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## **Measurement of E-Commerce**

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# Measurement of E-Commerce

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**Abstract.** The first part of the paper discusses the notion e-commerce, starting from a definition, and covering types and benefits of e-commerce transactions. In the second part, the Eurostat Community surveys on ICT usage in enterprises are summarized with respect to design and some results. These surveys demonstrate the growth of the use of information and communication technologies within the EU; e-commerce transactions have already achieved a substantial portion of the turnover in certain sectors of economic activities. The third part gives some arguments why additional statistics are needed to give a comprehensive picture of the complex phenomenon e-commerce.

## 1. The Concept of E-Commerce

During the last years, e-commerce has increasingly gained an important role for enterprises as well as for the whole society. E-commerce has been developed as an entirely new way of distributing, buying, selling, marketing and servicing of products and services. Online banking has become daily practice for the majority of people; Amazon or eBay are familiar names to everybody who uses the Internet. The rapid growth of e-commerce, the impact on the whole economy, and the heterogeneity of this development over the countries and other aspects ask for detailed statistics and for analyses of this phenomenon.

### 1.1 *The Definition of E-Commerce*

If e-commerce is understood to consist in any facilitation of commercial interactions by means of computer-mediated networks, the first e-commerce activities took place in the 1970s when Electronic Data Interchange (EDI) started to be used for the transmission of purchase orders and invoices. Facilitating the traditional way of transacting goods and services is still the essence of e-commerce. Correspondingly, a definition of e-commerce typically may state: “E-commerce is any transaction completed over a computer-mediated network that involves the transfer of ownership or rights to use goods or services” or simpler “e-commerce is buying and selling over the Internet” [1]. The definition suggested by the OECD states: “E-commerce is the sale or purchase of goods or services, whether between businesses, households, individuals, governments and other public or private organisations, conducted over computer-mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line (include: orders received or placed on any online application used in automated transactions such as Internet applications, EDI, Minitel or interactive telephone

systems)” [2]. The term e-commerce became popular with the increase of the Internet in the 1980s. However, the Internet is only one among several computer-mediated networks, most of them owned by companies or private institutions. Actually, the majority of e-commerce transactions is operated over other networks than the Internet. Hence, the above mentioned simplified definition should read: “E-commerce is buying and selling over computer-mediated networks such as the Internet”.

Looking at a typical e-commerce transaction between a seller and a buyer indicates that the processes behind such a transaction have reached a considerable degree of sophistication and complexity. Typically, the seller is an enterprise that has a corporate website with e-commerce capabilities such as a market place, an electronic payment system and a secure transaction server; the seller also has a corporate e-commerce environment that allows an efficient processing of customers’ purchase orders and payments, the administration of stocks and inventory, electronic links to production and suppliers, integration with market research and analysis, etc.; all these elements are linked and integrated with each other, and the seller also has IT-literate employees who manage the information flows and maintain the e-commerce system. The buyer has a computer, access to the Internet, and owns a credit card.

Besides the seller and the buyer, several transaction partners are involved. An authentication authority is needed that guarantees the integrity and security of the transactions to both the seller and the buyer. A banking institution is needed that offers the necessary transaction clearing services, e.g., the processing of a credit card payment. Finally, e-commerce transactions need a supporting legal environment which defines and regulates, e.g., consumer protection and protection measures against fraud in the context of e-commerce, electronic documents, and electronic signature. The Internet infrastructure has to be reliable and the pricing system for its use must not be prohibitive.

This picture shows that “facilitation of commercial interactions” or “buying and selling over the Internet” has developed from the transmission of purchase orders or invoices into a rather challenging process that encompasses the whole organization of the seller and makes use of the support of other agents. Similar are the structures of e-commerce applications such as Internet market places for travel agents, for the banking business, for online ticket selling, for entertainment services, for online brokerages, etc. For developing and maintaining each of these elements a specialized industry has emerged and developed over the recent years.

## *1.2 Types of E-Commerce and Benefits*

The most important e-commerce activities are business-to-business- or B2B transactions, i.e., transactions from one enterprise to another one. Typical e-commerce applications that serve B2B transactions support the supply management, e.g., purchase order processing, the inventory management, i.e., the order-ship-bill-cycle, and the payment management. In 2005, 93% of the turnovers made over computer-mediated networks including the Internet in the EU-25 countries come from B2B. Nearly all of the rest were business-to-customer- or B2C transactions, where business is providing customers with goods or services. Other types of transactions are from business to governmental (B2G), C2C, and C2B. B2G transactions refer to applications for the public procurement and other public administration operations [3].

The most relevant benefit of B2B e-commerce is the reduction of transaction costs and the increase of efficiency of the related processes. The buyer needs less time for searching for suppliers, products and prices as compared to the traditional supply chain. The business partners spend less for processing transactions, i.e., administrating purchase orders, invoices and payment schemes, activities that are automated within the e-commerce system. Reduction of costs is also due to the inventory management that is integrated in the e-commerce system. In B2B e-commerce, buyer and supplier typically interact directly without any intermediary or distributor. This again has the potential of increasing the efficiency. A further benefit is the increased transparency of the market and also of pricing. This is especially true for innovative pricing processes such as online auctions. The benefits to each user of the network grow more than proportional with the number of users.

The most typical B2C form of e-commerce is online retailing, as offered by the perhaps most well-known supplier Amazon. Online banking and online booking of travels and accommodations and of airline and other tickets are among the most popular B2C transactions. Benefits for the customers are the transparency of the market, the reduction of prices due to lower transaction costs and of efforts needed for finding a competitive offer for products and services. Benefits for the enterprise are the reduced transaction costs and the relatively small market entry costs.

## *1.3 Drivers of E-Commerce*

Growth of e-commerce is driven by progress in technology and by a number of economic factors. The communication network technology has experienced a tremendous progress during the last one or two decades. The most obvious feature of this development is the convergence of the various communication services into one single platform: A single network is used for telephone services, cable television, and Internet access. This is already reality in some areas and will be standard in the future. The consequence is a more economical, faster, and easier communication, factors that are of

special importance for non-urban areas. Besides, the extremely high speed of technological progress is unbroken with respect to computing power, digital storage of information, and related areas.

Economic factors refer to the increase in efficiency that has been experienced in the past and is further possible in the future, mainly through cost reductions by using e-commerce. Such cost reductions first of all concern communication costs between customers and suppliers: Transactions become faster and more economical. Advertising and customer service alternatives are becoming cheaper. Marketing and promotion activities are possible at a global level; more detailed product information can be provided. The Internet allows new customer service and support activities. In addition, the technical infrastructure is becoming cheaper. More and more potential users of e-commerce will see reasons to make use of this technology.

These arguments suggest that e-commerce will be of further growing importance for the growth of the economy.

## **2. ICT-surveys: The ESS-Approach**

During the last one or two decades, both consumers and enterprises understood within a short time the potentials of information and communication technologies (ICT) and learned to take advantages from them for their operations. Consumers use the internet for identifying sellers, comparing products and services, and finding best prices and buying conditions. Enterprises use ICT for networking among companies and for new and more efficient modes of processes in all areas of operation from production to marketing to accounting. Engagement in ICT means also investments and growth. This applies to many sectors of economic activities.

### *2.1 The Political Context*

For politics, such a development is of high interest: ICT was the major economic impact. EU politics understood that the European economy must not fall back with respect to the usage of ICT behind North America and the emerging Asian markets. Between 2000 and 2005, three action plans have been adopted.

- “eEurope2002”, adopted in 2000, stated the goal of bringing the whole Europe, i.e., every individual, every school, and every company, online as quickly as possible; for 2001, a survey of ICT usage in enterprises, for 2002 a survey in households was planned.
- “eEurope2005”, adopted in 2002, targeted at the promotion of e-Government, e-Learning, e-Health Services, adopted a dynamic e-Business environment; also at the widespread availability of broadband access at competitive prices.

- “i2010”, adopted in 2005, aims at promoting an open and competitive digital economy; ICT is seen as a driver of inclusion and to enhance a better quality of life.

Starting with a pilot survey on the ICT usage in enterprises in 2001, launched by Eurostat in cooperation with the EU-member states, ICT surveys have been established by an EU regulation. Some of the results are used to calculate the structural indicators which were chosen by the European Commission to evaluate the progress reached in this field.

## 2.2 *The Community surveys on ICT usage*

Since 2001, surveys of ICT usage are annually done both in enterprises, since 2002 also in households. In 2004, a regulation was adopted that states the need of measuring ICT usage in enterprises and households<sup>1</sup>. To cope with the fast changes in the ICT fields, an implementing regulation is foreseen for each survey year so that flexibility is guaranteed. In 2005, the first implementing regulation for the ICT surveys was adopted<sup>2</sup>.

The surveys in enterprises are formally called the Community Surveys on ICT usage and e-commerce in Enterprises. In this section, some methodological details of the surveys and some results are given for the surveys in enterprises.

### 2.2.1 *The Methodology of the ICT surveys*

The survey in enterprises uses as sampling frame those subsets of the business register, that correspond to the relevant economic activities, viz. sections 15-22, 23-25, 26-28, 29-37, F, 50, 51, 52, H (only 55.1 and 55.2), 60-63, 64, 65 (only 65.12 and 65.22), 66 (except 66.02), 72, 70+71+73+74, and 92 (only 92.1 and 92.2) from NACE Rev. 1.1.

The size classes are enterprises with 10 to 49 employees, 50 to 249 employees and 250 and more employees; eleven EU countries include also enterprises with 1 to 9 employees. From the approximately 1.4 million enterprises in the frame population of EU-25 in 2006, 80% had 10 to 49 employees, 17% had 50 to 249 employees and 3% enterprises had 250 and more employees [4].

For most of the EU countries, the sampling fraction was between 10% and 30% of the frame population. The gross sample over all countries was about 14% of the frame population, covering 9% of the small enterprises, 21% of the middle-size enterprises, and 90% of the large enterprises on average.

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<sup>1</sup> Regulation (EC) No 808/2004 of the European Parliament and of the Council of 21 April 2004 concerning Community statistics on the information society.

<sup>2</sup> Regulation used for the ICT-surveys in 2006: Commission Regulation (EC) No 1099/2005 of 13 July 2005 implementing Regulation (EC) No 808/2004 of the European Parliament and of the Council concerning Community statistics on the information society.

Regulation used for the ICT-surveys in 2007: Commission Regulation (EC) No 1031/2006 of 4 July 2006

The questionnaire of the 2006 survey had four modules. Module A asked for general information about ICT systems, module B about the use of Internet, module C about e-commerce over the Internet (purchases/sales) and module D about e-commerce over other electronic networks. All in all, the questionnaire contained 33 questions plus five questions about the background of the enterprise. Parts of the questions change from year to year. In 16 of the EU-25 countries, additional questions were asked.

### *2.2.2 Some Results of the ICT surveys<sup>3</sup>*

In 18 of the EU-25 countries, a national regulation supplements the EU regulation and obliges the enterprises to participate in the ICT survey. The average response rate within the EU-25 countries was 69%; in three countries the response rate was below 50%. In most of the countries with national regulation a response rate higher than 70% was reached. In the voluntary Austrian survey a response rate of 66% was achieved. EU-wide, the response rate was 65% for small enterprises, 73% for middle-size enterprises, and 76% for large enterprises.

#### *Buying and selling via e-commerce*

In 2005, 28% of the enterprises in the EU countries bought over Internet or other electronic networks. In the north of Europe, enterprises were buying more via e-commerce than in other countries. More large enterprises (41%) were using this channel than middle-sized (33%) and small enterprises (27%). Much more enterprises were buying over the Internet (38%) than over other electronic networks (5%).

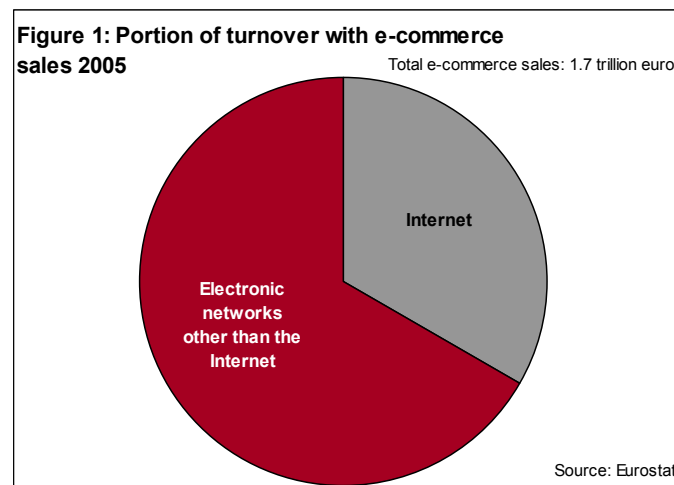
15% of all enterprises sold products over the Internet or other electronic networks. The Internet was used for that purpose by 14% of the enterprises; only 5% were selling via other electronic networks. Large enterprises used that channel more than middle-sized or small enterprises: Approximately three of ten large enterprises, two of ten middle-sized enterprises and one of ten small enterprises were selling online. The Internet was used by 24% of the large enterprises, by 18% of the middle-sized and by 13% of the small enterprises; other electronic networks than the Internet were used by 18% of the large, 9% of the middle-sized and 4% of the small enterprises.

Whereas the change of the number of enterprises with e-commerce activities stayed within random patterns, this is not true for the value of sales over e-commerce. In 2005, this average value was 12% of the total turnover, an increase of more than 30% as compared with this percentage in 2003, which was 9%. In eight of the EU-25 countries was the average value of sales over e-commerce

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<sup>3</sup> All data presented in this section come from Eurostat's database <http://epp.eurostat.ec.europa.eu>. This section includes only data of enterprises with 10 and more employees of the EU-25 countries from the years 2004 and 2006. Enterprises of the financial sector (65 and 66) were asked a different questionnaire, the data for this sector are not included.

higher than 10% of the total turnover. While sales over the Internet amounted on average to 4% of total turnover, those over other electronic networks accounted for about 8%; see Figure 1.



### *Use of special software applications*

The enterprises were asked whether they are using a software application for managing orders, and whether this application consists in a system for the administration of stocks and inventory, an invoicing and payment system, or a system for managing production, logistics or services operations [5].

In 2006, 43% of the enterprises in the EU-countries used a software application for managing orders. Since 2004, this portion has increased from 37% to 43%. This portion varies considerably with the size of the enterprise. In 2006, there were already 71% of the large enterprises and 59% of the middle-sized enterprises using such software applications, while this percentage was only 40% for the small enterprises.

Among the enterprises which are active in e-commerce, 28% are using such software applications. This portion varies similarly to that for all enterprises with the size of the enterprise: 43% of the large enterprises, 37% of the middle-sized, and 25% of the small enterprises that are active in e-commerce are using special software applications.

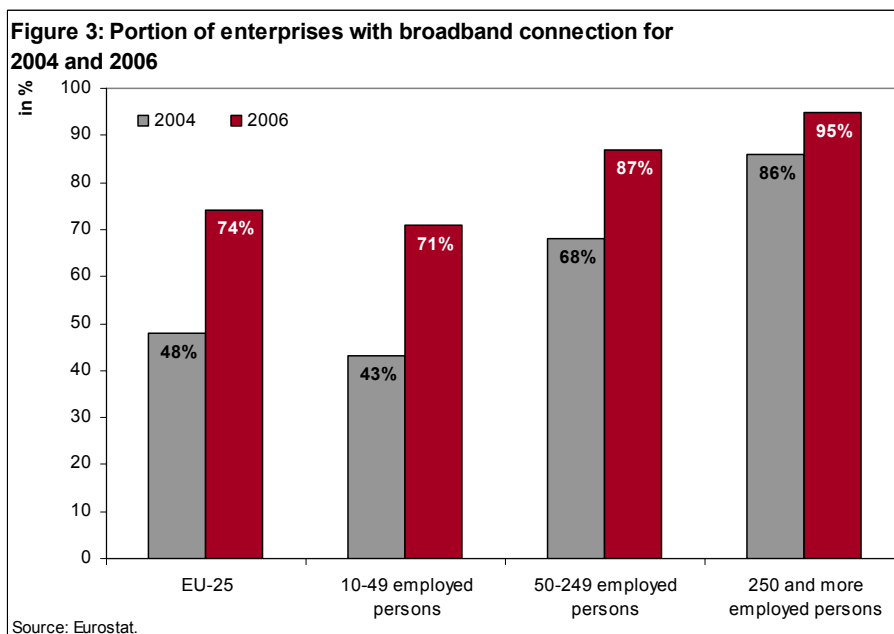
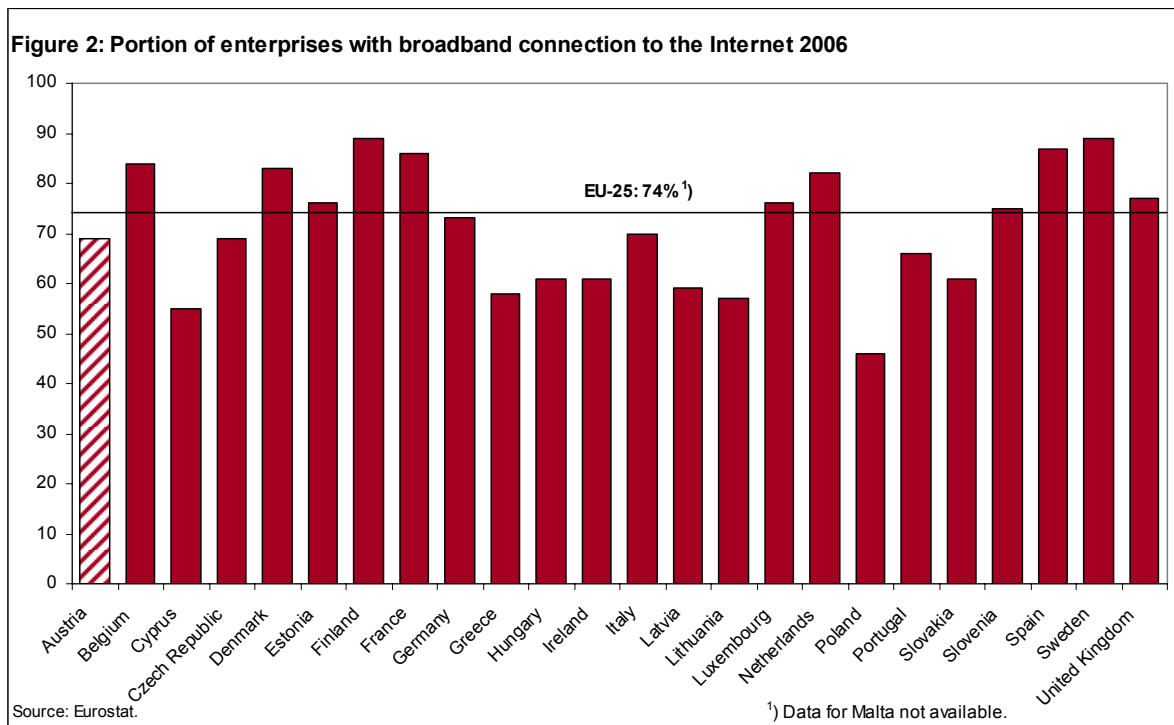
### *Computer and Internet usage*

Computers are indispensable tools for many working processes within an enterprise. The results of the ICT surveys clearly indicate this fact: In 2006, almost all enterprises (97%) within the EU-25 have used a computer; this percentage reached more than 95% in most countries. Similar is true for the Internet access: On the average, 93% of the enterprises in EU-25 had an Internet access in 2006. Nearly 100% of the large enterprises have this access. Since 2004, the portion of small enterprises with access to Internet has increased from 88% to 92%.



*Broadband connection*

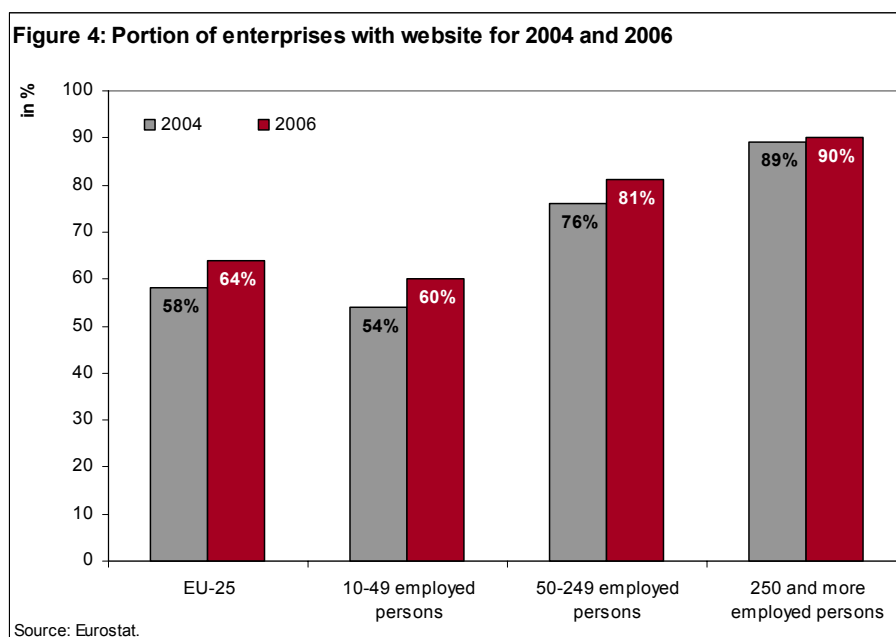
In 2006, 74% of the enterprises within the EU-25 countries used a broadband connection to access the Internet; since 2004, this portion has increased from 48% to this value. Figure 2 shows the corresponding portion for the EU-25 countries. Figure 3 shows the percentages for the different size classes of enterprises: In 2006, 95% of the large and 87% of the middle-sized enterprises were using a broadband connection, but only 71% of the small enterprises. Between 2004 and 2006, the growth was highest for the small enterprises, those showing an increase of 28 percentage points; the growth was 19 percentage points for middle-sized enterprises and about 11 percentage points for larger enterprises.



## Websites

In 2006, 64% of the enterprises in the EU countries were provided with a website to present themselves and their products or services to the market. While 90% of the large enterprises and 81% of the middle-sized enterprises are represented by a website, the portion of the small enterprises with a website is only 60%. Among the large enterprises, the percentage of having a website is higher than 60% in each of the EU-25 countries.

The percentage of enterprises having a website increased by 6 percentage points from 2004 to 2006 (2004: 58%; 2006: 64%). In 2004, 89% of the larger enterprises were already using a website in the Internet, a portion that rose to 90% in 2006. Among the middle-sized enterprises, the portion climbed from 76% to 81%; the figure for small enterprises, 54%, grew to 60%; see Figure 4.



### 3. From ICT Surveys to the Measurement of E-Commerce

In the EU, the annual results of the Community survey on ICT usage give a valuable report about the use of IT-based technologies in the member states. In the set of Structural Indicators on Innovation and Research are indicators that measure the level of Internet access in households, the e-commerce sales over the Internet, the e-government usage by individuals and by enterprises, and the broadband penetration rate. Comparisons over time allow the assessment of progress and trends, both for Europe and for each of the member states. Such results have been using for designing political actions; e.g., in Austria, a very successful initiative to foster the use of broadband connections was started in 2003 [6].

As it was discussed before, e-commerce transactions are defined as the transfer of ownership or rights to use goods or services via a computer-mediated network. In practice, even simple

transactions like selling and buying turns out to be a complex process, mainly through the involvement of several partners. The logistic of the order-ship-bill-cycle needs besides the seller and the buyer a shipping company, perhaps also a producer different from the seller; in addition, a financial institution is involved. The transaction consists of a complex set of integrated processes that need a number of mostly rather sophisticated IT-applications.

As a consequence, the measurement of e-commerce activities is not a straightforward procedure. Measurement of a phenomenon means giving a quantitative description of the reality. The question to answer is what quantities are suited in the given context, what measurement model should be applied. Complications are caused by several facts. Firstly, as sketched above, many partners are involved in each e-commerce transaction. Measuring the added value of such a transaction means identifying related accounting positions in several enterprises from several areas of economic activities. The design of a survey that gives an appropriate picture of e-commerce transactions had to take this situation into account. The global character of the e-commerce business, which is typically not restricted by national boundaries, is a further complication that needs to be considered. Another complication results from the dynamic of the e-commerce business: companies and also products and services emerge and expand at an otherwise hardly known rate.

Statistics that are available from the ICT surveys concern the technical prerequisites such as the availability of Internet access and of broadband connections, also the presence of companies in the market via their own websites. Moreover, statistics on selling and buying via e-commerce are available, such as the portion of enterprises that are active in this business and the portion of their turnover realized by these activities. What is not available are statistics on the number of transactions, on the amount of the corresponding turnover, on the processes and related software applications, on characteristics like size and qualification of the staff employed in these transactions. Such statistics might be helpful for analyses, e.g., of the growth of e-commerce transactions, of the effects of e-commerce on the economic growth in general, of the effects of various potential drivers on e-commerce. Such analyses are of interest for different areas of economic activities, for different sizes of enterprises and the like.

The EU regulation on ICT surveys allows for special modules in the questionnaire, so that the fast changes in the ICT field can flexibly be taken into account. In the 2007 survey, questions about the usage of ERP (Enterprise Resource Planning), CRM (Customer Relationship Management) and open source operating systems as well as questions about sending and receiving e-invoices were integrated in the questionnaire. In 2008, a special module is foreseen about e-business; it contains questions on the integration of business processes between different enterprises (external) and

within the enterprise (internal). Beside that, detailed question on the use of Intranet, i.e., an enterprise-internal website, and on facilities provided over the website will be asked.

In some of the EU-25 countries, the questionnaire as suggested by the EU regulation has been supplemented by some questions in order to cover additional national interests or needs. For the 2006 survey, in some of the countries questions on e-business topics were added.

#### **4. Some Conclusions**

E-commerce obviously is a topic of high political relevance. Besides enabling new ways of economic interaction that indicate a future which hardly can be imagined in all details, especially B2B transactions have already achieved a substantial volume and will further grow. The analysis of the phenomenon e-commerce indicates a high complexity of the technical processes and the economic implications. Available statistics that are related to e-commerce concern the technical prerequisites and to some extent the e-commerce market such as the portion of enterprises that are active in this business and the portion of their turnover realized by these activities.

As e-commerce is developing fast, a survey on this topic has to be adapted carefully, not to miss new things and not to keep issues with little information content. E.g., statistics on the availability of technical prerequisites become obsolete when saturation is achieved.

Further data will be needed in the future in order to allow a deeper understanding of the processes involved in e-commerce. These data have to cover the involved technical processes and also the economic implications. Also theoretical work will be necessary to identify those data that are needed for that purpose. It will be of interest to observe the results of the Community surveys on e-commerce in the coming years.

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