicians. Images can easily be distributed to other specialists for discussion, which is especially useful for difficult cases or for training purposes. With instant access to results, clinicians can make well-informed decisions and patients receive treatment sooner.

Patients directly benefit from improved picture quality and reduced time between test, diagnosis and actual treatment. Electronic information processing across departments makes it possible to coordinate exam scheduling with other appointments and tests. All this reduces delays and errors in patient care.

Lessons learned

Among the main lessons learned during digital imaging implementation and system integration at John Paul II Hospital are the interoperability issues. According to Zbigniew Les from John Paul II Hospital, *"only with closely integrated ICT systems throughout the hospital, the full image-enabled medical electronic patient record can become reality"*. However, while extending the ICT network within the hospital and interconnecting it with the systems of other institutions, the hospital faced interoperability problems. Due to a lack of interoperability, John Paul II Hospital cannot take full advantage of the technology in place to extend its usage outside the campus:

- **Lack of industry standards:** On the one hand, *"there are still too many versions of software that are not compatible within the sector causing difficulty to exchange data"*, Mr. Les said.
- A **lack of state regulation** is a further reason: *"The process of system integration within the hospital and with other institutions, for example the NHF, is hampered by a lack of clear state regulation about electronic data storage and exchange as well as a lack of standards for exchanging medical information."* Consequently, beside technical solutions, *"the involvement of policy makers is equally important to bring clarity and impose some common solutions for the healthcare sector."*.

Currently, large institutions with competitive advantage such as John Paul II Hospital impose their solutions to others, Mr Les explained. This may lead to several competitive standards. Their coexistence may result in unnecessary complications for the users and may make the creation of interoperable solutions at the national level more difficult.

The diffusion of more advanced ICT applications is also slowed down by frequent changes in electronic exchange procedures with the Polish National Health Fund and other health care institutions, as well as a lack of appropriate infrastructure and funds needed to receive and produce digital records.

References

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

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4.2.4. Integrating separate information systems

About the importance of systems integration

As hospital health services require the interaction of various medical and administrative departments, information systems also need to be functional across departments in order to best treat patients. The information systems need to be integrated, not separated. For example, a core criterion for the integration of medical records involves a single, central medical record library or fully interoperable departmental libraries with interfaces between each other. Principal criteria for the integration of patient administration systems include a unique patient identifier used by all departments and in consecutive hospital stays as well as the use of a Master Patient Index. A Master Patient Index (PMI or MPI) is a software database programme that collects a patient's various hospital identification numbers, perhaps from the blood lab, radiology, admission and so on, and keeps them under a single, enterprise-wide identification number.[108]

The lack of integration of separate information systems is a common problem in European hospitals. Possible consequences of non-integration include frictions in communication processes, time-consuming data conversion, various patient data files with different kind of information and stemming from different dates, errors and omissions.

Reasons for non-integration of separate information systems

When the various information systems in a certain hospital are not integrated, there may basically be three reasons: a lack of ICT planning, difficulties with ICT suppliers, and a lack of standards and interoperability:

[108] See http://www.theebusinesssite.com/IT%20Terms/Health%20Terms.htm; Health Informatics online.

- **Lack of ICT planning.** There are numerous possible reasons why ICT planning in hospitals may be suboptimal. First of all, large hospitals are complex entities with numerous departments and professions.[109] There may be a lack of enterprise-wide management of implementing and integrating ICT systems in a hospital, caused by cultural differences across wards, by departmental specialists who do not adequately consider the needs of the whole hospital, and by a relatively weak central management. Some of the specialist departments may be powerful and afraid of loosing power by integrating their systems with other parts of the hospital. Others may be afraid that their level of performance becomes transparent in an integrated system. In the e-Business Survey 2006, 58% of the hospitals said they expect important impacts of ICT on management in the future. This assessment may be related to the need for a stronger hospital-wide management in the course of HIS implementation integration.

- Beside the issue of organisational complexity and fragmentation, there may be other reasons for insufficient planning for ICT implementation and integration in hospitals. Hospital management may assign ICT issues a relatively low priority,[110] there may be a lack of in-house ICT skills or a weak ICT department, the ICT department may be reluctant to outsource services,[111] or external e-business consulting may be inadequate. According to HINE, ICT professionals are currently rarely represented on hospitals' boards so that the "ICT perspective" may often not be reflected adequately in high-level management decisions.[112] Furthermore, HINE found that many ICT professionals in hospitals rely on demonstrable technical functionality of ICT systems without sufficiently advocating the user needs. Finally, a lack of ICT planning may in some countries or regions also be due to a lack of need, for example a lack of pressure from competitors or the absence of health policy initiatives promoting ICT use in hospitals.

- **Difficulties with ICT suppliers.** Hospitals may face various difficulties with information system suppliers. First, the market for hospital ICT is quite fragmented and localised.[113] Small and local ICT suppliers usually offer confined solutions that cannot necessarily be integrated with other systems in the same hospital. Even if hospitals buy from large suppliers, these may not necessarily spend enough effort on properly integrating competitors' systems.[114] If hospitals seek tailor-made

[109] The importance of management challenges due to complexity has been confirmed in an interview with P. Garel, chief executive of the European Hospital and Healthcare Federation (HOPE), by the *e-Business W@tch* Advisory Board Member V. Lessens (Agfa) as well as in the *e-Business W@tch* hospital activities workshop at the High Level eHealth Conference in Malaga, 10 May 2006 – see the workshop's conclusions at http://www.ebusiness-watch.org/events/hospital_activities.htm.

[110] HINE found that ICT is not yet a strategic board-level issue in most hospitals.

[111] This argument is supported by findings from the e-Business Survey 2006 about IT outsourcing in large firms which was reported to be lower in hospitals than in the all-sector average (see chapter 3.2) as well as by statements from the HINE representative in the *e-Business W@tch* hospital activities workshop at the High Level eHealth Conference in Malaga, 10 May 2006.

[112] Information from V. Lessens, member of the e-Business Advisory Board, Agfa, a HINE member.

[113] Information from V. Lessens, member of the e-Business Advisory Board, Agfa, a HINE member.

[114] The Son Llàtzer Hospital in Spain managed this problem by engaging an independent IT company with integrating the systems from competing systems providers.

solutions, the suppliers may rather seek to sell their standard systems.[115] The fact that a "lack of reliable IT providers" appeared to be a more important barrier in hospitals (34%) than in other sectors (20%) in the e-Business Survey 2006 may reflect all these shortcomings.[116] A consequence is that there is long track-record of solutions developed by the hospitals themselves, which may however not be highly sophisticated and suited for systems integration.

- **Lack of standards and interoperability.** The integration of separate HIS may be hampered by a lack of standards applied by industry and requested by users, i.e. a lack of general, industry-wide technical, semantic and organisational norms.[117] Even when a hospital is built from scratch, standardisation issues will arise.[118] When hospitals introduce HIS for various departments and functions and legacy systems are still in place, interoperability problems will surely arise. This issue may particularly apply to large hospitals with many departments and systems operating with different standards, and it is a special issue when several hospitals are merged. For small hospitals the challenge may rather be to invest in an expensive tailor-made integration application.

All in all, findings suggest that suboptimal ICT planning may be a more important reason for a lack of systems integration than difficulties with suppliers and a lack of interoperable standards.

Case study findings

Various case studies in this report deal with HIS integration as one issue among others. All case studies indicate the importance of appropriate management for implementing and integrating an HIS successfully, implying strong medical leadership, close interaction between the administrative and technical managers involved, and involvement of the clinical users in decision making. The Son Llàtzer Hospital in Spain and the National Heart Hospital in Bulgaria show that a special software application can be developed in order to integrate ICT applications operating with different standards. The following case study is about the integration of hospital information systems at the Ambroise Paré hospital in Mons, Belgium. It presents a simple but effective way to have formerly separate systems from various suppliers communicate with each other.

[115] The Ambroise Paré hospital unsuccessfully asked large ICT providers to create a tailor-made solution and then had it constructed by a local supplier, see the case study below.

[116] See chapter 3.10 about barriers of ICT adoption.

[117] See chapter 3.4 above in this report. See also European Commission (2005), "e-Business Interoperability and Standards: A Cross-Sector Perspective and Outlook", for current background information on the subject.

[118] See the example of the Son Llàtzer Hospital elaborated in a case study in section 4.1.

CASE STUDY: INTEGRATING HIS AT AMBROISE PARÉ HOSPITAL, BELGIUM

Abstract

The Ambroise Paré hospital is a public university hospital with 500 beds located in Mons, Belgium. It is an example of a mid-sized hospital that effectively integrated its information resources by focusing on the staff's point of view and by selecting a rather simple, pragmatic approach. The integration effort improved workflows and accessibility of patient records without large investments and without replacing well-known and well working specialised information systems. The hospital unified all information about the patient in one database named b-doc and made it accessible all over the hospital via a single user interface. The physicians' commitment in using b-doc shows that it is a valuable tool that supports them in their everyday work. Among the benefits are flexibility in adapting subsystems, reduced loss of documents, round-the-clock availability of all data, and savings due to reduced personnel and of material cost.

Case study fact sheet

Full name of the hospital:	*CHU Ambroise Paré*
Location:	*Mons, Belgium*
Main business activity:	*Public university hospital with all major medical specialties except radiotherapy and burns*
Year of foundation:	*1954*
Number of beds:	*500 beds*
Number of employees:	*~1,200, including 160 physicians*
Income in last financial year:	*~70 million euros (2005)*
Area from which patients are drawn:	*Mons-Borinage region (~200.000 inhabitants)*
Focus of case study:	*b-doc middleware and HIS*
Key words:	*Hospital Information Systems integration*

Background and objectives

The Ambroise Paré hospital is located in Mons, a city with 100,000 inhabitants in South-West Belgium.[119] It is a mid-size hospital with about 500 beds and 125,000 outpatients a year and a teaching and training facility affiliated to the Université Libre de Bruxelles. HAP is a general hospital covering all kinds of medical specialities except radiotherapy and severe burns.

In 2001 the hospital management realised that the patient administration system was outdated. When looking for a new system, the hospital's CIO already had the idea to integrate all the medical and administrative data produced into a single resource. In this way, physicians should be able to exchange information about their patients in a very easy manner to make treatment more effective. A new, highly sophisticated information system for the whole hospital was regarded as too difficult to implement within an established and operating hospital. Too many systems would have to be replaced or adapted, and the problem of being bound to one supplier would have arisen.

[119] The hospital is named after the famous medieval physician Ambroise Paré. Its full name is Centre Hospitalier Universitaire (CHU) Ambroise Paré.

In order to implement this concept, the hospital contacted several large established companies. However, the companies refused because they wanted to sell only their holistic hospital information systems. Thus the CIO contacted the small Belgium informatics company Ciges which then took over the project.[120] Within the first half of 2002, the core system components were created: a database, connectors to the medical devices, and a user interface. The system was named b-doc. During the second half of 2002 it was successfully tested in two wards of the hospital with a basic set of information systems connected. In the following year all other wards were connected and further medical devices integrated. Integrating new medical devices is more or less an ongoing process.

e-Business activities

Basic functionality of b-doc

B-doc offers quite a pragmatic and straightforward solution: The data output of all computerised medical devices and all information systems are transformed into a format complying with web standards such as gif, jpeg or xml. As the medical devices formerly outputted their results on paper it was not difficult to replace the paper printer by a virtual printer that stores the document in the database under the visit number of a patient. The physicians on the ward can then retrieve the information from the database using a web browser that is installed in workstations all over the hospital.

The browser offers the hospital's staff a single user interface. The user interface provides several functions for looking up patient examination results and other documents. For example, a physician can list all patients on his or her ward or prepare for consultations using a personal examination schedule.

For authentication the system uses a combination of user name and password with a single-session log-in, which ends automatically when the browser is closed. Authorisation is regulated by user groups that are granted or denied access to parts of b-doc. For about 1,200 employees there are 100 different user groups.

If a patient is registered in the admission department, the administration system creates a new entry in b-doc that constitutes the basic entity in the system's database. A unique number is created for every patient visit. In b-doc one can then find the patient under his or her name or ward, or the name of the treating physician.

Different workflows

Blood analysis results that are transferred to the patient file can illustrate the different workflows before and after the introduction of b-doc: Before the introduction the laboratory computer processed the results and a print-out of them was filed in the patient's paper record. Physicians and nurses also had the opportunity to access the results through the intranet, but this was inconvenient and rarely used. The physicians or nurses had to use an interface designed for laboratory staff use and they had to ask laboratory staff for a certain number to access the results. With b-doc the laboratory output is transferred electronically to the database. The new electronic solution has only

[120] See the company's website at http://www.ciges.be/.

slightly changed the workflow of laboratory staff, which is an important issue with regard to the amount of training involved. However, b-doc at the same time offers medical staff improved data access, improving their workflows. If a physician wants to consult the results of the blood analysis, he or she can look them up in the patient's entry via a web browser in the hospital's intranet from anywhere in the hospital.

The physician can attach comments to the results of the blood analysis and to any medical report sent to b-doc. In the first instance this was a simple comment function with one free text field, but during the test the physicians asked for an extension of this function. Forms formerly in paper format were integrated into b-doc to have comments in the same consistent structure as before. The system now contains about 300 specialised forms related to different specialities and specific examinations.

User acceptance

The physicians themselves fostered the further development of the system because it eased their daily work. Marco Turco, the hospital's CIO, said that he never forced anyone to use the b-doc system; it was only offered as a toolkit. Paper and electronic files were used in parallel free of choice for a transition phase of about six months. After the transition phase all medical results were stored in the system due to the good support by physicians. The nursing care record is for the moment still in paper form but is planned to be transferred to b-doc in the near future, too.

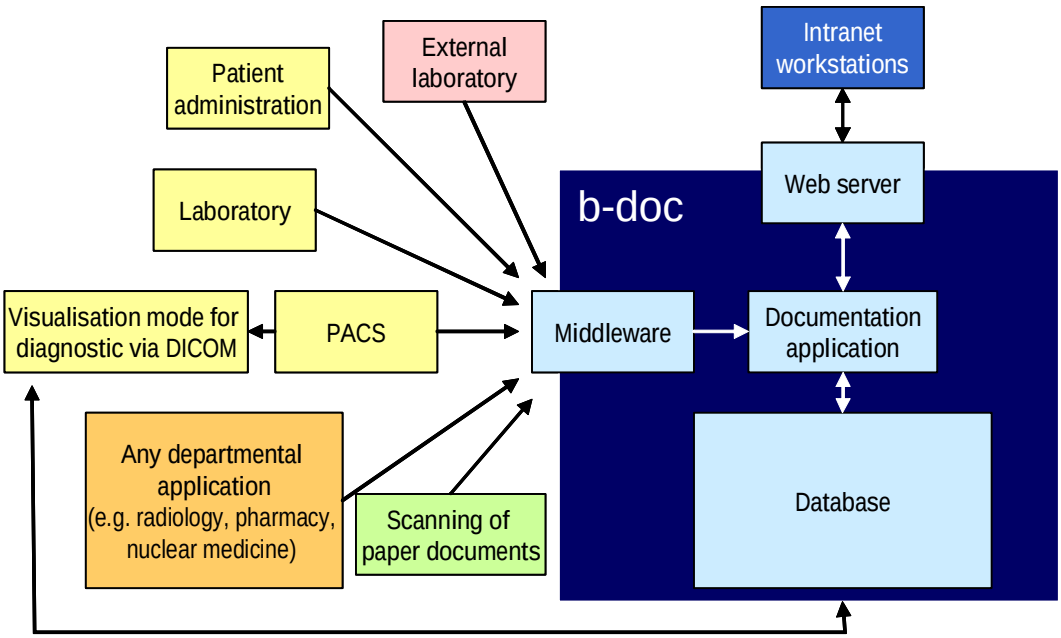
Systems development

The hospital's information system comprises of numerous elements that were integrated step by step. The complete system is shown in Exhibit 1. Important examples of the integration effort included a new imaging system, referral letters, paper documents and external laboratory results:

- The former imaging system of the Ambroise Paré hospital had no electronic system but produced output in paper and X-ray film format. The new imaging system could be integrated easily because it can output general imaging formats and it supports the DICOM standard which is common for medical imaging. The b-doc database, which stores its images in jpeg format, is back-linked with the imaging software that loads a special web-client for further in-depth visual examination. The data itself is stored solely in established and widely used formats to ensure convertibility in case the format vanishes from the market.
- Referral letters written by medical secretaries are still in MS Word and transferred to b-doc as any other document via the printing driver.
- In order to complete the patient file, paper documents for example from external laboratories or referral letters from GPs had to be integrated into the system, too. These documents receive a label with the unique visit number of the patient and are scanned in a special department.
- An external laboratory was also connected by tunnelling the results through the internet using the Secure Shell (SSH)[121] technology.

[121] Secure Shell is a set of standards and an associated network protocol that allows establishing a secure channel between a local and a remote computer. It uses public-key cryptography to

Figure 1: Integration of departmental and external information resources in b-doc



Source: Hôpital Ambroise Paré 2006, modified by empirica

User training

The informatics department of the Ambroise Paré hospital employs six persons. Two of them are responsible for hardware maintenance, the other two manage the templates of and connections with b-doc. Training was carried out by, on average, one person half a day throughout the six-month introduction of the system. One hour per ward proved to be sufficient to train the staff on the system. A helpdesk was established but then abolished because it was never used by staff. Once a year physicians receive an update training session on newly integrated medical devices as well as on planned connections. If new personnel are employed, initial training takes place on the job by experienced staff. The simplicity of the system makes special training near to redundant.

In order to improve the solution, the integration of a nursing care record is ongoing. Furthermore it is planned to connect external physicians like GPs to the system and give them access to the examination results of their patients. A next add-on planned is the implementation of a voice recognition system for dictating reports directly into the reporting templates.

Impacts

The following benefits of integrating the information systems in Ambroise Paré hospital are most important:

- **Flexibility through integration:** The integration of separate information resources into a rather loosely coupled database makes the hospital independent from determined hard- and software vendors of the subsystems.

authenticate the remote computer and to allow the remote computer to authenticate the user optionally.

Thus departmental systems can be changed independently from the whole system and also provide the possibility of a stepwise integration.

- **Reduced document loss:** The loss of documents is largely reduced. Before the introduction of b-doc, losses and confusion of documents could occur more easily.
- **Round-the-clock access to documents:** For cost reasons, the hospital's archives were often not open 24 hours. Time consuming search for older documents thus delayed the medical process in some cases or even prevented physicians from the consultation of these documents. Instant availability motivated physicians to consult more material, in the end improving the quality of treatment.
- **Increased trust:** Well-informed physicians who are aware of outcomes of previous treatments increase the trust and confidence of the patients. This is especially important for a hospital where different physicians treat its patients.

While these benefits may imply indirect financial benefits, the direct financial benefits of the b-doc system are considerable: The number of medical secretaries was reduced from 16 to seven, the number of archive assistants was reduced from eight to two, expenditure for radiology film was reduced from 400,000 to less than 12,000 euros a year, and paper archive costs were reduced from 100,000 to 25,000 euros a year.

These cost savings already equal the construction and implementation costs for b-doc within a time period of about two years. The costs for creating and implementing the solution were about 2.5 million euros, requiring the installation of about 430 PCs all over the hospital to allow access to b-doc.

Lessons learned

Ambroise Paré hospital is a good example for the integration of separate hospital information resources. The most important lessons learned are the following:

- **Integration from the user's point of view**. When the Hôpital Ambroise Paré aimed at integrating its information resources, it was more important to receive instant access to information than achieving sophisticated integration of information formats which would very likely involve semantic problems.
- **Staff and patient at the centre of efforts**. Ambroise Paré hospital shows that involving staff in the development process and in the general design of a solution meant to support users makes a solution accepted and widely applied.
- **Pragmatism in solution specification**. An important success factor was simply the availability of nearly all medical information through a single user interface, even if only provided as an image or scan. The hospital focused on its core aim and found a simple, reliable and sufficient solution. The current integration can later on become the basis for harmonisation of information and aligning medical terminologies.

- **Simple operation**. As with many other successful ICT products, like Google, it is their ease of use that makes them widely accepted. Again this is the result of a strong focus on both staff and patient.

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- *Ambroise Paré Hospital's website at http://www.hap.be, August 2006.*

4.2.5. Summary of main points and conclusions

This chapter dealt with the implementation and integration of departmental hospital information systems which are the core means of e-business in hospitals. The analysis shows that HIS can offer considerable benefits to hospitals. However, there is yet no comprehensive use of HIS in European hospitals and systems are often not integrated.

- **Implementation of hospital information systems**: The market offers a large number of departmental HIS for administration and management, medical records, orders, medical departments, clinical infrastructure and knowledge management. Their implementation can be beneficial to hospitals with regard to efficient resource use, improved quality of care and also job satisfaction of health professionals. However, there may also be downsides of HIS use, e.g. ICT can fail or may reduce personal relationships.
- **e-Prescribing and medication management**: Electronic medication management by systems such as Computerised Physician Order Entry (CPOE) can potentially reduce medical errors and, ultimately, save lives. Yet, only a few hospitals reported to have such systems (see section 4.2.1). This may make the introduction of medication management systems a high health policy priority. However, there is also evidence that under particular circumstances such as a need for very quick medical intervention, CPOE systems may not be useful.
- **Imaging technologies** are among the most important diagnostic methods in hospitals. Electronic imaging offers improved visualising, archiving and communication methods and can thus improve diagnosis and quality of care as well as reduce administration costs. Electronic imaging can be supported by Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS). Nevertheless, only around a quarter of hospitals in Europe reported having such systems (see section 4.2.1).
- **Integration of Hospital Information System**: As hospital health services require the interaction of various departments, the interoperability of departmental information systems should be assured. However, often the systems are not integrated. The main reasons for a lack of systems integration may be a lack of ICT planning which may to some extend be due to an often complex organisation of hospitals, difficulties with ICT providers (see section 3.10) as well as a lack of industry standards (see section 3.4).

4.3 Impacts of hospital's ICT investment on the wider health care system

4.3.1. HIS support to continuity of care

About the importance of continuity of care

Healthcare is often specialised and fragmented. Health care for a certain patient may involve numerous points of care, i.e. different hospital departments, various hospitals and health care providers outside the hospital. There may also be various stages of healthcare such as prevention, diagnosis, treatment and rehabilitation.[122] Continuity of care may be hampered because the data flow between various health professionals and institutions may not be optimal. Data availability may be delayed, data may be insufficient or data may be neglected:

- **Delayed availability of data.** Patient records in paper files may be not at the place where they are supposed to be. They may be mislaid, used by a colleague or sent to the hospital's financial department for accounting purposes. This requires to searching for the records or waiting for their availability, thus delaying the treatment of the patient.
- **Low-quality data.** Health professionals involved in providing a sequence of tests and treatments may find that the information they receive from their predecessors is not of adequate quality. It may be insufficient, wrong or the source may be not clear. For example, a general practitioner continuing treatment after a patient's release from hospital may feel that the discharge letter does not provide enough information. This problem arises particularly for patients with chronic diseases. It may also be that the data are wrong or that their source is not clear.
- **Neglect of data.** Suboptimal care processes may cause neglecting of data. For example, after change of shifts in ambulatory departments, staff may neglect test results that come in when the patients are no longer in the hospital. Data may also be neglected if one health care professional does not trust the data from another.

Consequently, further treatment may be delayed or repeated which causes unnecessary costs, may cause discomfort for patients, and which reduced the quality of care.

ICT can support the structured communication among clinicians for health care provision. ICT can facilitate the integration of large amounts of data and the access to this data that is required for continuity of care. This is a complex task. There are several related challenges with several dimensions, such as cross-aggregation, cross-interoperability, cross-interrogation and cross-quality control. Electronic health records and patient summaries as well as web services are all means of improving continuity of care which are currently on the e-health agenda of many European countries and hospitals. They will be defined and discussed in more detail in the following.[123]

[122] See Iakovidis (1998), pp. 105 – 106.

[123] Further ICT-supported methods which are however not discussed here include shared clinical pathways and disease management programmes which define processes that can minimise variability in treatment and ordering by staff.

The role of electronic health records and patient summaries

For records administered in a simpler manner, for example in single organisations or units, the term "electronic patient record" is used in this report. The term "electronic health record" in this report refers to a comprehensive concept: Electronic health records (EHRs) are *"digitally stored health care information about an individual's lifetime with the purpose of supporting continuity of care, education and research, and ensuring confidentiality at all times"*[124]. When defined in this comprehensive way, there are currently only few, if any electronic health record systems in Europe or around the world.

In practice, the term "electronic health record" is quite often used for the administrative or clinical records of a patient in a single institution, not covering all encounters with the health system during his or her lifetime.[125] According to the HINE surveys, roughly 50% of the hospitals in Western European countries claim to have EHR systems. However, the survey also revealed that in most cases the systems lack functionality and are not integrated with the internet or do not allow access by other providers. This reflects the wide variety of differing EHR definitions which make reliable comparison of data on this subject more or less impossible. The HINE survey 2004 also included interviews with 14 public authorities of European countries about the benefits of EHRs.[126] The interviewees said that continuity of care is the most important benefit of electronic health records, followed by quality of care improvement and patient safety all of which are closely related.

The reasons for the underdevelopment of EHRs are manifold:[127]

- health professionals' professional backgrounds do not necessarily support the idea of the sharing of patient information;
- common standards are not yet agreed;
- legal requirements are complex;
- industry is facing high costs for development and customisation of EHR systems due to different legal requirements, languages and work processes in each country and hospital;
- health care managers and authorities often lack vision and leadership; and.
- electronic patient records are not necessarily accepted by the health professionals supposed to use them.

Hospitals may have electronic patient records, but there may be different systems for clinical and administrative patient data or for data from different departments. Furthermore, data access from outside the hospital or by other organisations may be impossible.

In order to progress towards the vision of EHRs, several European countries are currently preparing to introduce electronic patient summaries. They are meant to include an extract from a more comprehensive electronic patient record or they represent a specific

[124] Iakovidis (1998), p. 106.

[125] See also Wilson (2006), p. 18 – 20.

[126] The question was: "*What opportunities for improvements do you foresee through a wider use of EHRs?*"

[127] See Iakovidis (1998), pp. 109 – 113.

document summarising key health data. The information is stored on a small electronic file and is accessible via electronic networks or a smart card. This information will help a medical professional to assure basic continuity of care of a patient who is hitherto unknown to him. Thus, electronic patient summaries would also be of high value to hospitals.

In the framework of the eHealth ERA project funded by the European Commission, a survey of national e-health decision makers and experts was conducted in early 2006. [128] 18 countries, of which 15 were EU Member States, responded to the survey. Results show that the plans of many countries have various parts in common. The patient summaries generally include information on the medical history, allergies, current problems, test results, and medications, as well as similar administrative data. The survey also showed that most standards used are national so that an international use of a patient summary may not be currently possible.

The role of web services

Web services are software applications for automated information services that use Internet technologies and are accessed through the Internet and intranet. There is an obvious possibility of misunderstanding: the term "web services" does not refer to the design and maintenance of websites and they are not "services marketed through the internet". In fact, web services imply communication between computers only and do not have a user interface; the user at the PC may only trigger such services. For example, a hospital physician may, from a workstation, send a command to the hospital's database asking to retrieve X-rays of a certain patient. The database then may "ask" the hospital's PACS and the computer system of an external radiologist whether such X-rays are available. The automatic communication between the database on the one hand and the PACS and the external system on the other hand may be carried out by a web service. In this way, comprehensive and immediate information retrieval is facilitated.

Web services are now gaining foothold as a key integration technology and as a new approach to extend information services beyond the boundary of traditional information systems. For example, the ICT Director at Barts and The London Trust hospital, asked about emerging technologies, replies: *"Web services offering intelligent data integration across the various public sector providers."*[129]

Vendors and standardisation bodies are striving to arrive at standards for interoperable infrastructures that are essential for building systems based on web services. Hospital information systems based on service-oriented architecture can overcome major limitations of traditional internet and software development and evolution. Web services provide the agility to configure and reengineer information systems that are in pace with their growth and changing requirements. The potential benefits of web services paradigm make it attractive for a range of hospital applications in particular, where there is a growing need to share information and services.

[128] See the project's website at http://www.ehealth-era.org. Results of the survey will be published on this website.

[129] See Major (2005).

The impact and influence of this emerging new paradigm on health information system application development and deployment is yet limited. In spite of their potential benefits, web services based health information systems are far and few. The level of adoption may partly be due to unique problems and challenges in developing and deploying real-life applications based on web services in the healthcare domain.[130]

Case study findings

The case study about ICT implementation in *Son Llàtzer Hospital* indicated how ICT can improve the continuity of care when general practitioners' can access patient data from the hospital's electronic health records. The following case study about the *Institut Curie* in Paris illustrates the benefits of HIS for the continuity of care in more detail. It shows how an Electronic Patient Record can facilitate access to patient data within and also outside the hospital, reducing times between diagnosis and treatment significantly. It also shows how a "meta search engine" can be used to improve clinical pathways. The case furthermore provides lessons about successful change management from a paper-based hospital to an electronic one.

[130] Information on this sub-chapter partly taken from a call for papers about web services at http://www.idea-group.com/downloads/pdf/CFP-WS%20in%20HIS.pdf. The International Journal of Healthcare Information Systems and Informatics will have a special issue on web services in health care in April 2007. A number of research and technology development projects funded by the European Commission in its 6th Framework Programme are based on web services, e.g. ARTEMIS (http://www.srdc.metu.edu.tr/webpage/projects/artemis/index.html) and NOESIS (http://www.noesis-eu.org/).

CASE STUDY: ELECTRONIC PATIENT RECORD AND SEARCH ENGINE AT THE INSTITUT CURIE, FRANCE

Abstract

The Institut Curie in Paris, France, is a hospital specialised in oncology seeking enhanced continuity of care inside and outside its walls by using computerised applications. Two e-health tools form the heart of the institute's ICT systems: Elios and Prométhée. Elios is a comprehensive Electronic Patient Record system, allowing patient data access during consultations, diagnosis and treatment. Prométhée is a sophisticated, yet simple to use search engine that enables the healthcare professionals to clarify medical questions across the hospital's databases, including Elios. Elios and Prométhée together fundamentally transformed healthcare processes. They improved the continuity and quality of care by offering access to patient data anytime, from anywhere in the hospital and from outside. Both tools can be accessed by all members of the healthcare team involved in their treatment. In the case of Elios this includes external partners such as other hospitals or General Practitioners. The tools also led to considerable economic benefits.

Case study fact sheet

Full name of the hospital:	*Institut Curie*
Location:	*Paris, France*
Main business activity:	*Research and treatment, specialised in oncology*
Year of foundation:	*1921 (accredited)*
Number of beds:	*185*
Number of employees:	*1,200*
Income in last financial year:	*100 million euros*
Area from which patients are drawn:	*75% Paris region, 25% France and other countries, including all EU Member States*
Focus of case study:	*Electronic Patient Records, Meta Search Engine*
Key words:	*Continuity of care, electronic patient records*

Background and objectives

The Institut Curie in Paris, France, is a private, not-for-profit foundation that was accredited as a public service in 1921. Its twin missions are treatment of and research into cancer; its activities range across direct healthcare, clinical research and fundamental research. The Institut Curie is one of 20 cancer centres in France and carries out up to 2% of all cancer treatments in France. Cancer centres are complex organisations with many multi-disciplinary teams. At the Institut Curie, there are more than 100 different professions within a total staff of about 1,200 people. Curie is one of a few extensively computerised oncology institutes in Europe.

e-Business activities

A dynamic development towards continuity of care applying e-health

Until the early 1990s, the Institut Curie mainly worked with conventional paper records. It had a few departmental ICT systems that were poorly coordinated. Today, the Institut

Curie is equipped with 60 distinct information systems. The most important ones are an electronic patient record named Elios and a meta search engine named Promethée which are described in detail in the next sub-sections. The institute's development strategy for the next few years focuses on consolidating these 60 systems as well as expanding the number and range of deployed e-health applications and tools. The strategy addresses information exchange with citizens and healthcare professionals outside the Institut Curie, seeking to ensure continuity of care even outside the hospital's walls. This is an important issue because cancer is a chronic disease that requires a multi-disciplinary team to provide effective healthcare, often involving several hospitals and general practitioners. Outward-oriented e-health activities of the Institut Curie include the following:

- Active participation in centralised patient record systems: nationally, in the personal medical record (Dossier Médical Personnel) development which is in an experimental stage; regionally, in the oncology communication record (Dossier Communiquant en Cancerologie) project, which is in planning stage and specific to cancer care. These record systems are meant to allow any physician involved in treating a certain patient to access the patient's data online at any point of care.
- Managing the mobility of Curie medical teams and ensuring the continuity of their access to patient information. At the moment, Institut Curie professionals can already access the institute's computer system remotely via the Internet. This is an important opportunity, for example when the condition of a patient changes and the physician who can help best is not at the hospital but, e.g. at a conference. Current difficulties are mainly related to appropriate authentication of the users in order to ensure data confidentiality.

The long-term e-health vision of the Institut Curie includes the full integration of the hospital with national and regional health networks. It also includes the integration of healthcare and research between the Curie hospital and research centre.

Elios – a sophisticated electronic patient record

Elios is an electronic patient record established in 2001. In June 2006, Elios contained 78,000 electronic patient records. It also comprised some 15 ICT systems, such as clinical reporting, medico-technical reporting, Picture Archiving and Communication System, reporting laboratory results, and a repository tool. Clinicians and their teams use Elios during consultations, for diagnosis and treatment, and dealing with patients' questions on the phone. Elios replaced paper and film systems comprising of a huge compilation of text and images, often lacking precision and completeness. Elios is heavily used and critical to effective and efficient operation of the hospital. As paper records are no longer produced in the hospital, Elios is now the unique and validated reference for Curie's medical information.

Prométhée – an advanced search tool for medical information

Prométhée is a tool for searching data in the Institut Curie's information systems, including Elios, established for routine operation in 2002. Unlike Elios, it is not accessible from outside the institute, but this is an option for the future. The institute's professionals use Prométhée for finding information for interpreting and evaluating medical data. Typical contexts of use for Prométhée include finding answers to questions about clinical patient data on-demand and evaluate medical practices. While Elios provides data for a

specific patient, Prométhée enables doctors to compare the condition of several patients and their histories, thus aiding diagnosis and information about possible treatment procedures: Did a particular treatment work in other similar cases? If not, why? What did work? Prior to the implementation of Prométhée, computerised information could only be interrogated by three different services: the ICT Department, the Medical Information Service, and the Biostatistics Service. A typical result was a delay of a few days or up to several months in receiving the answer to a question. The use of Prométhée increased from about 6,000 inquiries and 119 users in 2002 to over 30,000 inquiries and 142 users in 2005.

Change management resources

For the implementation and development of ICT systems, the Institut Curie put in place dedicated resources for change management. A Medical Information Department was one of the teams that were created, comprising of doctors, nurses, secretaries, technicians and ICT project managers. Training resources ensure that new personnel are trained in all the ICT tools they need in their profession. The e-health development process is reviewed formally by internal managers and users – i.e. physicians and nurses – every two years to ensure its integration into the overall strategy of the Institut Curie.

Impacts

Main benefits from Elios

Main benefits of Elios arise from enhanced availability of patient records, facilitated navigation through patient records, data completeness and improved data quality, leading to improved healthcare quality, reduced storage space and dedicated human resources:

- **Enhanced availability of patient records.** Patient records are available continuously, instantaneously and concurrently, therefore considerably improving the continuity of care. Elios reduced the time for accessing patient records from 30 minutes or longer to a few seconds. Doctors no longer need to rely on secretaries and archivists to find and fetch paper records. With Elios, information can be shared between members of multi-disciplinary teams, facilitating better healthcare. It supports information exchange and data sharing between healthcare professionals inside and outside Curie, and it is available to all of Curie's physicians from outside the institute.
- **Facilitated navigation.** The Elios user interface provides numerous features that facilitate the navigation. This is achieved through constantly maintained classified and structured information, as well as a summary view of each record.
- **Improved quality of care.** Identifying the information needed for each record is more structured with Elios, improving data quality and benefiting clinical risk management. Before Elios, more than eight different paper or film records were needed, each with different storage and archiving systems, including administrative, clinical, radiology, radiotherapy, anaesthesia, nurse, transfusion and social care.
- **Reduced storage space.** Space needed for paper document storage typically is hundreds of cubic metres, and considerable personnel are also required, mainly archivists, to maintain the documentation supply chain.

Main benefits from Prométhée

Prométhée offers the following benefits: Prompt answers to questions on-demand, activity reporting, faster completion of research and evaluation studies leading to earlier implementation, rapid evaluation of medical procedures reducing the cost of studies, as well as audits permitting faster adjustments of the hospital's organisation. These benefits are achieved through evaluation of medical practices, medical pathways, and medical information quality:

- **Evaluation of medical practices** is easier and faster with Prométhée compared to paper records. It enables evaluations that use all available data and that are repeatable. These studies define a novel concept of real-time clinical audit, with benefits that include faster compliance to international standards and evidence, improved clinical effectiveness and improved clinical risk management. Compared to a typical paper-based evaluation, Prométhée can advance the pace of change towards new practices by about three years.
- **Evaluation of healthcare pathways.** A concrete example of using Prométhée as a tool to evaluate and set healthcare pathways is the treatment decision for breast cancer. Switching to a new healthcare pathway needed co-ordination, modelling, processes and hence change management. Prométhée was used to provide rapid access to the information needed to evaluate the new model, define the new roles and specify the new information needed to support the team's efforts.
- **Evaluating medical information quality.** A Prométhée tool which is currently under development will ensure data quality. It enables nightly quality control checks across ICT systems and generates quality reports to support data audit, ensuring that data quality is maintained.

Economic and productivity analysis

Elios and Prométhée are very different types of e-health investments. Elios had a long lead-in time of six years for development and design (1995 – 2001); Prométhée had a much shorter time period of ten months (May 2001 – February 2002) for the release of the first deployed prototype which had rather simple possibilities. Since then, it has been in constant development. Over the 14 years from 1995 to 2008 – including planned and estimated costs for the years of 2006 to 2008 –, 11 million euros were spent on Elios and 800,000 euro on Prométhée.[131] Thus, Elios is a high-cost application, while Prométhée is relatively low-cost. Elios accounts for about 90% of the total recurring costs of both applications, Prométhée for about 10%. Development, hardware and software costs were incurred from 1995 to 2005 and represent about 76% of the total cost for both systems; associated costs of organisational change are estimated at about 24% of total costs.

The cost-benefit ratios of Elios and Prométhée differ, too. Elios' ratio is 1 to 3.8; Prométhée's ratio is 1 to 5.1, with a combined ratio of 1 to 3.9. Over the whole life-cycle of the evaluation of the two systems, 91% of the benefits are from Elios, 9% from Prométhée. These figures reflect the higher cost of change and longer preliminary cost

[131] These and the following figures are taken from the eHealth Impact project, http://www.ehealth-impact.org.

curve and training need for Elios. Core numbers of the analysis, as estimated at 2005 constant prices, are presented in the following Exhibit 2.

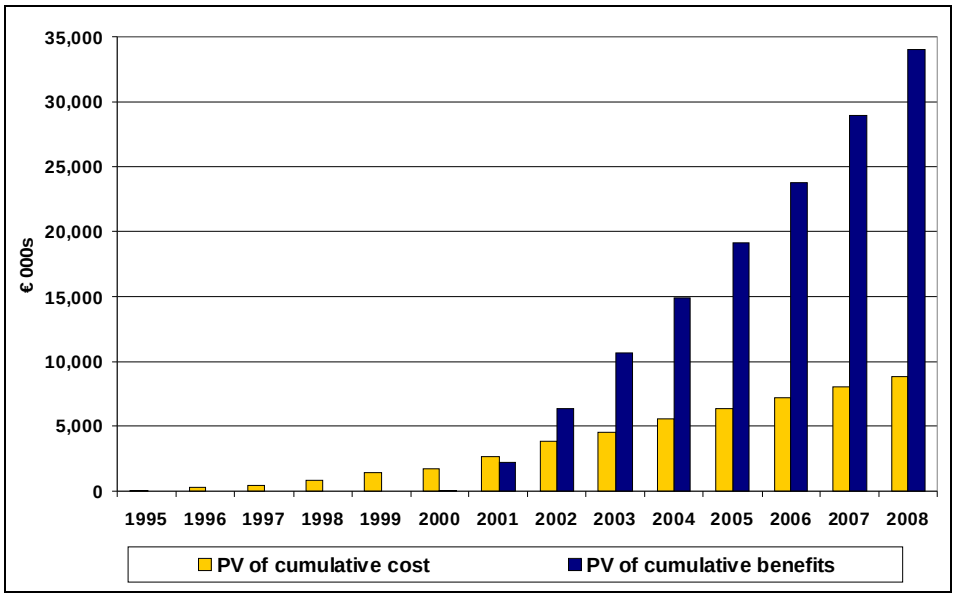
Exhibit 2: Costs and benefits of Elios and Prométhée (estimations)

	Elios	Prométhée
costs over 14 years	11 million euros	0.8 million euros
benefits over 14 years	43.7 million euros	4.3 million euros
Spending profile	Hardware 39%, software development 22%, change 39%	Hardware 4%, software development 49%, change 47%
Combined spending profile	Hardware 37%, software development 24%, change 39%	

Source: eHealth Impact project 2005

Together both systems achieve a positive estimated present value of annual net benefit from year seven, i.e. 2001. The rapid increase in benefits from 2001 reflects the comprehensive implementation of Elios. This translates to a cumulative net benefit from year eight onwards, i.e. 2002, as shown in Exhibit 3. Hence it represents good value for money in economic terms.

Exhibit 3: Present value of cumulative costs and benefits for Elios and Prométhée



Source: eHealth Impact project 2005

Lessons learned

Recommendations for effective change management

Institut Curie provides the following lessons to be learned about managing the change from a paper-based hospital to a hospital with large-scale computerised applications:

- **Effective medical leadership.** The successful implementation and development of ICT systems such as Elios and Prométhée depends on effective medical leadership with excellent clinical and ICT skills as well as on effective integration, motivation and engagement of the clinical staff. The implementation of an additional organisational unit – such as the Medical Information Department – may be useful. The Institut Curie avoided several potential barriers to success, including

resistance of clinicians, losing direction and momentum during the seven year wait for net benefits, and failing to recognise the need for effective change management.

- **Multi-disciplinarity.** Quality and expertise of the principal multi-disciplinary teams in dealing with all the dimensions of the investment needs to be ensured. Team members need to be highly specialised in more than one discipline, ensuring sufficient overlap of common vocabulary. The teams need to sustain a continuum of understanding across a wide range of disciplines and professions.
- **Regular reviews and evaluations.** There needs to be a frequent comprehensive review of whether the e-health solution at its current stage of development meets the organisations' overall strategies. Different views and priorities need to be presented and assessed.
- **Easy accessibility of Electronic Patient Records (EPRs).** For establishing an EPR, the focus should be on combining text, structured data and images into one easily accessible patient record so that clinicians can improve their performance and team work. In addition to the EPR, clinicians should receive an e-health tool like Prométhée that can provide information beyond data on a patient in treatment at a particular point in time; e.g., enabling comparisons with previous diagnosis and treatment of other patients.
- **Modest resource allocation.** Allocation of resources towards ICT as a percentage of total resources should be modest, yet sufficient and well managed.
- **Perseverance.** Efforts towards change must be made every day, but achieving complex changes in a complex organisation can take up to seven or eight years.

Transferability

Elios was designed and developed for the Institut Curie, so may not be directly transferable to other hospitals without modification. Prométhée could be transferable with some minor modifications. Probably the most important, yet challenging, feature of transferability is the approach, attitude and culture of the Institut Curie to eHealth investment, as described in the lessons learned above.

References

Research for this case study was conducted by Veli N. Stroetmann and Alexander Dobrev, empirica, as well as Tom Jones, TanJent Consultancy, on behalf of e-Business W@tch. Sources and references used:

- *Interviews with the following executives at Institut Curie: Alain Livartowski (Medical Information Service and Institut Curie eHealth Co-ordinator, Paul-Christophe Varoutas (Medical Infocentre Coordinator), Mylène Jarossay (Executive CIO), Brigitte Sigal-Zafrani (Institut Curie Breast Cancer Group Co-ordinator), March and May 2006.*
- *Institut Curie's website at http://www.curie.fr/hopital.*
- *Findings from the eHealth Impact project, http://www.ehealth-impact.org.*

4.3.2. A changing role of hospitals due to ICT investment?

Domains to be considered and importance of the issue

Due to increasing investments in ICT the role of hospitals – i.e. their functional position within the overall health care system – may change. Such a change of roles can affect at least two domains. Firstly, the relationship towards patients; secondly, the division of labour with other health care providers, including primary versus secondary and also tertiary care providers, public versus private hospitals, and local versus regional and national or even international level hospitals. A discussion of the role of hospitals is important because this changing context may lead to considerable investment and policy implications.

Role of hospitals: in-house, comprehensive, specialised, around the clock care

The general role of acute care hospitals is that of providing health care in a way that cannot be dealt with adequately by general practitioners. The subsidiary role of hospitals is indicated by the notion of "primary care" which general practitioners or nurses are in charge of and "secondary care" which is mostly undertaken by hospitals. "Tertiary" care denotes university hospitals engaged with scientific teaching and research or other highly specialised hospitals concerned with services for particularly difficult, complex or rare diagnostic and treatment needs. The reasons why secondary or tertiary care in hospitals may be necessary for a citizen can be related to four core functions of hospitals: in-house care, comprehensiveness, specificity, point of time of care or a combination of these:

- **In-house.** The health condition of the patient may be so serious that in-house health care with overnight stays is required, for example in case of emergency or for more serious surgical treatment. Offering in-house care is by definition a characteristic of hospitals. In-house care includes the possibility of continuous care and monitoring the patient's vital data continuously, applying immediate action if necessary. Hospitals may also offer ambulatory care.
- **Comprehensive.** Hospitals have different medical departments and wards, and a comprehensive infrastructure that offers rapid access to different tests, diagnostic devices and comprehensive treatments.
- **Specific.** The health condition of the patient may require specific treatment that is only possible in a hospital, sometimes maybe only in a highly specialised tertiary hospital. Such specificity may be related to the availability of knowledge or technical facilities.
- **Around the clock.** Health treatment may be necessary at a time when a GP is not available, for example at night or during weekends. Acute care hospitals provide services around the clock. However, service provision may nevertheless be restricted due to necessary waiting times or unavailability of certain specialists.

ICT may affect all of these criteria, directly or indirectly. The possibly changing role of hospitals can therefore be analysed in a matrix of role domains and role characteristics, as shown in Exhibit 4-5. The core aspects of this matrix are elaborated in the following.

Exhibit 4-5: Matrix for analysing a possible changing role of hospitals due to ICT investment

Role domain	Core functions of hospital care			
	in-house	*comprehensive (no impact identified)*	*specific*	*around the clock*
Relationship towards patients:				
Remote care	ICT allow home monitoring, reducing need for in-house care			e-Mails and EPRs can make health information available anytime
Ambulatory care	Health data submitted to the hospital electronically before and after an operation may prevent the need of overnight stays			
Division of labour with other providers:				
Primary, secondary, tertiary care	EPRs facilitate communication between hospitals and GPs, reducing need for in-house care			
Public versus private hospitals			Possible crowding out of public hospitals by private ones due to their larger investment power, also in ICT, can potentially compromise the provision of specific health care in certain regions	
Geographical level			ICT can help specialised hospitals to support general hospitals in the countryside in treating patients with specific diseases	

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

Relationship to patients

ICT can offer the opportunity of remote care, reducing the need for in-house care and potentially making health information available anytime. Firstly, if a patient's vital data – for example his or her heart condition – need to be monitored regularly, he or she may be monitored remotely without needing to stay in a hospital. Thus the in-house care role of

the hospital becomes less important. However, such monitoring applications are still in a premature state, if not from a technical point of view then commercially. Another barrier is reimbursement rules, respectively their absence.

Secondly, ICT may facilitate the patients' reception of medical advice in his or her home, or even while mobile, independent from particular times. For example, he or she may have the opportunity to exchange e-mails with the hospital's health professionals or to search for information in the individual electronic patient record stored in the hospital's database. In some cases, such online information may be sufficient for a proper diagnosis and self-treatment if necessary.

ICT may also facilitate the provision of ambulatory care in hospitals rather than in-house care. By submitting health data electronically prior to and after an operation, an overnight stay in hospital may be unnecessary in some cases.[132] However, ambulatory care opportunities currently rather tend to emerge through medical innovation, e.g. ambulatory surgery possibilities, not through ICT.

Primary versus secondary and tertiary care

ICT may make it easier for a hospital to communicate with GPs directly to provide a second opinion or specialised knowledge so that the patient does not need to go to the hospital. In this way, the need for hospital care and in some cases resident care can be reduced. For example, an electronic patient record (EPR) to which all hospitals and doctors have access can offer data availability independent of time or location. If, for example, a patient was treated in a hospital and a general practitioner who now is dealing with the patient wants to have more information, it may be difficult for him or her to reach the hospital professionals because they are off duty or in an operating theatre. Instead, the general practitioner can simply access patient data from the electronic record. This does not imply a different distribution of roles – the hospital remains the centre for more specialised treatment – but a change of interaction modes between professionals from different levels.

Public versus private hospitals

Secondary health care may be provided by public, private for-profit and private non-profit hospitals. The importance of these three different kinds of hospitals differs by country, and even between regions of the same country. The role of public hospitals is generally to ensure a certain level of secondary health care provision in a particular region. It may also have the role of contributing to practical education of medicine students and research. Private hospitals have the primary objective of making profit without necessarily having to follow regional or educational health care objectives. On the other hand, due to their sometimes superior quality of service they may be leading attractions at the national and even international level.

There are indications that private hospitals have better access to investment funds and actually invest more in ICT than public hospitals, at least in some countries, e.g.

[132] The Hospital District of Helsinki and Uusimaa is seeking this.

Germany.[133] The consequence may be that public hospitals are incrementally crowded out by private hospitals, either through them taking over parts of their responsibilities, through privatisation or through the independent closure of public hospitals. In the long run, this may in some cases negatively affect regional health care provision in general or in specific disciplines as well as medical student education and research. Thoughtful political planning may be required to prevent such possible negative consequences, depending on national rules and legislation.

Data from the e-Business Survey 2006 and also from HINE do not indicate a clear advantage of private hospitals over public ones with regard to ICT investment, as Exhibit 4-6 shows. As regards ICT investments in 2005, 84% of the public hospitals said they made such investments but only 77% of the private hospitals. HINE found that ICT expenditures by public hospitals were larger than by private hospitals. According to the e-Business Survey 2006, one third of the public hospitals (36%) said they plan to increase their ICT budget in the next twelve months, but only one quarter of the private hospitals (24%) said they plan to do so. However, private hospitals appear to have fewer difficulties in drawing funds for ICT investment: While 25% of the public hospitals in the whole sample indicated to have such difficulties, only 19% of the private hospitals did so.[134]

Exhibit 4-6: ICT investment indicators by hospital ownership

	Have made ICT investments in 2005		**Will increase ICT budget**		**Difficulty to draw funds for investments**	
Weighting:	% of empl.	% of hospitals	% of empl.	% of hospitals	% of empl.	% of hospitals
Hospitals (EU-10)	**87**	**79**	**34**	**27**	**36**	**23**
public	87	84		36	44	25
private for-profit	85	77		24	8	19
private non-profit	89	76		33	32	34
All 10 sectors (EU-10)	**65**	**50**	**25**	**21**	**19**	**15**
Base (100%)	hospitals using computers		all hospitals (excl. "don't know")		Hospitals with external funding sources for their ICT investments	
N (for sector, EU-10)	539		494		81	

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

Regional levels of hospital care

Hospitals often have particular functions in specific geographic spaces. These functions may be defined by health policy authorities in order to ensure cost-effectiveness of hospital health service provision. This applies in particular to small hospitals in regions with a low population density and relatively low numbers of patients. For example, hospitals in a certain region may coordinate their specialisation in particular disciplines so that only one hospital provides services in a certain field, e.g. paediatrics or gynaecology.

[133] See Sleegers (2006). The HINE surveys rather suggest that private for profit hospitals are less advanced and also spending less on ICT than public ones.

[134] The e-Business Survey 2006 findings for ICT budget share are not included in the discussion here because the data appear to be inconsistently high; see chapter 3.3, “outsourcing of ICT services and ICT investments”, Exhibit 3-6.

ICT can strengthen such specialisation. Computerised applications[135] can facilitate the communication of hospitals among each other, in some cases allowing the treatment of a patient who would otherwise have to be referred to a more specialised hospital. In sophisticated cases, ICT may even allow operations with remote support. Today this is practised in military applications and also on cruise ships and other maritime services. This does not change the overall role of hospitals but it affects the role of general hospitals by allowing them to offer more specialised services than before.

Conclusions on a possibly changing role of hospitals

The findings suggest that ICT-enabled solutions can indeed affect the role of hospitals particularly with regard to in-house care and specific care and in some respect to round-the-clock care. No influences on the comprehensiveness of care have been identified. Should indeed the options and new services discussed that are facilitated by e-health applications become more prevalent, it could impact the role of hospitals in three directions:

- Firstly, depending on the national regulatory framework, hospitals may involve themselves more directly in out-of-hospital services for citizens and patients than previously in case they are allowed to do so, thereby invading the realm of primary care.
- Secondly, primary care facilities become enabled to also deal with more complicated interventions, which would force general hospitals to focus on more complicated and demanding cases. Thereby general hospitals would become more specialised, and the role of research and teaching may become even stronger.
- A third direction would be more integrated care across various providers with hospitals acting as regional hubs, easing the sometimes very strict boundaries between primary and secondary care in national health systems.

All in all, the hospitals' boundaries appear to become incrementally more permeable; the role of hospitals appears to slowly shift from in-house care providers to what one could call "outbound communicators".

Case study findings

The *Son Llàtzer Hospital* and the *Institut Curie* support the suggestion that ICT impact on division of labour between hospitals and general practitioners. In the opinion of the Chief Information Officer of the Son Llàtzer Hospital, ICT changes the role of hospitals particularly as regards the communication between health care providers. He confirmed the importance of an electronic patient record that is accessible all the time also by health care provides outside the hospital. The Institut Curie stressed that continuity of care between various health care providers is important for treating chronic diseases and requires breaking down walls between health care providers. The following case study about the *Hospital District of Helsinki and Uusimaa* focuses on the possibly changing role of hospitals due to ICT. It shows that role changes primarily effect the relationship towards patients and that the impacts are rather incremental and slow.

[135] An example is the Medibridge software used in Belgium; see http://www.medibridge.de.

CASE STUDY: ICT IMPACTS IN THE HOSPITAL DISTRICT OF HELSINKI AND UUSIMAA, FINLAND

Abstract

In the Hospital District of Helsinki and Uusimaa (HUS) in Finland, electronic health services and Electronic Patient Records are incrementally impacting on the role of hospitals. The most important changes are taking place with regard to the relationship to patients. The patients are meant to be endowed with much more information about their health condition than previously, and as many tests and treatments as possible are meant to be done outside the hospitals. ICT supports the related flow of information. This will enable a reduction in the number of hospital visits necessary, reduce the length of stay in hospital, and lead to more outpatient visits instead of inpatient stays. ICT also lowers the boundaries between hospitals and primary care centres as information flow is speeded up and increased. There is also increased specialisation of hospitals in the region facilitated by ICT, i.e. the related enhanced level of information. The division of labour between hospitals of different size and of public or private ownership is apparently not affected by increased ICT use.

Case study fact sheet

Full name of the hospital:	*Hospital District of Helsinki and Uusimaa, 23 hospitals*
Location:	*Helsinki, Finland*
Main business activity:	*Specialised medical care*
Year of foundation:	*2000*
Number of beds:	*3,674*
Number of employees:	*20,382*
Income in last financial year:	*1,205 million euros*
Area from which patients are drawn:	*32 member municipalities of the Uusimaa province, whole of Finland for rare diseases*
Focus of case study:	*Changing role of hospitals due to ICT use*
Key words:	*Electronic health services, electronic patient records,*

Background and objectives

The Hospital District of Helsinki and Uusimaa (HUS) comprises 23 hospitals in the province of Uusimaa, which includes the Finish capital of Helsinki, in Southern Finland. In order to organise the provision of specialised medical care, Finland is subdivided into 20 hospital districts. The HUS is the largest of these. As a joint authority it was founded in 2000 to provide health services for the 1,434,513 residents in its 32 member municipalities. Among the HUS' hospitals is Helsinki University Central Hospital that is nationally responsible for treating special, severe and rare illnesses. In 2004, around 470,000 different people were treated in the HUS, roughly 310,000 of them outpatients.

In Finland the provision of health services is the responsibility of the municipalities. Health care is funded primarily from tax revenues. In the municipalities, primary health care services are provided by health centres, while specialised medical care is provided by

hospitals. A municipality may run its own health centre or it may do so together with other municipalities. Some municipalities purchase nearly all their health centre services from private providers. Maintaining the current standard of health services is a challenge because "municipalities are experiencing severe financial problems", as the chair of the HUS executive board, Aatto Prihti said. Although the Finnish economy continues to grow, the public economy is not keeping up. The HUS seeks to make health service operations more effective. One of the future challenges is the development of co-operation with primary care, implying to lower the boundary between primary and hospital healthcare. The HUS seeks high-level treatment results as well as patient and personnel satisfaction but the HUS vision does not include the implementation of ICT as a goal in itself.[136]

e-Business applications

In the HUS, the use of ICT is already very common. In the hospitals of the region, currently 15,000 PCs with 22,000 user accounts are installed, and 2.7 million e-mail messages are sent every month. The HUS hospitals are connected with each other and with municipal health services through a regional health information network. All HUS hospitals are filmless and use one central PACS for storing images since 2004.

Already in 1990, the Vanta hospital in the Helsinki region which today is one of the HUS hospitals was one of the first in the world to implement the "e-referral". It enables primary care physicians to refer patients to hospitals by electronic means. Since 2001 the e-referral it is also used in Helsinki hospitals. 50% of the referrals take place electronically; the others are done by means of paper. The e-referral is gradually being taken over, said Kari Harno, Chief Physician of the Helsinki University Central Hospital.

The HUS runs various projects for improving the use of ICT. Some of them are linked to national projects:

- **Electronic patient records project (ESPA).** The development of electronic patient records is one of the largest HUS projects. Currently almost every municipality in the HUS region uses a different patient record system. By the end of 2007, the introduction of electronic patient records is sought to be concluded, complying with a National Health Project. The ESPA project began in 2003. It will gradually introduce a patient administration system named MD-Oberon, a patient record system (MD-Miranda) and a client invoicing system (Asla). These will then be linked to other systems, e.g. for laboratory and imaging. Standardisation of HUS patient document systems is part of the project. In August 2006, 700,000 electronic patient records were already in place, covering 90% of the patients. At the end of 2005, MD-Oberon was already in use at Hyvinkää Hospital, the Skin and Allergy Hospital and the Surgical Hospital. The Eye and Ear Hospital and Töölö Hospital were the next in line.
- The **Uusimaa regional project** UUMA promotes new regional procedures using ICT. The core of the regional information system will be a reference data system that allows a patient's treatment data to be used, with his or her permission, regardless of where the treatment is taking place. UUMA pursues the objectives of

[136] See HUS Annual Report 2005, p. 11.

the National Health Project regarding smoothly functioning services and was brought into life in 2002.

- **Digital imaging.** In the framework of a national plan for archiving digital imagery, the HUS seeks to consolidate imaging services into a single administrative unit in the HUS area. Municipalities of the Helsinki Metropolitan Area already widely use the regional data system for the distribution of digital images.
- **Laboratory systems.** HUS seeks to standardise laboratory information systems and integrate them into the patient information systems of the region's municipalities.
- **Digital invoices.** A digital invoice project is proceeding. By the end of 2005, HUS estimated that it resulted in work input savings of two person-years.

There are also plans to introduce patient self-service applications, for example for electronic booking of appointments. The first of such applications may be available in 2007 or 2008.

The HUS has an ICT vision for 2012. Some of the most important elements of this vision include that patients are meant to contact healthcare providers from home using electronic communication, care personnel is meant to have all necessary information readily available, management is independent from organisation boundaries, and municipalities have real-time information about costs and quality of health services.

Impacts

Incremental impacts of ICT

Electronic health services and Electronic Patient Records are incrementally impacting on the role of hospitals in the HUS. ICT affect the relationship to patients, the interaction with primary care facilities, and the distribution of labour between hospitals in the region. Some of the impacts are actually taking place, others will occur or become much stronger in the future. In the HUS, no considerable impacts on hospitals of different size classes, ownership – i.e. public or private – as well as research and teaching duties are currently observed. The impacts are elaborated in more detail in the following.

Impacts on the relationship to patients

The most important changes are taking place with regard to the relationship to patients. The patients are meant to be endowed with much more information about their health condition than previously. As Kari Harno put is, the patient is meant to become "a part of the core team" of health care. ICT supports the related flow of information. Patients may submit vital data collected at home through electronic applications to a hospital. Tests that cannot be done at home are meant be done at primary care facilities to the largest possible extent and also transmitted to the hospital electronically. Necessary personal communication between the patient and the primary care facilities on the one hand and the hospital on the other hand may be done by phone. This will allow a reduction in the number of hospital visits necessary, the length of stay in hospital, and will lead to more outpatient visits instead of inpatient stays. Related procedures are not yet in place on a

large scale; there is no routine electronic interaction between patients, hospitals and primary care centres yet.

Some operations that previously had to be carried out with the patient staying overnight may be in the future carried out as ambulatory. In May 2006 a trial with 50 patients started to check out related opportunities. According to Kari Harno this is currently the only trial of this kind in Finland. Exhibit 1 shows how the administrative processes for a surgery run today and how they may run in the future, supported by ICT.

Exhibit 1: Administrative processes for a surgery at the HUS today and prospectively

Process step	Process today	Process in the future
Referral from primary clinician to hospital	Paper referral.	Electronic referral.
Appointment for initial information about the surgery at hospital	Hospital calls in the patient by mail. If schedule does not fit: telephone call.	Hospital calls in the patient by e-mail or SMS. Patient schedules the appointment in the internet with a personal code. Patient fills in basic information in an electronic form, maybe using his electronic health record.
Check-in for initial appointment	Patient comes to hospital. Registration at check-in desk. Patient fills in basic information in paper form.	Patient comes to the hospital. Check-in possible electronically (like at the airport). Basic information already filled in before at home.
Scheduling the surgery appointment	Surgery appointment by mail. If schedule does not fit: telephone call.	Patient schedules his appointment in the internet. Filling in further information, if need be, in electronic form.
Check-in for surgery appointment	Patient comes to hospital on day before surgery. Filling in of further information in paper form.	Patient comes to the hospital on the day of the surgery. Further information already filled in before at home.
Medical record after surgery	Patient receives copy of medical record by mail.	Patient receives copy of the medical record by e-mail or on the hospital's portal.

Source: Presentation by Janne Altonen, HUS, Chief Administrative Physician, at NCeHT 2006, Helsinki, 30/08/2006; modified by empirica

Lowered boundaries between hospitals and primary care centres

As primary care facilities carry out tests and examinations that were previously done by hospitals, and as test results are communicated electronically, the boundaries between hospitals and primary care centres become lower. The HUS seeks such a lowering of boundaries in order to improve continuity of care. *"Currently there is an information block between primary and secondary care"*, said Kari Harno. While improved information exchange directly improves the quality of care, it also opens up the ability to observe treatment outcomes across organisational boundaries. With such information *"you are able to redirect resources, money and personnel, to the place where they are used most beneficial"*, said Kari Harno.

ICT speeds up and increases the information flow between patient, primary care facilities and hospitals. The HUS' Electronic Patient Record also fosters electronic communication

between primary and secondary care. The related concept foresees that "diagnostic imaging and laboratory tests can be carried out near the patient's home or workplace even if the actual treatment is given at a different unit".[137]

Impacts on types of hospitals

There is also increased specialisation of hospitals in the Helsinki region, i.e. concentration of certain health services on certain hospitals. HUS hospitals seek such concentration in order to contain costs and improve quality of care. As regards care quality, physicians need a certain number of treatments and operations in order to maintain their professional capabilities. Such specialisation and concentration requires an enhanced level of information exchange between hospitals and also primary care facilities. Health professionals of different facilities need to exchange information about the availability of special services and capacities at other facilities. As Kari Harno put it, *"if you cannot exchange information, you cannot centralise hospitals' health services"*.

The division of labour between hospitals of different sizes is apparently not affected by increased ICT use. As Kari Harno said, specialisation is the most important issue. There is also no impact on tasks of hospitals in charge of university teaching and hospitals without this task. The Helsinki University Central Hospital is the only teaching hospital in the HUS and will remain the only one.

As regards hospitals of public and private ownership, public hospitals are buying more and more services from private hospitals but private hospital still do not play an important role. In Finland only 1 – 2 % of hospital services are provided by private hospitals, and they have an investment disadvantage against public hospitals because they are subject to value added tax.

Lessons learned

The most striking lesson of the HUS may be that even in a region with advanced ICT applications in hospitals, impacts of ICT on the role of hospitals are taking place slowly and incrementally. While it would technically be possible to fulfil the HUS ICT vision within a few years, it is planned to take until 2012 for organisational reasons. As is said in a brochure about the ESPA project: "*Changes in the organisation of the healthcare sector brought about by the introduction of electronic systems represent one of the greatest challenges. Old routines and work distribution will have to give way to new, more efficient methods.*"

One of the biggest barriers to enhanced ICT communication between primary and secondary care facilities is, as Kari Harno put it, *"that all doctors are used to seeing patients"*. They often do not want to rely on impersonal electronic information. Another barrier is that physicians are *"not easy to govern"* as they have a strong professional esteem. Furthermore, mature or eminent health professionals do not necessarily like to learn new procedures.

[137] See the HUS (2006) leaflet "ESPA means Electronic Patient Records", p. 5.

References

Research for this case study was conducted by Stefan Lilischkis, empirica. Sources and references used:

- *Interview with Kari Harno, Chief Physician, Helsinki University Central Hospital, 30 August 2006.*
- *http://www.hus.fi.*
- *HUS: Annual Report 2005.*
- *HUS: ESPA means Electronic Patient Records, 2006 (leaflet).*
- *HUS: UUMA promotes the smooth running of health care and social services, 2006 (leaflet).*
- *Presentations at the 6th Nordic Conference on eHealth and Telemedicine, pre-conference workshop at HUS, 30 August 2006, Helsinki, by the following experts: Antti Larsio, CIO, HUS ICT and Medical Engineering (HUC ICT for patients and personnel – objectives and basic information); Kari Harno, Chief Physician (Shared EHR and regional eServices). Selected presentations available for download at http://www.nceht.org.*

4.3.3. Summary of main points and conclusions

The previous sections dealt with impacts of ICT investment in hospitals on the wider health care system. Firstly, issues of continuity of care within hospitals as well as, and most importantly, across hospital borders were analysed. Secondly, the question whether the role of hospitals changes with regard to relationships towards patients and the division of labour in different hospitals and other health care providers was discussed.

- **ICT support for continuity of care**: Since healthcare is often specialised and fragmented, particularly when treating chronic diseases, there is a need for ensuring continuity of care across departmental and extra-mural interfaces of health care. ICT can support the structured communication among clinicians for health care provision, also according to shared clinical pathways. Patient summaries and web services are means of improving continuity of care which are currently on the e-health deployment agenda of many European countries and hospitals. However, there is yet little evidence for actual implementation of these two services.
- **Changing role of hospitals**: The role of acute care hospitals is to provide in-house, comprehensive, specific and round-the-clock care. In the course of increasing investment in ICT, the role of hospitals may change. The analysis suggests that the relationship towards patients and the need for in-patient care is affected particularly strongly. Certain applications may allow monitoring of patients' vital data at home, and electronic communication between hospitals and general practitioners may make a patient's visit at the hospital unnecessary. As regards geographic coverage and specialisation, small, general hospitals in less densely populated areas may benefit from ICT links to larger, specialised hospitals in other regions. Data from the e-Business Survey 2006 (see Exhibit 4.6 and also, in this context, Exhibit 3.6) do not indicate a clear advantage of private hospitals over public ones with regard to ICT investment. All in all, the hospitals' boundaries incrementally appear to become more permeable due to ICT; the role of hospitals appears to shift slowly from an in-house care provider to an outbound communicator.

5 Conclusions

This final section draws conclusions from the e-Business Survey 2006 findings and the analysis of core topics. Section 5.1 discusses business impacts of ICT and e-business. Section 5.1.1 deals with impacts on single hospitals, starting with further survey findings about the overall importance of e-business in hospitals. Section 5.1.2 deals with impacts on the hospital industry as a whole. Finally, section 5.2 elaborates on potential policy implications.

5.1 Business impacts

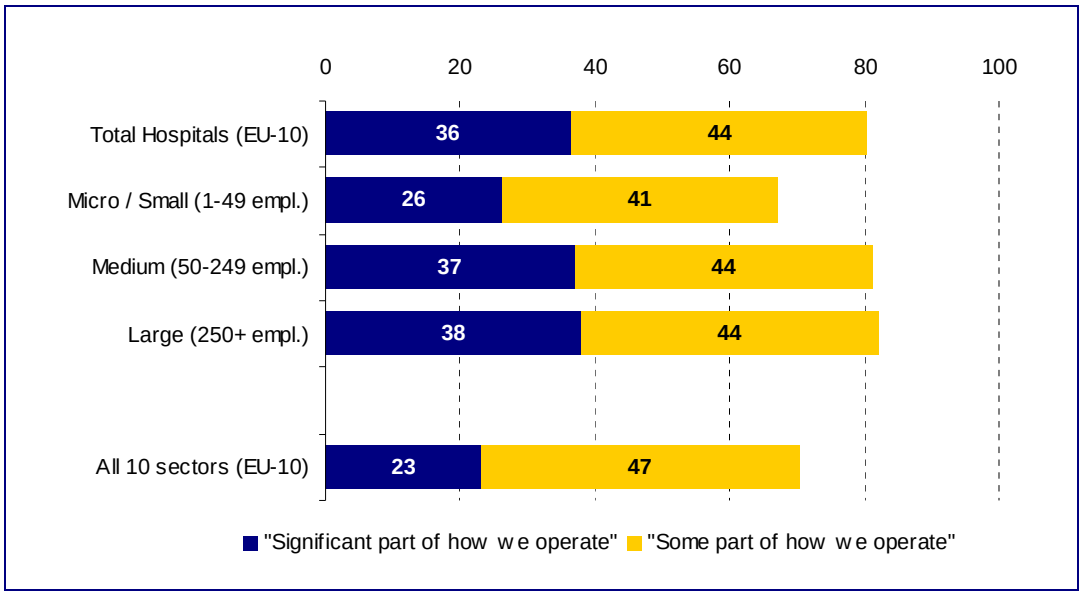
5.1.1. Implications for hospitals

Perceived overall importance of e-business

Overall findings: Interviewees of the e-Business Survey 2006 were also asked about their perception of the overall importance of e-business for their hospital's operations. 36% of the hospitals reported that e-business makes up a significant part of how the hospital operates. In 44% of the hospitals e-business was reported to have at least some part. The remaining 20% said that e-business does not play a role (see Exhibit 5-1).

Findings by sector: e-Business appeared to be more important in hospitals than in the other sectors considered in the e-Business Survey 2006. Only 23% of interviewees in all sectors together identified e-business as a significant part of their firm's operations.

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



Base (100%): Hospitals using computers (excluding "don't know"). N (for sector, EU-10) = 529
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H1

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

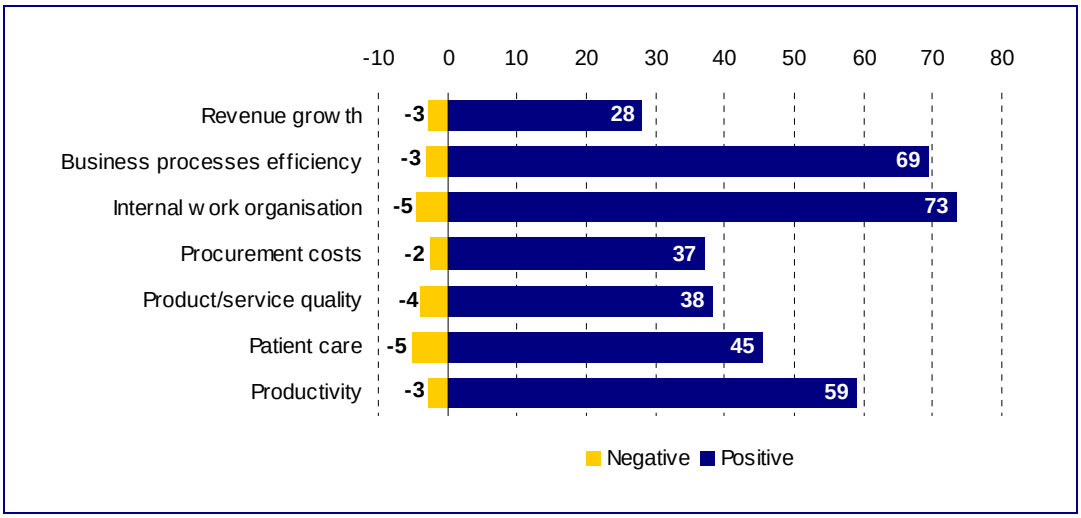
Findings by size class: e-Business appeared to be equally important in large and medium-sized hospitals. In small hospitals, the percentage of answers of "some part" were almost as large as in medium-sized and large hospitals, but the share of small hospitals stating that e-business constitutes a significant part of the operations was smaller (26% in small hospitals versus 37% and 38% in medium-sized and large hospitals).

Perceived influence of e-business for the hospitals' business

Overall findings: In the e-Business Survey 2006, the interviewees were asked about the influence of ICT use on various aspects of the hospital's business. The interviewees could assess the influence as positive, negative or not existing. The levels of reported negative impacts of e-business were negligible. As Exhibit 5-2 shows, positive effects of e-business were reported to be largest on internal work organisation (73%), business process efficiency (69%) and also productivity (59%).[138] These items are quite closely related and may be summarised with the term "streamlining".

This finding suggests that ICT use in the majority of hospitals helped to fulfil the objective of cost containment (see section 3-10). As shown in the same section, the level of reported positive impacts on patient care (45%) and service quality (38%) were considerably lower. Most interviewees stated that there was no influence on patient care and service quality at all. 5% of the interviewees reported negative impacts on patient care.

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



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H2

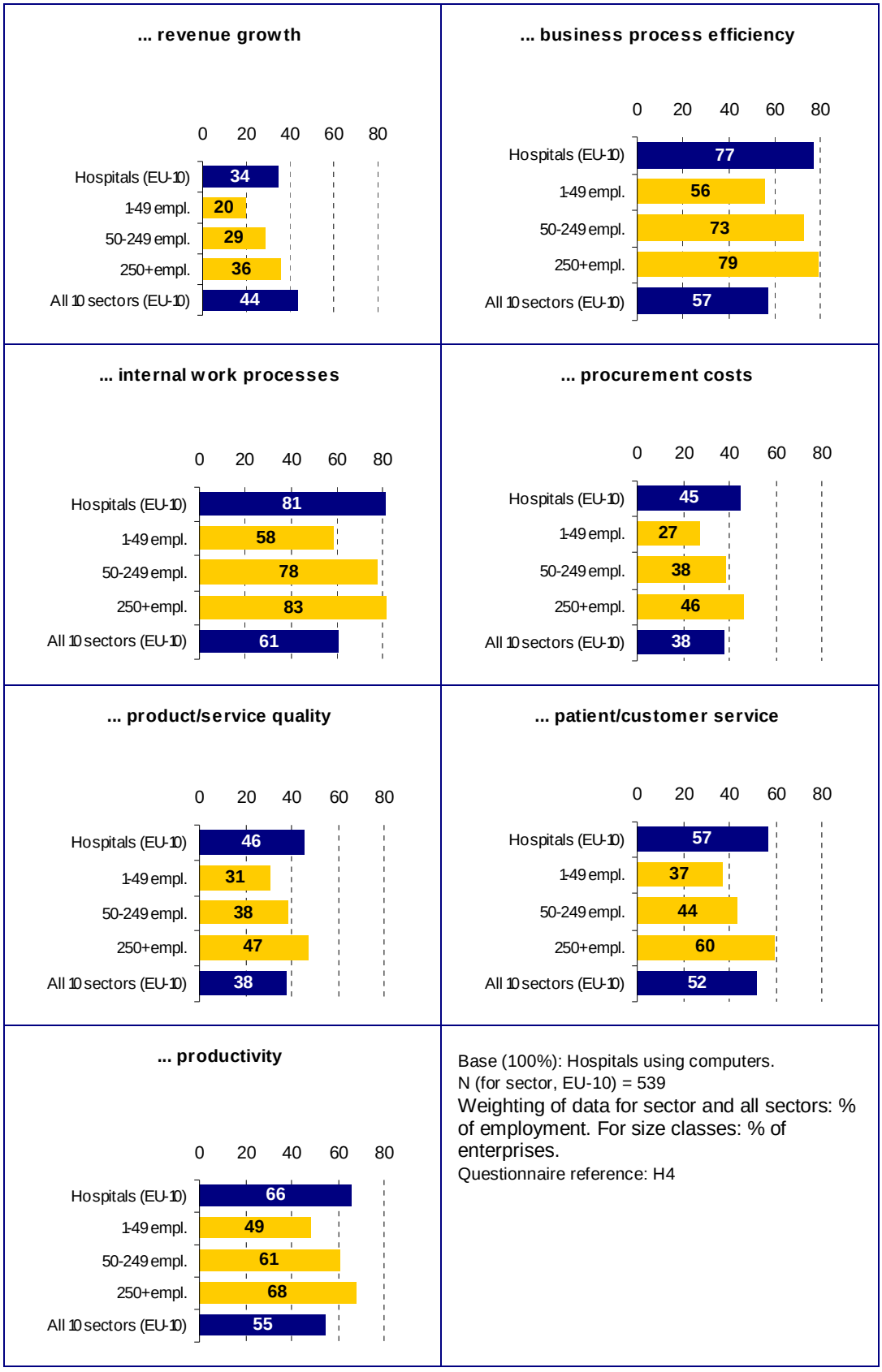
Source: *e-Business W@tch* (Survey 2006)

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

More than one third (37%) of hospitals interviewed this year by *e-Business W@tch* reported positive ICT impacts on procurement costs. The least important influence appears to have been on revenue growth (28%). This may be related to the fact that "sales" and revenues of hospitals cannot be extended as discretionarily as in other sectors – the number of potential patients is limited and the revenues are largely subject to state regulation.

Findings by sector and by size class: Exhibit 5-3 provides insights to differences between hospitals and the other sectors. Hospitals reported higher levels of positive impacts for all indicators except revenue growth. More positive impacts were reported in particular for internal work processes (81% versus 61% in all sectors) and business process efficiency (77% versus 57% in all sectors). These findings may to some extend be influenced by the fact that large firms generally find it easier to capture benefits of e-business than small firms and that there are fewer micro and small organisations in the hospital sector. For all indicators, large hospitals reported the largest shares of positive impacts, followed by medium-sized and small hospitals. However, as regards business process efficiency and internal work processes, the level of positive impacts reported by micro and small hospitals is similar to the value for firms from all size classes in all sectors together.

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



Base (100%): Hospitals using computers.
N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H4

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

Perceived influence of e-business on the organisational structure

Hospitals surveyed by *e-Business W@tch* in 2006 were specifically asked about ICT impacts on four organisational aspects, namely "organisational structure", "task and job descriptions", "employee training" and "outsourcing decisions". The answer options were "yes" or "no" and, according to the related results shown in Exhibit 5-4, hospitals reported considerable impacts.

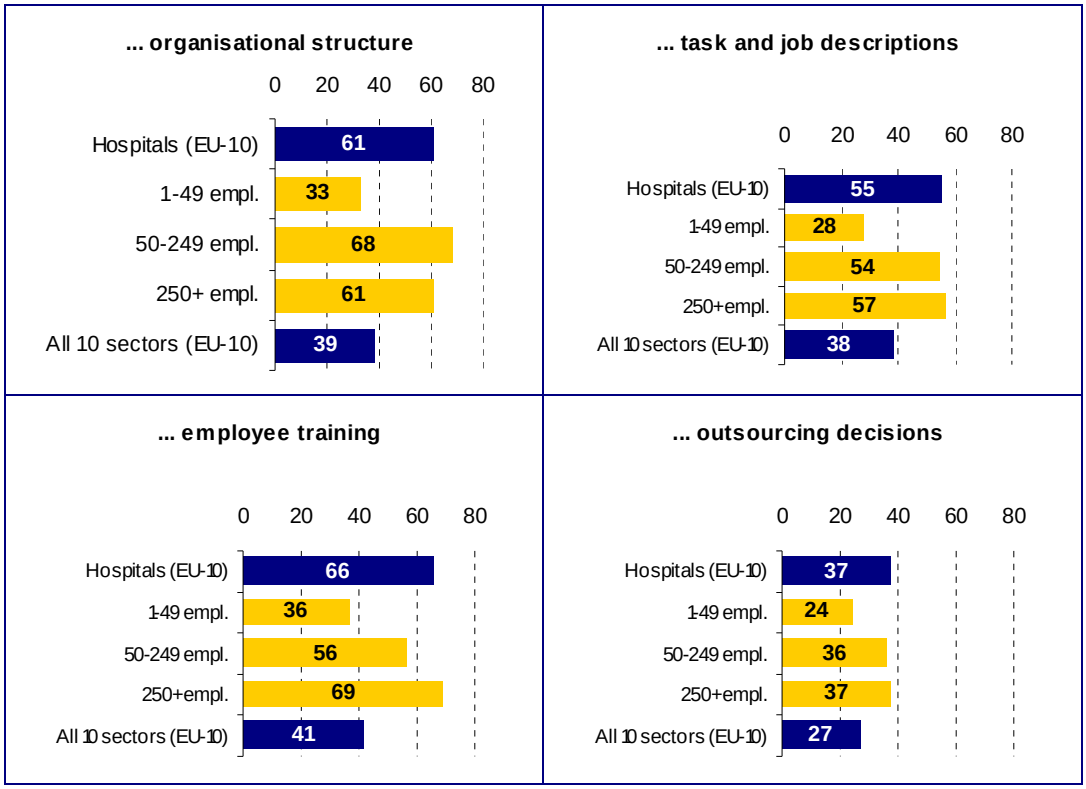
Overall findings: Most importantly, 66% of the interviewees said that ICT had an important influence on employee training, supposedly because ICT induced a need for special training about new electronic facilities. 61% of the hospitals reported an important influence of ICT on the hospital's organisational structure. This may mean, for example, the realignment of medical departments according to clinical pathways or the establishment of a medical informatics department. Increased transparency of data, more rigorously defined clinical pathways, as well as improved controlling and planning may have led to shifts of power and organisational structure in these hospitals.

55% of the hospitals stated an important impact on task and job descriptions. ICT appears to not simply substitute paper-based tasks to electronic tasks and make task fulfilment quicker, but to actually modify the task. An example may be that electronic health records can easily be distributed and facilitate the discussion about further treatment with professionals in other locations. In a minority of 37% of the hospitals, ICT had an important influence on outsourcing decisions. It may be that, after implementation of more complex hospital information systems, systems became too complex for complete in-house maintenance. It may also be that outsourced ICT services were "in-sourced" again in order to be able to immediately react in case of system failure.

Findings by sector: The reported impacts by hospitals were all larger than the average of all sectors. This difference to other sectors appears to be due to the dominance of large organisations in the hospital sector, as the values for hospitals overall and for large hospitals are quite similar.

Findings by size class: In large and medium-sized hospitals, the influence of ICT on organisational issues appeared to be considerably more pronounced than in small hospitals. Medium-sized hospitals reported a higher influence of ICT on the organisational structure than large hospitals. In the other three items the influence was highest in large hospitals.

Exhibit 5-4: Hospitals perceiving an important influence of ICT on their…



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H7

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

Expected future impacts of ICT

The interviewees were also asked about several possible future impacts of ICT. They said that they expect high future impacts of ICT particularly on accounting (59%) and management (58%) – see Exhibit 5-5. As regards accounting, a possible interpretation is that ICT can improve the availability and systematisation of cost data from different medical departments. Such data are today quite scattered and unsystematic. The increasing importance of Disease-Related Groups makes the streamlining of the accounting system a necessity.

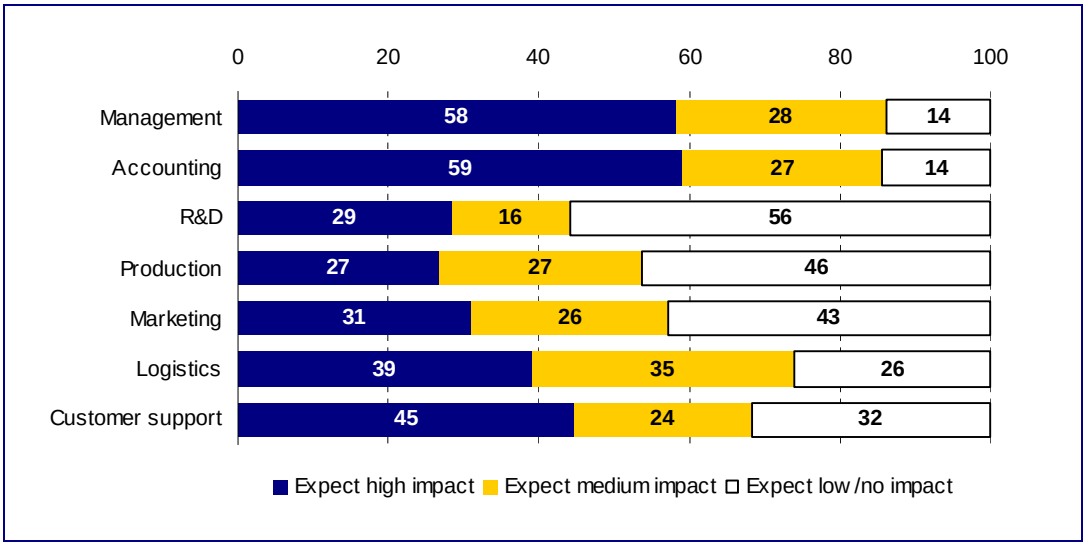
The high predicted impact on management may be related to the fact that hospitals are often complex organisations with many medical departments. Hospital information systems that enable and require the sharing of data across medical departments may lead to a shift of power from the departments to central management.[139] It may also be that more comprehensive and detailed cost data, provided by ICT, enable improved planning and tighter controlling.

A considerable share of 45% of the interviewees said that they expect high impacts of ICT on patient, i.e. customer, support. This may indicate that hospitals are aware that current ICT applications are not much oriented towards patients and citizens, as

[139] See discussion on hospital-wide management and organisational complexity in section 4.2.5.

discussed above in section 3.8, and that there is potential for improvement. The ICT impacts on other pre-formulated items in the future were assessed as less important but still as considerable: logistics (39% "high impact"), marketing (31%), Research and Development (R&D) (29%), and production (27%).

Exhibit 5-5: Anticipated future impact of ICT



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting: % of employment. Questionnaire reference: H8

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

Summary: ICT impacts on selected business parameters

On the basis of the analysis of findings from the e-Business Survey 2006 in chapter 3, of current principal topics of e-business in hospitals in chapter 4, and of e-business impacts discussed in the previous paragraphs of this section, one may conclude that ICT and e-business can have a very significant impact on hospitals. In the following summary, the impacts of e-business are subdivided into four groups: organisational issues, supply and sales, service provision, as well as human and financial resources. The core impacts of e-business were found to be on organisational issues.

- **Workflows and business processes.** Several findings from the e-Business Survey 2006 suggest that ICT and e-business have a strong impact on workflows and business processes. Firstly, around 70% of the interviewees perceived impacts on business process efficiency and workflow organisation as important, and these were the largest values of all items proposed (see Exhibit 5-2). Secondly, 34% of the hospitals reported ICT-related process innovation in the past twelve months, which was considerably higher than in the other sectors (see Exhibit 3-31). Findings from all case studies in this report also support the argument that ICT implementation and integration impacts on workflows and processes. In open, responsive organisations the effect of ICT on hospital workflows can be very large. Workflows are likely to become more streamlined and efficient because data are available much quicker and potentially from any workstation in the hospital.

- **Organisational structure.** Findings from the 2006 e-Business Survey also suggest considerable ICT impacts on the hospitals' organisational structure: 61% of the interviewees stated impacts in this respect (see Exhibit 5-4). Case study findings also substantiate this view. For example, the *Institut Curie* implemented a new medical informatics department (see section 4.3.1) in the course of ICT development. The CIO of the *Son Llàtzer Hospital* (see section 4.1) pointed to improved opportunities of using, for example, a laboratory jointly by various hospitals in a region. On the other hand, realising organisational changes may be difficult in hospitals with powerful departments – see the discussion about hospital organisation and management in section 4.2.5.

Impacts on indicators related to supply and "sales" include the following:

- **Procurement and logistics.** The e-Business Survey 2006 confirmed that hospitals are quite advanced in e-procurement in comparison with other sectors (see section 3.7) but did not go into further detail about the impacts. Logistics can be improved by information systems, as case studies for this report show. The inventory control system of the *National Heart Hospital* in Bulgaria optimised the use of warehouse personnel and facilities (see section 4.2.1). In the *Chelsea and Westminster Hospital* (see section 4.2.2), stock holding of medication was reduced due to an e-pharmacy system.
- **Marketing and bookings.** e-Booking systems relate to an important administrative feature of all hospitals and may offer considerable efficiencies. Related benefits are illustrated in the case study of the *Hospital District of Helsinki and Uusimaa*, presented in section 4.3.2. e-Booking and e-marketing, however, are not at the top of most hospitals' e-business priorities (see survey findings in section 3.8). Nevertheless, as shown in Exhibit 5-5, they may gain importance in the future. The benefits of e-marketing and online booking are presumably larger for large hospitals than for small ones because large hospitals can benefit from economies of scale and scope. For example, the implementation of an online booking system is unlikely to pay off in a small hospital with only a small number of patients.

ICT impacts on indicators related to hospital services, which are primarily health services and in some hospitals secondarily also research, include the following:

- **Service provision.** ICT and e-business can have strongly positive impacts on patient service. The related impacts attributed by the interviewees of the e-Business Survey 2006 were lower than for workflow and business processes but still considerably high (see Exhibit 5-2). Furthermore, all case studies in this report provide examples of improved service provision through ICT use. e-Prescribing, for instance, can reduce medical errors, prevent patient discomfort and, ultimately, save lives (see the case study on the *Chelsea and Westminster Hospital* in section 4.2.2). Immediate data interchange between health service providers or immediate remote access to patient data at distant locations may prevent unnecessary treatments and patient transferrals, as illustrated in the *Hospital District of Helsinki and Uusimaa* case study (see section 4.3.2). ICT may also improve patient support, for example by enabling patients and citizens to retrieve health-related information from the hospital's website or offering additional services. The *Son Llàtzer Hospital* in Spain offers for related efforts (see section 4.1).

- **Service innovation.** The e-Business Survey 2006 showed that the reported level of ICT-related service innovation in hospitals was low in comparison with ICT-related process innovation (see section 3.9). The *Son Llàtzer Hospital* offers an example of a simple service innovation: SMS reminding patients about appointments. More influential service innovations may be introduced in European hospitals in the future, for example applications allowing remote monitoring of patients' vital data. In some cases ICT may allow hospitals to expand their service repertoire, for example when small countryside hospitals are enabled to conduct more complicated operations with online assistance from an urban specialised hospital (see the discussion of "regional levels of hospital care" in section 4.3.2).
- **Research.** As patient data are accessible more easily and possibly in larger amounts, and as ICT facilitate data exchange between hospitals, research facilities and universities, medical studies become easier. The *Institut Curie* uses its meta-search engine for research purposes (see the case study in section 4.3.1).

ICT impacts on indicators related to human and financial resources include the following:

- **Skills requirements.** Since many hospitals are not yet advanced in the use of e-business (see the HINE classification in section 3.11), new ICT may impose considerable skills and training requirements on them. The e-Business Survey 2006 showed that hospitals respond to these requirements on a level similar to other sectors (see section 3.2). The example of the *Chelsea and Westminster* hospital (see section 4.2.2) suggests that training curricula should be tailored to the needs of particular professionals.
- **Outsourcing.** As ICT business is generally not a core competency of hospitals, one would expect that ICT services are outsourced in many hospitals. However, the e-Business Survey 2006 showed that the outsourcing practices induced by ICT are of smaller importance than in other sectors (see section 3.3). Hospitals like the *Son Llàtzer Hospital* (see case study in section 4.1), where 80% of the hospital's ICT budget is spent on outsourced ICT services, may be an exception.
- **Employment.** Due to more efficient workflows, e-business is likely to reduce the number of hospital personnel unless this is compensated by increased demand, e.g. due to ageing of societies, or investment of time saved into better care. Two case studies in this report support this assessment: the *Chelsea and Westminster Hospital* (see section 4.2.2), where overtime in the pharmacy was reduced significantly due to an e-pharmacy system, and the *Ambroise Paré* hospital (see section 4.2.4), where the number of secretaries and archiving staff was reduced after information systems integration. Such developments, if ongoing, would need to be closely monitored because they could become a major concern for policy makers.

Exhibit 5-6 summarises the assessment of ICT impact on hospitals, based on survey results, case studies, interviews and desk research conducted for this study. The exhibit distinguishes between large and small hospitals. Differences in the observed impacts between large and small hospitals relate to size-class differences in the findings of the e-Business Survey 2006 to the extent available. The scores are by no means to be understood as "exact" results of a quantitative computation, based on any model. They

are tentative, reflecting the picture emerging from the study, and should be regarded as a vehicle to stimulate debate. It is also clear that no such general conclusion can apply to each individual hospital. There will be specific cases of small and large hospitals, with totally different ICT experiences, for which the pattern would not apply.

Exhibit 5-6: Impact of ICT and e-business on hospital activities

	Business areas where ICT and e-business can have an impact	Impacts in large hospitals *low < > high*	Impacts in small hospitals *low < > high*
1	Workflows / operational organisation		
2	Organisational structure		
3	Service provision / patient support		
4	Procurement and logistics		
5	Marketing / bookings		
6	Research and development		
7	Service innovation		
8	Process innovation		
9	Skills requirements		
10	Outsourcing		
11	Employment		
Maximum: 3 points (or)			

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

5.1.2. Implications for hospital industry structure

Hospital activities and Porter's "five competitive forces"

This chapter assesses the implications of ICT and e-business adoption on the structure of the hospital activities industry. "Structure" refers to aspects such as the total number of hospitals, the sector composition by size-class and the interrelation of hospitals with other health service providers. As in 2005, the "five forces model" developed by Michael E. Porter (1980) is used to discuss and assess e-business implications on the industry's structure. Although the health sector is not comparable to a manufacturing industry or most service sectors, this model nevertheless allows drawing some insightful conclusions, particularly when reflecting that there is a tendency to improve competitive structures within national health systems in many European countries.

Background information:

Michael E. Porter's Five-Forces Model

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

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

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

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

As discussed in section 3.10, among the main driving forces of ICT and e-business in hospital activities are the need for cost reduction and quality of care improvement. ICT and e-business have the potential to fulfil these objectives by streamlining internal and external business processes.

The European hospital activities sector is subject to particular economic framework conditions because the majority of hospitals are public, the health sector is heavily regulated and market forces are limited. Nevertheless, common notions of business markets and Porter's competitive forces model are applicable. Porter's model is meant to apply to any industry although it was found to be particularly relevant for manufacturing industries. The five forces are "rivalry in the market", "threat of new entrants", "substitution of services", "bargaining power of suppliers", "bargaining power of citizens and patients", whereby "citizens and patients" replaces the notions of consumers and customers. Exhibit 5-7 provides an overview of the importance of the five forces for the hospital activities industry. The single items are discussed in the following.

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

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

"New entrants" in the sense of new companies being founded. New entrants in the sense of companies from a different geographic area entering the European market is considered under "rivalry in the market".

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

Rivalry in the market

Rivalry in the market refers to the level of competition in an industry. Although the majority of hospitals in Europe are public, there is considerable competition in the market – among the hospitals and between hospitals and primary care providers. In many European countries, particularly in those which are above the OECD average in number of beds per inhabitants, it may be politically desirable that the number of beds per inhabitants diminishes – see Exhibit 2-5 and the related paragraph in section 2.2 about hospital beds. It may also be desirable that hospitals reduce the number of employees and wards or even that the number of hospitals diminishes in order to contain costs. Consequently, many hospitals are struggling for maintaining their size or even for survival and are seeking cost reduction. ICT and e-business use may play an important role for achieving this objective.[140] Thus, ICT use may be a response to rivalry in the market caused by political framework conditions, but it may also further fuel competition and rivalry.

The reality of a "struggle for survival" is substantiated by HINE findings that there has been increased activity of closing or merging hospitals across Europe in recent years.[141] However, these activities often failed to produce the expected economies of scale. Currently there is a further wave of activities aiming at building networks of more specialist hospitals or healthcare networks including other types of providers such as dialysis clinics, long-term and social care, physicians, and pharmacies. Concepts vary considerably between countries but ICT use plays an important role in all of them.

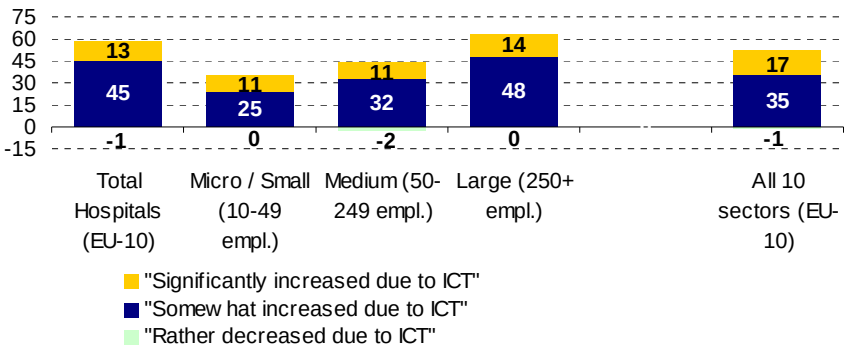
The e-Business Survey 2006 provides evidence about increased competition in the hospital sector in Europe due to ICT. The interviewees were asked: "To what extent do you think that competition in your sector has increased or decreased due to ICT? Has competition significantly increased, somewhat increased, or rather decreased?" 13% of the hospitals stated a significant increase of competition in the sector due to ICT, 45%

[140] Among many public hospitals there is also political struggle about investment funds and shut-down decisions.

[141] Information in this paragraph provided by V. Lessens, member of the e-Business Advisory Board 2006 (Agfa, a HINE member).

said that that ICT had somewhat increased. Exhibit 5-8 shows the results in detail. The all-sector average for “significant increase of competition due to ICT” was 17% and thus slightly larger than in the hospital sector. However, the percentage of answers of “somewhat increased” was smaller in all ten sectors than in hospitals (35% in all sectors versus 45%). Large hospitals reported a higher level of perceived impact of ICT on competition (14% “significant“, 48% “somewhat”) than medium-sized hospitals (11% “significant”, 32% “somewhat”), and the percentage for small hospitals (11% “significant”, 25% “somewhat”) was even lower. Furthermore, 40% of the interviewees stated that the fact that “competitors do it” is a driver of ICT use in their hospital (see Exhibit 3-32).

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



Base (100%): Hospitals using computers. N (for sector, EU-10) = 539
Weighting of data for sector and all sectors: % of employment. For size classes: % of enterprises.
Questionnaire reference: H6

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

Threat of new entrants

Although the overall number of hospitals in Europe tends to decline, new hospitals enter the market. For example, the Son Llàtzer Hospital which is presented in a case study in section 4.1 was built from scratch and opened in 2001.

However, hospital activities is a sector with a relatively low level of start-up activity. The threat of new entrants in the hospital sector is relatively low, which is substantiated with data from the e-Business Survey 2006: Around 5% of the hospitals were reported to be founded between 2006 and 2003, 13% were founded between 2002 and 1997, 23% between 1996 and 1981, and the remaining 57% before 1981. Together with the food and beverages sector, hospital activities had the smallest percentage of new firms, i.e. firms founded in the past three years before the survey. The percentage of new firms was highest in telecommunications (21%) and consumer electronics (11%). The average percentage of all ten sectors included in the e-Business Survey 2006 was 9%.

The low level of new entrants in the hospital sector can be attributed to high market entry barriers: starting a hospital requires considerable investment, and market entry is highly regulated. These circumstances are hardly influenced by ICT.

Substitution of services

ICT may allow hospital services to be modified but services will rarely really be substituted by new ones. For example, tele-monitoring allows patients to stay at home while their vital data is checked but the service itself remains more or less the same. There is no obvious competitive advantage of hospitals or general practitioners for such services that may induce a restructuring of organisations in the health sector. The same applies to home visits of clinicians enabled and supported by portable wireless computers. ICT can improve processes inside hospitals as well as between hospitals and other health service providers – see the discussion about continuity of care in section 4.2.2 – rather than substitute these services. However, remote ICT support – as discussed in section 4.2.3 in the sub-section about regional levels of hospital care – may, to a limited extent, enable small hospitals in remote areas to introduce new services and sustain the profitability and existence of these hospitals.

Findings from the e-Business Survey 2006 support the argument that there is little service innovation induced by ICT: Only 16% of the hospitals reported having introduced ICT-related new products or services in the past twelve months prior to the survey (see section 3.9).

Bargaining power of suppliers

Hospitals usually have a large number of suppliers for a wide range of goods and services to be procured. Necessary inputs include medical goods and equipment and non-medical goods, for example for accommodation and food provision. Some services may be outsourced, for example for laundry and building maintenance. The bargaining power of suppliers depends on the market situation, e.g. whether the hospital can choose between various suppliers. ICT can improve the bargaining position of hospitals, for example by using e-marketplaces that facilitate the identification of alternative suppliers, or by establishing combined procurement of several hospitals supported by ICT. Findings from the e-Business survey 2006 showed that for a notable share of hospitals (21% compared to 26% in all sectors) the number of suppliers increased due to ICT, suggesting that the bargaining power of suppliers decreased (see section 3.7).

Bargaining power of "customers"

Hospitals have two kinds of "customers": firstly, patients and citizens that receive the services and, secondly, third parties such as insurance funds that pay for the services. The patients and citizens have little bargaining power because prices for hospital services are fixed. They cannot bargain for better conditions. Their power is, if possible, in "voting by feet", i.e. selecting the hospital that meets their requirements best. While this may not be possible in emergency or in areas with only one or a small number of hospitals, patients may well select hospitals in areas with a larger number of hospitals. ICT may enhance this form of power somewhat, as hospitals' internet presentations improve the patients' opportunities to select "their" hospital. Findings from the e-Business Survey 2006 show that 79% of the hospitals have a website that may support such opportunities. There may also be encouragement from the regional or national-level authorities to make relevant information public. An example is the National Institute for Health and Clinical Excellence (NICE) in the UK, according to its internet presentation "*the independent*

organisation responsible for providing national guidance on the promotion of good health and the prevention and treatment of ill health".[142]

Hospitals usually offer services for prices that are determined by public or semi-public authorities. Thus, there is little bargaining between hospitals and patients, but more between hospitals –or their associations (i.e. pressure groups)– and the authorities deciding about service prices. These may be third-party payers, such as insurances. This bargaining process is presently hardly influenced by ICT, but this is about to change. Disease-Related Groups require much more transparency about cost structures, and an improved transparency of service quality is on the agenda in various Member States. In this context the US "pay for performance" paradigm is gaining great interest.[143]

Summary

In summary, ICT and e-business have a small effect on the structure of the hospital activities industry. While there are indications of ICT impacts for each of Porter's indicators, these effects are not large. The largest effect is for rivalry in the market, substantiated by the finding from the e-Business Survey 2006 that more than half of the hospitals reported a perceived increase of competition due to ICT. The impact of ICT and e-business on the industry structure may however become more important in the future.

5.2 Policy implications

5.2.1. General remarks on policy implications

Possible policy initiators

Policy implications elaborated in the following arise from all principal subjects discussed in this report. These policy implications are directed primarily to health and e-business policy makers in public or semi-public authorities, as well as to health and e-business associations at EU, national and regional levels.

ICT and e-business use always requires investment in technology and human resources, and it requires related decisions. Health policy makers may have direct or indirect influence on investment decisions and thus e-business use in hospitals – public hospitals in particular. Health policy makers have influence on hospitals' investment for example through hospital-related legislation, regional health care provision plans, or through membership on hospital boards. Therefore, some of the policy implications described here affect hospital management.[144] In the following, implications affecting more general, sector-wide aspects of ICT use, e-business and health policy are listed first, followed by implications that affect hospital management, i.e. individual units.

[142] See http://www.nice.org.uk.

[143] See Porter/Olmsted Teisberg (2006) for various references.

[144] In this way, policy implications in this report are somewhat different from those in other *e-Business W@tch* sector reports.

Policy issues and leverage opportunities

Exhibit 5-9 lists policy implications arising from e-business activity in hospitals. The issues are ranked from special to general ones. The sector-wide subjects begin with improving interoperability, are followed by continuity of care, educational issues, and monitoring the role of hospitals, and end with informing the general public. Similarly, the managerial issues begin with the special issues of investment, security, and medication management and end with the overarching issue of hospital systems integration. The numbering is not meant to indicate priorities in terms of importance.

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

	Policy issues	Possible initiators	Policy leverage *low < > high*
Sector-wide issues of ICT use in hospitals and the health sector			
1	Improving interoperability of ICT in the health field	Health policy and ICT policy authorities at national and international level; standardisation organisations	
2	Promoting continuity of care through inter-organisational use of electronic patient records and patient summaries	Health policy and ICT policy authorities in charge of defining patient summary characteristics	
3	Improving education and training in health ICT	Policy makers in health, ICT, and education; industry associations	
4	Monitoring a possibly changing role of hospitals due to ICT investment	Health policy authorities at all geographical levels	
5	Informing the public about benefits and challenges of ICT in hospitals	Health policy makers at all geographical levels; medical professional associations	
Issues affecting hospital management			
6	Enhancing e-business investment	National and regional health policy authorities with direct or indirect influence on investment	
7	Ensuring data security	Health policy authorities in charge of legal issues as well as with direct or indirect influence on investment	
8	Promote electronic medication management	Health policy authorities in charge of investment decisions or legal requirements about medication management in hospitals	
9	Fostering Hospital Information System integration	Health policy authorities in charge of public hospital organisation	
Maximum: 3 points (or)			

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

Policy may not have the same leverage – as indicated in the scale in the right column of Exhibit 5-9 – in each of these areas. This means that the extent to which policy initiatives can have a direct impact differs. The health field is very complex and involves numerous

actors so that policy generally has a limited leverage impact. However, this does not mean that an issue with a low leverage becomes irrelevant. It may require more indirect measures to address it, e.g. multi-stakeholder initiatives. The leverage scores are tentative (see also the summary of section 5.1.1); they are not based on any model but on a qualitative assessment.

5.2.2. Sector-wide issues of ICT use in hospitals

Improving interoperability of ICT technology in the field of health

According to findings presented in this report, there is a considerable lack of interoperability and use of ICT standards in the health field. In fact, the e-Business Survey 2006 found that the use of proprietary standards was much higher among hospitals than in other sectors and that only a minority of hospitals used the health-specific HL7 standard (see Exhibit 3-12). The shares of interviewees reporting operative problems related to a lack of interoperability tended to be larger than in the all-sectors average (see Exhibit 3-10). The percentage of hospitals indicating lack of systems compatibility as a barrier to e-business adoption was also higher than in the other sectors studied this year by *e-Business W@tch* (see Exhibit 3-33). The case of the *John Paul II Hospital* (see section 4.2.3) also provides illustrative interoperability problems, in particular related to digital imaging. One may, therefore, conclude the following policy implications:

- **Raising awareness about interoperability benefits:** Policy makers should increase awareness among ICT producers as well as managers and users in hospitals about the benefits of and the need for interoperability. Benefits from interoperable systems are not necessarily reaped by those who provide them. Therefore, seeking interoperability is not necessarily in the interest of those producing, managing and using ICT in the health sector. Interoperability benefits are generated within the overall system, e.g. by improved healthcare across the healthcare value chains. Benefits include better care for chronically ill citizens, better quality surveillance and control, improved public health services or benefits for education, training and research. Voluntary use of standards by companies could contribute tremendously to e-health interoperability.[145]
- **Promoting standardisation organisations and efforts:** Policy makers should also actively promote and facilitate interoperability by appropriate investments in standardisation organisations and efforts. Activities related to interoperability need to increase as ICT diffuses through the national health systems. This interoperability issue will need permanent attention and clear structural and process organisation. Challenges are immense because there is continuous progress in technology and in medical knowledge, regulations and legal frameworks are changing, and organisational adaptations occur within and among institutions. Some Member States like Denmark, the UK, France, Germany, the Netherlands or Slovenia recognised this challenge. On implementing large scale e-

[145] See European Commission, Information Society and Media Directorate General (2006), p. 23.

health measures and infrastructures, they also established platforms or organisations in charge of standardisation at the national level.[146]

- **Seeking interoperability within hospitals and beyond:** Two of the case studies conducted for this report – about the *Son Llàtzer* and the *National Heart* hospitals (see sections 4.1 and 4.2.1, respectively) – illustrate that hospitals can deal with interoperability challenges by implementing an interoperability engine which ensures proper integration of all information systems involved. Such a tailor-made solution may however not be an option for small hospitals with limited ICT investment funds and limited ICT management capabilities. For them, a rather simple solution such as the one implemented in the *Ambroise Paré* hospital (see section 4.2.4) may be more relevant. Furthermore, policy makers should assure proper measures to extend such intra-hospital interoperability across the wider health system.

- **Seeking interoperability in Europe:** Interoperability of ICT for health should also be sought at the European level. The objectives should be to adequately respond to an increasing cross-border mobility of patients and to strengthen the European health ICT manufacturing industry. In autumn 2006 a European Commission (EC) e-health interoperability report was published that supports related activities and increases awareness on needs across Member States.[147] EC services are currently preparing a draft standardisation mandate, addressed to European Standardisation Organisations and inviting them to prepare an integrated standardisation work programme in response to current e-health policy needs in the EU. Furthermore, the 2005 Report from the Centre Européen de Normalisation / Information Society Standardisation System (CEN/ISSS)[148] and its e-health Standardisation Focus Group, recommended the creation of a European interoperability platform or initiative. Among other tasks, this initiative would establish a Europe-wide view on the requirements for e-health standardisation and its implementation, in collaboration with standardisation organisations. This could be based on input from relevant stakeholders' communities. Such an initiative could be led by respected neutral organisations in the field of ICT standards for the health sector.[149]

[146] An example is the establishment of the gematik GmbH (see http://www.gematik.de) in the course of preparing the introduction of a nation-wide health card in Germany. Gematik is in charge of defining common standards for the health card infrastructure so that nationwide interoperability of card-related information systems is assured.

[147] See European Commission, Information Society and Media Directorate General (2006). In a wider healthcare perspective, the European Commission (DG Health and Consumer Protection) opened a consultation for the future EU legislation on health care services until January 31, 2007. Following this consultation, the Commission intends to bring forward appropriate proposals. See http://ec.europa.eu/health/ph_overview/co_operation/mobility/patient_mobility_en.htm.

[148] See http://www.cenorm.be/cenorm/businessdomains/businessdomains/isss/index.asp.

[149] See the recommendations in the *e-Business W@tch* Special Report about standards and interoperability in European Commission (2005), p. 9.

Promoting continuity of care through patient records and summaries

Electronic patient records (EPRs) and patient summaries can be an important means of ensuring continuity of care within hospitals as well as between hospitals and other health service providers. The benefits of EPR systems are shown, for example, by the patient record system of the *Institut Curie* (see case study in section 4.3.1). Questions about EPRs were not included in the e-Business Survey 2006. According to findings from HINE (see section 4.3.1), about half of the hospitals in Western European countries claimed to have EPR systems. However, in most cases the systems lacked functionality and do not allow access by other health service providers.

In order to ensure cross-border usability of national patient summaries, European Member States need to co-operate closer when defining standards of patient summaries. Currently there is a tendency towards national solutions. There are various measures that would contribute to achieve the goal of cross-border usability faster:

- Cooperation of national competent authorities and their experts.
- Funding of large scale implementation projects in Member States by the new Competition and Innovation Programme (CIP) programme.[150]
- Involvement of patients' and citizens' lobbying groups as well as professional medical and hospital associations.

Due to the complexity of the issues involved, it would be beneficial to establish a temporary support mechanism to streamline and accelerate related efforts. A key success factor would be the support of national health policy makers.

Improving education and training in health ICT

Effective use of ICT in hospitals requires adequate education of the users, i.e. the medical staff – e.g. physicians, nurses, pharmacists – as well as administrative staff. Overall, hospitals appear to meet the challenge of ICT education: The e-Business survey 2006 found that hospitals have larger shares of ICT skills indicators than the average of all sectors (see section 3.3). However, since the impacts of ICT on internal workflows (see Exhibit 5-3) and job task and descriptions (see Exhibit 5-4) were reported to be significantly larger than in the other sectors, hospitals should further increase their training activities.

In particular, there appears to be a need for training of hospital Chief Information Officers (CIOs) and Chief Executive Officers (CEOs), as the e-Business Survey 2006 found that ICT is expected to heavily impact on hospital management in the future (see Exhibit 5-5). Policy makers should strive for providing adequate education and training opportunities for hospital managers. Related initiatives could be pursued by policy makers in the fields of health, ICT and education as well as industry and professional associations. Education and training should seek to raise the CIOs' and CEOs' technological and managerial capability of implementing and integrating ICT in hospitals. For both managerial and medical professions, universities could increase their offers of education in health ICT,

[150] See http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm.

e.g. medical informatics and health ICT management. Currently there are not many comprehensive academic offers of health ICT education in Europe.[151]

The type of education needed may depend on the particular circumstances of ICT implementation and use in the hospital. Two case studies in this report provide relevant examples: In the course of a consecutive roll-out of an electronic medication management system, the *Chelsea and Westminster Hospital* (see section 4.2.2) arranged training sessions early before the application was launched. It was found that training tailor-made to the various user groups was particularly important. When integrating its information systems, the *Ambroise Paré* hospital's ICT unit offered training to staff members by ward. The simplicity of the system made special training almost unnecessary (see section 4.2.4).

Monitoring the changing role of hospitals

The role of acute care hospitals is to provide in-house, comprehensive, specific and round-the-clock health care. In the course of increasing investment in ICT, the role of hospitals may change. The analysis in this report, largely based on desk-top research and case studies and to a limited extent on e-Business Survey 2006 findings, suggests that the relationship towards patients and the need for in-house care is strongly affected. An example is the *Hospital District of Helsinki and Uusimaa* (see section 4.3.2). It shows how, due to the use of ICT, the need for in-patient care may be replaced by outpatient care and how the relationship changes between hospitals and primary care providers.

Health and e-business policy makers should develop a clear concept of the future of e-business in hospitals. Health policy makers should continue or strengthen the monitoring and analysing of e-health activities and progress. They should monitor the changing role of hospitals thoroughly in order to drive the desired developments and to react proactively to unwanted developments if need be. Relevant indicators to be monitored include the following relationships of hospitals: towards patients, towards other hospitals, towards primary health service providers, between small and large hospitals, between hospitals in agglomerations and remote areas, and between private and public hospitals. Furthermore, as shifting responsibilities of hospitals and increased efficiency of work processes due to ICT deployment may reduce the number of employees needed,[152] employment implications could also be monitored in this context.

The 2006 survey data did not provide crucial evidence about a shifting division of labour between public and private hospitals. However, this issue may require particular policy attention in the future in countries with strong private hospital service providers.

Inform the public about benefits and challenges of e-business in hospitals

This report has shown that ICT and e-business in hospitals can improve the quality of health care significantly. For example, e-prescribing and medication management can reduce medical errors (see section 4.2.2), electronically storing and communicating digital

[151] Examples of ICT education offers will be published in country reports produced in the eHealth ERA project; the reports will be made available on the project's website at http://www.ehealth-era.org.

[152] See section 5.1.1 about employment implications of ICT use in hospitals.

diagnostic images can make further diagnosis unnecessary (see section 4.2.3), and electronic patient records can improve the continuity of care (see section 4.3.1). Almost half of the hospitals interviewed in the e-Business Survey 2006 stated that e-business had a positive impact on patient care (see Exhibit 5-2).

However, research for this report has not revealed any signs that patients and citizens are requiring more ICT use in hospitals. Patients may complain about insufficient service, e.g. long waiting times as in the case of the Chelsea and Westminster Hospital (see section 4.2.2). However, they may not necessarily call for ICT as a means for better service. Thus, a potentially important driver of ICT and e-business use in hospital appears to be missing. The e-Business Survey 2006 does not provide hints to citizens and patients as a driver for ICT use in hospitals; there were no related questions.

One may conclude that the European public, i.e. patients and citizens, should be better informed about the benefits but also the challenges of ICT use in health services.[153] Information about the benefits of ICT in the field of health could be provided by public authorities in the field of health and ICT, such as relevant General Directorates of the European Commission as well as health authorities in the nation states and regions. Medical professional associations could also support this objective.

5.2.3. Policy issues aiming at hospital management

Enhancing investment in ICT and e-business

Improvements in ICT applications in hospitals can come about only if the hospitals have adequately investment in these technologies. The e-Business Survey 2006 found that the percentages of hospitals investing in ICT were similar to the all-sector averages when comparing size classes (see Exhibit 3-6). This does not point to shortcomings in ICT investment. However, the interviewees in hospitals also reported a higher level of difficulties in acquiring funds than in the all-sector average (see Exhibit 3-6). Furthermore, HINE found that the average level of investment of ICT in European hospitals was smaller than in US hospitals. The following policy measures may be considered in order to improve European hospitals' investment in ICT:

- **Strategic investment planning.** Hospitals should carefully plan ICT spending within the near future and also develop a long-term strategic ICT plan. They should make sure that the level of spending is appropriate to meet the objectives of the hospital.[154] Hospitals should not expect quick returns of ICT investment. The case of the *Institut Curie* (see section 4.2.1) indicates that it may take several years until ICT investment benefits outweigh the investment costs. Other case studies, notably about the *Son Llàtzer Hospital* and the *National Heart Hospital*, illustrated some cost benefits of ICT use but there was no detailed cost-benefit analysis yet proving that ICT investment was financially beneficial for the single hospital.

[153] See a similar recommendation for the US in Committee on Quality of Health Care in America (2000), p. 177.

[154] Implication suggested by V. Lessens, Agfa, member of the e-Business Advisory Board 2006.

- **Step-by-step investment.** Many hospitals lack the investment capabilities as well as human resources for a "great thrust" towards implementation of comprehensive ICT applications. A step-by-step investment approach however appears to be appropriate. Initial spending should focus on infrastructure and service support, while further spending should concentrate on making ICT services pervasive, including remote working, mobile technology, and integrated messaging.[155] Hospitals could also start with applications offering quick return on investment. An illustrative example is an SMS service reminding ambulatory patients about their appointments. The *Son Llàtzer Hospital* reported good experiences with such a service (see case study in section 4.1).
- **Involving ICT and medical personnel.** ICT professionals should be part of the strategic decision making bodies of the hospital. Involve users, i.e. clinicians and nurses, in the decision making process about ICT investment. This is a lesson learned in several of the case studies, above all *Son Llàtzer Hospital* (section 4.1), *Ambroise Paré* hospital (section 4.2.4) and *Institut Curie* (section 4.3.1).
- **Increasing available investment funds.** Increasing available investment funds may require, primarily, awareness raising among those who are in charge of deciding about hospital funding. This may in the case of public hospitals be health policy makers at various geographical levels. Further measures meaningful to increase ICT investment may include adjustments in reimbursement regulations, new loan facilities, government incentives, tax breaks, private-public partnerships and other means of improvement.
- **Acknowledging size-class differences.** Investment levels need to reflect hospital size. Large hospitals can draw from economies of scale and scope and thus tend to have a smaller personnel cost share than smaller hospitals. A level of 3% to 4% ICT spending related to hospital income seems a reasonable target for large hospitals.[156]
- **Seeking equivalence of costs and benefits.** Policy makers should seek that hospitals actually receive the returns on ICT investment,[157] i.e. equivalence of costs and benefits in economic terms. Appropriate reimbursement schemes may be a measure supporting this objective. For example, avoiding double examinations by improved communication between hospitals and general practitioners is meaningful on a macro level but not necessarily for revenue generation on the individual hospitals' side.

Ensuring data security

Security is a major hurdle to e-business applications in hospitals, as the e-Business Survey 2006 showed: "Security concerns" was the item with the highest agreement by

[155] See Major (2005), p. IT5.

[156] See Major (2005), p. IT5.

[157] Implication suggested by V. Lessens, Agfa, member of the e-Business Advisory Board 2006.

interviewees in the hospital sector when they were asked about barriers to e-business – see Exhibit 3-33.[158] The agreement by interviewees in the other sectors was much lower.

While complete security of hospital information systems cannot be achieved, hospitals can nevertheless implement measures to achieve an acceptable level of security without compromising work flows. Thereby, hospitals need to be aware that security and privacy issues cannot be solved by purely technical means. A security policy and organisational provisions have to be put into place, too. The following actions on three levels – policy, organisational, and technical – can be suggested:

- **Policy level.** Hospitals need to take into account legislation on security and confidentiality on the European, national and local levels and need to formulate an overall policy for their organisation that is clear and comprehensive.[159] An example is the *National Heart Hospital* (see section 4.2.1) that drafted a security master plan.
- **Organisational level.** Hospitals need to raise awareness on issues of data security and confidentiality by training their staff at all levels. Large organisations in particular should nominate a data protection officer and a security officer to clearly delineate the possibilities for respecting the patient's right to confidentiality and data security.[160]
- **Technical level.** Technical solutions to prevent unauthorised access to patient data need to be implemented. Applications that can make communication more secure include firewalls, virus scanners, encryption software and authentication processes. The security system needs to be sophisticated enough to take into account the access rights of different types of clinicians. The e-Business Survey 2006 showed that European hospitals are quite advanced in this respect: the shares of hospitals using secure server technology, digital signatures or public key infrastructure, and a firewall were also higher than the average values of the other sectors (see Exhibit 3-16).

As regards cross-border identification and authentication of professionals and patients on a European level, efforts to facilitate interoperability may for the time being only be promising for concrete use cases. Otherwise the task would be too complex. For example, for the *Institut Curie* (see the case study in section 4.3.1), authentication of users outside the hospital is currently an important challenge. Political efforts in this regard should focus on authentication applications either for patients or healthcare professionals or health insurance firms.

Improving medication management for the sake of patient safety

There is considerable evidence about the opportunity to reduce medication errors by e-prescribing and computerised medication management. This applies at least to "knowledgeable" systems that provide information to the point of care, for example about drug-drug interaction, allergy checking and ordering support by evidence-based best

[158] See also the Special Report about security issues authored within the framework of the *e-Business W@tch* in 2005, available at http://www.ebusiness-watch.org.

[159] See Blobel/Pommerening (1997).

[160] See Blobel/Pommerening (1997). See also Barber et. al (1998).

practices. Beside evidence from literature, the case of the *Chelsea and Westminster Hospital* (see section 4.2.2) illustrates the benefits of e-prescribing. However, in the e-Business Survey 2006, a small share of 12% of the hospitals reported using an e-prescribing system, and 19% said they have a Computerised Physician Order Entry (CPOE) system. According to HINE, the share of hospitals that have "knowledgeable" systems is even lower, only around 2%.

Hospital managers and health policy makers should pay particular attention to computerised medication management. Hospitals' design of such systems should focus on the reduction of errors with the potential for patient harm and include the complex clinical decision support necessary for effective practitioner guidance.[161] However, decision makers should consider that CPOE technology is still evolving and requires ongoing assessment of systems integration and "human-machine interface effects" which may be unpredictable.[162] They should also be aware that CPOE is a complex issue and should, therefore, not be the first computerised information system in a hospital. In order to prevent unintended risks of CPOE, health policy makers would also have a role in introducing appropriate certification standards that ensure the safety of computer technologies in administrative medicine.

Fostering Hospital Information Systems integration

Research for this report found that hospital systems are often not integrated. According to the HINE survey, only 10% of the hospitals used an advanced medical library in the way that electronic patient records are linked to various functions such as archiving and managing patient data integration (see section 3-11). A lack of integration implies that many benefits of ICT use in hospitals are not realised. The analysis in section 4.2.4 suggests three reasons for such a lack of integration:

- a lack of ICT investment planning in hospitals,
- difficulties with ICT suppliers, and
- lacking interoperability of ICT systems.

Given the importance of interoperability of separate information systems, the policy implications about interoperability and standards mentioned in section 5.2.2 apply. To the extent that ICT suppliers do not meet the requirements of hospitals, market forces may decide about the suppliers' behaviour.

Considering that the core problems may be related to organisational complexity and lack of ICT planning, the situation is more difficult. As far as public hospitals are concerned, political authorities should support developments ensuring that interoperability issues are properly identified and addressed. To achieve this objective, the following means could be considered:

- regulatory provisions, e.g. about increased transparency of costs and outcomes;

[161] See Bobb et al. (2004), p. 791.

[162] See Han/Carcillo/Venkataraman (2005), p. 1512.

- establishment of university curricula for educating hospital managers, for example dedicated courses in the medical and the business departments, and special training programmes that could be run by professionals' organisations;
- awareness and learning from "good practice" cases, as well as workshops to exchange relevant experiences.

Pressure by health insurances and patients' associations could also be supportive. Furthermore, hospitals, whether public or private, could also consider taking ICT professionals on their boards, thus ensuring that the "*ICT perspective*" is adequately reflected in their high-level management decisions.

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Pascal Garel, European Hospital and Healthcare Federation, chief executive.

Annex I: The e-Business Survey 2006 – Methodology Report

Background and scope

e-Business W@tch collects data relating to the use of ICT and e-business in European enterprises by means of representative surveys. The e-Business Survey 2006, which was the fourth survey after those of 2002, 2003 and 2005, had a scope of 14,081 telephone interviews with decision-makers in enterprises from 29 countries, including the 25 EU Member States, EEA and Acceding / Candidate Countries.[163] Interviews were carried out in March and April 2006, using computer-aided telephone interview (CATI) technology.

Questionnaire

The questionnaire is similar to those used in the previous surveys from 2002 to 2005 in order to ensure a basic continuity of the research approach. The module on ICT impact was substantially extended compared to 2005, in response to current policy interest, in exchange for some questions from other modules.

Some questions which were also used in previous surveys were slightly modified. The most important change in this context concerns questions on e-commerce: up to 2005, companies were asked whether they "purchase / sell online"; in 2006, companies were asked whether they "place / accept orders online". This is a more precise question, since the terms "purchasing" and "selling" leave it open whether ordered goods also have to be paid online in order to qualify for "online purchasing / selling".

Some specific topics were added or expanded in the questionnaire in order to reflect the latest e-business developments; examples are the new questions on the use of RFID and Voice-over-IP.

The questionnaires of all four surveys (2002, 2003, 2005, 2006) can be downloaded from the *e-Business W@tch* website (www.ebusiness-watch.org/about/methodology.htm).

Population

As in 2005, the survey considered only **companies that used computers**. Thus, the highest level of the population was the set of all computer-using enterprises which were active within the national territory of one of the 29 countries covered, and which had their primary business activity in one of the 10 sectors specified on the basis of NACE Rev. 1.1.

Evidence from previous surveys shows that computer use can be expected to be 99% or more in all sectors among medium-sized and large firms. Differences are more relevant, however, for micro and small enterprises, in particular in the food and beverages industry, the textile and footwear industries, construction and tourism. In these four sectors, 10-30% of micro enterprises and 4-15% of small firms (depending on the country and sector) do not use a computer.[164] This should be considered when comparing figures over the years, as figures either represent a percentage of "all companies" (as in 2002 and 2003)

[163] The EEA (European Economic Area) includes, in addition to EU Member States, Iceland, Liechtenstein and Norway. Acceding Countries with whom an Accession Treaty has been signed are Bulgaria and Romania; Candidate Countries, which are candidates for accession into the EU, are (as of September 2006) Croatia, the former Yugoslav Republic of Macedonia, and Turkey. In most of these countries, interviews and/or case studies were conducted.

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

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

The 10 sectors which were selected for the 2006 survey are extremely heterogeneous in terms of their size. Construction and tourism are by far the largest with about 1.5 million enterprises in each of the EU-25.[165] At the other end of the range is the consumer electronics industry with about 5,400 enterprises; this is a factor of about 280 between the largest and smallest sector. This imbalance has inevitably a substantial impact on weighting and thus on aggregate results, which are dominated by figures from construction and tourism.

Table 1: Population coverage of the e-Business Survey 2006

No.	NACE Rev. 1.1	Sectors covered	No. of enterprises in EU-25 *	No. of interviews conducted
1	DA 15 (most groups)	Food and beverages	282,000	1,709
2	DC 19.3	Footwear	13,700	980
3	DE 21	Pulp, paper and paper products	18,400	1,158
4	DL 30, 32.1+2	ICT manufacturing	31,800	1,687
5	DL 32.3	Consumer electronics	5,400	665
6	DM 35.11	Shipbuilding and repair	7,200	150
7	F 45.2+3 (selected classes)	Construction	1,546,000	2,655
8	H 55.1/3, I 63.3, O 92.33/52	Tourism	1,500,000	2,663
9	I 64.2	Telecommunication services	12,900	1,580
10	N 85.11	Hospital activities	(e) 13,000	834

* mostly based on Eurostat SBS, latest available figures

(e) = estimated on the basis of figures for the former EU-15 (no figures available for EU-25)

Sampling frame and method

No cut-off was made in terms of minimum size of firms. The sample drawn was a random sample of companies from the respective sector population in each of the countries, with the objective of fulfilling minimum strata with respect to company size class per country-sector cell. Strata were to include a 10% share of large companies (250+ employees), 30% of medium sized enterprises (50-249 employees), 25% of small enterprises (10-49 employees) and up to 35% of micro enterprises with less than 10 employees.

Samples were drawn locally by fieldwork organisations based on official statistical records and widely recognised business directories such as Dun & Bradstreet or Heins und Partner Business Pool (both used in several countries).

The survey was carried out as an enterprise survey: data collection and reporting focus on the enterprise, defined as a business organisation (legal unit) with one or more establishments.

Due to the rather small population of enterprises in some of the sectors, target quota, particularly in the larger enterprise size-bands, could not be accomplished in each of the countries. In these cases, interviews were shifted to the next largest size-band (from large to medium-sized, from medium-sized to small), or to other sectors.

[165] Construction (NACE Rev. 1.1 F 45) in total has about 2.3 million enterprises. The sub-sectors covered in 2006 (see Table 1) account for about 1.5 million out of these.

Fieldwork

Fieldwork was coordinated by the German branch of Ipsos GmbH (www.ipsos.de) and conducted in cooperation with its local partner organisations (see Table 2) on behalf of *e-Business W@tch*.[166]

The survey had a scope of 14,081 interviews, spread across the 29 countries and 10 industries covered. In 10 countries ("EU-10"), all 10 sectors were covered; in the other countries, selected industries were surveyed. In most countries, between 400 and 750 interviews were conducted. Pilot interviews prior to the regular fieldwork were conducted with 23 companies in Germany in February 2006, in order to test the questionnaire (structure, comprehensibility of questions).

Table 2: Institutes that conducted the fieldwork of the e-Business Survey 2006 and no. of interviews per country (#)

	Institute	# Int.		Institute	# Int.
BE	Ipsos Belgium, 1050 Brussels	400	MT	Misco International Ltd., Valetta VLT 04	101
CZ	Ipsos Czech Republic, Skolska 32/694, 110 00 Praha 1	750	NL	Ipsos Belgium, 1050 Brussels	400
DK	Vilstrup Research AS, 1360 Copenhagen	403	AT	Spectra Marktforschungs-gesellschaft m.b.H., 4020 Linz	400
DE	Ipsos GmbH, 23879 Mölln	800	PL	Ipsos Poland, 02-508 Warszawa	752
EE	Marketing and Public Opinion Research Centre SKDS, Riga LV-1010	314	PT	Ipsos Portugal, 1070-15 Lisbon	400
EL	Synovate Hellas, 15451 Athens	407	SI	GfK Gral-Iteo trazne raziskave d.o.o., 1000 Ljubljana	400
ES	Ipsos Eco Consulting, 28036 Madrid	754	SK	GfK Slovakia Ltd., 813 41 Bratislava 1	400
FR	Ipsos France, 75739 Paris	751	FI	Taloustutkimus Oy, 00510 Helsinki	752
IE	Landsdowne Market Research, Dublin 1	400	SE	GfK Sverige AB, 22100 Lund	400
IT	Demoskopea S.p.A., 00199 Roma	756	UK	Continental Research, London EC1V 7DY	750
CY	Synovate Cyprus, 2107 Nicosia	209		EEA and Acceding/Candidate countries	
LV	Marketing and Public Opinion Research Centre SKDS, Riga LV-1010	432	NO	Norstat Norway, 0159 Oslo	401
LT		404	BG	TNS BBSS Gallup Interbational, 1164 Sofia	400
LU	Ipsos GmbH, 23879 Mölln/20097 Hamburg	117	RO	Field Insights, Bucharest 2	440
HU	Szonda Ipsos, 1096 Budapest	772	TR	Bilesim International Research & Consultancy Inc. Turkey, 34676 Istanbul	400

[166] The survey was carried out under two different contracts. The survey in the six largest EU countries (DE, ES, FR, IT, PL, UK) was carried out as part of the e-Business W@tch contract between the European Commission and empirica GmbH; the survey in the other countries was carried out in parallel, but under a different contract (following an open call for tender for the "extended e-Business W@tch survey", issued in 2005).

Non response: In a voluntary telephone survey, in order to achieve the targeted interview totals, it is always necessary to contact more companies than just the number equal to the target. In addition to refusals, or eligible respondents being unavailable, any sample contains a proportion of "wrong" businesses (e.g., from another sector), and wrong and/or unobtainable telephone numbers. Table 3 shows the completion rate by country (completed interviews as percentage of contacts made) and reasons for non-completion of interviews. Higher refusal rates in some countries, sectors or size bands (especially among large businesses) inevitably raises questions about a possible refusal bias. That is, the possibility that respondents differ in their characteristics from those that refuse to participate. However, this effect cannot be avoided in any voluntary survey (be it telephone- or paper-based).

Table 3: Interview contact protocols: completion rates and non-response reasons (2006, examples)

		CZ	DE	ES	FR	HU	IT	NL	PL	FI	UK
1	**Sample (gross)**	5595	7763	7730	8686	21540	8533	4576	11054	3016	11821
1.1	Telephone number does not exist	283	1055	0	186	5545	717	349	2282	139	2663
1.2	Not a company (e.g. private household)	79	80	356	66	2076	89	219	681	34	324
1.3	Fax machine / modem	56	48	0	79	1120	61	28	53	4	130
1.4	Quota completed -> address not used	43	124	660	1939	1665	2154	1002	877	66	158
1.5	No target person in company	17	359	730	142	9	178	232	959	319	736
1.6	Language problems	9	18	0	25	0	1	36	0	41	20
1.7	No answer on no. of employees	2	1	10	13	6	8	1	19	1	0
1.8	Company does not use computers	48	47	158	250	279	314	235	460	28	51
1.9	Company does not qualify	134	330	103	156	0	113	47	813	49	215
	Sum 1.1 – 1.9	671	2062	2017	2856	10700	3635	2149	6144	681	4297
2	**Sample (net)**	4924	5701	5713	5830	10840	4898	2427	4910	2335	7524
2.1	Nobody picks up phone	1071	582	1645	6	1023	647	82	513	22	1898
2.2	Line busy, engaged	83	122	57	46	89	0	3	73	1	1
2.3	Answering machine	143	145	121	1315	1200	0	9	127	1	145
2.4	Contact person refuses	2080	1125	2553	131	2011	729	1653	2009	578	2523
2.5	Target person refuses	450	1865	202	1475	2776	642	113	280	405	1618
2.6	No appointment during fieldwork period	3	11	70	182	2571	384	112	150	50	376
2.7	Open appointment	295	953	35	1896	258	1041	21	763	459	51
2.8	Target person is ill / unavailable	2	31	0	0	0	13	0	29	2	32
2.9	Interview abandoned	43	67	271	29	108	686	34	176	15	130
2.10	Interview error, cannot be used	4	0	5	5	32	0	0	38	50	0
	Sum 2.1 – 2.10	4174	4901	4959	5085	10068	4142	2027	4158	1583	6774
3	**Successful interviews**	750	800	754	751	772	756	400	752	752	750
	Completion rate (= [3] / [2])	15%	14%	13%	13%	7,12%	15%	16,48%	15%	32%	10%
	Average interview time (min:sec)	19:19	18:46	17:29	19:39	17:14	16:43	19:00	23:44	20:19	20:16

Feedback from interviewers

No major problems were reported from the fieldwork with respect to interviewing (comprehensibility of the questionnaire, logical structure). The overall feedback from the survey organisations was that fieldwork ran smoothly and that the questionnaire was well understood by most respondents. The main challenge was the fulfilment of the quotas, which was difficult or impossible in some of the sectors, in particular among the larger size-bands. Some of the more specific remarks from fieldwork organisations, which point at difficulties encountered in the local situation, are summarised in Table 4.

Table 4: Comments by national fieldwork companies on their experience (2006, examples)

Country	Comments
Belgium	• The questionnaire was very clear. • Business-to-business (B2B) research (i.e. surveys on behalf of companies or authorities amongst companies) is often difficult when the questionnaire length is longer than 15 minutes; target persons often complained that they have no time for an interview during their normal work. • Positive reaction from respondents that the results can be found on the website.
Bulgaria	• Many companies (especially within the tourism sector) have outsourced their ICT operations. Therefore, it was sometimes difficult for respondents to understand the questions.
Czech Republic	• It was difficult to fulfil quotas in several sectors which are mainly represented by very small companies, often by one-person-companies (self-employed), many of which are not willing to do a relatively long interview. There was a high percentage of refusals among micro-companies.
Denmark	• Some technical terms (such as internet protocol, LAN, W-LAN, VPN, RFID, and EDI) were hard for interviewers and respondents to understand.
Finland	• The questionnaire was quite long and that is why there were more refusals than normal. • Smaller companies often refused to answer or interrupted the interview because they thought that they did not know enough about e-business. Respondents in the pulp and paper sector were especially not interested in this topic due to comparably low ICT usage.
Germany	• As with previous e-Business surveys carried out, fieldwork ran relative smoothly overall and the questionnaire was easy to understand and interesting for most of respondents. • Respondents from small companies often had difficulty when answering questions related to specific technical terms and applications. • Respondents reacted positively to the fact that the survey was carried out on behalf of the European Commission.
Greece	• There were several cases where companies have outsourced the IT support and thus there was no person to interview. • Respondents who were not IT specialists found some of the IT terminology difficult to understand.
Spain	• Fieldwork did not run as smoothly as expected due to several bank holidays occurring during the period, therefore it was difficult to reach the target persons. • IT professionals in large companies were the most available.
France	• In general, the fieldwork went without any problems and the questionnaire was understood by the respondents. • For some sectors, the lack of contact addresses was a serious problem. • For future surveys, the case concerning new companies which cannot answer the financial questions should be considered.
Hungary	• The cooperation level in this survey was similar to other telephone surveys among companies; but a problem was that many small companies use only one computer, and only for basic functions.
Ireland	• The B2B sector (not general population or household surveys) is very over researched in Ireland; hence there was a high level of refusals. • In Ireland more than 90% of businesses employ less than 9 employees so many companies do not have the need nor use for ICT.

Italy	• Many refusals among the smallest and/or family owned business, where only one PC is available and used more for personal reasons than for business. • Respondents often lost their patience because considering the low use of the PC in their business, they had to spend time on the phone always giving the same answers ("no, do not use …").
Latvia	• The main problem was the length of the questionnaire. Although the average interview length was 16 minutes and thus the shortest of all participating countries, surveys among companies with interviews lasting more than 15 minutes are generally not recommended in Latvia. • It was rather hard for IT managers to answer about budget, market shares and so on.
The Netherlands	• The questionnaire was very clear, so positive. • Business-to-business surveys are often difficult when the questionnaire length is longer than 15 minutes. • Secretaries/receptionists in the Netherlands are very well trained in refusing the transferring of a call.
Norway	• Interviewers experienced that many respondents / businesses did not wish to participate due to the topic of the survey. Main reason was that they did not feel competent, although they qualified from the results of the screening.
Poland	• There were some difficulties in getting an interview with computer/IT specialists. In many big companies they refuse to take time for an interview. • Many small companies did not understand some of the more technical terms.
Sweden	• The questionnaire was understood by most of the respondents.
UK	• Although some of the questions do appear to be quite technical, this did not prove a particular problem for respondents. • There was a very low universe of companies in certain quota cells. Given the limited sample available in some sectors, and the need to target a high proportion of large companies, a longer field period would probably have helped to maximize the number of complete interviews. • It is becoming increasingly difficult to secure interviews with IT/DP professionals, and we suspect that this situation will only worsen in the future.

Weighting schemes

Due to stratified sampling, the sample size in each size-band is not proportional to the population numbers. If proportional allocation had been used, the sample sizes in the 250+ size-band would have been extremely small, not allowing any reasonable presentation of results. Thus, weighting is required so that results adequately reflect the structure and distribution of enterprises in the population of the respective sector or geographic area. *e-Business W@tch* applies two different weighting schemes: weighting by employment and by the number of enterprises.[167]

- Weighting by employment: Values that are reported as employment-weighted figures should be read as "enterprises comprising x% of employees" (in the respective sector or country). The reason for using employment weighting is that there are many more micro-enterprises than any other firms. If the weights did not take into account the economic importance of businesses of different sizes in some way, the results would be dominated by the percentages observed in the micro size-band.
- Weighting by the number of enterprises: Values that are reported as "x% of enterprises" show the share of firms irrespective of their size, i.e. a micro-company with a few employees and a large company with thousands of employees both count equally.

[167] In the tables of this report, data are normally presented in both ways, except for data by size-bands. These are shown in % of firms within a size-band, where employment-weighting is implicit.

The use of filter questions in interviews

In the interviews, not all questions were asked to all companies. The use of filter questions is a common method in standardised questionnaire surveys to make the interview more efficient. For example, questions on the type of internet access used were only asked to those companies that had replied to have internet access. Thus, the question whether a company has Internet access or not serves as a filter for follow-up questions.

The results for filtered questions can be computed on the base of only those enterprises that were actually asked the question (e.g. "in % of enterprises with internet access"), but can also be computed on the base of "all companies". In this report, both methods are used, depending on the indicator. The base (as specified in footnotes of tables and charts) is therefore not necessarily identical to the set of companies that were actually asked the underlying question.

Statistical accuracy of the survey: confidence intervals

Statistics vary in their accuracy, depending on the kind of data and sources. A 'confidence interval' is a measure that helps to assess the accuracy that can be expected from data. The confidence interval is the estimated range of values on a certain level of significance. Confidence intervals for estimates of a population fraction (percentages) depend on the sample size, the probability of error, and the survey result (value of the percentage) itself. Further to this, variance of the weighting factors has negative effects on confidence intervals.

Table 7 gives some indication about the level of accuracy that can be expected for industry totals for the EU-10[168] (based on all respondents) depending on the weighting scheme applied. For totals of all-sectors (in the EU-10), an accuracy of about +/- 3 percentage points can be expected for most values that are expressed as "% of firms", and of about +/- 2 percentage points for values that are weighted by employment.

The confidence intervals for industry totals (EU-10) differ considerably depending on the industry and the respective value; on average, it is about +/- 5 percentage points (in both weighting schemes). Confidence intervals are highest for the shipbuilding and repair industry, due to the small number of observations, and because this sector is more sensitive to weights due to its structure (i.e. the dominance of large firms in a comparatively small population). Data for this industry are therefore indicative and cannot claim to have statistical accuracy.

The calculation of confidence intervals is based on the assumption of (quasi-) infinite population universes. In practice, however, in some industries and in some countries the complete population of businesses consists of only several hundred or even a few dozen enterprises. In some cases, literally each and every enterprise within a country-industry and size-band cell was contacted and asked to participate in the survey. This means that it is practically impossible to achieve a higher confidence interval through representative enterprise surveys in which participation is not obligatory. This should be borne in mind when comparing the confidence intervals of *e-Business W@tch* surveys to those commonly found in general population surveys.

[168] The EU-10 are composed of those countries in which all 10 sectors were covered by the survey. To ensure data comparability, only interviews from these countries are included in the aggregated "total" values. The EU-10 are: CZ, DE, ES, FR, IT, HU, NL, PL, FI, UK. These 10 countries represent more than 80% of the population and GDP of the EU.

Table5: Confidence intervals for all-sector and sector totals (EU-10)

		Confidence interval								
	Survey result	Weighted as "% of firms"			Weighted by employment			Unweighted		
All sectors (aggregate), EU-10	**10%**	**8.1%**	**-**	**12.3%**	**8.7%**	**-**	**11.5%**	**9.4%**	**-**	**10.6%**
Food and beverages	10%	**6.6%**	-	**14.8%**	**7.3%**	-	**13.6%**	**8.4%**	-	**11.9%**
Footwear	10%	**7.5%**	-	**13.2%**	**7.6%**	-	**13.1%**	**8.4%**	-	**11.9%**
Pulp and paper	10%	**7.8%**	-	**12.7%**	**7.5%**	-	**13.3%**	**8.5%**	-	**11.7%**
ICT manufacturing	10%	**7.9%**	-	**12.6%**	**7.6%**	-	**13.0%**	**8.7%**	-	**11.5%**
Consumer electronics	10%	**7.4%**	-	**13.4%**	**6.0%**	-	**16.2%**	**8.0%**	-	**12.4%**
Shipbuilding and repair	10%	**4.8%**	-	**19.7%**	**4.6%**	-	**20.4%**	**6.0%**	-	**16.1%**
Construction	10%	**6.9%**	-	**14.3%**	**7.6%**	-	**13.1%**	**8.3%**	-	**11.9%**
Tourism	10%	**6.6%**	-	**14.8%**	**6.8%**	-	**14.4%**	**8.3%**	-	**12.0%**
Telecommunication services	10%	**7.6%**	-	**13.1%**	**6.6%**	-	**14.8%**	**8.4%**	-	**11.9%**
Hospital activities	10%	**7.2%**	-	**13.7%**	**7.2%**	-	**13.8%**	**8.1%**	-	**12.3%**
All sectors (aggregate), EU-10	**30%**	**26.8%**	**-**	**33.4%**	**27.9%**	**-**	**32.2%**	**29.1%**	**-**	**30.9%**
Food and beverages	30%	**24.2%**	-	**36.6%**	**25.4%**	-	**35.0%**	**27.4%**	-	**32.8%**
Footwear	30%	**25.9%**	-	**34.5%**	**26.0%**	-	**34.3%**	**27.3%**	-	**32.8%**
Pulp and paper	30%	**26.4%**	-	**33.9%**	**25.8%**	-	**34.6%**	**27.6%**	-	**32.5%**
ICT manufacturing	30%	**26.5%**	-	**33.8%**	**26.1%**	-	**34.2%**	**27.9%**	-	**32.2%**
Consumer electronics	30%	**25.6%**	-	**34.8%**	**22.9%**	-	**38.1%**	**26.8%**	-	**33.5%**
Shipbuilding and repair	30%	**20.2%**	-	**42.0%**	**19.7%**	-	**42.8%**	**23.0%**	-	**38.1%**
Construction	30%	**24.7%**	-	**35.9%**	**25.9%**	-	**34.4%**	**27.3%**	-	**32.8%**
Tourism	30%	**24.2%**	-	**36.5%**	**24.6%**	-	**36.1%**	**27.3%**	-	**32.9%**
Telecommunication services	30%	**25.9%**	-	**34.4%**	**24.2%**	-	**36.5%**	**27.4%**	-	**32.7%**
Hospital activities	30%	**25.3%**	-	**35.2%**	**25.3%**	-	**35.2%**	**26.9%**	-	**33.4%**
All sectors (aggregate), EU-10	**50%**	**46.4%**	**-**	**53.6%**	**47.6%**	**-**	**52.4%**	**49.0%**	**-**	**51.0%**
Food and beverages	50%	**43.2%**	-	**56.8%**	**44.7%**	-	**55.3%**	**47.0%**	-	**53.0%**
Footwear	50%	**45.3%**	-	**54.7%**	**45.5%**	-	**54.5%**	**47.0%**	-	**53.0%**
Pulp and paper	50%	**45.9%**	-	**54.1%**	**45.2%**	-	**54.8%**	**47.3%**	-	**52.7%**
ICT manufacturing	50%	**46.0%**	-	**54.0%**	**45.5%**	-	**54.5%**	**47.7%**	-	**52.3%**
Consumer electronics	50%	**45.0%**	-	**55.0%**	**41.7%**	-	**58.3%**	**46.3%**	-	**53.7%**
Shipbuilding and repair	50%	**38.2%**	-	**61.8%**	**37.5%**	-	**62.5%**	**41.8%**	-	**58.2%**
Construction	50%	**43.9%**	-	**56.1%**	**45.4%**	-	**54.6%**	**47.0%**	-	**53.0%**
Tourism	50%	**43.3%**	-	**56.7%**	**43.7%**	-	**56.3%**	**46.9%**	-	**53.1%**
Telecommunication services	50%	**45.4%**	-	**54.6%**	**43.3%**	-	**56.7%**	**47.1%**	-	**52.9%**
Hospital activities	50%	**44.6%**	-	**55.4%**	**44.6%**	-	**55.4%**	**46.5%**	-	**53.5%**
All sectors (aggregate), EU-7	**70%**	**66.6%**	**-**	**73.2%**	**67.8%**	**-**	**72.1%**	**69.1%**	**-**	**70.9%**
Food and beverages	70%	**63.4%**	-	**75.8%**	**65.0%**	-	**74.6%**	**67.2%**	-	**72.6%**
Footwear	70%	**65.5%**	-	**74.1%**	**65.7%**	-	**74.0%**	**67.2%**	-	**72.7%**
Pulp and paper	70%	**66.1%**	-	**73.6%**	**65.4%**	-	**74.2%**	**67.5%**	-	**72.4%**
ICT manufacturing	70%	**66.2%**	-	**73.5%**	**65.8%**	-	**73.9%**	**67.8%**	-	**72.1%**
Consumer electronics	70%	**65.2%**	-	**74.4%**	**61.9%**	-	**77.1%**	**66.5%**	-	**73.2%**
Shipbuilding and repair	70%	**58.0%**	-	**79.8%**	**57.2%**	-	**80.3%**	**61.9%**	-	**77.0%**
Construction	70%	**64.1%**	-	**75.3%**	**65.6%**	-	**74.1%**	**67.2%**	-	**72.7%**
Tourism	70%	**63.5%**	-	**75.8%**	**63.9%**	-	**75.4%**	**67.1%**	-	**72.7%**
Telecommunication services	70%	**65.6%**	-	**74.1%**	**63.5%**	-	**75.8%**	**67.3%**	-	**72.6%**
Hospital activities	70%	**64.8%**	-	**74.7%**	**64.8%**	-	**74.7%**	**66.6%**	-	**73.1%**
All sectors (aggregate), EU-7	**90%**	**87.7%**	**-**	**91.9%**	**88.5%**	**-**	**91.3%**	**89.4%**	**-**	**90.6%**
Food and beverages	90%	**85.2%**	-	**93.4%**	**86.4%**	-	**92.7%**	**88.1%**	-	**91.6%**
Footwear	90%	**86.8%**	-	**92.5%**	**86.9%**	-	**92.4%**	**88.1%**	-	**91.6%**
Pulp and paper	90%	**87.3%**	-	**92.2%**	**86.7%**	-	**92.5%**	**88.3%**	-	**91.5%**
ICT manufacturing	90%	**87.4%**	-	**92.1%**	**87.0%**	-	**92.4%**	**88.5%**	-	**91.3%**
Consumer electronics	90%	**86.6%**	-	**92.6%**	**83.8%**	-	**94.0%**	**87.6%**	-	**92.0%**
Shipbuilding and repair	90%	**80.3%**	-	**95.2%**	**79.6%**	-	**95.4%**	**83.9%**	-	**94.0%**
Construction	90%	**85.7%**	-	**93.1%**	**86.9%**	-	**92.4%**	**88.1%**	-	**91.7%**
Tourism	90%	**85.2%**	-	**93.4%**	**85.6%**	-	**93.2%**	**88.0%**	-	**91.7%**
Telecommunication services	90%	**86.9%**	-	**92.4%**	**85.2%**	-	**93.4%**	**88.1%**	-	**91.6%**
Hospital activities	90%	**86.3%**	-	**92.8%**	**86.2%**	-	**92.8%**	**87.7%**	-	**91.9%**

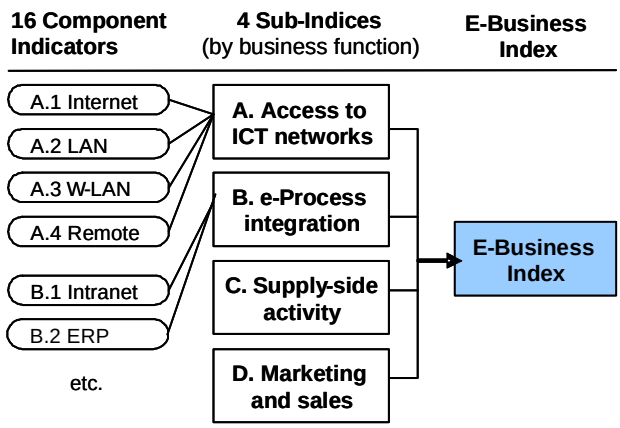
confidence intervals at α=.90

The e-Business Scoreboard 2006

The e-Business Scoreboard approach was developed by *e-Business W@tch* in 2004. It is a compound index that condenses data on ICT adoption and e-business activity, enabling comparisons across different sectors, countries or size-bands.

Conceptually, the e-Business Scoreboard owes a debt to the Balanced Scorecard (BSC) approach, which suggests that an organisation should be viewed from four perspectives, and that metrics (and targets) are to be defined for each perspective. Similarly, the e-Business Scoreboard looks at ICT use by enterprises from four (inter-related) perspectives. The Scoreboard consists of **16 component indicators** (see next page), which represent the metrics for these perspectives. Component indicators (CI) can be aggregated on several levels.

- First, CI can be aggregated into the 4 main **sub-indices** (with 4 CI each) that represent major application areas of e-business.
- Second, the four sub-indices can be further aggregated into 2 dimensions and, finally, into the overall "**e-Business Index**".



The e-Business Scoreboard takes into account the percentages (diffusion rates) from all sectors (size-bands, …) and show how a specific sector (size-band, …) differs from the all-sector-average. An index value is based on mean values and standard deviations. Thus, index values express the multiple of the standard deviation (1 or (-1)) for a specific sector and the selected indicator. 0 equals the mean value for all sectors (size-bands, …).

Indexes simplify multi-dimensional concepts. To correctly assess the validity and shortcomings of the Scoreboard and its overall index, the following notes should be taken into account:

- **Weighting**: Results are influenced by the selection of the underlying weighting scheme for component indicators. If employment-weighted figures are used, e-business activity in large firms is emphasized. If indicators are weighted by the number of enterprises (irrespective of their size), the situation in smaller firms is emphasized.
- **Component indicators**: The selection of component indicators may have a bias towards manufacturing activities, as some indicators can be more relevant for manufacturing than for service sectors (e.g. ERP use).
- **Relative comparison**: The Scoreboard results do not represent absolute measures of e-business activity, but depend on the respective set of sectors (or countries, ...) that are compared to each other, because figures express standard deviations from the *average* of the respective set.

Component indicators of the e-Business Scoreboard 2006

(Definitions for indicators weighted by employment)

A. ICT infrastructure and basic connectivity		
A.1	**Internet** connectivity	= the percentage of employees working in enterprises that are connected to the internet, with a supplementary indicator for the type of internet connection in terms of bandwidth. Enterprises that are connected with broadband (via DSL, cable, direct fibre or wireless broadband) are computed with a factor of 1.0, enterprises connected via analogue dial-up modem or ISDN with a factor of 0.5. The maximum value of 100 would be returned if all employees work in enterprises with broadband connections.
A.2	Use of **LAN**	= the percentage of employees from a sector working in enterprises that have connected computers with a Local Area Network (LAN).
A.3	Use of a **Wireless LAN**	= the percentage of employees working in enterprises which use a Wireless LAN.
A.4	**Remote access** to the company's computer network	= the percentage of employees from a sector working in enterprises where it is possible to access data from the company's computer system from a remote location.
B. Internal business process automation		
B.1	Use of an **intranet**	= the percentage of employees working in enterprises that use an intranet.
B.2	Use of an **ERP** system	= the percentage of employees working in enterprises that have implemented an ERP (enterprise resource planning) system.
B.3	Use of online technology to **track** working hours and/or production time	= the percentage of employees working in enterprises that use online technologies (other than e-mail) to track working hours and/or production times.
B.4	Companies sending or receiving **e-invoices**	= the percentage of employees working in enterprises that send and/or receive e-invoices.
C. Procurement and supply chain integration		
C.1	Companies placing >5% of their **orders to suppliers online**	= the percentage of employees working in enterprises saying that they place orders to suppliers online on the web or via other computer-mediated networks, for example via EDI based connections to their suppliers, and that these online orders account for at least 5% of their total orders.
C.2	Use of **specific ICT** solutions for e-procurement	= the percentage of employees working in enterprises that use specific IT solutions to support the selection of their suppliers and/or procurement processes.
C.3	Companies **linking their ICT system with suppliers**	= the percentage of employees that work in enterprises whose ICT system is linked with those of suppliers.
C.4	Companies managing **capacity and inventory online**	= the percentage of employees working in enterprises that that use technologies to manage capacity and inventory online.
D. Marketing and sales processes		
D.1	Use of **CRM** software systems	= the percentage of employees working in enterprises that use a CRM (customer relationship management) software to organise data about their customers electronically.
D.2	Companies receiving >5% of **orders from customers online**	= the percentage of employees working in enterprises saying that they accept orders from customers online on the web or via other computer-mediated networks, and that these online orders account for at least 5% of their total orders received.
D.3	Use of **specific ICT** solutions to support marketing and sales processes	= the percentage of employees working in enterprises that uses specific IT solutions to support marketing and sales processes.
D.4	Companies **linking their ICT system with customers**	= the percentage of employees that work in enterprises whose ICT system is linked with those of customers.

Annex II: Extended tables

General remarks on country data break-downs

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

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

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

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

	Hospitals with internet access		Hospitals with broadband internet access		Share of employees with internet access		Remote access to hospital network	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**100**	**98**	**85**	**78**	**41**	**41**	**39**	**34**
Small (1-49 empl.)		93		64		46		28
Medium (50-249 empl.)		100		84		39		34
Large (250+ empl.)		100		86		42		41
Belgium	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Czech Republic	100	100	87	91	58	58	52	46
Germany	100	96	86	66	39	41	45	38
Greece	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Spain	(100)*	(89)*	(83)*	(74)*	(49)*	(60)*	(33)*	(18)*
France	100	98	95	86	39	28	35	29
Italy	(99)*	(96)*	(85)*	(91)*	(28)*	(24)*	(32)*	(25)*
Latvia	100	98	63	63	32	35	22	16
Lithuania	96	95	89	86	36	34	9	5
Hungary	100	95	94	88	46	58	21	27
Netherlands	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Poland	100	100	82	69	31	36	22	24
Portugal	100	100	60	73	28	31	15	11
Finland	(100)*	(100)*	(100)*	(94)*	(90)*	(67)*	(74)*	(43)*
Sweden	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
United Kingdom	(100)*	(95)*	(50)*	(66)*	(77)*	(70)*	(62)*	(36)*
Norway	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Turkey	100	99	85	79	55	49	42	39
All 10 sectors (EU-10)	**95**	**93**	**76**	**69**	**40**	**43**	**35**	**16**
Base (100%)	hospitals using computers		hospitals using computers		hospitals with internet access		hospitals using computers	
N (for sector, EU-10)	539		539		539		539	
Questionnaire reference	A1		A3		A2		A5	

* Percentage only indicative, due to small number of observations (n<50)
** Values not displayed because number of observations is too small (n < 25). Some information about survey results from these countries (e.g. from other sectors) is available at the website, see www.ebusiness-watch.org/resources/by_sector.htm

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

Findings by country: In all countries the share of hospitals with internet access was reported to be at least 95% (see Exhibit A2-1). In broadband access there were large differences between the countries. Broadband access was found to be most common in the Czech Republic (91%), Hungary (88%) and Lithuania (86%) and least common in Latvia (63%), Germany (66%) and Poland (69%). The reported share of employees with internet access differed between 58% in the Czech Republic and Hungary and 31% in Portugal. Remote access to the hospitals computer network was found to be most common in the Czech Republic and least common in Lithuania (5%).

Exhibit A2-2: Demand for ICT skills and skills development

	Hospitals employing ICT practitioners		Regular ICT training of employees		Hospitals with hard-to-fill vacancies for ICT jobs in 2005		Hospitals using e-learning	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**57**	**39**	**39**	**34**	**5**	**3**	**26**	**22**
Small (1-49 empl.)		16		20		1		16
Medium (50-249 empl.)		42		41		2		22
Large (250+ empl.)		62		39		6		28
Belgium	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Czech Republic	43	35	54	51	0	0	50	46
Germany	63	29	44	31	6	2	24	17
Greece	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Spain	(43)*	(34)*	(41)*	(25)*	(6)*	(2)*	(19)*	(10)*
France	47	32	31	30	0	0	11	12
Italy	(71)*	(52)*	(75)*	(64)*	(11)*	(2)*	(45)*	(41)*
Latvia	79	52	53	35	15	8	35	23
Lithuania	56	58	21	23	17	9	29	27
Hungary	35	27	20	12	3	3	47	44
Netherlands	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Poland	56	47	17	15	5	7	13	11
Portugal	72	60	68	67	14	8	16	17
Finland	(91)*	(77)*	(79)*	(52)*	(10)*	(10)*	(51)*	(49)*
Sweden	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
United Kingdom	(61)*	(31)*	(60)*	(24)*	(7)*	(2)*	(64)*	(20)*
Norway	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Turkey	30	19	44	35	7	14	60	48
All 10 sectors (EU-10)	**27**	**14**	**22**	**13**	**2**	**1**	**21**	**11**
Base (100%)	hospitals using computers		hospitals using computers		hospitals using computers		hospitals using computers	
N (for sector, EU-10)	539		539		539		539	
Questionnaire reference	B1		B4		B2		B5	
* Percentage only indicative, due to small number of observations (n<50)								
Data for Belgium, Greece, Netherlands, Sweden, and Norway not shown because the number of interviews is too small (n < 25)								

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

Findings by country: Portugal (60%) and Lithuania (58%) reported the highest levels of hospitals employing ICT practitioners, while the level is lowest in Turkey (19%) – see Annex II, Exhibit A2-2. Regular ICT training of employees appeared to be most common in Portugal (67%) and the Czech Republic (51%) and least common in Hungary (12%) and Poland (15%). Turkish hospitals reported the highest level of e-learning (48%), followed by the Czech Republic (46%) and Hungary (44%).

Exhibit A2-3: Hospitals ordering supply goods online

	Place orders online		Place more than 5% of orders online		Place more than 25% of orders online		Use specific ICT solutions for e-sourcing	
	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms	% of empl.	% of firms
Hospitals (EU-10)	**67**	**67**	**71**	**73**	**29**	**27**	**19**	**12**
Small (10-49 empl.)		55		73		27		7
Medium (50-249 empl.)		75		74		26		11
Large (250+ empl.)		66		70		30		21
Belgium	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Czech Republic	62	66	66	81	34	19	13	9
Germany	81	72	69	67	31	33	26	11
Greece	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Spain	(35)*	(38)*	(90)*	(85)*	(10)*	(15)*	(43)*	(26)*
France	63	64	77	72	23	28	16	16
Italy	(40)*	(39)*	(100)*	(100)*	(0)*	(0)*	(15)*	(15)*
Latvia	37	29	98	94	2	6	19	13
Lithuania	41	32	67	68	33	32	20	21
Hungary	38	41	75	86	25	14	11	13
Netherlands	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Poland	60	58	78	74	22	26	3	2
Portugal	44	42	96	82	4	18	16	17
Finland	(87)*	(75)*	(50)*	(64)*	(50)*	(36)*	(50)*	(24)*
Sweden	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
United Kingdom	(76)*	(73)*	(43)*	(64)*	(56)*	(36)*	(26)*	(12)*
Norway	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)
Turkey	33	40	59	64	41	36	27	20
All 10 sectors (EU-10)	**57**	**48**	**74**	**75**	**26**	**25**	**16**	**9**
Base (100%)	hospitals using computers		hospitals placing orders online		hospitals placing orders online		hospitals using computers	
N (for sector, EU-10)	539		300		300		539	
Questionnaire reference	E1		E3		E3		E7	
* Percentage only indicative, due to small number of observations (n between 25 and 50)								
Data for Belgium, Greece, Netherlands, Sweden, and Norway not shown because the number of interviews is too small (n < 25)								

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

Findings by country: The practice of placing orders online differed considerably between countries – see Exhibit A2-3. Online ordering was found to be most widespread in Germany (72%) and the Czech Republic (66%) and least common in Latvia (29%) and Lithuania (32%).

Annex III: Glossary of Technical Terms

Term	Definition[169]
Access	The ability to retrieve information and to communicate online through the use of digital information and communication technologies.
B2B	Business to Business. Electronic transactions between companies.
B2B e-marketplace	Electronic trading platforms on the internet where companies can sell and/or buy goods or services to/from other companies. They can be operated by a single buyer or seller or by a third party. Many marketplaces are industry-specific. Some marketplaces require registration and membership fees from companies that want to conduct trade on them.
B2C	Business to Consumer. Electronic transactions, between companies and consumers.
Bandwidth	The physical characteristic of a telecommunications system that indicates the speed at which information can be transferred. In analogue systems, it is measured in cycles per second (Hertz), and in digital systems in binary bits per second. (Bit/s).
Broadband	High bandwidth internet access. In *e-Business W@tch* reports, broadband is defined as the capacity to transfer data at rates of 2 Mbit/s (megabits per second) or greater.
Channel	In communications, a physical or logical path allowing the transmission of information; the path connecting a data source and a receiver.
CRM	Customer Relationship Management. Software systems that promise the ability to synthesize data on customers' behaviour and needs and thus to provide a universal view of the customer.
Dial-up	The process of establishing a temporary connection (to the internet) via the switched telephone network.
Digital signature	An electronic signature that can be used to authenticate the identity of the sender of a message or the signer of a document, and to ensure that the original content of the message or document that has been sent is unchanged. Digital signature usually refers specifically to a cryptographic signature, either on a document, or on a lower-level data structure.
DRM	Digital rights management. DRM is a system of IT components and services, along with corresponding law, policies and business models, which strive to distribute and control intellectual property and its rights. Product authenticity, user charges, terms-of-use and expiration of rights are typical concerns of DRM.
DSL	Digital Subscriber Line. A family of technologies generically referred to as DSL, or xDSL, capable of transforming ordinary phone lines (also known as "twisted copper pairs") into high-speed digital lines, capable of supporting advanced services. ADSL (Asymmetric Digital Subscriber Line), HDSL (High data rate Digital Subscriber Line) and VDSL (Very high data rate Digital Subscriber Line) are all variants of xDSL
e-Business	Electronic business. The *e-Business W@tch* uses the term "e-business" in the broad sense, relating both to external and to company internal processes. This includes external communication and transaction functions, but also ICT supported flows of information within the company, for example, between departments and subsidiaries.
ebXML	Electronic business using XML. A proven framework and unified set of internationally agreed upon technical specifications and common XML semantics designed to facilitate global trade.
e-Commerce	Electronic commerce. As distinct from the broader concept of e-business, e-commerce refers to external transactions in goods and services between companies (B2B), between companies and consumers (B2C), or between companies and governments (B2G) and may therefore be seen as a subgroup or component of e-business activities.
EDI	Electronic Data Interchange. A way for unaffiliated companies to use networks to link their businesses by using a common technical standard for exchanging business data. While electronic mail between companies is common, electronic data interchange passes bigger bundles that replace large paper documents such as bills and contracts.

[169] Some of the definitions in this glossary are derived from or based on definitions suggested by Whatis?com, a leading online ICT encyclopaedia and learning centre. See http://whatis.techtarget.com.

Term	Definition[169]
EDM	Electronic Document Management. The management of different kinds of documents in an enterprise using computer programmes and storage devices. An EDM system allows an enterprise and its users to create a document or capture a hard copy in electronic form, store, edit, print, process, and otherwise manage documents.
e-Invoicing	Electronic invoicing. A business-to-business transaction in which invoices are generated, delivered (and normally paid) electronically, replacing the equivalent traditional paper-based invoicing processes.
e-Learning	e-Learning means supporting training with learning material in electronic format, for example material that is available on the intranet or the internet. e-Learning applications can be used for ICT-related training, but also for sector-specific or even company-specific training content.
ERP	Enterprise Resource Planning. A software system that helps to integrate and cover all major business activities within a company, including product planning, parts purchasing, inventory management, order tracking, human resources and finance.
Extranet	A network using internet protocols that allows external organisations (for example customers or suppliers) access to selected internal data. Essentially it is an Intranet which gives external users restricted access (often password protected) to information through the firewall.
Firewall	A firewall is a set of related programmes that protects the resources of a private network from users from other networks. The term also refers to the security policy that is used with the programmes.
ICT	Information and communication technology. ICT includes networks, computers, other data processing and transmitting equipment, and software. The application of ICT in business processes leads to e-business.
Information security	Measures taken to protect information systems against unauthorised use and attacks
Internet	The world's largest computer communication system, with an estimated 700 million users worldwide.[170] The internet is a loose confederation of principally academic and research computer networks. It is not a network but rather the interconnection of thousands of separate networks using a common language.
Interoperability	The technical features of a group of interconnected systems (includes equipment owned and operated by the customer which is attached to the public telecommunication network) which ensure end-to-end provision of a given service in a consistent and predictable way.
Intranet	An internal internet, that is an internal network running using TCP/IP, which makes information available within the company. Most Intranets are connected to the internet, and use firewalls to prevent unauthorised access.
ISDN	Integrated Services Digital Network. An international telecommunications standard for transmission of voice and data over dial-up lines running at 64 Kbit/s (kilobits per second). It allows sharing of multiple devices on a single line (for example, phone, computer, fax).
IT	Information technology. IT includes hardware (computers, other data processing and transmitting equipment) and software.
KM	Knowledge Management. ICT solutions that support enterprises in systematically gathering, organising, sharing, and analysing their knowledge in terms of resources, documents, and people skills. Knowledge management software typically involves data mining and some method of operation to push information to users.
LAN	Local Area Network. The most common way of connecting computers in a small area (typically inside a building or organisation) for sharing databases and communication facilities. The two most common versions are Ethernet and Token Ring. Implementation is based on coaxial cables or plain wires. Speed achieved ranges from 10 Mbps to 100 Mbps.
Leased line	A private communication channel leased from the common carrier. It is usually a dedicated fixed-route link (e.g. point-to-point frame relay).
m-Commerce	Mobile commerce. E-commerce that takes place using mobile connection devices and through data transmission via technical standards for mobile communication.
Micro enterprise	A company with fewer than 10 employees.

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

Term	Definition[169]
Modem	Modulator/Demodulator. A device that modulates outgoing digital signals from a computer or other digital device to analogue signals suitable to be transmitted through a conventional telephone line (copper twisted pair telephone). The reverse procedure takes place for incoming signals.
MRO goods	Maintenance, repair and operating goods. Supplies which companies need to maintain their operations, for example office supplies, in contrast to "direct production goods" which are components of the goods and services the company produces.
OOS	Open source software refers to computer software under an open source license. An open-source license is a copyright license for software that makes the source code available and allows for modification and redistribution without having to pay the original author.
Processes	Business processes are operations that transform the state of an object or a person. This can, for example, be an order placed via the internet. Ordering an object or a service creates a liability for the supplier to deliver, and initiates the transfer of property rights from one entity to another. The electronic handling of processes is likely to speed them up and to introduce new processes in the realisation of the same transaction.
PLM	Product lifecycle management. The process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal. PLM software helps companies effectively and efficiently innovate, for example by managing descriptions and properties of a product starting from conception and development.
Remote access	The ability of a company computer network's transmission points to gain access to a computer at a different location.
RFID	Radio Frequency Identification. A wireless technology which is used to uniquely identify an object, animal, or person. RFID is coming into increasing use in industry as an alternative to the bar code. The advantage of RFID is that it does not require direct contact or line-of-sight scanning.
SCM	Supply Chain Management. Software that helps businesses to match supply and demand through integrated and collaborative planning tools.
Sector	Sectors of the economy with comparable business activities. These constitute the main research unit of the *e-Business W@tch*. Aggregated information at the industry level is used to document the diffusion of activities within the industries as well as the overall importance of the observed phenomena for changes in the economy as a whole. The definition of sectors follows NACE Rev.1.1 classifications.
Secure server technology	Secure server technology means that data exchange between computers is based on certain technical standards or protocols, for example "Secure Sockets Layer" (SSL).
SME	Small and medium-sized enterprises with 0-249 employees. To be classified as an SME, an enterprise has to satisfy the criteria for the number of employees and one of the two financial criteria, i.e. either the turnover total or the balance sheet total. In addition, it must be independent, which means less than 25% owned by one enterprise (or jointly by several enterprises) falling outside the definition of an SME or a micro-enterprise, whichever may apply. The thresholds for the turnover and the balance sheet total will be adjusted regularly, to take account of changing economic circumstances in Europe.
SSL	Secure Sockets Layer. A commonly-used protocol for managing the security of a message transmission on the internet. SSL has recently been succeeded by Transport Layer Security (TLS), which is based on SSL.
Standard	A standard is a technical specification approved by a recognised standardisation body for repeated or continuous application, with which compliance is not compulsory.
Transaction	Electronic transactions can be subdivided into several steps, each of which initiates a process. There are pre-sale (or pre-purchase) phases, sale and after-sale phases. Typically a transaction starts with information gathering, price and quality comparisons and possibly pre-sale negotiations. During the sale phase contracting and delivery are the core processes, and payment is the final stage of this phase. After-purchase transaction stages comprise customer service, the administration of credit payments and the handling of returns as well as marketing activities preparing for the next purchase.
UMTS	Universal Mobile Telecommunications Service. A third-generation (3G) digital standard for mobile communication, enabling packet-based transmission of voice, text and video at data rates up to 2 megabits per second (Mbps).
Value added	Gross output minus intermediate inputs. It is valued at producers' prices and includes all indirect taxes, but excludes VAT and subsidies.

Term	Definition[169]
VoIP	Voice over Internet Protocol (IP). The use of telephony services over internet networks, by means of digitised voice transfer technology.
VPN	Virtual Private Network. A way to use a public telecommunication infrastructure, such as the internet, to provide remote offices or individual users with secure access to their organisation's network.
WAN	Wide Area Network. A network allowing the interconnection and intercommunication of a group of computers over a long distance.
WAP	Wireless Application Protocol. A communication protocol for delivering data over mobile telephone systems, allowing cellular phone sets and other mobile hand-set systems to access WWW pages and other wireless services.
Website	A related collection of World Wide Web files that includes a beginning file called a home page.
Wi-Fi	Wireless fidelity. A popular term for a high-frequency wireless local area network (W-LAN). Wi-Fi technology is rapidly gaining acceptance as an alternative or complementary infrastructure to a wired LAN.
W-LAN	Wireless Local Area Network. An implementation of a LAN with no physical wires, using wireless transmitters and receivers. It allows a mobile user to connect to a LAN or WAN through a wireless (radio) connection. A standard, IEEE 802.11, specifies the technologies for wireless LANs.
WWW	World Wide Web. The collection of pages in HTML format which reside on web-servers. Although WWW and the internet are different, the terms are increasingly becoming interchangeably used.
XML	Extensible Mark-up Language. A standard to describe the contents of a page or file. XML is a way to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere.

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