



The Sectoral e-Business Watch

# ICT and e-Business Impact Studies – 2009

ICT for innovation and a sustainable economy



EUROPEAN  
COMMISSION



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## The Sectoral e-Business Watch

The Sectoral e-Business Watch (SeBW) studies the adoption, implications and impact of electronic business practices in different sectors of the economy. It continues activities of the preceding “e-Business W@tch” which was launched by the European Commission, DG Enterprise and Industry, in late 2001, to support policy in the fields of ICT and e-business. The SeBW is based on a Framework Contract and Specific Contract between DG Enterprise and Industry and empirica GmbH.

In ICT-related fields, DG Enterprise and Industry has a twin mission: to enhance the competitiveness of the ICT sector, and to make the efficient uptake of ICT easier in European enterprises in general. The SeBW helps in achieving these goals by supporting informed policy decision-making.

Cornerstones of SeBW research include enterprise surveys, case studies, expert interviews and econometric analyses. The resulting data enable the study team to analyse drivers and impacts of ICT adoption. In 2009, the SeBW is conducting five sectoral and thematic studies. This brochure presents some of the results. The full sector studies, and further resources such as Table Reports with detailed survey results, can be downloaded from the programme’s website ([www.ebusiness-watch.org](http://www.ebusiness-watch.org)).

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## Imprint

This brochure has been prepared by empirica Gesellschaft für Kommunikations- und Technologieforschung mbH on behalf of the European Commission, Enterprise and Industry Directorate General. It is a publication of the Sectoral e-Business Watch programme, which is managed by empirica GmbH and implemented in cooperation with DIW econ, IDC EMEA, Ipsos and GOPA-Cartermill, based on a service contract with the European Commission.

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Design and layout: GOPA-Cartermill  
Printed in Belgium

## Tackling the economic crisis and climate change



While cutting costs is a key motivation for e-business activity, particularly in the current economic circumstances, the Sectoral e-Business Watch 2009 shows that firms are exploiting the enabling potential of Information and Communication Technologies (ICT) to achieve their major business objectives. For strategic purposes, they have integrated ICT into their production processes, quality management, marketing, logistics and customer services. Companies that exploit the innovative potential of ICT even in times of economic difficulty can emerge stronger and more competitive.

While the outlook for ICT investment has become less favourable since mid-2008, the Sectoral e-Business Watch shows that the evolutionary development of e-business has certainly not come to an end. It is widely recognised that “e” elements have become an essential component of modern business. The competitive pressure that companies are increasingly subject to remains a strong driver for ICT adoption to reduce costs and improve customer service.

Recently, the use of ICT to save energy and reduce greenhouse gas emissions gained new prominence, with potentially wide impacts for the economy and society as a whole. The e-Business Watch in 2009 has responded to the importance of climate change issues with specific studies: one on the energy supply industry, another on the glass, ceramics and cement industries – which are energy-intensive – and a third on ICT impact on greenhouse gas emissions.

The results show that ICT is increasingly used for efficient and environmentally-friendly use of resources and that there remains much scope for further improvement. Survey findings also confirm the key enabling role of ICT for innovation: In the energy supply industry, almost all companies that introduced new products, services or processes in the past year reported that ICT was a component of their innovation.

A further study dealing with ICT-related industrial policy acknowledges that the economic crisis may call for new ways of supporting ICT innovation and adoption. Finally, e-skills continue to deserve particular attention for successful ICT and e-business implementation. The e-Business Watch found that a shortage in the supply of ICT practitioners is a main concern, particularly for ICT service providers.

The European Commission has always considered that ICT uptake is instrumental in improving the competitiveness of the European economy as a whole. The results of the Sectoral e-Business Watch for 2009 once again confirmed the validity of this approach.

### **Costas Andropoulos**

Head of Unit, Unit D4 “ICT for Competitiveness and Innovation”  
European Commission, DG Enterprise and Industry

# Snapshots – key findings of the Sectoral e-Business Watch in 2009

The five studies of the Sectoral e-Business Watch (SeBW) in 2009 focus on ICT issues related to climate change and innovation. Overall, the studies confirm the key enabling role of ICT for innovation in general as well as for enhanced energy efficiency and reduced greenhouse gas emissions in particular.

## Enabling role of ICT for innovation substantiated for entire stream of R&D and commercialisation

The SeBW surveys found that ICT is crucial for innovation of new products and services and, even more so, of new processes – it has an “enabling role” in this respect. SeBW enterprise surveys confirmed this for the entire stream of research, development and market introduction. In the energy supply industry, 89% of respondents said that new products or services have ICT components and as many as 97% stated that their new processes are supported by ICT – the highest values for ICT-enabled innovation that the e-Business Watch has ever encountered in an industry.

## ICT can greatly support energy supply – but lack of interoperability hampers smart metering

Smart metering, smart grids, demand management and intelligent power plants are some of most prominent issues in the energy supply industry. Supply of energy requires complex interactions of generation, transmission and distribution facilities which can be greatly facilitated through ICT. Most important for successful ICT implementation is integration of the core supporting technologies. However, the e-Business Watch survey found that a lack of interoperability is one of the most relevant issues preventing the adoption of smart metering.

## ICT is important for process innovation and growth in the glass, ceramics and cement industries

The ability to innovate is a critical success factor for European glass, ceramics and cement industries to keep their position in high value-added market segments. ICT has an important role to play as an enabler of process innovation. Case studies show that successful use of ICT does not necessarily require major investments in hardware or software. Furthermore, growth accounting shows that ICT capital (the stock of hardware, software and telecommunications equipment) contributed positively to value added growth in the sector from 1995-2005.

## ICT tends to increase energy efficiency and lower emissions in energy-intensive industries

Climate change is one of the main challenges of our time. Energy use produces, on average, 80% of greenhouse gas emissions, and consequently energy-intensive industries are the subject of much attention. ICT can help reduce the emissions intensity, but the potential differs between industries. An e-Business Watch study finds that in three of the five most energy-intensive sectors in the EU, greater ICT capital intensity has been associated with increased efficiency and lower emissions intensity. This trend bodes well for a future reduction in emissions intensity due to ICT.

## A suggested need for ICT-related industrial policy to foster ICT innovation and adoption

Findings from an SeBW expert survey indicate a need for industrial policy to support ICT research, development, innovation (RDI) and adoption. The experts confirmed that the European Commission is focusing on the right issues in its ICT- and e-business related industrial policies but their assessment can encourage the EC to extend the scope of these policies. The results also suggest that the importance of the European single market for the ICT companies' ability to sell their products is less well understood than the importance of ICT RDI.

## e-Skills shortage concerns ICT service providers – demands on user skills increased

A shortage in the supply of ICT practitioners appears to be a concern mainly for ICT service providers. Interviewees from the ICT using sectors had not experienced major recent difficulties in hiring ICT practitioners. Most of the managers interviewed stressed the importance of properly training for ICT practitioners so that they understand business processes. While demands on employees regarding their e-skills have noticeably increased in recent years, it appears that the vast majority of employees can cope well with the requirements.



# e-Business and company strategy: how ICT can transform **business models**

Companies use ICT in many different ways, and at different levels of sophistication. At a very basic level, applications such as e-mail and using the web do not have major implications for the existing business. They support processes as they are. To effectively use more advanced forms of e-business, such as the exchange of standardised data with business partners, companies often have to implement significant organisational changes in parallel. In some sectors, the rise of e-business has not only had an impact on internal processes, but is transforming the entire business model of companies or the sector as a whole.

## Level 1: Basic ICT use – little organisational impact

ICT use has become a commonplace in modern business. Nearly all companies use e-mail. Many have a website, and many of them offer basic e-commerce services on their website. These basic ICT applications do not have a significant impact on how the company operates, i.e. on its processes or business model. Many of the SMEs in manufacturing sectors, notably in the more traditional industries, use ICT on this level. The gains in process efficiency and cost savings are limited; on the other hand, investments in the technology are low as well. For many of the smaller companies this may be the optimal use of ICT, provided that they are not forced by large buyers to upgrade their e-business capabilities.

## Level 2: Advanced e-business activity – significant impact on business processes

“Advanced” e-business means that companies can exchange data electronically with suppliers or customers based on e-business standards. This is the precondition that ICT systems can then automatically process the data (without having to manually key them into the system). Taking the step from basic to advanced e-business must, however, be well planned and is not without challenges. For most companies, this innovation has organisational and financial implications. They may need new technology such as e-business software (e.g. an ERP / CRM system); they have to decide which standards to use and organise their business data (e.g. product catalogues) accordingly; and they have to make sure that the new systems are aligned with their actual business processes.

**Table 1: The impact of ICT and e-business in different sectors**

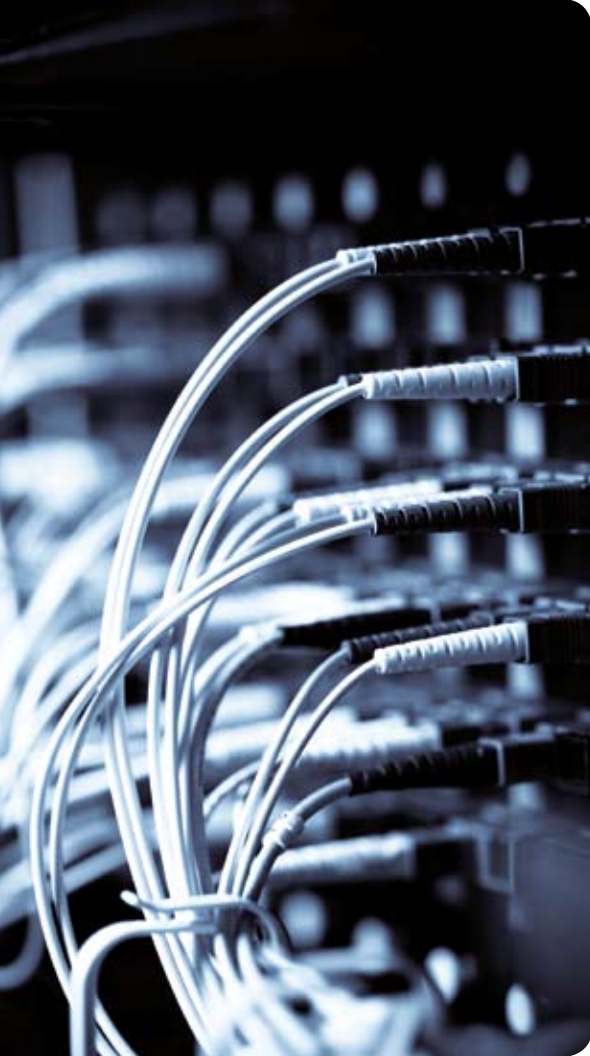
Level 1: Basic ICT use – with little impact on business processes	Level 2: Advanced e-business activity – sector-wide exchange of standardised data	Level 3: Sectors undergoing a major transformation due to e-business
Most SMEs in process manufacturing sectors (e.g. paper, chemical, basic metals, glass, ceramics, cement)	Automotive industry	ICT services
SMEs in manufacturing sectors such as food, furniture	Electronics industry	Tourism
Construction SMEs	Pharmaceutical industry	Financial services
	Large companies in other manufacturing sectors (e.g. chemicals, paper)	Knowledge-intensive business services
	Large retail chains	Publishing
		Logistics

## Level 3: e-Business transformation – new business models and value chains

The sectors which have been most affected by ICT include the ICT services industry itself, tourism, financial services, publishing and the logistics industry. In these industries, the role of ICT and e-business goes far beyond improving process efficiency. ICT, and in particular the internet, have had a profound impact on value chains, including the emergence of new players. Many companies have to adapt their business model in order to stay in business.

In tourism, for example, the internet permits service providers to interact directly with tourism customers, which puts enormous pressure on traditional market intermediaries (travel agencies and tour operators). At the same time, new entrants in the market operate exclusively

online and successfully provide intermediary services. In publishing, the advertising and sales revenues of newspaper publishers are decreasing as many young people of the “internet-generation” do not subscribe to a printed newspaper. Convergence of services, multi-channel publishing and the offer of mobile services are some of the catchwords that attempt to give a concrete quality to future developments in this sector.



# Insights into the **role** of ICT for **in**

ICT is crucial for innovation of new products and services and, even more so, of new processes – it has an “enabling role” in this respect. SeBW surveys among enterprises in energy supply as well as in the glass, ceramics and cement industries confirmed this for the entire research, development and innovation stream. Furthermore, “open innovation”, i.e. involving external experts and business partners in the innovation process, is very common. The surveys also showed differences between industries.

## **ICT is a general purpose technology**

ICT has far-reaching properties. It is a so-called general-purpose technology with three basic characteristics: it is pervasive as it spreads to all sectors; it improves over time and hence keeps lowering the costs for users; and it spawns innovation, i.e. it facilitates research, development and market introduction of new products, services or processes. This last property can be termed the “enabling role of ICT for innovation”. For example, in the energy supply industry, “smart metering” and “smart grids”, two technologies with high potential to transform European energy provision, are ICT-enabled.

## **ICT is crucial for product, service and process innovation**

According to the SeBW enterprise surveys 2009, companies representing 53% of the energy supply industry’s employment said they introduced new products or services in the past twelve months, and 76% introduced new processes. In glass, ceramics and cement, companies representing 45% of employment introduced new products or services and 54% new processes.

The vast majority of innovators in both industries stated that ICT played a crucial role for innovating. In energy supply, 89% said that the new products or services have ICT components (48% “applies fully”, 41% “applies partly”), and 97% said that their new processes are supported by ICT (54% fully, 43% partly). These are the highest values for ICT-enabled innovation that the e-Business Watch has ever found in an industry. In glass, ceramics and cement, 42% said that the new products or

services have ICT components (13% fully, 29% partly) and 75% stated that the new processes are supported by ICT (33% fully, 42% partly). (See [Chart 1](#) for the role of ICT in the energy supply industry and [Chart 2](#) for the glass, ceramics and cement industry.)

## **ICT is also important for R&D and market launch**

In both industries, ICT also played an important role in R&D processes leading to innovation, as well as in market launch or implementation. In energy supply, 71% of the companies (employment-weighted) stated that ICT was important for R&D leading to the product and service innovation, and also for market launch. For process innovation, the related values were greater than 90%. In the glass, ceramics and cement industry, the role of ICT is smaller: 56% of the companies reported that ICT was important for R&D and 54% said that ICT was important for market launch. For process innovation the related values were around 70%. This more detailed view shows that ICT has multi-faceted functions in the innovation stream, which also supports the notion of the “enabling role” of ICT.

## **Joint innovation is prevalent**

The surveys also showed that a large proportion of companies collaborated with business partners or external experts in developing the new product, service or process. This type of “joint innovation” may be beneficial for the companies in that it expands the scope of new knowledge involved, reduces costs and also reduces risks – particularly in pre-competitive R&D. External links may for example be with

### **DATA SOURCES AND METHODOLOGY**

This analysis is based on micro data from representative IT decision-maker surveys (telephone interviews) among 676 glass, ceramics and cement companies and 359 energy supply companies from the six largest EU countries (Germany, France, Italy, United Kingdom, Spain, Poland).

### **MORE INFORMATION**

Further information about the enabling role of ICT for innovation will be included in the study reports about ICT and e-business impact in the energy supply industry and in the glass, ceramics and cement industry. Both reports will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information, please contact Dr Stefan Lilischkis ([stefan.lilischkis@empirica.com](mailto:stefan.lilischkis@empirica.com)).

# enabling novation

universities. More than 80% of the innovative companies in the energy supply industry and more than 50% in the glass, ceramics and cement industry said that they involved external experts or business partners in product, service or process innovation. This finding underlines how much innovation in both industries relies strongly on expertise from outside the company.

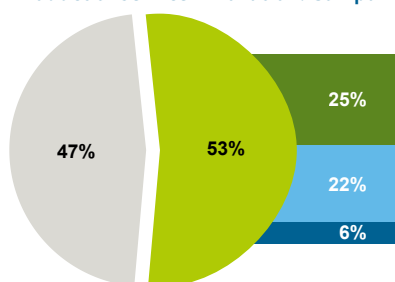
## Overall differences between industries

All in all, the results confirm the crucial importance of ICT for innovation. Policy makers may thus be well advised to recognise that there should be a link between ICT policies and innovation policies.

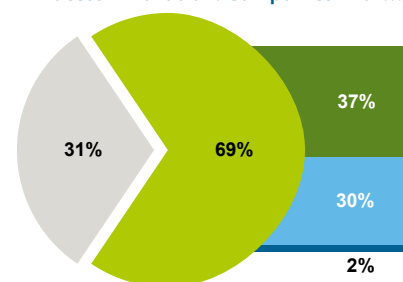
However, the surveys also indicate industry differences in the level of importance of ICT. In energy supply, ICT appears to be indispensable for innovation, while in the glass, ceramics and cement industry ICT is important but there are apparently other important technologies used for innovation as well.

Chart 1: Role of ICT in innovation in the energy supply industry 2009

Product or service innovation: Companies with...



Process innovation: Companies with...



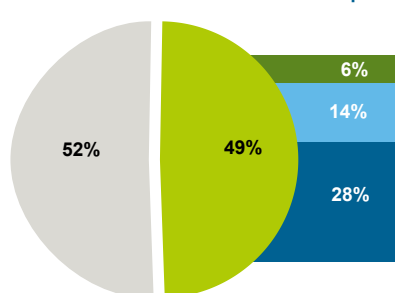
- no new products or services in past 12 months
- new products or services with ICT components ("applies fully")
- new products or services with ICT components ("applies partly")
- new products or services but without ICT components

- no new processes in past 12 months
- new processes ICT-enabled ("applies fully")
- new processes ICT-enabled ("applies partly")
- new processes but not ICT-enabled

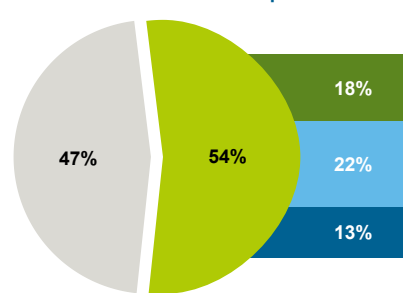
Weighted by employment (i.e. firms representing x% of sector employment). N = 351

Chart 2: Role of ICT for innovation in the glass, ceramics and cement industry 2009

Product or service innovation: Companies with...



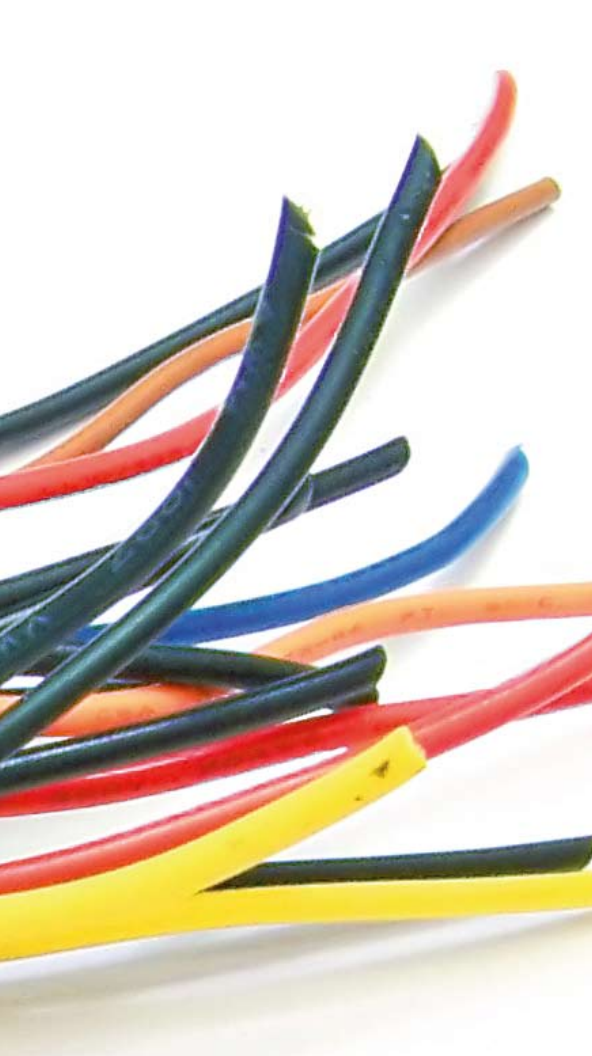
Process innovation: Companies with...



- no new products or services in past 12 months
- new products or services with ICT components ("applies fully")
- new products or services with ICT components ("applies partly")
- new products or services but without ICT components

- no new processes in past 12 months
- new processes ICT-enabled ("applies fully")
- new processes ICT-enabled ("applies partly")
- new processes but not ICT-enabled

Weighted by employment (i.e. firms representing x% of sector employment). N = 676



# ICT and e-business the **energy** supply

There is a flurry of activity related to the use of ICT in the energy supply industry. Smart metering, intelligent or smart grids, demand management, intelligent power plants are some of most prominent issues. The central issue is how ICT can better support the evolution of the utilities industry and make it possible to achieve the EU objectives of security of supply, environmental sustainability, and the creation of an efficient, reliable and competitive European energy market.

## Characteristics of the energy supply industry

The energy supply industry, as defined by NACE Rev. 2 Group 35, includes “electricity, gas, steam and air conditioning supply”. The value chain encompasses production, transmission, distribution and trading of energy as well as its supply to final consumers. In the EU-27, the sector includes 31,000 firms, employs nearly 1.6 million people and generates a turnover of 932 billion euro. Moreover, the energy industry is pivotal to any other industrial and private activity.

The EU energy supply industry faces many challenges. Above all, the EU is highly dependent on imported primary energy sources and is subject to the inherent volatility of prices. The national markets lack integration into a European market, as indicated by the absence of pan-European price convergence and the low level of cross-border trading. There are still wide differences in market structure, competitiveness, public service and customer protection between European countries. The EU is also active in the fight against climate change, and the European energy supply industry is aiming to shift towards decarbonised power or new technologies to capture and store CO<sub>2</sub>.

The deployment of smart grids, including the pilot and roll-out of smart metering, is a strategic element in order to meet these challenges. To stay competitive, energy supply companies need to increase process efficiency along the entire value chain. It is increasingly necessary to integrate ICT applications and to migrate systems to more cost-effective IT architectures, both for electricity and gas.

## e-Business activity in the sector

ICT and e-business can contribute to improved efficiency along the entire value chain, including final usage. They can make possible changes in

business models, production and distribution practices and they can influence customers’ behaviour to become more energy efficient. Utilities increasingly use ICT to improve network reliability, reduce losses and efficiently manage demand. The e-Business Watch survey found that firms representing 71% of the industry’s employment are adopting systems for energy network automation and control.

The successful implementation of ICT and e-business applications in energy supply depends on several factors. The most important is system integration of the core supporting technologies. This implies development and improvement of standards at various levels, including data formats, database management, interfaces between users and machines, and interoperability among devices from different vendors. The lack of interoperability is one of the most significant factors that the e-Business Watch survey found to be impeding the adoption of smart metering (Chart 1). The survey also showed that the level of adoption of smart metering is low but increasing: 20% of energy supply companies (employment-weighted) said they have it, 18% said they are piloting it, and 16% said they were planning to instal or test smart meters in the next two years.

## ICT improves business processes

ICT plays a fundamental role in improving business processes in the European energy supply industry. Currently, the most widespread business application deployed is enterprise resource planning (ERP), used by firms representing two thirds (67%) of the industry’s employment, followed by computer-aided design systems (CAD, 63%) and document management (DMS 61%) – see Chart 2. Other widely deployed sector-specific ICT solutions include: customer relationship management

### DATA SOURCES AND METHODOLOGY

The study is based on a selected set of data sources and methodologies, including primary data collection, desk research and case studies. More specifically, information was collected from a survey of 351 energy supply companies in the six largest EU countries in March 2009 and interviews with industry experts. Econometric methods leveraging the EU KLEMS database were used to gain evidence on links between ICT adoption and greenhouse gas emissions.

### MORE INFORMATION

This Sectoral e-Business Watch study is conducted by IDC Energy Insights (<http://www.energy-insights.com/EL/index.jsp>), with inputs from case study correspondents and DIW econ ([www.diw-econ.de](http://www.diw-econ.de)). It is managed by empirica GmbH ([www.empirica.com](http://www.empirica.com)). The study report will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information about this study, please contact Mr Stefan Lilischkis ([stefan.lilischkis@empirica.com](mailto:stefan.lilischkis@empirica.com)) or Roberta Bigliani ([rbigliani@idc.com](mailto:rbigliani@idc.com)).



# impact in industry

(CRM, 56%), health, safety and environment systems (HS&E, 50%), energy trading and risk management (ETRM, 45%), and carbon management systems (25%). The penetration of these solutions enhances value chain visibility and ensures continuity of operations, while at the same time responding to changing regulatory, safety, and security requirements

however requires enhancing or upgrading of existing infrastructure, implementing new ICT systems and improving integration throughout the ICT operating environment. There is a major role for ICT in all the application areas: in grid management and monitoring, in maintenance operations, in managing and controlling distributed energy resources and in security.

infrastructure solutions. On the demand side, ICT may have a potential to increase energy efficiency among businesses and private households, as shown in [Charts 3 and 4](#). Companies engaging in distribution or retail sale of energy or heating/cooling supply were asked for an assessment of the potential of ICT to increase energy efficiency among customers. Overall, players in this sector believe that the potential impact of ICT on energy efficiency of business customers is significant. About 41% see a high potential to increase the energy efficiency of other companies and 31% think ICT have a medium potential. The scope for improving energy efficiency among private households, however, is perceived by nearly half the interviewed companies as small. These figures demonstrate what a distance still has to be travelled to realise the potential benefits of smart systems.

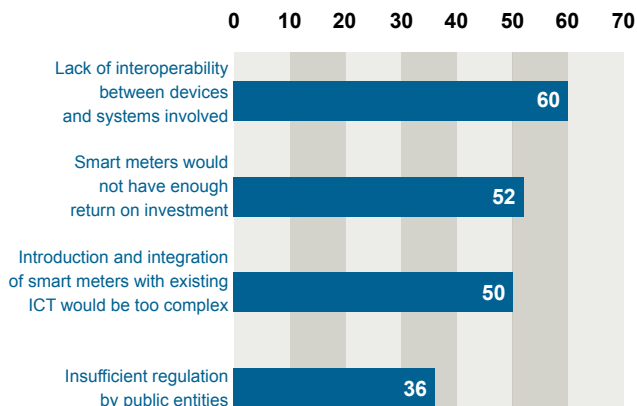
## ICT enables innovation

ICT is also driving profound innovation, bringing the industry closer to the vision of the "intelligent utility" to which users can actively participate. Smart grids represent the new vision on how transmission and distribution networks and consumers are all connected and can interact in real time, thus making it possible to predict and adjust network changes. This

## ICT enables energy efficiency

ICT can facilitate the efficient use of energy by helping energy suppliers to analyse consumption data and to stimulate consumers to respond to energy prices at specific times. On the supply side, companies installing, controlling, managing and monitoring energy distribution grids can use ICT for purposes such as complex billing, remote meter reading and advanced metering

Chart 1: Barriers to smart meter adoption



\* Weightings are based on % of employees. Base: energy supply companies neither implementing nor testing nor planning to instal smart meters. Number of Respondents: 76.

Chart 2: Use of ICT systems



\* Weightings are based on % of employees. Base: all energy supply companies. Number of respondents: 351.

Chart 3: Assumed ICT potential to increase energy efficiency of companies

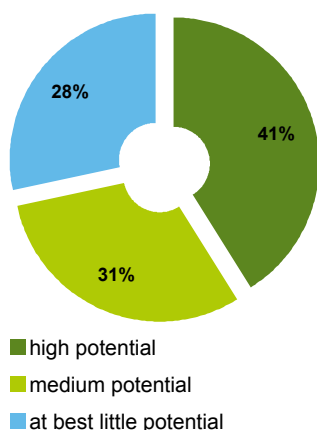
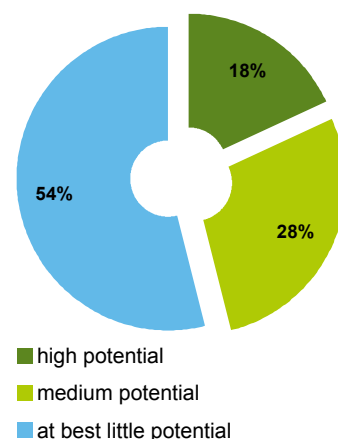


Chart 4: ICT potential to increase energy efficiency among private households.



\*weighted by employment (i.e. firms representing x% of sector employment). Base: Companies engaging in distribution or retail sale of energy or heating/cooling supply. Number of respondents: 249 (for other companies), 241 (for private households).



# ICT and e-Business in the **Glass, Ceramics and Cement Industry**

The ability to innovate is a critical success factor for companies in the European glass, ceramics and cement industries to stay competitive and keep their position in high value-added market segments. ICT has an important role to play here as an enabler of process innovation. This does not necessarily imply large investments in hardware and software – simple ICT solutions can often be sufficient.

## Characteristics of the glass, ceramics and cement industries

The glass, ceramics and cement (GCC) industries are a long-established manufacturing sector in the EU and an important supplier to other industries. The sector produces raw materials and components for the building and construction industry, packaging solutions (container glass) for the consumer goods industry, and specific materials or components used –for example– in the aerospace, automobile, electronics and medical industries. The sector also produces household goods such as glass and ceramic tableware and cookware.

The EU still has a surplus in international trade in this sector and the leading producer world-wide in several segments. However, in some segments such as flat and container glass, imports have surged in the past five years. The GCC industries are energy intensive. Energy costs, and coping with environmental regulation, such as the EU Emissions Trading Scheme for greenhouse gas emissions, are key issues in this sector. Europe is confronted with the challenge of balancing its ambitious environmental objectives against the risk of relocation of production to regions with lower environmental standards.

## e-Business activity in the sector

By definition, e-business means “automating business processes”, that is replacing formerly paper-based document exchanges and their manual processing by electronic exchanges. In most segments of the GCC industry, e-business adoption in general is slightly less advanced than in other process manufacturing sectors. Smaller companies in particular tend to have

little incentive to use e-business. In a survey of 676 companies from the sector, only 16% of the companies (by their share of employment) said that they conducted at least “a good deal” of their business processes electronically, compared to nearly 30% in the chemical industry (2007, see [Chart 1](#)).

Looking at e-commerce, online sales channels (e.g. EDI, sales on the internet) tend to be less relevant than in other sectors. Only about 20% of the companies receive orders from customers online, compared to more than 30% in other manufacturing sectors (see [Chart 2b](#)). This is partly related to supply chain characteristics, e.g. the fact that heavy products such as cement are mainly traded in regional markets, with stable customer-buyer relationships. e-Procurement is a common activity in medium-sized and large companies, but not widely used by small firms, compared to other sectors (see [Chart 2a](#)).

## ICT enables innovation

Nevertheless, ICT matters for this sector. The European GCC industry, in order to withstand global competition, needs to keep its strong position in value-added market segments which rely on product differentiation, quality and service. This requires a continuous effort to innovate business processes. The majority of process innovations in the industry (about 75%), according to the innovating companies interviewed, are linked in one way or the other with ICT usage, in particular in larger companies.

Case studies show that successful use of ICT does not necessarily require major investments in hardware or software. In one case, a medium-sized ceramics manufacturer uses a self-programmed production planning

## DATA SOURCES AND METHODOLOGY

The study is based on micro and macro data, primary and secondary sources. Micro-data about the e-business activity of firms were collected in two ways: (i) through a representative IT decision-maker survey (telephone interviews) among 676 GCC companies from six EU countries, and (ii) through case studies. The macro-economic analysis is based on growth accounting and correlation analysis, using aggregate industry accounts from the EU KLEMS database ([www.euklems.net](http://www.euklems.net)). This database was specifically established for the economic analysis of productivity developments.

## MORE INFORMATION

This Sectoral e-Business Watch study is conducted by empirica GmbH ([www.empirica.com](http://www.empirica.com)) with inputs from DIW econ ([www.diw-econ.de](http://www.diw-econ.de)) and case study correspondents. The study report will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information about this study, please contact Hannes Selhofer ([hannes.selhofer@empirica.com](mailto:hannes.selhofer@empirica.com)).



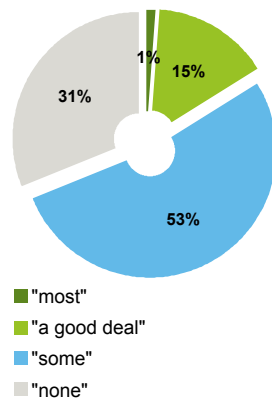
and management system which is based on a standard office software application. This was sufficient to enable the company to move from on-stock to order-based production, with a significant business impact.

## The economic impact of ICT – a macro-perspective

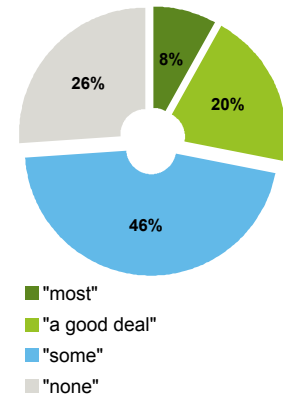
Growth accounting shows that ICT capital (the stock of hardware, software and telecommunications equipment) contributed positively to value added growth in the GCC sector as well as in the total manufacturing industry from 1995-2005. However, but the contribution of ICT capital was not substantial, typically accounting for less than 0.5 percentage points of annual growth. Total factor productivity (TFP), the residual that cannot be statistically explained (or accounted for) by other input factors, accounts for a relatively high share of growth in the GCC sector. This finding is quite specific for capital intensive manufacturing industries such as the GCC sector. It indicates the importance of non-tangible “assets” such as organisational innovation. Changes in ICT capital are strongly positively correlated with labour productivity growth in the manufacturing industry and even more so in the GCC sector. In contrast to (accumulated) ICT capital stock, however, annual ICT investments are not correlated with labour productivity growth and hours worked. This implies a time lag between the point of investment in ICT and the actual return on investment in terms of productivity growth.

**Chart 1: Share of business processes** conducted electronically: % of companies\* saying that most / a good deal / some / none of their business processes are conducted as e-business

(a) Glass, ceramics & cement (2009)



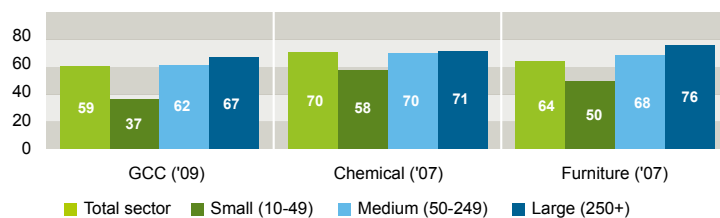
(b) Chemical, rubber & plastics (2007)



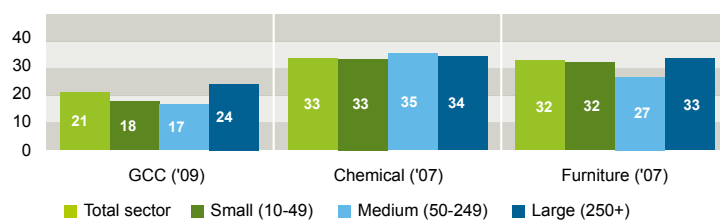
\* weighted by employment (i.e. firms representing x% of sector employment). N = 671 (GCC) / 895 (Chemical)

**Chart 2: % of companies\* using e-Commerce**

(a) Companies placing orders for supplies online



(b) Companies receiving orders from customers online



\* Data for sector totals are weighted by employment (i.e. firms representing x% of sector employment), data for size-bands in % of companies. N = 676 (GCC) / 911 (Chemical) / 761 (Furniture)



# ICT impacts on greenhouse gas emissions in intensive industries

Climate change is one of the main challenges of our time. Energy use produces, on average, 80% of greenhouse gas emissions. Energy-intensive industries are consequently the object of much attention. ICT can help reducing the emissions intensity, but the potential differs between industries. An e-Business Watch study finds that in three of the five most energy-intensive sectors in the EU, greater ICT capital intensity has been associated with increased efficiency and lower emissions intensity. The trend bodes well for a future reduction in emissions intensity due to ICT.

## Energy-intensive industries in Europe

The study focuses on five sectors which all use a high level of energy in their production processes:

- Transport services (NACE Rev.1.1, Divisions 60 to 63);
- Pulp, paper, printing and paper products (NACE Rev. 1.1, Divisions 21 and 22);
- Chemicals, rubber, plastics and coke (NACE Rev. 1.1, Divisions 23 to 25);
- Glass, cement and ceramic (NACE Rev. 1.1, Division 26);
- Basic metals and fabricated metal (NACE Rev. 1.1, Divisions 27 and 28).

These five sectors together comprise one third of the greenhouse gas (GHG) emissions emitted from all EU countries. Absolute emissions from these sectors increased by about 6% between 1995 and 2005 (see [Chart 1](#)). However, the emissions intensity (defined as the ratio of the quantity of GHG emissions to euros of gross output) has been steadily decreasing (see [Chart 2](#)).

Policy plays an important role in setting incentives for companies to reduce their GHG emissions. The EU Emissions Trading System (EU-ETS) was implemented in the paper, metal, and glass-ceramic-cement sectors in 2005 as an important step toward regulating and reducing these industries' high level of emissions. However, individual firms' decisions regarding factors of production and production efficiency standards can be just as important as policy in reducing emissions.

## Case-level evidence: strong emissions-reduction potential of ICT

Capital is an essential input into the production process. ICT capital stock is growing as a percentage of total capital stock in all sectors studied (see [Chart 3](#)). The current and potential uses of ICT suggest that it might also have been an important factor in the observed decrease in emissions intensity in the past decade.

A survey of environmental managers and representatives from each industry demonstrates the importance of ICT. The participating representatives noted a medium to major change in their sector's business practices due to both environmental regulations related to carbon emissions and the EU-ETS (when applicable to the sector). Respondents reported that dedicated processes for systematically monitoring GHG emissions are widely used, and these processes are almost always ICT-enabled. However, views on the potential of ICT systems for reducing GHG emissions were mixed. Respondents emphasised the indirect importance of ICT in emissions monitoring systems, noting that ICT systems are also installed simply to improve overall production efficiency.

Case studies were conducted with companies that use ICT systems to collect, transfer, and process information about their energy consumption in order to optimise their energy use and business processes. The cases show that this leads to a reduction in GHG emissions. In rail production, for example, ICT is used to optimise furnace temperature; in logistics, ICT helps to optimise delivery routes and thus save energy.

### DATA SOURCES

The study is based on both micro and macro data. Macro data about production activity and greenhouse gas emissions (for the years 1995-2005) were extracted from the EU KLEMS database ([www.euklems.net](http://www.euklems.net)) and Eurostat ([epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu)); supplementary data sources used include the United Nations Framework on Climate Change database ([www.unfccc.int](http://www.unfccc.int)) and the OECD ([www.oecd.org](http://www.oecd.org)). Micro-data about the ICT use for controlling energy consumption and emissions were collected through case studies and a representative survey among 676 companies from the glass, ceramics and cement industry.

### MORE INFORMATION

This Sectoral e-Business Watch study is conducted by DIW econ ([www.diw-econ.de](http://www.diw-econ.de)) with inputs from case-study correspondents. The study report will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information, please contact Ferdinand Pavel ([fpavel@diw-econ.de](mailto:fpavel@diw-econ.de)).

# Greenhouse energy- intensity

The typical reduction of energy use found in the case studies is considerable, ranging from 10-20%. ICT is also an integral element in carbon-accounting systems, providing the feedback necessary to make sustainable management decisions.

Theoretically, this marginal ICT contributes more directly to emissions-abatement.

The parametric regressions also support the interpretation of the results in the other three sectors. They suggest a decreasing marginal return to ICT investment in terms of emissions

intensity. ICT capital stock can certainly improve the emissions intensity levels of European energy-intensive sectors, but the marginal decision to invest in more ICT must be made taking account of the investment cost relative to the expected reduction.

## Macro-economic evidence

It is a challenging task to assess the impact of ICT capital on emissions at the aggregate level. GHG missions can be thought of as a result of the normal production process or as a substance that is subject to a specific abatement process. Limited data is available, and there is a lack of research on this topic. Furthermore, the production processes and capital intensity levels of firms differ considerably among the five sectors studied. The study opted for a sectoral approach, implementing both parametric (regressions) and non-parametric (two-stage Data Envelopment Analysis) econometric techniques simultaneously. Parametric regressions were used to model and quantify the relationship between ICT capital intensity and emissions intensity. Non-parametric methods were applied to discover patterns in the data while making fewer assumptions.

Over the past decade, the relationship between the size of ICT capital stock and aggregate sectoral sustainable efficiency has been mixed. The chemical, glass-ceramic-cement, and metal sectors exhibit the expected association between greater ICT capital and greater efficiency. In contrast, in the paper and transport sectors, more ICT capital was associated with less efficiency.

The unexpected association in the paper and transport sectors can be explained through parametric regressions, which identify a quadratic relationship between ICT capital stock and emissions intensity. Despite increasing emissions intensity at low levels of ICT capital, a critical point exists at which ICT capital begins to contribute to an overall reduction in emissions intensity. This relationship suggests that in the paper and transport sectors, more ICT investment can improve sectoral GHG intensity.

Chart 1: Greenhouse gas emissions in Europe (absolute values)

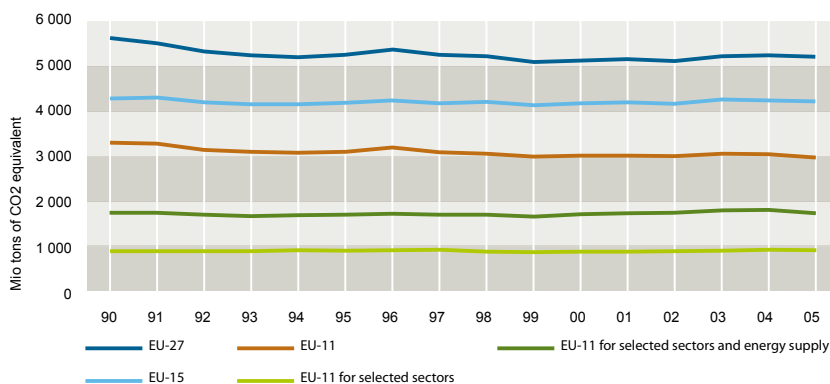


Chart 2: Emissions intensity in the EU-15 and selected countries

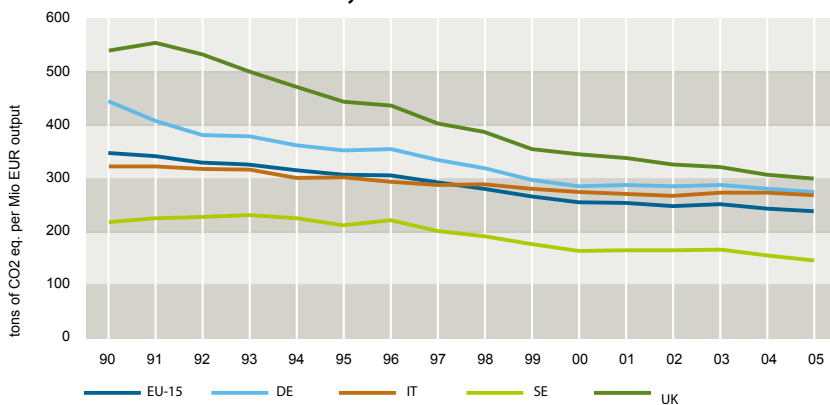
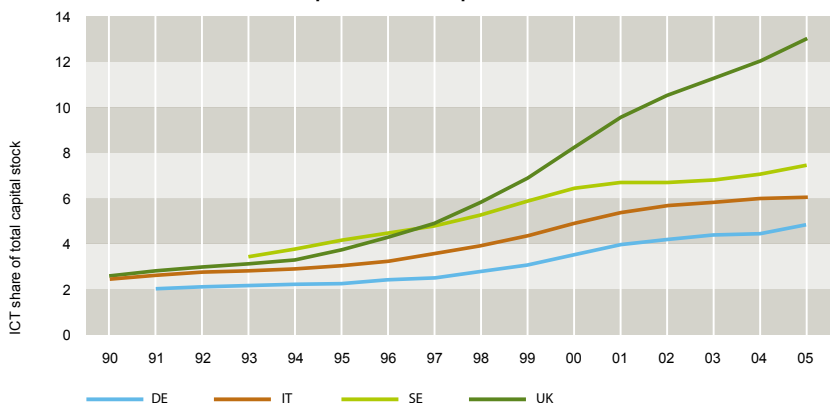


Chart 3: Share of ICT capital in total capital stock





# An **economic assessment** of ICT-related **industry** policy

Findings from an SeBW expert survey indicate a clear need for public policy to support ICT research, development and innovation in ICT-producing companies as well as to support e-business adoption in ICT-using manufacturing companies. The European Commission was assessed as focusing on the right issues but was encouraged to extend the scope of its ICT and e-business related policies. The experts also see a need for closer co-operation between the EC and the Member States in related policies.

## **Competitive pressure in ICT-producing and ICT-using industries**

The European Commission (EC) sees a critical need to increase spending on ICT research, development and innovation (RDI) to stay competitive with the US and East Asia. The EC is also anxious about highly fragmented ICT RDI in Europe, calling for more co-operation between the EC and the Member States, as well as for specialisation and concentration of ICT RDI. The 50 respondents to an SeBW expert survey in June and July 2009 share this anxiety, particularly with regard to the European hardware industry: The majority of respondents who answered this question doubt that European ICT RDI is sufficiently strong to maintain hardware manufacturing.

As regards e-business adoption in ICT-using manufacturing industries, there may be a critical need to improve electronic value systems, i.e. electronic data exchange between companies. In particular, small and medium-sized enterprises (SMEs) are at risk of dropping out of large enterprises' supply chains if they do not adopt e-business practices. 85% of the experts confirmed this. They also agreed that a lack of widely used e-business standards is impeding e-business communication.

In both ICT-producing and ICT-using enterprises, the experts see a danger that investments in RDI and ICT adoption, respectively, are reduced due to the economic crisis.

## **A need to enhance ICT RDI and use ICT to improve industrial competitiveness**

There was almost unanimous agreement among the experts that ICT R&D and innovation in Europe needs to be improved. The agreement was strongest for the statement that "ICT R&D in companies needs to be improved": 50% of the respondents agreed strongly and also 43% rather agreed; no one disagreed. The lowest agreement was for the statement that "legislation ensuring that ICT companies can sell to customers EU-wide needs to be improved" (52% agreed; 26% disagreed). For this statement, the share of respondents providing no answer (22%) was one of the highest in the whole survey. Possibly the importance of the European single market for the ICT companies' ability to sell their products is less well understood than the importance of ICT research, development and innovation.

There was very wide agreement with the statements about improvement needs related to e-business adoption in ICT-using manufacturing companies in Europe. According to the respondents, improving SMEs' e-business relationships with large companies is the most important issue, while e-business adoption and e-business understanding in SMEs are important but less pressing. However, a focus on sustaining SMEs' participation in large companies' value systems is challenged by theoretical considerations. The observation that only a number of firms invest in ICT and that markets become more concentrated over time can simply reflect the fact that the number of efficient firms is decreasing. Thus, policy measures to support SMEs may imply that an inefficiently high number of SMEs remains active.

### **DATA SOURCES AND METHODOLOGY**

The study is based on micro data, primary and secondary sources, and a theoretical analysis. Micro-data about ICT and e-business policies were mainly collected through an online survey of ICT and e-business experts in all countries of the European Union which took place in June 2009. The experts comprised the members of the European e-Business Support Network (eBSN) and selected members of the "European Network for Information Society Research" (ENIR) co-ordinated by empirica. 48 answers were received. Further data were collected through expert interviews and case studies.

### **MORE INFORMATION**

This Sectoral e-Business Watch study is conducted by empirica GmbH ([www.empirica.com](http://www.empirica.com)) with inputs from DIW Berlin ([www.diw.de](http://www.diw.de)) and case study correspondents. The study report will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information about this study, please contact Stefan Lilischkis ([stefan.lilischkis@empirica.com](mailto:stefan.lilischkis@empirica.com)).

## Policy assessment: encouraging to do more of the right things

There was also wide agreement among the experts that ICT RDI as well as ICT adoption by companies should not be left to the market: there is a need for policy initiatives. The majority of respondents also agreed with the statement that the EC's policies to enhance ICT RDI and e-business adoption in companies are focused on the right issues. As for e-business policies, this can be taken as a confirmation of the focus on electronic value system enhancement, e-business standards adoption and e-skills development. The majority of respondents did not agree with the suggested statements that "the European Commission's policies to enhance ICT RDI and e-business adoption are sufficient in scope", and that "the EC's policies to enhance ICT RDI and e-business adoption contribute to industrial competitiveness". This should not, however, be interpreted as a critique of the EC's policies as such. Taken together, the answers confirm the focus of EC's policies but encourage the EC to take a more strategic and coordinated approach to effectively capitalise on R&D results. In this context, this Sectoral e-Business Watch study uses game theory to assess the strategies of companies, Member States and the European Commission when interacting about ICT RDI to improve the basis for designing related industrial policies.

The respondents would also appreciate more co-operation between the EC and the Member States. They agreed that there is a lack of co-operation between EC and EU Member States in enhancing ICT RDI and e-business adoption in companies. An even higher share of respondents agreed that EC and Member States should foster regional clusters of ICT-producing companies and regional or sectoral electronic networks of ICT-using companies. (See [Chart 1](#) for policies to support ICT RDI and [Chart 2](#) for policies to support e-business adoption in ICT-using manufacturing industries.)

Chart 1: Expert assessment of policies for ICT-producing companies in Europe

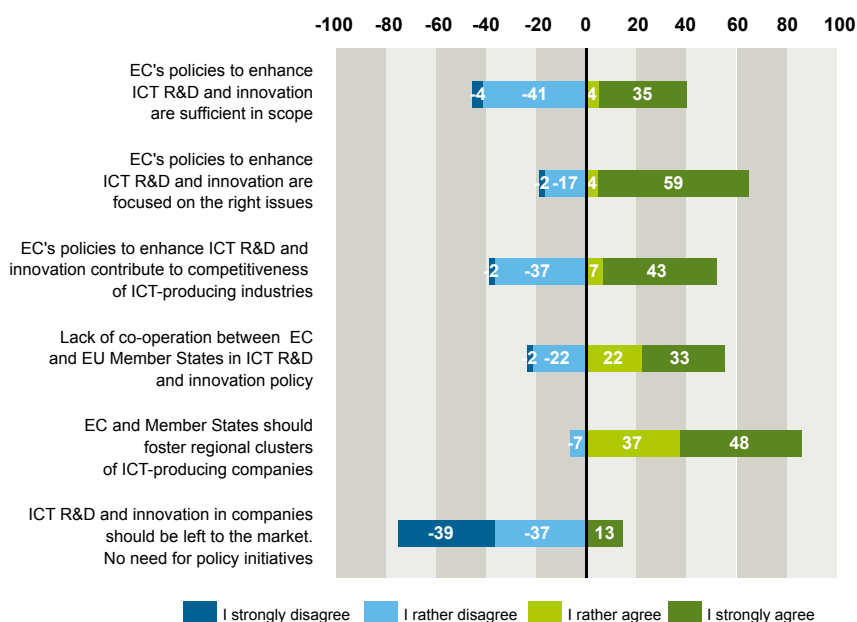
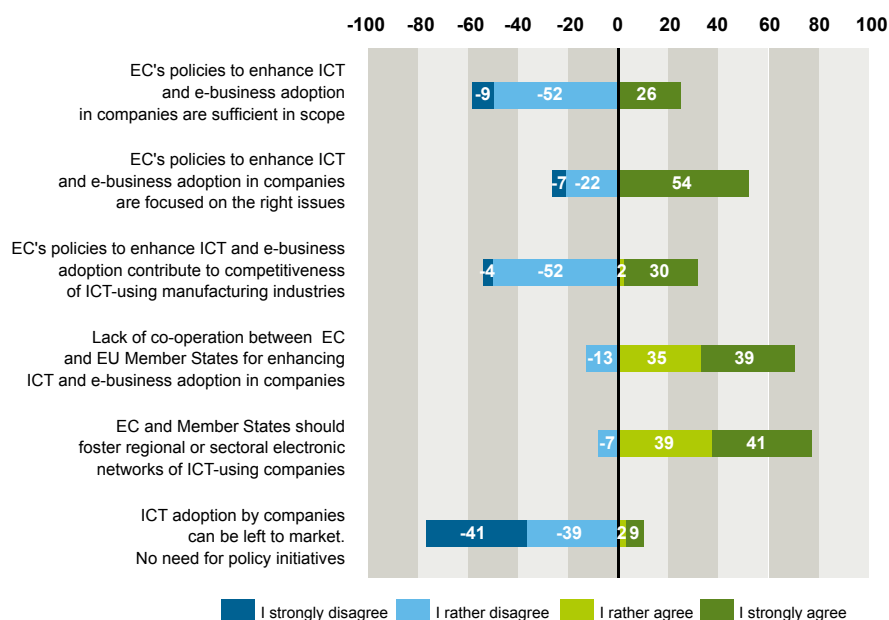


Chart 2: Expert assessment of policies for ICT-using manufacturing companies in Europe





# Which “e-skills” do need? **Trends** in demand and **challenges** experienced

Having the right ICT-related skills (“e-skills”) is important to create and sustain competitive advantage – for individual companies and for the economy as a whole. A shortage of e-skills in the market is an obstacle to productivity growth and can therefore have a negative impact on competitiveness and employment. A study by the Sectoral e-Business Watch explored the actual e-skills demand of enterprises.

## Three levels of e-skills

The term “e-skills”, when used in a business context, covers three levels of ICT-related competencies:

1. specialists that plan, implement, run and maintain ICT systems in companies (“ICT practitioners”);
2. ICT skills of the workforce that use computers and software applications in their daily routines (“ICT user skills”);
3. the management’s strategic approach to e-business, that is how the company uses ICT to support its strategy (“e-business skills”).

The Sectoral e-Business Watch interviewed IT and human resources managers of several large companies about the requirements of their companies in this area. The study aimed to explore trends in demand and to derive recommendations for education and training in ICT subjects.

## ICT practitioners: understanding business processes & open source

A quantitative shortage in the supply of ICT practitioners is mainly a concern for ICT service providers. An interviewee from a large company in the ICT industry said that they typically could not fill about one in four positions they offer. Interviewees from the ICT using sectors, on the other hand, had not experienced major difficulties recently in finding and hiring ICT practitioners with the required qualifications.

Most of the IT and e-business managers interviewed stressed the importance that

ICT practitioners are properly trained in understanding business processes. “They need to have the ‘big picture’ and understand the entire process from start to finish in order to select or develop the right solutions for each step in the process,” said one of the interviewees.

Another IT manager of an international company said that the importance of “soft skills” was often underestimated. He suggested that developing communication and presentation skills should be a vital element in ICT training curricula. He believed that complaints about the “tech-speak” of some IT people result from a lack of such skills.

“Open source, open source, open source” said one IT manager of another large company when asked about the main trends for future requirements. He recommended that ICT programmes at universities and colleges should pay more attention to offering certified trainings in how to work with open source software.

## ICT user skills: no major difficulties encountered

While the number of ICT specialists is limited in most companies, many more jobs require computer and software user skills. In most cases, this means operating basic office applications such as text editing and spreadsheet calculation, communication tools (e-mail) and the web. Depending on the department they work in, employees may also be users of specific applications such as the ERP or CRM system or a procurement system, or design tools (CAD/CAM). A manager from a large manufacturing company with about 8,000 employees interviewed for this study said that about 2,500 of them were mainly PC workers.

### THE E-SKILLS POLICY FRAMEWORK OF DG ENTERPRISE & INDUSTRY

The European Commission adopted on 7 September 2007 a Communication on “e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs”. It presents a long term e-skills agenda, based on five major action lines at EU level for the period 2008-2010. These include long-term cooperation between public authorities and the private sector, ensuring sufficient investment in human resources development, and promoting the attractiveness of ICT-related career perspectives. See: [http://ec.europa.eu/enterprise/ict/policy/ict-skills/ict-skills\\_en.htm](http://ec.europa.eu/enterprise/ict/policy/ict-skills/ict-skills_en.htm)

### MORE INFORMATION

This Sectoral e-Business Watch study is conducted by empirica GmbH ([www.empirica.com](http://www.empirica.com)). The study report will be available on the website at [www.ebusiness-watch.org](http://www.ebusiness-watch.org). For more information about this study, please contact Hannes Selhofer ([hannes.selhofer@empirica.com](mailto:hannes.selhofer@empirica.com)).



# enterprises demand experienced



In a survey among companies from the glass, ceramics and cement industry, more than 50% of the respondents felt that the demands on employees regarding their computer and software skills "have noticeably increased" in the past few years (see [Chart 1](#)). However, it appears that the vast majority of employees can cope well with the requirements. Only few respondents said that many employees in their company experienced difficulties in this respect (see [Chart 2](#)). This was broadly confirmed in the detailed case studies conducted for this study, where ICT user skills were not found to be a problem.

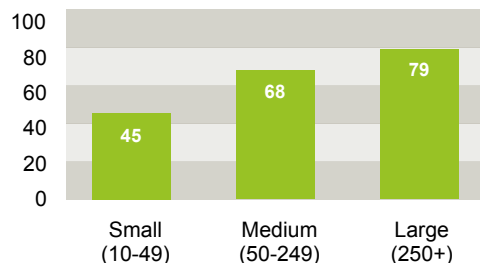
## e-Business skills: translating business requirements into e-solutions

Many large companies have a dedicated e-business manager, often heading a unit within the ICT services department. His or her job is to explore opportunities for using ICT to support the marketing and sales activities of a company. Often they are responsible for developing the functionalities of the company's ERP system and extranet, as these are central platforms for data exchanges with customers and for service provision.

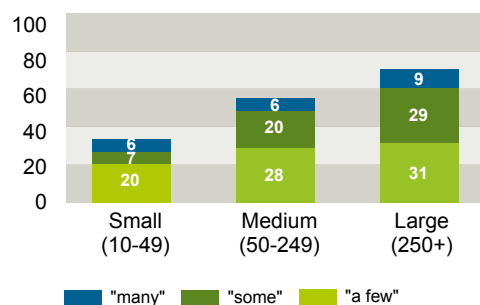
e-Business managers need not necessarily come from a technical background. Many have moved into this function from a position in marketing and sales. Requirements are excellent management skills, a thorough understanding of the company's strategy and its operations, and practical experience with e-business software such as ERP systems. Typically, there are only few positions in a company with this profile, even in large companies.

e-Business activity is closely linked with financial and accounting issues. One e-business manager said that he would ideally need "a financial accountant with good ICT and e-business skills" for his unit, but that it was impossible to find this combination in the market. Another manager said that his unit was searching for graduates with business and ICT skills, in particular with know-how in business process design.

**Chart 1: % of companies saying that the demands on employees regarding their computer and software skills have noticeably increased over the past few years (glass, ceramics and cement industry, 2009)**



**Chart 2: % of companies observing that many / some / a few employees have problems because of insufficient computer skills (glass, ceramics and cement industry, 2009)**



## Methods applied in 2009

The SeBW approach is descriptive, exploratory and explanatory, applying a broad methodological basis: Quantitative surveys are combined with qualitative case studies and expert interviews as well as with economic analysis. This threefold approach is designed to produce an in-depth understanding of current ICT and e-business use and impact in industries.

### Quantitative methods: enterprise surveys 2009

Since 2002, the Sectoral e-Business Watch has been collecting data on the use of ICT and e-business in European enterprises by means of representative surveys. In 2009, two surveys were conducted, with a total coverage of more than 1,000 interviews with decision-makers in enterprises from the six largest European countries (see table). The survey field work was coordinated by Ipsos GmbH (German branch office) and conducted locally by its partner institutes.

#### Coverage of the two e-Business Surveys 2009

Survey	Sectors covered	Countries covered	Number of interviews
ICT and e-business in energy supply	Electricity, gas, steam and air conditioning supply	France, Germany, Italy, Poland, Spain, United Kingdom	351
ICT and e-business in glass, ceramics and cement	Manufacture of glass, ceramics and cement		676

Interviews were carried out in March 2009, using computer-aided telephone interview (CATI) technology. The decision-maker in the enterprise targeted by the survey was normally the person responsible for ICT within the company, typically the IT manager. Alternatively, particularly in small enterprises without a separate IT unit, the managing director or owner was interviewed. The survey included only companies that used computers. The average interview length was 15-20 minutes.

For data presentation, two weighting schemes have been applied: weighting by employment and weighting by the number of enterprises. Employment-weighted data should be read as "enterprises comprising x% of employees" in a sector or country.

### Qualitative methods: case studies and expert interviews

The use of case studies as real-life examples of e-business activity in enterprises has become a very important part of the work of the e-Business Watch. The case studies are typically based on interviews with company representatives and complementary resources such as company annual reports, brochures and websites. In 2009, a total number of 25-30 case studies have been conducted for all studies. In addition, personal in-depth interviews with experts in the field of ICT and e-business from industry, research and policy have been conducted.

### Analytical methods: econometric and theoretical analyses

The SeBW applies analytical methods to examine the impact of ICT investment in industries, using extended macro-economic databases such as EU KLEMS and Eurostat databases. In 2009, a focus of macro-economic data analysis is the relationship between ICT capital and greenhouse gas emissions in energy-intensive industries and in the energy supply industry. Furthermore, for the study "an economic assessment of ICT-related industrial policy", an analysis based on selected economic theories has been conducted.

#### MORE INFORMATION

More detailed information about the methods applied in 2009 is available at the Sectoral e-Business Watch website ([www.ebusiness-watch.org](http://www.ebusiness-watch.org)) in the "About" section (see: "methodology").

# The Advisory Boards of 2009 – networking and debate of results

To validate study results, the Sectoral e-Business Watch seeks regular exchange and debate with international experts on ICT and e-business and from the sectors covered. For the studies in 2009 an advisory board was established that comprised 18 representatives from industry, research, consulting and public authorities. They provide comments on interim and final reports and specific inputs to the research work. Their services are gratefully recognised.

Advisory Board member	Company / organisation and position	Country *
<b>Study on ICT and e-business impact in the energy supply industry</b>		
Bernard Aebischer	ETH Zurich, CEPE Centre for Energy Policy and Economics	Switzerland
Maher Chebbo	SAP AG, Vice President of Utilities Industry for Europe, Chairman of the EU SmartGrids Demand and Metering	France / EU
Iiro Rinta-Jouppi	Vattenfall, Head of Business Development - Distribution operation Nordic area	Sweden
Miguel A. Sánchez Fornie	European Utilities Telecom Council (EUTC), Chairman of the European Utilities Telecom Council Board of Directors	Spain / EU
Thomas Theisen	RWE Energy, Head R&D	Germany
<b>Study on ICT and e-business impact in the glass, ceramics and cement industry</b>		
Renaud Batier	Managing Director, Ceramie-Unie - The European Ceramics Industries	EU
Jean Francois Mottint	Head of Intelligence Unit, Cembureau	EU
Brigitte Preissl	Editor-in-chief, Intereconomics	Germany
Frédéric Van Houte	Secretary General, CPIV, Standing Committee of the European Glass Industries	EU
<b>Study on ICT impact on greenhouse gas emissions in energy-intensive industries</b>		
Pietro Evangelista	National Research Council (CNR), National Institute for Transport and Logistics (NITL)	Italy
Enrico Gibellieri	European Steel Technology Platform, Deputy Vice President	Italy / EU
Graham Vickery	OECD, Directorate for Science, Technology and Industry; Information, Computer and Communications Policy Division; Information Economy	UK / international
Martin Wörter	ETH Zurich, KOF Swiss Economic Institute	Switzerland
<b>Study on an economic assessment of ICT-related industrial policy</b>		
Antti Eskola	Ministry of Employment and the Economy, Innovation Department	Finland
Paul Heidhues	Professor for Economic Theory, University of Bonn,	Germany
Philipp Koellinger	Assistant Professor in Economics, Erasmus University Rotterdam	Netherlands
Paula Swatman	Professor for Information Systems, University of South Australia	Australia

\* EU = representative of a European industry federation / organisation (sorted alphabetically within each advisory board)

## Contact information

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