



Globalization and E-Commerce: Diffusion and Impacts of the Internet and E-Commerce in Germany

July 2004

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This research is part of the Globalization and E-Commerce project of the Center for Research on Information Technology and Organizations (CRITO) at the University of California, Irvine. This material is based upon work supported by the National Science Foundation under Grant No. 0085852. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.



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ABSTRACT

- The diffusion of e-commerce applications and solutions among the investigated firms in the three German industry sectors seems to have reached a high level of saturation of e-commerce technologies. This applies more or less for both types of establishments, large as well as small and medium-sized ones (SMEs) in all of the three investigated industries (manufacturing, retail/wholesale and banking/insurance). Although a kind of e-commerce maturity is observable, statements about the de facto usage behavior and intensity cannot be made based on the underlying survey data.
- In contrast to the results of the global survey, German firms less often regarded e-commerce as an enabler for entering new markets or increasing sales at an international level. Given the existing global market orientation, German firms were already acting competitively in international markets, even in the pre-e-commerce era.
- After e-commerce solutions proved successful, SMEs were at the forefront, implementing e-commerce applications and are therefore important drivers of innovation diffusion in Germany. Although all industry sectors are well equipped, industry-related differences remain. The manufacturing industry started from a high level of existing advanced digital technologies such as EDI or joint supply chain management systems.
- The retail/wholesale industry, with its large number of SMEs, can benefit more from new forms of e-commerce such as Internet-based EDI. SMEs in this sector are able to improve their business processes more often than SMEs in other sectors where industry-related EDI standards were not in place.
- The banking and insurance sector heavily invests in online business models. While most benefits of online banking and brokerage appears on the customer side, firms in this sector cannot benefit in the same way. As long as banks are not able to decrease their costs, e.g., by reducing the number of branches, the multi-channel distribution strategy offers limited benefits.
- The relative efficient usage of e-commerce seems to depend directly on the strategic focus of firms. While strategically unfocused firms might still be experimenting with e-commerce applications, others are already gaining benefits from e-commerce.
- SMEs as the backbone of German industry are not only able to reach the same stage of diffusion as large firms, but are also able to achieve commercial success. Especially in the retail/wholesale industry, SMEs may benefit for the first time from decreasing costs due to supply chain improvements and electronic transactions.
- Government and public administration as a public sector cannot be regarded as drivers of e-commerce in Germany. Far from it, the lack of e-commerce applications in the public sector makes electronic processes impossible for the private industry sector, resulting in additional manual coordination efforts.

INTRODUCTION

The research results presented in this paper are based on a survey conducted by the Center for Research on Information Technology and Organizations (CRITO) at the University of California at Irvine, in conjunction with the International Data Corporation (IDC). Aside from Germany, the survey participants include Brazil, China, Denmark, France, Japan, Mexico, Singapore, Taiwan and the United States. The focus of the research is to identify the degree of e-commerce technology diffusion and usage in each of these countries together with the impact of e-commerce on industry, as well as society. The different diffusion paths in the studied industries seem to be intertwined with the extent of acquired ICT (Information and Communication Technology) over time, but also with differences in national mentalities such as openness to innovative technologies, general adoption behavior or consumer preferences. Phenomena of path dependencies are known from the network effect theory for network effect-goods such as e-commerce and related technologies. Therefore, the varying usage of e-commerce technologies in the three studied sectors is partly based on the different usage of IT and computer technologies in the past. While the manufacturing, as well as the banking/insurance sectors have traditionally used ERP-systems, EDI data conversion or management information systems, the retail and wholesale sector started using such technologies rather late, yet, at the same time, began with the implementation of e-commerce technologies. Accordingly, data processing has, on average, a more sophisticated reputation in the first two sectors (manufacturing and wholesale/retail distribution) in comparison to the latter (banking/insurance).

The usage of e-commerce is not an end in and of itself. E-commerce is implemented to reduce costs, to improve internal and external processes and/or to enter new markets. It may be used as a substitute to existing products, distribution channels or business processes but also as a complementary product or service. Knowledge about the different ways of using e-commerce together with the degree of e-commerce implementation may help to answer the question as to how innovation-friendly and future-oriented a nation's economy is and how competitive it may be in the future.

In the following section, we present a short introduction to the German economic situation, make a few statements about drivers and inhibitors of e-commerce, as well as the impact of e-commerce on industry itself. We conclude by offering four propositions.

Subsequently, we describe the research results for Germany at the country and industry levels. In addition, we provide benchmark data for Germany vis-à-vis other participating European countries, specifically Denmark and France, as well as the US. For a more detailed discussion of the influence of e-commerce on the efficiency of firms, a Data Envelopment Analysis (DEA) is used. Moreover, an analysis of the impact of strategic versus non-strategic usage of e-commerce is provided. We conclude by presenting the most essential findings and answers to the underlying questions pertaining to the four propositions.

BACKGROUND AND A PRIORI EXPECTATIONS

Germany has silently become something like a European e-commerce power house. After the first five years of unification, Germany's interest and politics were focused on rebuilding the East German infrastructure to bring the new local states to internationally comparative levels and

standards. This ambitious challenge absorbed the political and economic attention in Germany. But everyday challenges like improving e-commerce readiness factors have gained more and more importance in the last few years. German firms have been able to catch up with leading countries like the US and Denmark over the last two years.

As the largest economy in Europe and being highly export-oriented, Germany plays an important role in the area of e-commerce usage, due to its competitive and international business activities. In other words, German enterprises had already reached a most competitive level in terms of efficient and innovative production in the world even without e-commerce.

The most important e-commerce enabler in the B2C sector is the generally highly educated and skilled population as a broad base of well-informed Internet users and potential online customers. This will also help reduce workforce shortages in the ICT industry, as well as in industries deploying e-commerce applications in the near future. Together with the relatively high income level of German wage earners, education and wealth are the most important e-commerce enablers, both of which are realized in Germany.

A natural advantage is the geographic location of Germany in the center of Europe, which allows it an excellent network infrastructure as well as short physical distances to all other European countries and markets. The assertion that in view of modern telecommunications physical distance is losing its importance appears to be true concerning digital goods. But physical distance is still of considerable importance for distributing physical products. The central position of Germany as a hub within Europe, together with the excellent public and private infrastructure, attracts foreign investment. For example, every important European business region is reachable in less than two flight hours and package deliveries inside Germany are delivered within one day or even faster. This means efficient connectivity to e-commerce markets in Europe based on the German infrastructure. Another reason for MNCs to enter Germany is the prevailing and generally stable social peace and continuity in the cooperation between management and unions.

The social interest and willingness to take an active part in developing “the e-society” is increasing. Germany has not only entered the catch-up phase compared to the first-adopter innovation schema, but in many areas has already caught up and is now gaining a competitive advantage in Europe and in the world. The utility of the Internet in all aspects of life, in the office or at home, for work or fun, has, together with the maturity of services and products available online in Germany, convinced users and customers of the need to use the Internet.

The main drivers of e-commerce use and diffusion in the B2B sector are the strong international competition and globalization of the export-oriented German industry. The manifold international trade connections increase the speed of diffusion of standardized electronic transactions. This trend is not only observed within large firms but especially in the strong and innovation-friendly German SMEs (*Mittelstand*), which are of high importance for ICT diffusion in Germany. Our survey data shows that the German economy is not only an important export-oriented industry, but it is also highly interconnected with foreign branches or headquarters (see Table 1).

TABLE 1 Indicators of Globalization, 2002

	Manufacturing ^a		Retail/Wholesale ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Percent of companies with establishments abroad	35.7	27.6	41.6	22.2	29.9	23.3	39.5	23.9
Percent of companies with headquarters abroad	23.6	12.0	7.6	6.4	17.1	11.0	11.6	8.5
Mean percent of total sales from abroad	18.2	14.6	14.8	11.4	13.0	8.1	15.3	12.1
Mean percent of total procurement spending from abroad	29.0	24.0	23.6	20.8	2.1	4.6	23.0	20.3
Degree affected by competitors abroad								
Low	60.4	47.3	64.1	77.2	80.7	82.8	64.6	68.3
Moderate	14.9	20.8	15.4	14.2	13.2	7.7	15.1	15.7
High	24.8	31.9	20.5	8.6	6.1	9.5	20.2	18.0

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

In comparison to the global sample, all analyzed industry sectors are above average with regard to the percentage of foreign establishments, headquarters, or sales from abroad. International diversification enables and increases the number of foreign business contacts, which is also observable when focusing on the percentage of procurement from abroad, which is above the global average in Germany, with the exception of the banking/insurance sector.

In spite of strong international competition, German industry seems to be well positioned in the global sample in the manufacturing and banking/insurance industry, where the intensity or impact of high competition is below average. Possible reasons are a highly competitive manufacturing industry and a national-oriented banking/insurance market in Germany. Competitive pressure in the retail/wholesale sector was already mentioned and was found to be above the global average. The retail/wholesale sector is currently involved in centralization processes and merger and acquisition (M & A) activities. Global players such as Wal-Mart and others increase the pressure on the national market together with successful international e-commerce firms in the B2C area.

Based on the above findings, observations and discussion, we offer four propositions:

Proposition 1: *Close international trade connections together with strong international competition increase and reinforce the diffusion of standardized electronic transactions in Germany. Globalized firms with establishments abroad deploy e-commerce applications more often than local firms.*

The impact of globalization is not only observable within large firms but also among strong and innovation-friendly German SMEs (*Mittelstand*), which are of high importance for ICT diffusion

in Germany. In fact, the high level of ICT and e-commerce usage enables SMEs, in particular, to achieve the full potential of these benefits.

Proposition 2: *SMEs are important drivers of e-commerce implementation and usage. The innovation-friendly character of SMEs in the form of early adopters of new technologies together with the potential benefits offered by a variety of different solutions will help to close the digital divide between large firms and SMEs.*

As an export-oriented nation, Germany has to compete in nearly all economic sectors on an international level. Due to this, the need for cost-oriented and efficient production and distribution processes has a long tradition. Nevertheless, some industry sectors have done better and are today relatively more famous for their long tradition of computer-based electronic data processing and transmission than other sectors. For instance, inside the manufacturing sector, the automotive industry developed successful EDI standards and delivery processes, resulting in considerable savings of time and money. Data medium exchange, EDI standards such as SWIFT, as well as payment clearing in computer centers are inventions made in the last century in the banking industry. In comparison to these two latter sectors with their high market concentration and mature experiences in electronic-based business processing, the retail and wholesale sectors are much more fragmented and best-practice cases such as in the latter sectors are relatively unknown. EDI diffusion in these two sectors, for instance, is not as far developed as in the other two sectors surveyed in this paper.

Proposition 3: *The affiliation to an industry sector has a direct impact on the extent of diffusion of e-commerce-related technologies and standards within that industry. Industries with a long tradition in mainframe and EDI applications enjoy better prerequisites to initiate successful e-commerce solutions.*

Gaining the full potential and benefits from e-commerce technologies depends, aside from the size and industry affiliation of a firm, even more on the subsequent integration and implementation into business processes (while, at the same time, these processes must be adjusted). The efficient and consistent usage is therefore more important than the mere existence of such technologies.

Proposition 4: *A strategic and consistent realization of e-commerce is necessary to develop its full benefit. An efficient implementation improves the strategic position of a firm and increases both the measurable outputs and the satisfaction with new technologies. Therefore, the efficient use of e-commerce is positively related to the number of e-commerce solutions deployed.*

In order to analyze the stated propositions, the authors describe the methods used to identify the rate of e-commerce diffusion among the surveyed industries. The following section provides information about the underlying survey and the empirical data used to test the validity of the formulated propositions. This is followed by a discussion of the chosen methods of analysis and the results to explain the rate of diffusion, as well as efficient usage behavior.

METHODS

Sample

This discussion describes the statistical procedures used to prepare the following sections. It covers the methods employed for calculating national and firm size-dependent differences.

The survey questionnaire was designed by CRITO; the survey itself was conducted by IDC during the period of February 18, 2002 to April 5, 2002. The survey was conducted in ten countries (Brazil, Denmark, China, Germany, France, Japan, Mexico, Singapore, Taiwan, and United States) with altogether 2,100 establishments. An establishment is defined as the physical location of a firm. The sampling was a stratified random sample classified by size (large firms with 250 or more employees, and small firms with between 25 and 249 employees) and by industry (manufacturing, wholesale/retail distribution and banking/insurance). In Germany, 202 establishments were investigated, subdivided into 68 from the manufacturing industry, 66 from the wholesale/retail industry and 68 from the banking and insurance industry. A total of 102 interviewed establishments belong to the class of small and medium-sized enterprises, 100 to the class of large establishments. The survey included only establishments which used the Internet to buy, sell or support products or services.

Data Analysis

In general, two different methods are used to analyze the data at hand. To analyze the relative efficiency of e-commerce users (both SMEs and large firms), a data envelopment analysis (DEA) is used. DEA (Charnes et al., 1978) may be used to compare multi-input with multi-output data to analyze the efficient combinations of implemented IT infrastructure and resulting impacts on the output-side.

The object of interest in a DEA model is the decision making unit (DMU) which is similar to a firm in this case. For analyzing the relative efficiency of e-commerce-deploying SMEs, a Data Envelopment Analysis (DEA) was used (Charnes, Cooper & Rhodes, 1978). Since most SMEs cannot determine the benefits they derive from implementing innovative technologies in monetary units, the survey asked for the set of e-commerce technologies adopted on the one hand, and the individually perceived efficiency or satisfaction on the other hand.

The model used in the DEA analysis is the BCC model (Banker, Charnes and Cooper) which offers a differentiation between technical efficiency and scale-efficiency (Golany & Roll 1989, p. 249) and evaluates solutions for non-increasing, decreasing, and variable returns of scale. The object of interest in a DEA model is the decision-making unit (DMU) which is similar to a firm. A DMU is a flexible unit responsible for the input and output variables. DEA only compares each DMU with the 'most efficient' DMUs in the sample (Bala, 2003). Efficient combinations of input and output relations or efficient DMUs of a sample form the so-called 'efficient frontier line.' In an n-dimensional space the efficient frontier is equivalent to an imaginary umbrella over the sample, covering the efficient DMUs and all theoretically possible combinations of efficient, virtual DMUs. The DEA model calculates the relative position inside the data sample for each DMU, based on its set of inputs and set of outputs (Parsons, 1992). Using a linear programming procedure for the frontier analysis of inputs and outputs, DEA accordingly evaluates the "best

practice” users of e-commerce. The basic idea of DEA is multi-input and multi-output-oriented efficiency evaluation without any further assumptions about the structure (e.g., normal distribution) or side conditions. Unlike parametric methods, DEA can use all kinds of input and output data to analyze the production behavior. The DEA model used was non input- or output-oriented because neither an input minimizing (input-oriented) nor an output-maximizing (output-oriented) analysis was necessary to evaluate the observed, actual input/output relation identified in the survey. Moreover, the model assumes returns of scale for each DMU depending on the size and a concave function of decreasing returns. The software used for the data analysis together with a detailed description is available from Scheel (2000).

DEA was chosen due to the unique alternative way of analyzing a set of data in comparison to the best performing data sets. A regression analysis, for example, only describes the deviation of best performing data sets from the average. Unlike parametric approaches, DEA optimizes on each individual observation independent of any distribution assumptions (Charnes et al., 1994, p. 5; Cooper, Seifert & Tone 2003, p. 13). Different kinds of DEA models have been used in a large number of ways to measure the impacts of IT, e.g., in the banking industry (Barr et al. 2002), the manufacturing industry (Beck, Wigand & König, 2004), or in the distribution industry (Beck, König & Wigand, 2003).

In this paper, the DEA was used as follows: As input variables for the DEA model, the results of seven questions are used (Table 16), measuring the number of e-commerce technologies in place as binary variables. The variables are coded as 0 when an establishment uses the e-commerce technology and 1 if it does not use it. The coding is equivalent to more costs of input when e-commerce is not available or the other way around, i.e., firms using e-commerce gain benefits by reducing their processing costs.

Input variables (Internet usage indicator) = u (online advertising, online sales, online procurement, ..., same formal business processes along supply chain)
s.t. $v_i \in \{0,1\}$

The ten output variables of the model are measured by a five-point scale (Table 24) with 1 (no impact at all) to 5 (a great deal). The DEA model uses a linear program to analyze the ratio between low costs of input (using e-commerce) and the resulting satisfaction output for each establishment. As a result, the DEA identifies the best practice cases or the most efficient establishments within the sample. Firms on this so-called “efficient frontier line” are relatively more efficient users than other firms below the frontier line. For a better explanation of the results, the average of “efficient” and “inefficient” establishments was calculated. The seven input variables are aggregated to an Internet usage indicator, while the ten output variables are aggregated as an average e-commerce satisfaction index. The input variables are used unweighted so that each e-commerce technology has the same explanation weight or loading for the efficiency of DMUs.

Output variables (E-commerce satisfaction index) = v (internal process more efficient, staff productivity increased, ..., competitive position improved)
s.t. $u_j \in \{1;2;3;4;5\}$

The basic formula of the chosen model is similar to the CCR model (Charnes, Cooper, Rhodes):

$$\max \theta = \frac{\sum_{j=1}^s u_j y_j}{\sum_{i=1}^t v_i x_i}$$

The previous formulation cannot be solved by linear programming tools and therefore has to be transformed in the following equation which is an output-oriented maximization example:

$$\max = \sum_{j=1}^s u_j y_j \quad \text{with constant input} \quad \sum_{i=1}^t v_i x_i = 1$$

$$\sum_{j=1}^s u_j y_j \leq \sum_{i=1}^t v_i x_i$$

with s.t. $u_j \geq 0, v_i \geq 0$

The second method used in the analysis is focused on the strategic goals of e-commerce using firms, as defined in Kraemer et al., 1999. According to the four-quadrant-model developed by Kraemer, firms are asked about driving reasons and current application of e-commerce in two different ways: the impacts on internal process optimization (operational focus to reduce costs) and external market penetration (market focus to enter new businesses or markets). In the original model, Kraemer used a seven-point Likert scale where “1” indicates “do not agree” and “7” indicates “agree completely” to measure the degree of IT impact on the focused strategic goal. The model used in this paper is modified and uses a five-point Likert scale. For example, if executives rated two or less on each item, they were assigned to the “unfocused” group since their responses suggested they had no discernible goal for information technology (IT). If executives rated three or above on the operational focus and two or less on the strategic market positioning, they were assigned to the “operations-focus” group. Alternatively, if executives scored two or less on the first item, and three or above on the second item, they were assigned to the “market-focus” group. If executives rated three or above on both items, they were assigned to the “dual-focus” group. Based on executives’ responses to these items, firms were assigned to one of four quadrants.

E-COMMERCE READINESS

In spite of the downturn of the former euphoric developments and enthusiastic expectations about the new era called the “new economy” and in spite of the “bubble burst,” e-commerce usage has become more routine. After the hype, substantial e-commerce business models were implemented or reinvented by traditional non e-commerce firms in the retail and wholesale distribution, manufacturing, and banking and insurance sectors. The ratio of e-commerce sales rose to 0.98% of the German GDP, as the latest available figures for B2B and B2C revenues estimate for 2000. This is equivalent to the largest ratio or one-third of total e-commerce sales in continental Europe and looks promising for sustainable growth in the future (Table 2).

TABLE 2 E-Commerce Sales, 2000

	B2B trade in US\$M 2000	B2C trade in US\$M 2000	% E-commerce Sales of GDP 2000
Germany	15,171.02	3,185.51	0.98
France	6,170.95	1,119.60	0.57
Italy	5,544.70	841.43	0.60
United Kingdom	13,815.62	3,873.00	1.25
EU-15	53,734.62	11,735.30	0.84
United States	118,457.20	44,084.29	1.63

Source: IDC, Internet Commerce Market Model, Version 8.1 (2002).

Information Infrastructure

Germany leads Europe in terms of the total number of broadband connections, which has increased at a rate of 15 times over the last two years, partly because deployment of services began earlier there than in many other markets, as well as an aggressive strategy pursued by the telecommunication service providers. In 2002, 3.9% of all inhabitants or 3.2 million high speed broadband connections were established in Germany. In comparison, only 2.3% of the population in the U.S. had access to digital subscriber lines (DSL) (EITO, 2002).

Since becoming one of the first European countries to unbind its local loop, competitive access is technically available. In addition, Germany is one of the first European countries to offer commercial line-sharing services. Competition, forcing the reduction of local voice tariffs and the increasing reliance on mobile services, is the major inhibitor of growth in the fixed line area in Germany. Carriers are looking for alternative ways to generate revenues, including DSL services (EITO, 2002).

In the mobile area, data still represent a small amount of the overall traffic, but that is expected to change. German mobile carriers already offer some mobile applications, which include GPRS-based location-based services and Internet access. More advanced mobile multi-media services (MMS) are also available on GPRS networks. These services combine text messages with sound, pictures and video. In March 2002, German mobile phone operator E-plus was one of the first in Europe to launch location-based I-mode services that allow subscribers to search for restaurants, cinemas, ATMs, hotels, etc. on their mobile phones (Beck et al., 2003), (EITO, 2002).

Aside from the overall availability of e-commerce-enabling technologies at the country level, the usage of e-commerce solutions at industry levels is also entering an advanced stage after the completed first usage and experimentation phase.

The overall e-commerce readiness in German industry is high when considering the figures in Table 3. However, it must be kept in mind that this survey represents only advanced users, rather than German firms as a whole. It is worth noting that the observed readiness is not only present among large firms, but also SMEs. While often the existence of a “digital divide” or “digital gap” is mentioned in the literature, only slight differences are evident between SMEs and large

firms in this survey in Germany. Differences are observable when asking about Extranet usage and the usage of call centers. Depending on the chosen definition, Extranets connect additional establishments of the same firm as wide area networks and can offer access to suppliers and customers. Given that most SMEs have only one establishment, the low diffusion of Extranet technology might be a consequence of the missing necessity to connect other establishments over wide area networks. To test this assumption a supplementary question about the usage of Extranet technology to connect additional establishments is needed, i.e. in addition to the questions about the functionalities of Extranets to allow access to suppliers or customers. Interestingly, the usage of electronic funds transfer (EFT) is higher among SMEs than among large establishments. This may be primarily due to the usage of online banking by SMEs which may also be viewed as a type of EFT, while large establishments use such personnel-intensive and non automatic ways of transferring money less often. It should be noted that this electronic form of banking is widespread within Europe, but is not available, for example, in the US. It is fundamentally different and far exceeds what US banks refer to as electronic banking. The semantic meaning of EFT is therefore different for large establishments and accompanied by EDI transfer, rather than online transfer. Consequently, the two figures for SMEs and large establishments are not directly comparable and need to be interpreted cautiously.

An additional remarkable difference between SMEs and large firms, the usage of call centers, is somewhat more complex to explain. While the differences between the industry sectors are explainable (manufacturing: product information; retail/wholesale: mail order business; banking/insurance: telephone banking), the difference between SMEs and large firms might be explainable by the personnel cost-intensive nature of call centers which therefore are only available to large firms.

TABLE 3 E-Commerce Readiness by Size of Firm and Industry

Percent using:	Total ^a	Establishment Size ^a		Industry ^a		
		Small ^b	Large ^c	Manufacturing	Retail/ Wholesale	Banking/ Insurance
E-mail	100.0	100.0	100.0	100.0	100.0	100.0
Website	91.8	91.7	100.0	90.5	92.0	94.5
Intranet	84.4	84.4	84.4	77.8	85.9	88.8
Extranet	22.3	21.7	51.5	38.8	15.9	36.6
... accessible by suppliers	14.0	13.6	32.6	27.4	8.5	28.5
... accessible by customers	11.8	11.4	28.7	23.1	8.4	13.7
EDI	67.7	67.7	70.2	56.6	71.1	65.4
Electronic funds transfer	86.6	86.9	71.9	94.9	85.2	77.2
Call center	30.3	29.8	55.7	26.4	29.3	50.6

Notes: ^a Results are weighted by the total number of establishments in an industry by size of firm.

^b Small firms are defined as firms with 25 to 250 employees.

^c Large firms are defined as firms with more than 250 employees.

Source: CRITO Global E-Commerce Survey, 2002

Although Table 3 depicts a broad diffusion of e-commerce-enabling technologies, the survey offers no information about the intensity of usage, the impacts on traditional working processes or even the resulting efficiency. To analyze the character of e-commerce readiness, a purely descriptive comparison is not especially useful. Consequently, a DEA model described in the

methods section is used to analyze the relative efficiency of firms among the survey sample. Efficiency in this context is defined as the measured satisfaction on a five-point Likert scale, ranking e-commerce impact from “not at all” to “a great deal” and based on the individual set of IT and e-commerce implementations. A high satisfaction rate based on a certain set of IT infrastructure can therefore be defined as “efficient.” An aggregated result of the DEA model is provided in Table 4, where the efficient establishments are categorized by their appropriate industry and firm size. While one-third of all establishments can be regarded as “efficient” in the sample, a detailed analysis reveals more SMEs as efficient in the retail/wholesale and banking/insurance sectors in comparison to large establishments in these sectors. Even more interesting, the retail sector gains more efficiency from e-commerce usage than the manufacturing or the banking sectors.

TABLE 4 Percentage of Relative Efficient E-Commerce Users by Size and Industry

	Manufacturing	Retail/ Wholesale	Banking/ Insurance	Total
SME	24.2	47.1	31.4	34.3
Large	37.1	40.6	24.2	33.0
Total	30.9	42.4	27.9	33.7

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Looking at the differences between “efficient” and “inefficient” establishments per sector reveals that “efficient” establishments have not only put into operation an equivalent or higher percentage of easy-to-implement e-commerce solutions such as online advertising or online sales, but also a significantly higher percentage of more complex solutions such as EDI or Internet-based supply chain management. The data in Table 4 to Table 7 are the detailed results of the conducted DEA analysis. DEA uses a linear programming approach to differentiate the efficient from the inefficient establishments which DEA investigated as significant. The proposition that the degree of complexity increases (see the directionality reflected by the arrows in the following tables below) is based on the assumption that the complexity of technical integration together with the necessity of external coordination causes difficulties to increase. On the other hand, a real application-to-application integration reduces manual interruptions and media flow interruptions and increases the benefits by automation. This thesis is also true for online sales or online procurement. While online sales are, from a technical integration point of view, not really difficult to establish – one “only” needs to link a firm’s internal system with a web server – the online procurement procedure is much more difficult. Online procurement for large enterprises and for SMEs are based on automatic replenishment systems generating order messages automatically and submitting these by using EDI over the Internet.

Considering the differences in the usage of e-commerce technologies, efficient establishments often use more complex solutions, as Tables 5 to 7 indicate. The efficient establishments are marked by the “+” sign.

TABLE 5 Manufacturing: E-commerce Usage Depending on Relative Efficiency and Firm Size

Percent using:	Online advertising	Online Sales	After sales customer services	Online procurement	EDI with suppliers	EDI with customers	Internet based supply chain management
On average: Increasing complexity of integration							
SME+ (n=8)	100.0	50.0	75.0	75.0	75.0	75.0	37.5
SME (n=25)	68.0	20.0	32.0	44.0	44.0	52.0	16.0
Large+ (n=13)	76.9	46.2	69.2	69.2	61.5	61.5	46.2
Large (n=22)	68.2	13.6	31.8	45.5	40.9	36.4	22.7

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

TABLE 6 Retail/ Wholesale: E-Commerce Usage Depending on Relative Efficiency and Firm Size

Percent using:	Online advertising	Online Sales	After sales customer services	Online procurement	EDI with suppliers	EDI with customers	Internet based supply chain management
On average: Increasing complexity of integration							
SME+ (n=16)	75.0	75.0	50.0	81.3	87.5	62.5	50.0
SME (n=18)	88.9	38.9	33.3	66.7	44.4	38.9	38.9
Large+ (n=12)	91.7	75.0	58.3	66.7	91.7	58.3	58.3
Large (n=20)	75.0	20.0	40.0	25.0	45.0	45.0	40.0

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

TABLE 7 Banking/Insurance: E-commerce Usage Depending on Relative Efficiency and Firm Size

Percent using:	Online advertising	Online Sales	After sales customer services	Online procurement	EDI with suppliers	EDI with customers	Internet based supply chain management
On average: Increasing complexity of integration							
SME+ (n=11)	90.9	54.5	81.8	63.6	36.4	63.6	36.4
SME (n=24)	83.3	41.7	58.3	33.3	25.0	29.2	20.8
Large+ (n=8)	100.0	75.0	87.5	37.5	50.0	50.0	50.0
Large (n=25)	100.0	44.0	60.0	40.0	28.0	48.0	24.0

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

IT Investment

After a catch-up phase in the late nineties, Germany now enjoys a high level of ICT infrastructure at the country, as well as industry levels, especially in the telecommunications sector. Nevertheless, German investments shrank after the economic cycle slowdown in recent months (Table 8). Due to exchange rate effects, the real annual volume provides an increasing market in US dollars in 2002 for which the annual growth rate based on € is provided. The German ICT market declined for the first time from about 1.3% to \$126.1 billion in 2001. With the exception of telecommunications and Internet services, as part of the telecommunication

technology market, each sector has had to cope with revenue reductions. In the mobile phone sub-category the market has shrunk by about 11%. Only the telecommunication services market could count on an increase of 5.5% on average in 2002. The most affected sub-categories of the information technology market are the PC hardware and data communication hardware segments which registered an average loss of 10.3% (BITKOM, 2002).

TABLE 8 ICT Market Development, 2002

ICT market	Market volume (in \$ billion)				Annual growth rate		
	1999	2000	2001	2002	99/00	00/01	01/02
Information technology ^a	71.2	68.2	66.3	66.2	10.5%	0.3%	-3.4%
Telecommunication technology ^b	58.1	57.1	57.2	59.8	13.4%	3.4%	-1.1%
ICT total	129.3	125.2	123.5	126.1	11.8%	1.7%	-1.3%

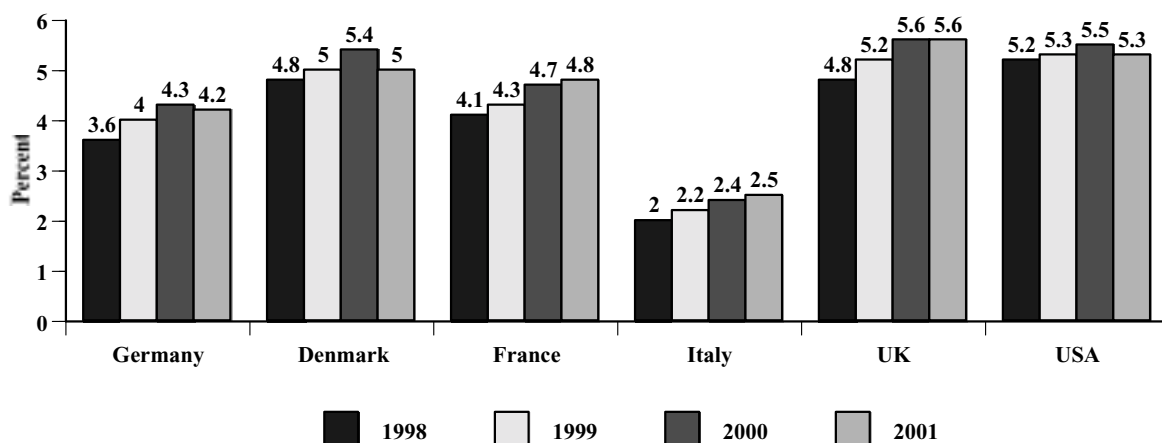
Notes: ^a PC hardware, office equipment, data communication hardware, software, IT services.

^b end devices, network infrastructure, telecommunication services.

Source: BITKOM update 2002, data calculations in annual exchange rates \$ to €.

In spite of the large investments made in the ICT and e-commerce infrastructure and extensive efforts in making this infrastructure ubiquitous during the last decade, the ratio of IT expenditures as a percent of GDP is still relatively low in Germany (Figure 1). In comparison to other industrial nations such as the US, UK or France, Germany does not spend as much on its ICT equipment. This may be explained by the fact that Germany starts from a high level of ICT development with an already broad-based and widely dispersed telecommunication infrastructure. Nevertheless, Germany risks losing this position when newer, state-of-the-art technologies are not implemented.

FIGURE 1 IT Expenditure as Percent of GDP



Source: Eurostat Structural Indicator, IT expenditure 2002.

Both consumer and corporate spending in the IT sector are suffering due to the widespread emphasis on cutting costs and investing cautiously. All major market segments are affected by this trend. A similar view is provided in Table 9 where the IT budget as a percentage of establishment revenue by firm size and affiliation is described. While the IT budget of all

establishments in the banking/insurance industry is the highest, followed by the retail and manufacturing industry, SMEs invest an average of 4.4%, nearly the same as large firms (5.4%) across all industry sectors. Weighted by the number of SMEs, the generated absolute amount of IT investments is significantly higher than the IT investments of large establishments. This resembles a relatively higher burden for SMEs than for large firms, which may profit from their sheer size and economies of scale. Nevertheless, the average percentage of IT investments is 5.4% with large firms and only 4.4% with SMEs. The total mean of 4.4% is equivalent to the average percentage of SMEs, due to the large number of SMEs.

TABLE 9 IT Operating Budget as a Percent of Establishments Revenue in 2001

	Total ^a	Establishment Size		Industry		
		SME	Large	Manufacturing	Retail/ Wholesale	Banking/ Insurance
<10%	66.7	67.3	44.1	62.0	67.6	74.4
10-20%	16.2	16.3	10.2	13.2	16.8	20.6
20-50%	0.1	0.0	2.6	0.0	0.1	0.0
Don't know or refused	17.0	16.4	43.1	24.8	15.5	5.0
Percent of establishment's total						
IT (mean)	4.4	4.4	5.4	3.9	4.3	6.4

Notes: ^aResults are weighted by the total number of establishments in an industry by size of firm.

Source: CRITO Global E-Commerce Survey, 2002

Aside from the relative amount of IT investments by revenue (Table 9), Table 10 provides information about the IT budget per employee. The heterogeneous responses allow no significant, error free proposition due to high volatility. However, the quantitative differences among the three industries are recognizable. Again, the highest IT investments are observable in the banking/insurance industry, followed by the retail/wholesale industry and the manufacturing industry. Surprisingly, SMEs have a higher IT budget per capita than large establishments in the banking/insurance sector. The large difference can be explained due to the bias of the unrepresentative data subset, which is not broad enough to calculate an average IT budget with a maintainable variance. Nevertheless, the results may provide a qualitative view on the situation of SMEs in this sector. Small banks and especially insurance firms have to invest more, while large ones have made their IT investments already.

TABLE 10 IT Operating Budget Per Establishment's Employee in Dollars

	Manufacturing		Retail/ Wholesale		Banking/ Insurance	
	SME	Large	SME	Large	SME	Large
IT Budget (mean)	\$472,039	\$13,757,086	\$6,871,840	\$127,246,705	\$13,725,253	\$19,431,766
Employees (mean)	85	1383	123	1772	113	943
Budget per Employee (mean)	\$5,553	\$9,947	\$55,869	\$71,810	\$121,462	\$20,606

Source: CRITO Global E-Commerce Survey, 2002, unweighted sample.

Considerable web-based investments were made (especially in the German bank sector) to build up a large variety of broad retail banking and brokerage online services (Table 11). Most of these investments are followed by additional huge IT back-end integration investments to connect already existing IT infrastructures. Today, banks realize that these customer-oriented charge-free services are welcomed benefits on the customer side, but such efforts do not increase their own benefits in the same way. More promising are the e-commerce B2B- and B2C-oriented investments in the retail/wholesale industry, where traditional catalog sellers have increased their online business significantly and successfully. Mail-order sellers are able to reduce the number of printed catalogs in favor of more web investments and web advertising. In the manufacturing industry, the Internet is mainly used as a cheap transmission layer to transport data between former non-EDI-capable suppliers or customers. Internet-based-EDI or WebEDI solutions in different variations and even some standardized WebEDI solutions like in the consumer products industry are becoming more and more popular. Especially of interest is the not yet standardized XML/EDI applications and data formats that connect even the smallest firms via the web (Figure 6).

TABLE 11 IT Operating Budget Devoted to Web-based

	Total ^a	Establishment Size		Industry		
		SME	Large	Manufacturing	Retail/ Wholesale	Banking/ Insurance
<10%	57.6	58.4	29.0	36.3	68.0	43.8
10-20%	5.6	5.6	4.4	18.9	0.1	3.9
20-50%	10.4	10.2	18.6	14.1	7.1	27.6
50%+	19.2	19.5	8.3	12.8	21.8	20.1
% Establishment's Web-based (Mean)	11.7	11.6	15.9	14.7	9.8	27.4

Notes: ^aResults are weighted by the total number of establishments in an industry by size of firm.

Source: CRITO Global E-Commerce Survey, 2002

Aside from the investigated e-commerce readiness in the studied three industries, the overall e-commerce readiness among German industry was measured for the first time in a survey of 1.2 million enterprises by the German Federal Statistical Office in 2002. The sample includes all sizes of enterprises, clustered into four categories from the manufacturing sector, the retail and hotel sector, the freight transport sector, the communications sector and selected enterprises from the service sector in general. Seventy-one percent of these enterprises used computers to support their business processes and 62% used the Internet to conduct business online. In comparison to other European countries, the Federal Statistical Office reported that Germany is until now not at the forefront of using e-commerce technologies, but has reached a high level of IT-integration which is not far from the level of the leading countries. When taking the large number of enterprises in Germany into account, Germany has not lost the challenge of using e-commerce (FSO, 03). This official statement supports our assumption that German firms are acting as fast followers after a new technology has proven successful.

Electronic communication increases by using e-mail and is an accepted way of corresponding aside from traditional, paper-bound messaging. More than 700,000 enterprises of the sample were reachable electronically in 2002. One-third or 400,000 enterprises had a website or

homepage. The Internet is mainly seen as a marketing platform for advertisements by the company or for its products. The rate of online sales was rather low (1%), in comparison to online procurement, which nearly every fourth company used in 2001. More than 17 million employees in the investigated industries were working with PCs at their offices and 4.9 million of them had online access (FSO, 03).

Considering the size of firms, 68% of SMEs used PCs. While small firms in special industries in the service sector such as software, telecommunication and data warehouse service providers had a high penetration (up to 98%) of PCs, small firms in the manufacturing sector such as in the print media industry used PCs on average of 93% in 2001 (FSO, 03).

In medium-sized enterprises with 20 to 249 employees, 98% used computers in their business processes. The Federal Statistical Office assumes that in firms with more than 20 employees one can expect a nearly 100% coverage of PC technologies (FSO, 03).

Nearly all large enterprises with more than 250 employees deployed PCs, with one remarkable exception. The diffusion of PC technology within the mail and courier services area has a penetration rate of PCs of only 68%. Although the online usage of tracking and tracing systems is rather common in Germany, the PC deployment per capita inside large carriers such as the German Postal Service seems to be rather low (FSO, 03).

KEY BARRIERS AND INCENTIVES

Now that e-commerce has shown its widespread potential to expand markets or to improve the quality of existing and new business processes, e-commerce is no longer only of interest to dot.com start-ups or large firms in Germany. While ICT and e-commerce solutions are able to support a large variety of internal and external business processes, the rate of diffusion still seems to be closely connected to the structure, traditions and particularities of industry sectors. Further differences are also observable at the country level in comparison to the results of the global survey.

As Table 12 indicates, competition is a significant factor for online activities. Nearly 43% of establishments in the three sectors consider major competitors going online as a significant incentive for e-commerce use. While only 29.8% of the manufacturing industry viewed this factor as significant, high competition is a significant pressure for distributors (45.5%) and even more for financial firms (53.7%). Surprisingly, pressure by customers (24.8%) or suppliers (8.3%) to use the Internet is rather low in Germany, compared to the global sample. One explanation may be the extensive usage of EDI to transmit business messages. In this area, especially in the retail & wholesale sector, one example showing how high pressure is exerted on suppliers is that of Metro AG, one of the largest supermarket chains. Metro AG exerts pressure on its suppliers to use the EDIFACT subset EANCOM. If a supplier is not able to submit messages via EDI he has to pay an extra fee for the additional manual work required on each order.

The most important overall driver of Internet usage is the desire to expand markets for products and services online (57.9%). This factor is less important for German bank and insurance institutions (45.2%) due to the existing multi-channel distribution strategy of their services on the

national market. Banks and insurance companies mainly use branches or traveling salespeople to distribute their products. In addition, the Internet, mobile portals and call centers are important tools to offer products and services to the customer. This increasing number of online accounts with direct access makes it less and less necessary to be physically present via branches in each city or village, but banks are not able to close their branches out of consideration for older or low-income customers without Internet access. For manufacturers (51.0%) and especially for retailers and wholesalers (61.3%), e-commerce opens not only the possibility to improve their services such as after-sale customer support, but also a further direct sales channel in the B2B and B2C area. While these two latter sectors manage to gain benefits from e-commerce applications, the banking/insurance sector has to cope with declining service prices and free online services, such as online banking and brokerage services. The excellent online service creates benefits for the customer, but the underlying business model is less successful.

TABLE 12 Drivers for Internet Use

Percent indicating a significant factor ...	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Customer demanded it	32.6	35.4	22.2	37.6	27.8	36.7	24.8	36.9
Major competitors were online	29.8	31.2	45.5	29.2	53.7	47.6	42.9	31.3
Suppliers required it	32.3	26.5	2.3	21.3	0.2	12.6	8.3	22.3
To reduce costs	32.5	42.8	16.3	32.3	24.8	34.3	20.3	35.7
To expand market for existing product/services	51.0	51.0	61.3	45.6	45.2	53.0	57.9	47.9
To enter new businesses or markets	39.3	39.2	49.6	44.4	27.5	35.6	45.7	42.0
To improve coordination with customers and suppliers	59.0	50.8	37.9	40.5	35.2	39.9	42.1	43.7
Required for government procurement	7.6	19.1	0.1	13.7	5.8	11.4	2.1	15.2
Government provided incentives	8.6	10.5	0.0	7.4	2.3	6.7	2.0	8.3

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

In addition to the strategic goal of expanding existing markets, the intention to enter new markets is at 45.7% in Germany, which is above the global sample percent. While this factor seems to be less significant for the already internationally active manufacturing industry (39.3%) and not an important factor for the also globalized banking/insurance sector (27.5%), the retail/wholesale industry sees its online and e-commerce activities (49.6%) as a highly significant factor to enter new markets.

The last important driver for Internet usage in the studied three industry sectors is the opportunity to improve the supply chain with customers and suppliers. Fifty-nine percent of establishments in the manufacturing industry expect site coordination benefits from using the

Internet, while only 37.9% in the wholesale/retail industry and 35.2% in the banking/insurance industry, respectively, do so.

Extremely unimportant are government-related factors which, consequently, cannot be regarded as drivers for the usage of Internet technologies. Neither government demand for online procurement capability (2.1%), nor direct governmental incentives or subsidies (2.0%) are mentioned as significant drivers for adoption decisions. On the contrary, the results suggest that lack of e-commerce knowledge and projects inside the government will become an impediment not only today but especially in the near future. While most business-to-business (B2B) processes can be conducted online, firms have to prepare paper-based and therefore inefficient processes in parallel to the business-to-government (B2G) side.

While Table 12 shows that it is impossible to identify the most important driver or “killer-application” supporting the diffusion of e-commerce solutions, Table 13 deals with the most important barriers. In comparison to the global average, most mentioned barriers are less important or restrictive, e.g., the need for face-to-face customer interaction (11.9% in Germany in comparison to 33.8% in the global sample), is not at all interpretable as a significant barrier for e-commerce. Concerns about privacy of data or even security issues are no longer an important obstacle in Germany (only 24.9% selected this issue as an important barrier) in contrast to the global sample (44.2%). This might be a good indicator for the maturity level of the offered online services and security applications, but also indicates that Germans have had good experiences with the Internet and are losing more of their resistance to use it. Further unimportant impeding reasons are Internet access costs due to the open and competitive telecommunications market (only 1.6%), the inadequate support of business laws (only 5.2%) due to one of the earliest e-commerce and digital signature legislation in the world and the taxation of online sales (only 1.5%), which is the same as traditional businesses in Germany and Europe. While the latter factors are unimportant barriers in Germany in contrast to other countries, German establishments have other important problems. Finding qualified and experienced e-commerce staff is more of a problem in Germany (41.2%) than anywhere else (26.5%). The lack of IT specialists is especially critical in the retail/wholesale industry, where nearly 50% of the respondents mentioned this as a significant obstacle.

As expected, the low diffusion of credit cards in Germany is an important obstacle in the B2C area (21.6%). In fact, it is more common to use debit cards for payment at stores or gas stations instead of using credit cards. Although the number of credit card owners increases the corresponding possibility of abuse using the card number online, the recognition of this potential has reduced the number of potential users notably.

An additional important barrier for German industry is the necessity of required structural changes of existing business processes when implementing e-commerce solutions. More than 30% of German establishments are worried or not able to implement needed organizational changes. This issue is especially salient in the retail/wholesale industry (34.2%), where the necessary prerequisites such as ERP or a general IT infrastructure are less likely to be available in comparison to other sectors. In order to gain full benefits from e-commerce, the needed change efforts are therefore greater in the manufacturing or banking industries.

Policy and environmental issues are also unimportant obstacles for doing business online. Good legal protection together with clear taxation and business laws, e.g., the long distance distribution law which covers traditional catalog sellers as well as online retailers are viewed by the respondents as drivers rather than barriers for doing business online in Germany.

TABLE 13 Barriers/Difficulties to Doing Business on the Internet:

Percent indicating it as a significant obstacle ...	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Need for face-to-face customer interaction	23.0	31.5	8.8	34.2	11.6	40.1	11.9	33.8
Concern about privacy of data or security issues	20.9	47.1	21.5	40.4	65.1	62.0	24.9	44.2
Customers do not use the technology	26.4	30.3	24.3	33.1	18.0	23.2	24.2	31.4
Finding staff with e-commerce expertise	28.2	23.8	47.7	28.8	13.5	19.9	41.2	26.5
Prevalence of credit card use in the country	17.3	22.4	23.0	19.9	19.7	15.4	21.6	20.3
Costs of implementing an e-commerce site	22.5	32.6	37.2	34.9	14.0	27.6	32.3	33.6
Making needed organizational changes	26.9	23.8	34.2	24.8	9.3	17.5	30.7	23.9
Level of ability to use the Internet as part of business	14.6	28.0	14.1	23.7	14.7	20.8	14.3	24.8
Cost of internet access	4.6	13.5	0.0	16.3	8.8	12.7	1.6	15.1
Business laws do not support e-commerce	17.0	27.6	0.0	22.6	21.6	23.3	5.2	24.2
Taxation of Internet sales	7.0	14.0	0.0	18.8	1.2	8.2	1.5	16.5
Inadequate legal protection for Internet purchases	13.3	37.3	22.2	33.6	26.2	26.0	20.8	34.1

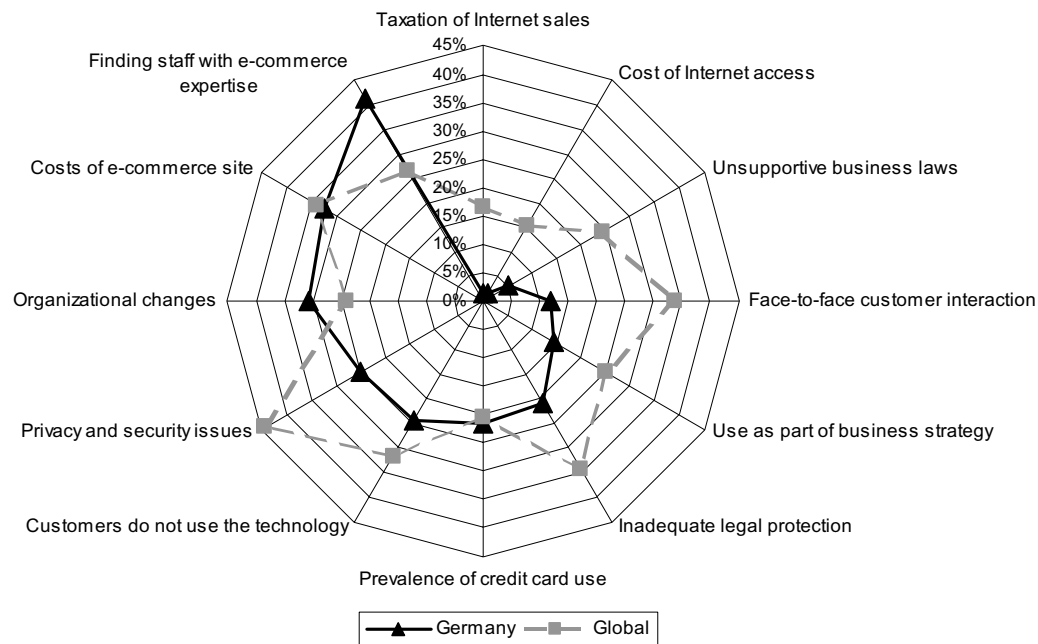
Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Aside from the difficulties in finding experienced staff and the expensive costs of e-commerce sites, organizational changes are the most significant impeding factors hindering the fast diffusion of e-commerce in Germany (Figure 2). Nevertheless, with some exceptions, German establishments deal with lower barriers in comparison to the global sample. However, without e-commerce experts, other obstacles such as making organizational changes remain unsolved problems hampering the process of e-commerce diffusion and usage. Moreover, without IT know-how, investments in more sophisticated and difficult to implement e-commerce solutions cannot be realized, hampering further development. Even after the dot.com bubble burst, the limited availability of IT personnel is the most serious bottle-neck today and in the near future for German industry.

FIGURE 2 Main Barriers of Internet Usage

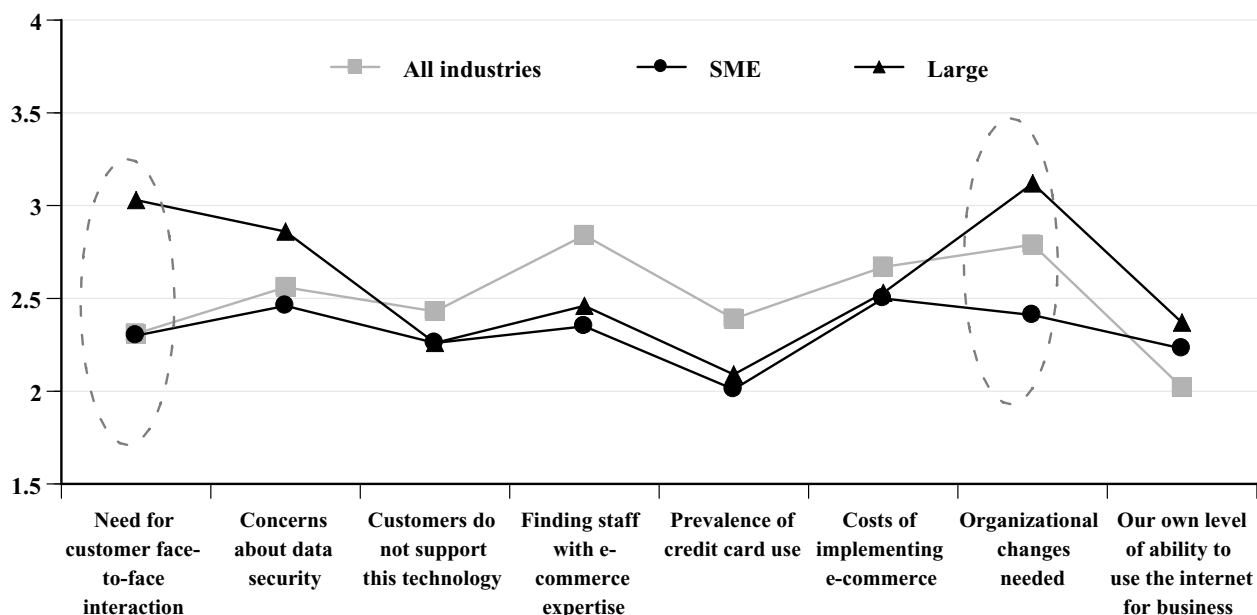


Source: CRITO Global E-Commerce Survey, 2002; weighted by the total number of establishments.

After the comparison of barriers among different industry sectors, as well as a comparison between Germany and the results of the global sample, the following figures provide a more detailed view of differences between SMEs and large establishments within the three industry sectors. The scale ranges from 1 “not at all” to 5 “very significant” obstacles. The impeding factors for SMEs and large establishments are not very different, but slight differences are still observable.

In the manufacturing industry, large firms consider the need for face-to-face interaction with customers more important than SMEs do (Figure 3). In this industry, trust seems to still be dependent on personal contacts. It might be possible that large establishments have to revise their opinion because SMEs do not seem to be as worried as large establishments might expect. On average, SMEs in the manufacturing industry are more optimistic than the overall average of all industries, while large establishments encounter more obstacles than the average. This holds also for making needed organizational changes to accommodate e-commerce use, where large establishments expect more difficulties than SMEs do.

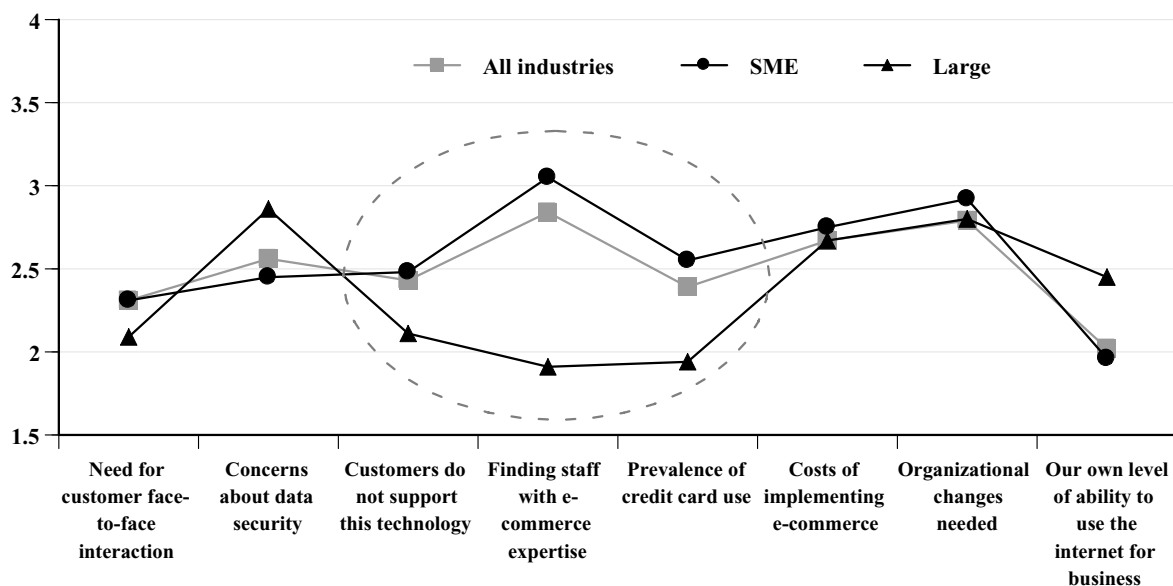
FIGURE 3 Main Barriers to Doing Business Online in the Manufacturing Industry



Source. CRITO Global E-Commerce Survey, 2002; weighted sample.

Slightly different obstacles can be observed in the retail/wholesale industry, where the largest differences between SMEs and large firms are concentrated on the lack of available support of e-commerce technology on the customer side, the lack of e-commerce skills and the low prevalence of credit cards (Figure 4). SMEs regard these factors as more significant than the global sample, while large retailers seem to be less impacted by these obstacles.

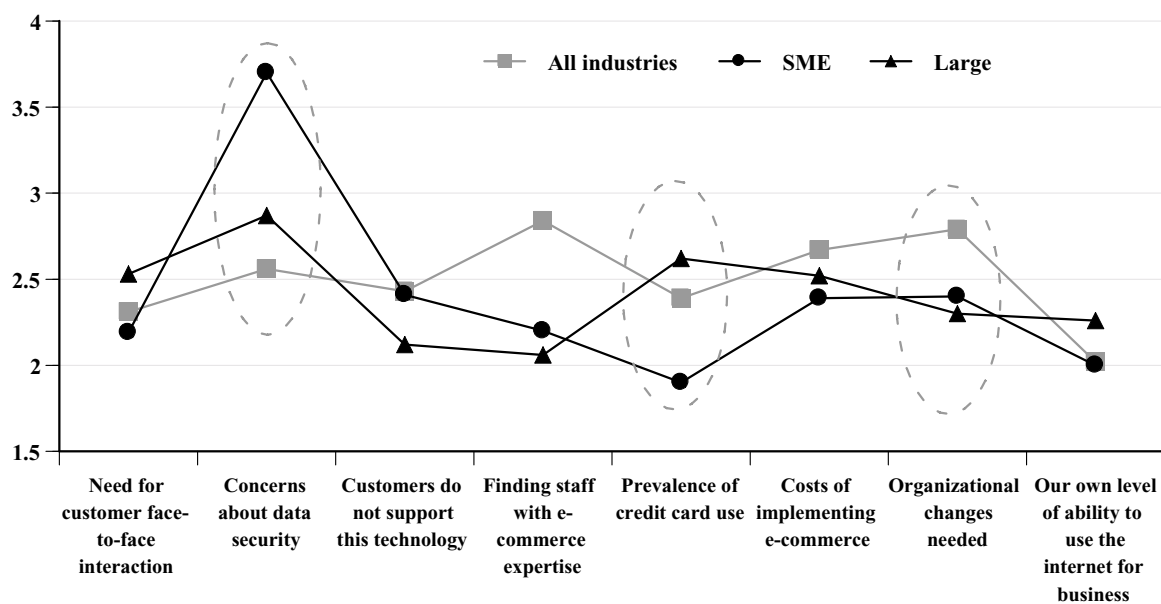
FIGURE 4 Main Barriers of Doing Business Online in the Retail/Wholesale Industry



Source. CRITO Global E-Commerce Survey, 2003; sample weighted by the total number of establishments.

The main differences in the banking/insurance sector between SMEs and large establishments have to do with concerns regarding security (Figure 5). While SMEs are more concerned about security problems accompanying online activities, large establishments seem to be more venturesome or more equipped to handle the possible risks, based on sophisticated security mechanisms such as authentication by using PIN/TAN procedures or HBCI together with firewalls and intrusion detection methods. Again, the low prevalence of credit cards is viewed as a barrier by large establishments, while SMEs do not share this perception as strongly. It is difficult to interpret these differences, but possibly SMEs are not as informed about the benefits of e-commerce or aware of the necessity to “be online” as large establishments. Another reason is that most credit cards are issued by large business banks rather than by small savings and loan banks. The usage of credit cards is therefore more important for large banks to generate revenue. Differences also occur in the field of organization change. The banking and insurance sector believes that its organization structure is better prepared on average to implement e-commerce successfully among all firms investigated. This self-assessment runs counter to the observable organizational difficulties today in the banking sector in Germany.

FIGURE 5 Main Barriers of Doing Business Online in the Banking and Insurance Industry



Source. CRITO Global E-Commerce Survey, 2002; sample weighted by the total number of establishments.

DIFFUSION OF E-COMMERCE

The macroeconomic benefits of IT are already apparent in Germany, accompanied by the increasing usage of a great variety of ICT and e-commerce technologies. In spite of the current slowdown in ICT investments, following overinvestment and the so-called bubble-burst, the long-term benefits and structural IT-related business improvements are likely to continue or even increase in the years to come. As a country with a relatively low ICT hardware production industry, Germany benefits as an importer from the falling prices of ICT goods. Although German industry has adopted and integrated e-commerce technologies in all areas of business processes, it was not able to increase the productivity factor in the same way as other countries in

the last decade. The contribution of IT usage and production is provided in Table 14. Germany has not been able to increase its productivity growth rate supported by IT in the same way as other industrialized nations.

TABLE 14 Contribution of Information Technology to GDP Growth, 1990-1998

	Real GDP Growth	Contribution of IT-related industries		
		Total	IT-Using	IT-Producing
Germany	1.1%	0.5%	0.4%	0.1%
France	1.3%	0.5%	0.2%	0.3%
Italy	1.4%	0.7%	0.5%	0.2%
UK	2.1%	1.0%	0.6%	0.4%
USA	3.2%	1.4%	0.9%	0.5%

Source: Van Ark 2001. For Germany, the numbers refer to 1991-97.

Diffusion of E-Commerce Use at the Country and Industry Levels

In spite of the temporary slowdown of the ICT industry, the number of installed ICT technologies is quite high at the industry level. With regard to the three industry sectors in Table 15 the usage of e-commerce standards is in most cases above average when compared to the global sample.

As Table 15 shows, the diffusion of rudimentary or basic e-commerce technologies seems to be completed to a great extent in all industry sectors. The existence of e-mail, websites or Intranets is quite common among the companies surveyed, with diffusion rates above the global sample at 84.4% to 100%. Nevertheless, the usage of Extranet technologies is far below the level of the global sample. While the manufacturing and banking/insurance industries use Extranet solutions extensively, the retail/wholesale sector is far behind. Innovative forms of electronic data interchange, such as Internet-based EDI, are not yet very far-reaching. Only 10.1% of the German industry uses Internet-based EDI, with the lowest percent (8.1%) in the retail/wholesale industry. This may be due to the long tradition and broad diffusion of traditional EDI, resulting in a lower urgency to connect business partners in other ways. It is only in the manufacturing sector where Internet-based WebEDI front-end systems are popular to integrate small business partners into existing supply chains. Call centers also are not common in Germany, with the exception of the banking/insurance industry where call centers are used to adjust insurance cases or assist in telephone banking.

TABLE 15 Use of E-Commerce Technologies 2002

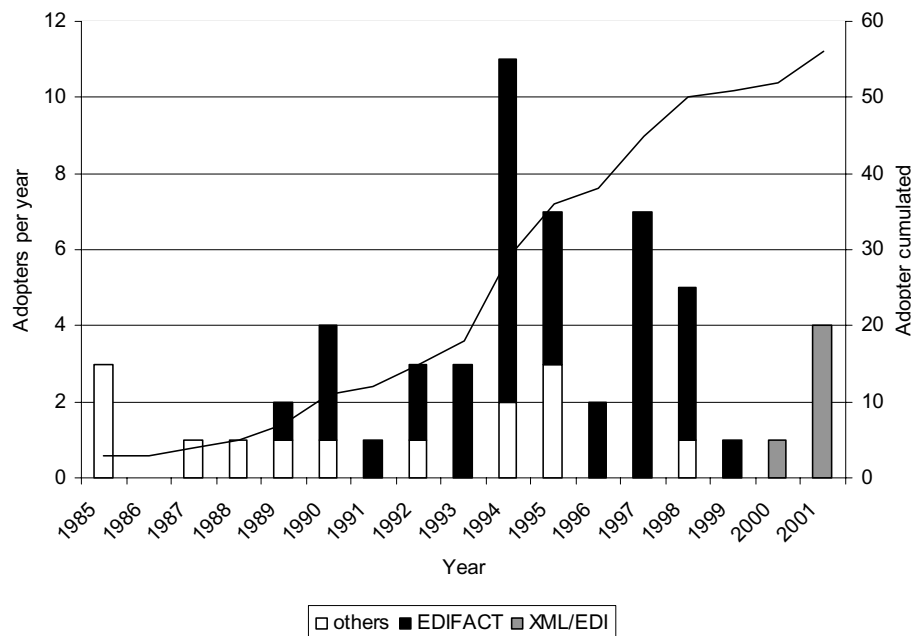
Percentage using...	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
E-mail	100.0	95.5	100.0	99.9	100.0	99.2	100.0	98.5
Web-site	90.5	80.5	92.0	69.9	94.5	81.5	91.8	74.1
Intranet	77.8	63.5	85.9	63.3	88.8	66.5	84.4	63.6
Extranet	38.8	31.4	15.9	33.4	36.6	32.4	22.3	32.7
accessible by suppliers ^c	27.4	18.7	8.5	21.8	28.5	21.7	14.0	20.9
accessible by customers ^c	23.1	18.5	8.4	17.0	13.7	20.8	11.8	17.8
EDI	56.6	43.0	71.1	45.2	65.4	42.2	67.7	44.3
EDI over private networks ^c	20.3	14.2	34.0	22.8	27.6	13.4	30.8	19.4
Internet-based EDI ^c	16.3	12.3	8.1	6.1	12.5	10.7	10.1	8.4
both ^c	20.0	15.5	28.9	15.9	22.3	17.0	26.6	15.9
EFT	94.9	40.7	85.2	42.1	77.2	62.3	86.6	43.4
Call center	26.4	32.6	29.3	31.3	50.6	38.6	30.3	32.3

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

^c Percentage based on total sample.

Source: CRITO Global E-Commerce Survey, 2002

FIGURE 6 Diffusion of EDI Standards

Source: Beck, 2002

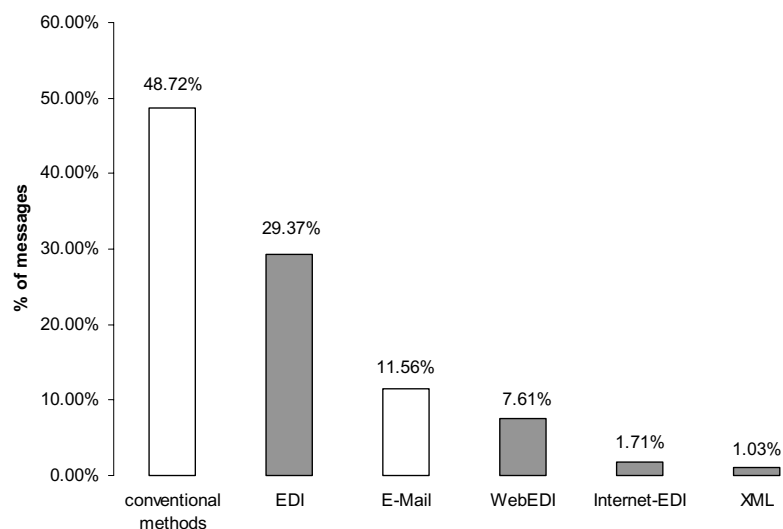
Further insight into German IT adoption behavior can be provided by considering the diffusion of EDI standards (Figure 6) per adopter per year. In Germany, the diffusion of innovations such as EDI is strongly driven by the advent of UN/EDIFACT in 1987. After a period with rather low

adoption rates until 1994, a period with high adoption rates followed between 1994 and 1998. In 2000 and 2001 no further EDIFACT implementation was reported. Instead of EDIFACT, the adoption of XML/EDI frameworks appeared in 2000 and increased in 2001. Earlier EDI frameworks in the finance (SWIFT) and automotive (VDA) sector were also mentioned. XML/EDI frameworks are becoming increasingly important to connect business partners with no EDI conversion systems over the Internet. Most of these business partners are small or medium-sized enterprises (Beck, 2002).

In spite of the increasing rate of XML/EDI implementations, the ratio of sent and received messages is rather low (Figure 7). The usage of further e-commerce innovations like Internet-EDI or WebEDI is slightly higher. The diffusion of these standards is at its beginning in Germany, although these technologies are not new.

More important than the potential availability of e-commerce is the de facto usage of these technologies (Beck, 2002). In 2002, firms using EDI were asked about the ratio of electronic messaging to paper-based, manual messaging. The results are provided in Figure 7. Although 100% of the respondents are EDI-using firms, less than one-third of all messages are processed electronically via traditional EDI systems, with an additional 10% via innovative EDI solutions such as WebEDI, Internet-EDI or XML/EDI. The survey shows that the hypothetical availability of e-commerce technologies is not sufficient to draw conclusions about their readiness or efficient usage.

FIGURE 7 Sent and Received Messages as a Ratio of Communication Channel

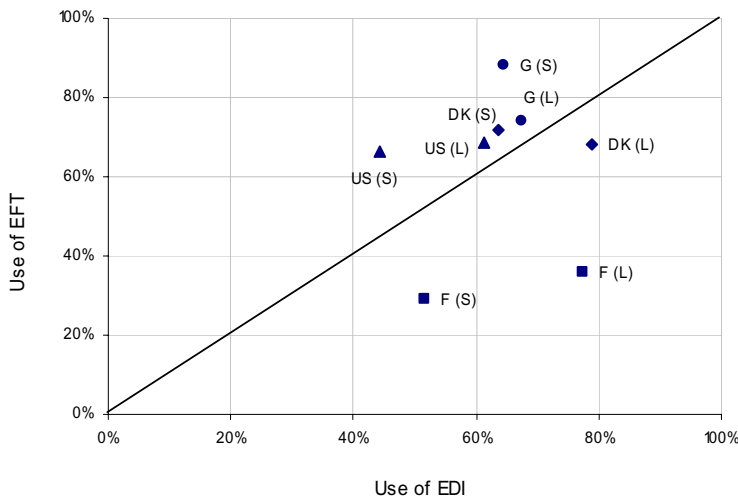


Source: Beck, 2002

The diffusion of e-commerce technologies among SMEs and large firms differs essentially only in comparison to other nations such as France, Denmark or the US. Figure 8 shows the usage of EDI and electronic funds transfer (EFT) in the four countries, divided into SMEs (S) and large establishments (L). While large-sized dependent differences in EDI use are observable, e.g., in France, both German SMEs and large establishments, use EDI nearly as often as EFT. In fact,

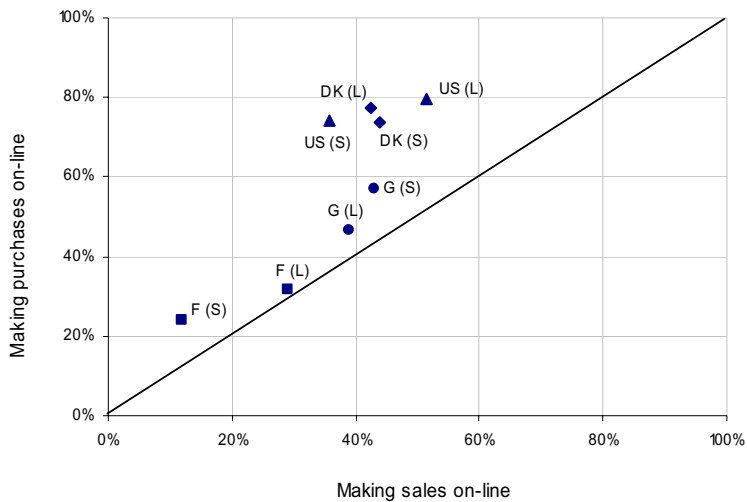
large establishments in Denmark or France are leading in the field of EDI usage, but on the other hand, SMEs in these countries are far behind. Even US establishments do not use EDI or EFT as often as Danish or German establishments. Surprisingly, German SMEs take the overall leading position with regard to EFT and are close to the percentage of EDI usage reported by large firms in Germany. Therefore, the often quoted “electronic gap” between large establishments and SMEs cannot be verified via this empirical study.

FIGURE 8 Use of EDI and Electronic Funds Transfer at the Country Level by Firm Size



Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

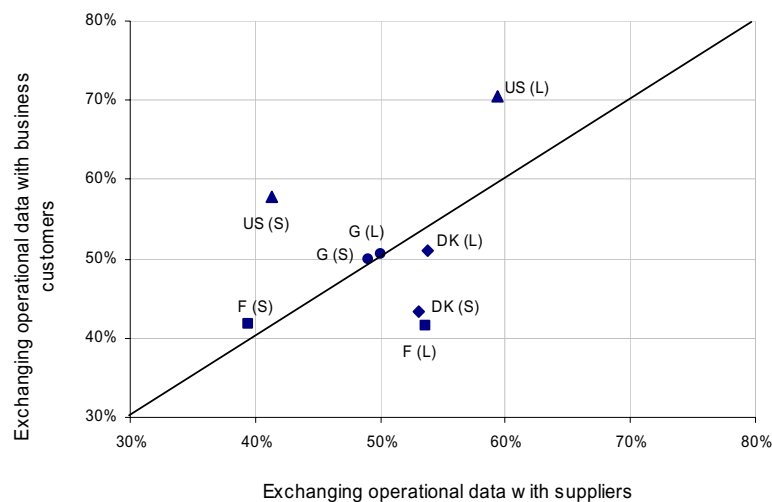
Regarding the percentage of establishments doing online sales and online purchasing or procurement, German firms take only a middle position (Figure 9). Nevertheless, German SMEs seem to utilize online services more than large establishments. In comparison to the leading countries, large US establishments do more online sales and purchasing than US SMEs, while French firms report the lowest percentage of all countries.

FIGURE 9 Use of Online Purchasing and Sales at the Country Level by Firm Size

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Interestingly, all countries and establishments conduct more online purchasing than online sales. While online sales are not as complex to integrate into existing ERP systems, firms in this study do more online procurement. This may be due to the fact that online sales is too complex for the manufacturing industry with its heterogeneous and complex products, while the retail/wholesale and banking/insurance industry use online sales more extensively. Another explanation for the higher usage of online procurement instead of online sales is that most establishments have not integrated automatic replenishment systems or interlinked their ERP systems with the Internet, but are ordering manually at web front-ends. This is, of course, the easiest way to use e-commerce in the first step, but holds no additional positive network effects for uses such as storage and processing of the data in in-house systems. The usage of these technologies is therefore not applicable to make assumptions about the e-commerce readiness of an industry. To analyze the degree of automation avoiding media-flow interruptions which occur often by using web front-ends manually, empirical data about the usage of electronic marketplaces by using standardized electronic formats such as the XML-based catalog standard BMEcat in Germany would be helpful. Nevertheless, the de facto proportion of online sales to total sales may still be a relatively low ratio.

In the area of more advanced and sophisticated e-commerce solutions, the overall penetration is lower in all countries and dominated by large establishments (Figure 10). Approximately 60% of large US firms use operational data exchange with their suppliers and also approximately 70% of them conduct operational data exchange with their customers. In comparison to German SMEs and large establishments, who use these two e-commerce categories up to 50% each, the differences between SMEs and large firms are considerably larger in other countries. French firms, as well as both small and large Danish firms, have higher usage of supplier-oriented supply chain management. At the same time, French and US SMEs use less of the latter-mentioned technology in comparison to German firms. SMEs do not use these two e-commerce solutions as often as German SMEs, which are again not far from the position of large establishments.

FIGURE 10 ICT based Supply Chain Management at the Country Level by Firm Size

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

A more detailed view of e-commerce usage at the industry level is provided in Table 16. Industry differences are evident, as significantly more retail/wholesale firms use e-commerce for online sales and purchasing, as well as data exchange with suppliers and formal integration of the same business process, than firms in the other two sectors.

TABLE 16 Uses of the Internet

	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Advertising and marketing purposes	75.4	55.8	79.3	57.1	77.8	68.3	78.4	57.6
Making sales online	29.0	25.1	68.1	31.9	37.8	33.0	57.8	29.9
After sales customer service and support	46.1	48.4	55.5	40.7	58.1	48.3	53.8	43.7
Making purchases online	51.3	43.4	65.1	47.8	45.3	52.2	60.7	46.8
Exchanging operational data with suppliers	49.5	49.9	65.1	48.0	42.8	41.9	60.2	48.1
Exchanging operational data with customers	57.9	53.4	50.4	49.0	56.4	52.5	52.4	50.7
Formally integrating the same business processes with suppliers/partners	23.6	26.8	55.5	37.5	37.2	33.5	47.7	33.9

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

The extent of integration of Internet applications with internal databases or ERP-systems is as low in Germany (55.2% reporting “little to no integration”) as in the global sample (52.5%) (Table 17). The same low extent of integration can be observed in the area of electronic integration of customers and suppliers, where 72.2% of the German sample reported little to no integration on par with 72.1% of the global sample. Regarding the percentage of firms reporting a great deal of back-end integration, more German firms are able to benefit from it. Fully 26.9% (Germany) compared to 23.9% of the global sample estimate that they actively use such integration solutions, while the percentage with only some integration is below the global sample. Most German firms seem to wait until they can benefit from Internet application integration, but they integrate completely if they see any advantage in doing so.

The electronic integration of customers and suppliers follows similar rules: “do it or forget it,” especially in the retail/wholesale sector. Nearly double the percentage of German firms as in the global sample, i.e. 17.1% in comparison to 9.6%, respectively, have integrated their business partners electronically.

Nevertheless, at the industry level different degrees of implementation are observable. In the banking/insurance industry, only 23.1% of German firms have achieved a great deal of back-end integration, compared to 40% of the firms in the global sample. This may be explained by the prevailing concerns about security issues accompanying the integration of open networks with their back-end systems, but it may also be an expression of the current economic slowdown in this sector. Most network effects benefits occur on the customer side while, conversely, banks are not able to reduce costs by using Internet technology.

TABLE 17 Enterprise Application Strategy

Extent to which Internet applications are electronically integrated with...	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Internal databases and information systems:								
Percent little to none	65.1	60.6	53.5	49.8	45.6	39.4	55.2	52.5
Percent some	16.4	23.8	16.0	23.9	31.3	20.6	17.3	23.6
Percent a great deal	15.5	15.6	30.5	26.3	23.1	40.0	26.9	23.9
Those of suppliers and business customers:								
Percent little to none	82.9	72.6	68.7	72.6	78.1	66.2	72.2	72.1
Percent some	16.6	19.1	8.8	18.2	13.4	15.8	10.7	18.3
Percent a great deal	0.4	8.3	22.4	9.1	8.5	17.9	17.1	9.6

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Very heterogeneous responses are also observable when asked about the extent of customer and supplier integration. The retail/wholesale industry is most advanced in its front-end integration of Internet applications, with 22.4% of firms reporting a great deal of integration, compared to only 9.1% in the global sample. Although the retail/wholesale industry has made great efforts to

integrate business partners using EDI and subsequently benefits from large cost reductions, the manufacturing and finance industries have not been as successful. The low penetration of business partner integration in the manufacturing industry (only 0.4% reporting “a great deal”) and in the banking/insurance industry (only 8.5%) is difficult to interpret. In the manufacturing sector, the automotive and mechanical engineering industries are known for their deep integration of first and second tier partners into the supply chain. In the banking sector, electronic data interchange with large customers, as well as electronic inter-bank clearing, is an established and common solution. These data imply that the integration in these two sectors is being done through non-Internet based EDI, rather than through Internet solutions.

In contrast to other countries, German firms do not use and understand the Internet and related e-commerce applications as a substitute for traditional markets or distribution channels. In contrast German establishments use the Internet as a complementary instrument to complete and support the already sophisticated market penetration (Table 18). Due to this, the necessity to address only new markets is not that important because national and international markets are still objects of market penetration (only 7.5% use the Internet to address new markets only). A high 75.8% of German firms reported using Internet capabilities to address existing distribution channels, while none reported using the Internet to reduce or replace traditional distribution channels.

Consequently, following a multi-channel strategy, the Internet does not compete directly with other distribution channels (only 16.7% affirm this) as in other countries and is not able or useful to replace existing channels (0.0%).

TABLE 18 How Establishments Use the Internet to Sell Products and Services

	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Addresses new markets only	0.0	23.2	9.0	12.2	0.1	12.6	7.5	15.3
Addresses traditional distribution channels only	90.9	38.8	73.3	47.8	84.5	33.4	75.8	44.1
Competes directly with traditional distribution channels	9.1	25.7	17.8	26.2	15.1	42.3	16.7	27.4
Replaces traditional distribution channels	0.0	12.2	0.0	13.8	0.3	11.8	0.0	13.2

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

In the last few years, German industry has developed into an intensive ICT-using e-economy (Table 19). The percentage of firms using online sales in the B2B area in Germany is nearly thrice as high (34.0%) as the global sample (12.9%). Both the manufacturing (19.3%) as well as the retail/wholesale (40.5%) industries are intensive adopters and users of B2B commerce. On the other hand, the importance of B2C commerce in Germany (11.5%) is not much higher than the average of the global sample (7.1%). Consequently, even in the retail/wholesale industry only

13.4% reported the sole use of B2C, while the B2C area in the banking/insurance industry seems to gain more and more importance with 16.1%. Although the overall percentage of establishments offering B2C seems to be rather low for an industrialized country, one can observe a steadily growing consumer demand for such services. Nearly one-third of consumer sales of the investigated firms are already conducted online (30.7%), especially in the retail/wholesale industry, with 32.7%. The manufacturing sector reported 7.5% of B2C sales; quite a low level of direct sales to private end consumers because this is rather uncommon for industry firms in Germany.

As expected, the highest ratio of online sales use for both B2C and B2B commerce is observable with the retail/wholesale industry, where 20.7% conduct both types of online sales at the same time.

Although Germans are evidently concerned about security issues, especially related to online payment procedures, most websites support such functionalities. A high 41.8% of all establishments in the investigated industry sectors offer online payments on their website, especially in the retail/wholesale industry (44.5%).

TABLE 19 Online Sales

	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
B2B only (%)	19.3	16.3	40.5	12.0	12.0	6.7	34.0	12.9
B2C only (%)	2.9	4.0	13.4	7.7	16.1	14.3	11.5	7.1
B2B and B2C (%)	9.9	11.2	20.7	16.9	19.7	15.5	18.4	15.0
Mean percentage of ...								
Total consumer sales conducted online (all establishments)	0.5	2.1	11.2	4.5	7.3	5.1	8.8	3.8
Total business sales conducted online (all establishments)	5.5	3.2	9.2	4.4	7.9	4.0	8.4	4.0
Total consumer sales conducted online (only those doing B2C sales)	7.5	15.3	32.7	19.5	22.2	19.6	30.7	18.6
Total business sales conducted online (only those doing B2B sales)	19.2	12.2	15.1	16.1	26.5	21.9	16.0	15.1
Websites supporting online payment (only those doing online sales)	27.8	25.0	44.5	36.7	28.8	37.4	41.8	33.6

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Aside from the widespread availability of online sales, a number of different online services are provided at the industry level. In the manufacturing industry (Table 20), most large establishments, as well as SMEs, offering online services provide technical product support and detailed product specifications (86% of total firms). Order tracking is provided more often by SMEs (47.7%) and more overall than among the global sample (46.2% compared to 21.5%). The low penetration of online tracking systems especially among large establishments might be explained by the extensive usage of EDI messages to guarantee just-in-time deliveries by a set of different message types. The freight and transport provider is often used as a so-called “extended workbench,” configuring and reporting the current location and stage of production through EDI, often supported by global positioning systems. Features such as product configuration or customer account information are used less often in Germany than in the global sample. Aside from order tracking, the diffusion of web services does not differ significantly between SMEs and large establishments.

TABLE 20 Type of Online Web Services in the Manufacturing Industry in Germany

Percent with web service for... ^a	SME	Large	Total	Global ^b
Product configuration	47.4	44.4	47.2	54.7
Order tracking	47.7	29.6	46.2	21.5
Service and technical support	56.5	63.1	57.1	54.4
Product specifications	86.3	81.5	86.0	79.9
Account information	13.7	11.2	13.5	17.0

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Although the technical equipment and infrastructure are already available, in the wholesale/retail distribution industry differences are evident when comparing the web services offered by large firms versus SMEs. Online services such as gift certificates, individual product customization, account information or even product reviews are less often supported by SMEs compared to large establishments in the retail/wholesale industry (Table 21). Basic functionalities such as product catalogs as a necessary prerequisite to sell online are available on nearly all websites. In this area, the German retail sector can benefit from standardization attempts in the past, resulting in catalog and product classifications for EDI in the form of EANCOM data pools, as well as XML-based catalog specifications (BMEcat) developed by the Federal Association for Material Logistics and Procurement (BME). At the international level, the German retail industry is not yet as well positioned as its global competitors.

TABLE 21 Types of Online Web Services in the Wholesale/Retail Industry in Germany

Percent with web service for... ^a	SME	Large	Total	Global ^b
Gift certificates and/or registry	15.4	42.9	15.6	20.6
Product catalog	91.9	91.6	91.9	69.8
Product reviews	44.8	72.7	45.0	48.6
Individual customization	15.4	50.7	15.7	21.3
Account information	16.3	37.6	16.4	21.7

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

The German bank/insurance industry offers a broad variety of online services (Table 22). More than three-quarters (77.2%) of firms support services such as filing applications, filing claims, paying bills, and transferring funds and 58.3% support web services and tools such as research and planning tools. Access to account information is more or less obligatory and provided by 65.9%. These services are more common in the banking sector than in the insurance sector. Again, an obvious “digital gap” between large and small establishments is not clearly observable. While SMEs provide online services and online account information less often than large establishments, they offer online tools to their customers more often.

TABLE 22 Types of Online Web Services in the Banking/Insurance Industry

Percent with web service for... ^a	SME	Large	Total	Global ^b
On-line services such as filing applications, filing claims, paying bills, transferring funds	76.8	96.1	77.2	53.9
Access to account information	65.8	71.9	65.9	57.3
On-line tools such as research tools, planning tools, etc.	58.7	40.8	58.3	52.0

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

German industry has adopted and implemented e-commerce solutions after they proved successful in other industry sectors or countries. The wait-and-see mentality together with a careful but consequent integration is observable in the diffusion pattern, e.g., for EDI (Figure 6) as well. Due to this, the adoption process of new e-commerce innovations in Germany cannot be characterized as enthusiastic. Nevertheless, in the field of mobile commerce (m-commerce), Europe and to a certain degree Germany has been driven by m-commerce hype (Table 23). The estimated boom of m-business has not started yet, since the lack of promising mobile business models hinders broader diffusion. In comparison to the global sample, slightly more German firms have installed m-commerce solutions (17.9% compared to 13.7%), but until m-commerce has demonstrated its viability, the willingness to invest in further implementation is somewhat below average (12.3% compared to 18.2%). High implementation rates were only observable in

the banking/insurance sector, where mobile payment methods, as well as mobile banking and brokerage, enjoy a degree of popularity (28.3%). Most insurance companies do not offer any mobile access at the moment, but plan to offer customized insurance on demand, e.g., ordering special one-day accident insurance at mountain ski lifts via mobile phone.

TABLE 23 Percent Providing or Planning to Provide Content or Services for Mobile Customers

	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Already available	6.7	14.2	19.9	12.5	28.3	21.2	17.9	13.7
Plan to add within the next year	7.7	17.7	13.4	18.4	14.7	18.9	12.3	18.2

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Diffusion of the E-Commerce Industry

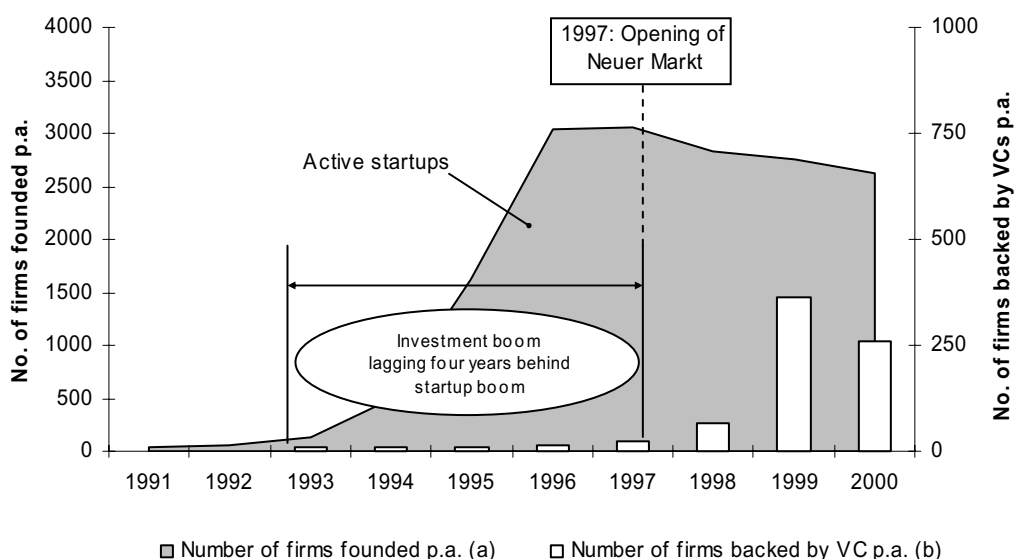
From 1993 to 2000, Germany enjoyed the development of new, economically important firms with about 15,000 start-ups. In 1996/97, when the start-up wave reached its peak, the number of companies founded per year started to decline. Most start-up activities were focused on B2C and B2B companies that offered products and services online. Of the companies using specific business models, approximately 54% were in the multimedia and web building area, 13% offered ISP services, 10% B2C and B2B sales, 8% system-houses and integration, 5% software production, and an additional 10% offered information, content, and infrastructure (Krafft, 2000).

The German e-commerce start-up landscape is highly affected by the current economic slowdown. Although four times more entrepreneurs are counted per year in Germany in comparison to insolvencies, the economic slowdown is hitting the young German e-commerce industry hard. A large number of formerly famous and promising dot-coms failed during the consolidation process since mid-2000. After the insolvency wave, accompanied by bad debt losses and loss of customer trust, the overall gloomy mood affected even solid firms in 2001. With 443 insolvencies, an additional 470 bankruptcies in 2001 and approximately 40 to 50 insolvencies per month in 2002 the speed of consolidation was high. According to German law, insolvency is more or less equivalent to the US protection provided by Chapter 11 bankruptcy. When a firm is finally closed after Chapter 11 and reorganization was unsuccessful, then the firm is finally bankrupt. In particular, the e-commerce business models in the B2C area had to struggle but multimedia agencies and software developers also encountered similar difficulties. The insolvencies of very innovative university and research spin-offs must be regarded as critical for the further development of e-commerce in Germany. Losing innovative firms will worsen the competitive position of Germany at the international level (Krafft, 2002).

Among the companies using an Internet or e-commerce business model, three segments may be identified: 15% of firms are offering products and services via the Internet in the B2B and B2C e-commerce sector, roughly 77% of all start-ups are in the Internet-related service sector (multimedia, ISPs, and integrators), and only 6% are in the Internet technology sector (infrastructure and software) (Krafft, 2000).

In the beginning of 2001, roughly 100 e-commerce firms were listed on the stock exchange, most of them in the so-called “new market” (*Neuer Markt*) segment. Most of the 750 IPO candidates at this time were venture capital-backed, while about 14,000 small and medium-sized start-ups with up to 50 employees were financed by their own funds or bank credits. The venture capital investment boom started in 1998, about four years after the first wave of start-ups. The formation of private venture capital investment in young and risk-afflicted start-ups started late because public subsidies for entrepreneurs are available in Germany relatively easily. The need for more money to invest increased with the increasing new economy bubble and from this point on, venture capital was needed (Krafft, 2000).

FIGURE 11 Start-up Wave was Without Access to Venture Capital



Source: Survey of 332 German VC firms, analysis of ~9,000 Internet/E-Commerce start-ups. (Krafft 2000)]

^a Projection based on ~9,000 identified startups

^b Projection based on 581 companies for which a VC investment could be identified. The year is determined by the first VC's announcement to invest.

Regarding the start-up profiles in the US and in Germany, significant differences are observable. In comparison to US start-up founders, German founders are younger (on average 30 years of age in comparison to 40 years of age in the US). German founders have reached a higher education level (74% university graduates or PhDs) in comparison to the US (50% postgraduate study or degree) in 2000. These circumstances might provide a competitive advantage in Germany when the business cycle and the accompanying interest in e-commerce regenerate themselves in the future (Krafft, 2000).

Aside from the pure e-commerce and Internet-oriented dot-coms, the German market is dominated by traditional software and engineering firms developing software products primarily as suppliers (such as SAP AG or Software AG) or for their own usage (such as in the automotive or telecommunications industry).

Official statistical data about the German software market provided by the Federal Statistical Office are unfortunately not available. Reliable data is only available in the form of a field study by the German Ministry of Education and Research, which reports about 35,800 firms in this area. Roughly 35,000 firms are estimated to be companies with less than 50 employees. In total, 300,000 employees are working in the software industry, and an additional 2.5 million in software-related industries, developing proprietary solutions for internal usage. Especially in the primary software market a concentration process is observable. Large software houses grow by acquiring smaller ones, but most of them are not involved in international corporations. Seventy-seven percent have neither their headquarters nor any establishment outside Germany (GFK 2000).

Focusing on the international versus national development or value-creation reveals that 77% of the software sold by the German software industry in Germany is developed in Germany. Only 3% of all software providers develop software solely abroad, while 19% share the development internationally. This business model is mainly used by large software houses. A more common model is outsourcing of clearly defined software modules to foreign firms. Forty-one percent used foreign software firms or specialists to support their own development; most do so to gain cost reductions and to escape the shortage of software engineering specialists in Germany. Although the German software industry produces most of its software in Germany, most firms are specialists in a specific industry or in non-standardized unique software areas. Consequently, the German software market is dominated by large American software providers with their broad palette of standardized products, with the exception of the enterprise resource planning (ERP) software of SAP AG or the software modeling tools of IDS Scheer AG, which are competitive on the international software mass market. Depending on the location of these software providers, “hot spots” of software industries are observable in Germany such as the areas surrounding SAP AG in Waldorf near Heidelberg or Saarbrücken, where IDS Scheer AG is located (GFK 2000).

Overall E-Commerce Diffusion

The overall diffusion of e-commerce technologies in Germany can be described as excellent. German firms are worldwide leaders in the field of e-commerce, as the Global Information Technology Report 2002-03 of the World Economic Forum (WEF) indicates (GITR 2003) *The Economist* ranked Germany in eighth place, while WEF ranked Germany in tenth place after being 17th in the previous report. The calculated network readiness indicator is composed of 64 variables classified into three categories: environment, readiness and usage. In the field of e-business, German enterprises placed first in usage based on variables such as Internet usage for general research, the sophisticated usage of online marketing, and the presence of wireless e-business applications. Germany placed third with regard to usage of the Internet to coordinate business with customers and suppliers. The e-business readiness index ranks Germany in fourteenth place worldwide, leading in the field of innovation capacity and the sophisticated

business usage of Intranets. The overall telecommunications infrastructure is in third place, while in the area of fax machines per 1,000 people (second place), and the availability of telephone mainlines (first place), Germany is again one of the leading countries in the world. Nevertheless, Germany only reached the tenth place on the overall network readiness index of the GIT report. This may be due to the low ranking of e-government readiness (ranked 32 of 82 investigated countries), as well as insufficient IT education (place 48 of 82) in Germany (GITR 2003).

IMPACT OF THE INTERNET AND E-COMMERCE

E-commerce applications have become common tools to support and improve traditional, as well as new, Internet-based business processes. While pure Internet-based e-commerce start-ups have had to cope with extensive competition alongside established firms and brands while experiencing declining markets, traditional firms have installed and improved new e-commerce solutions that were initially successfully developed by start-ups. Based on EDI and ERP know-how acquired over the last few decades, German firms have been able to profit from sophisticated e-commerce applications. German businesses first decided to wait until e-commerce applications had proven themselves successful, but they then, consequently, invested and implemented them in the last several years. A noticeable gauge for e-commerce development in Germany is the e-commerce readiness indicator published by *The Economist*. Germany has steadily improved its position over the last several years and ranks now in the eighth position. Aside from innovative but small European countries, only the US (first place) and UK (third place) are in front of Germany (Economist, 2002).

TABLE 24 Impact of Doing Business Online

Percent indicating impact is a great deal ...	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Internal processes more efficient	41.2	37.5	44.2	32.2	22.8	33.8	41.8	33.9
Staff productivity increased	11.4	25.9	20.0	27.6	23.6	29.6	18.6	27.2
Sales increased	12.1	18.8	20.8	21.5	21.4	19.5	19.1	20.5
Sales area widened	19.7	33.7	34.7	30.3	31.2	30.8	31.5	31.4
Customer service improved	22.9	40.8	37.2	31.1	50.9	39.7	35.5	34.8
International sales increased	13.7	24.0	35.6	18.5	1.2	9.1	28.0	19.5
Procurement costs decreased	1.3	23.5	14.8	15.2	1.3	13.8	11.2	17.7
Inventory costs decreased	3.7	16.0	7.4	13.1	1.5	12.8	6.2	14.0
Coordination with suppliers improved	32.5	32.7	9.0	28.9	19.5	25.2	14.5	29.8
Competitive position improved	21.2	34.1	22.2	27.5	36.2	30.9	23.1	29.8

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

Therefore, the impact of the diffusion of the Internet and e-commerce applications is now visible on both macro-economic industry and micro-economic firm levels (Table 24). A large 41.8% of

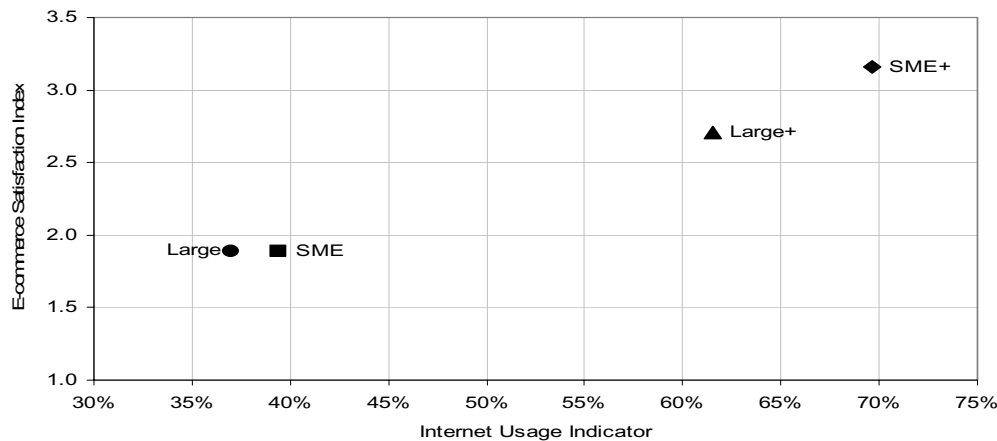
German firms feel they are able to improve their internal processes, compared to only 33.9% of the global sample. The lowest efficiency gains are reported in the banking/insurance industry, where only 22.8% see any improvements. While the efficiency of internal processes has increased, staff productivity did not increase in the same way. Only 18.6% of the German sample believes that e-commerce has had a positive impact on staff productivity. Aside from operational process improvements, e-commerce also has positive effects on the external, market-oriented side. Twenty-eight percent of German firms (compared to only 19.5% of the global sample), especially in the retail/wholesale sector (35.6%), were able to increase their international sales via the Internet. In contrast, procurement costs decreased less significantly than in the global sample. Only 1.3% of the manufacturing and banking/insurance industries were able to reduce their costs of procurement, in comparison to the retail/wholesale sector where 14.8% mentioned decreases. This is due to the still low prices on the competitive traditional market. The same holds true when asking about inventory costs. Most establishments have an efficient system in place, so the possibilities of additional optimization benefits are rather slim. Due to existing EDI systems, the coordination with suppliers, for instance, was already made possible and enabled in the pre-e-commerce era. Therefore, the impact of online services is not as important and far-reaching for German firms. On the other hand, there is still a large unused potential for greater coordination within the retail/wholesale industry (only 9.0%), and for the integration of SMEs in general.

The impact of e-commerce applications on SMEs and large establishments in Germany may also be calculated by using the Data Envelopment Analysis (DEA) described in the methods section above. The DEA utilizes the 202 data points as decision making units (DMU) of the German sample. Afterwards, the results are divided into “efficient” (e.g., SME+ for SMEs and Large+ for large establishments) and “inefficient” (*without* +).

In Figure 12, the results of the DEA are provided for the manufacturing industry. Efficient SMEs (24.2% of all SMEs in this sector) use, on average, about 70% of available Internet possibilities and gain high benefits from them (Index about 3.2). Efficient large establishments (37.1% of all large establishments in this sector) use, on average, only 61.5% of all Internet applications and gain only 2.7 on the satisfaction index scale.

Relatively inefficient establishments use only 39.4% (SME) and 37.0% (large establishments) of available Internet solutions on average, but generate the same satisfaction with 1.9 each. If the satisfaction with e-commerce correlates positively with the intensity of available Internet applications, then “inefficient” SMEs should be able to gain more, until now unrealized, benefits than large firms. On average, the DEA model identified 30.9% of establishments in the manufacturing sample as “efficient.”

FIGURE 12 Average Usage of Internet Technologies and Resulting E-Commerce Satisfaction in the Manufacturing Industry

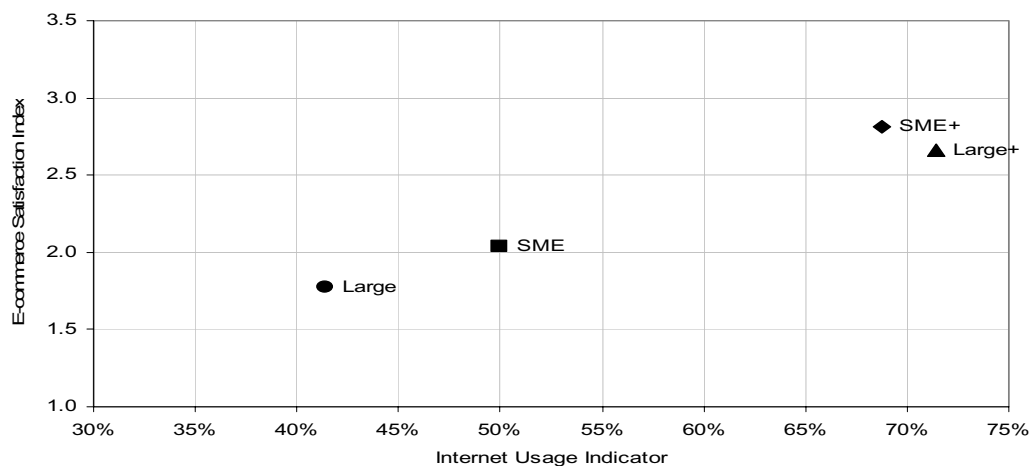


Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

In the retail/wholesale industry (Figure 13), efficient SMEs (47.1% of all) use, on average, 68.8% of Internet applications and gain an average satisfaction level of 2.8 in comparison to efficient large firms (40.6% of all) with higher Internet usage (mean = 71.4%) but a lower satisfaction level (mean = 2.7). SMEs seem to be able to improve and benefit more from e-commerce even with a slightly lower usage of the Internet than large establishments.

Among the group of “inefficient” establishments, SMEs use more Internet applications (mean = 50.0%) and gain a higher satisfaction (mean index = 2.0) in comparison to large ones (mean Internet usage = 41.4%, mean index = 1.8). In total, 42.1% of establishments in the retail/wholesale sector may be regarded as “efficient” in the terminology of DEA.

FIGURE 13 Average Usage of Internet Technologies and Resulting E-Commerce Satisfaction in the Retail/Wholesale Industry

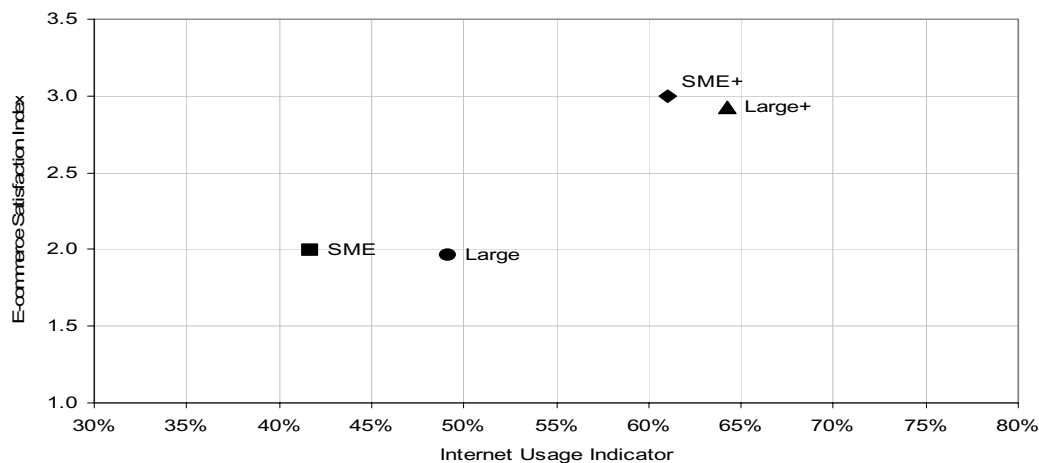


Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

In contrast to the former industries, the banking/insurance sector uses all possible Internet applications less often, on average (Figure 14). Relatively efficient SMEs (31.4% of all) use 61.1% of Internet applications, on average, but are more likely to regard e-commerce (with a satisfaction index of 3.0) as having a great deal of impact than efficient large establishments (only 24.1% of all). The latter use more Internet solutions (mean = 64.3%) but are, on average, less satisfied than SMEs (mean = 2.9).

The same holds true when looking at relatively inefficient establishments. Large establishments use more Internet solutions, on average (mean = 49.1%), in comparison to SMEs (mean = 41.7%) but are equally as satisfied as they are (mean index = 2.0).

FIGURE 14 Average Usage of Internet Technologies and Resulting E-Commerce Satisfaction in the Banking/Insurance Industry

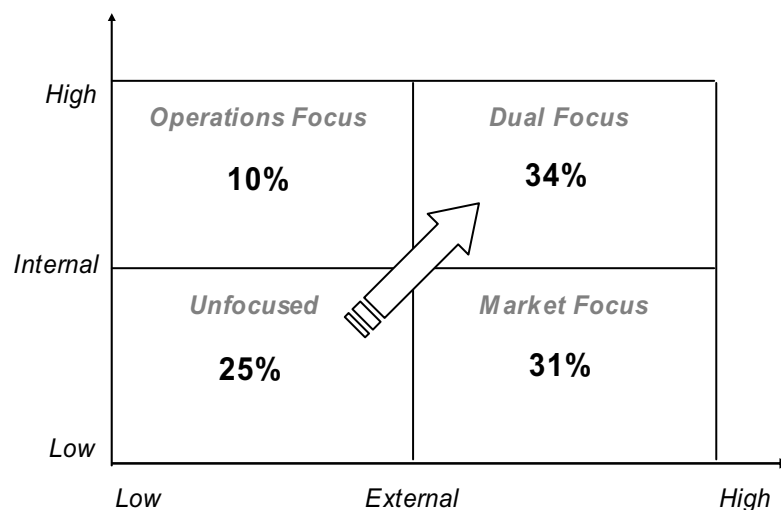


Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

While e-commerce seems to have a great impact on SMEs in terms of both improving their internal processes and strengthening their role to play an active part in supply chains, large establishments do not benefit by using e-commerce technologies in the same way, due to existing solutions such as EDI or internal process management systems dating back to the pre e-commerce era. So the potential to improve their business is not as large as it is on the side of SMEs. Large establishments can, of course, use e-commerce to widen their market like SMEs can, but again, the possible efficiency gains from improving internal processes or supply chains are lower for large establishments. In the manufacturing industry, for example, the concentration process and the disintermediation process started ten years ago. A prominent example is Volkswagen in the auto industry. VW CEO Lopez reduced the number of suppliers and lowered the costs for preliminary products over five months to \$360 million in 1993. Other auto suppliers and large players in other industries tightened their supply chains as well during the following years. Due to these early developments, most industries, perhaps with the exception of the banking industry, have already developed lean supply chains which can hardly be created in a more efficient way, even through usage of the Internet and related technologies.

Aside from the impact on the relative efficiency of establishments within the sample, e-commerce use also impacts strategic goals. According to a model developed by Kraemer (Kraemer et al., 1999), firms are asked about the impact and use of e-commerce in two different ways: use for internal process optimization (to reduce costs) and external market penetration (to enter new businesses or markets). In the original model, Kraemer used a seven-point-scale to measure the degree of impact of IT on the strategic goal of focus using four questions. The model used in this paper is modified to use a five-point scale and only two questions. Using the results of four questions is not possible due to the lack of matching questions. The results for all German firms are provided in Figure 15. While 34% regard e-commerce as a significant factor for both foci, 25% use e-commerce technologies more or less without specific focus. The potential of e-commerce is seen more often in the areas of market penetration (31%) than in the operational area (10%). An average of only 34% regard e-commerce solutions as important to support strategic goals across all industry sectors, and they cannot assess whether or not the strategic use of e-commerce has an impact on the efficiency of firms. To answer this question and to test the results of the DEA analysis provided above, a closer look at the strategic goals of “efficient” and “inefficient” firms is provided in Figures 16 and 17.

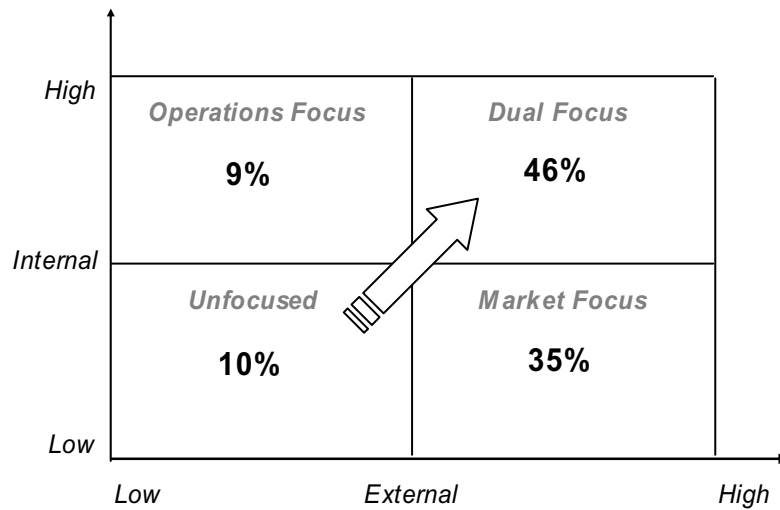
FIGURE 15 Strategic Goals of IT Usage as an Average of all Firms and Sectors



Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Significant differences are observable between “efficient” and “inefficient” establishments. DEA-efficient firms responded more often that e-commerce was a significant factor for their strategic goals than inefficient ones. Conversely, only 10% of efficient establishments are unfocused users of e-commerce, seeing no further impact on their strategic goals, while 3% of DEA-inefficient establishments reported an unfocused usage.

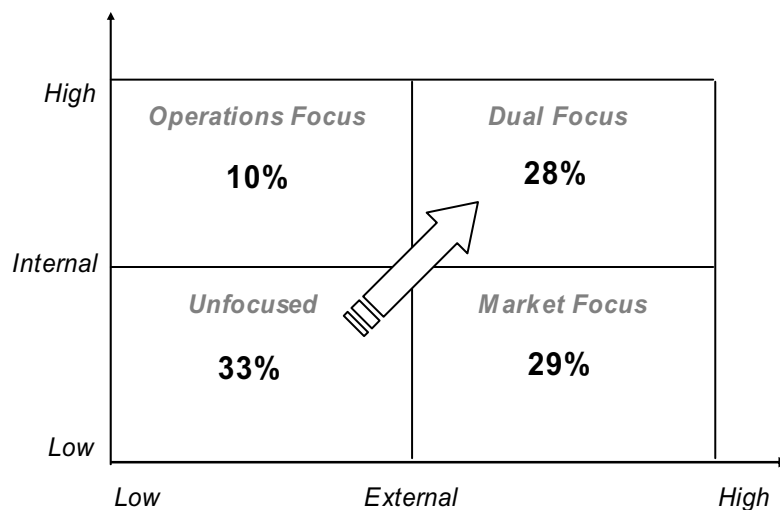
FIGURE 16 Strategic Goals of IT Usage as an Average of “Relative Efficient” Firms



Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Figures 16 and 17 indicate that the results of the DEA model are not random. The differences between “efficient” and “inefficient” users of e-commerce are measurable in the DEA, as well as in the Kraemer model. Based on different questions, significant differences occur.

FIGURE 17 Strategic Goals of IT Usage as an Average of “Relative Inefficient” Firms



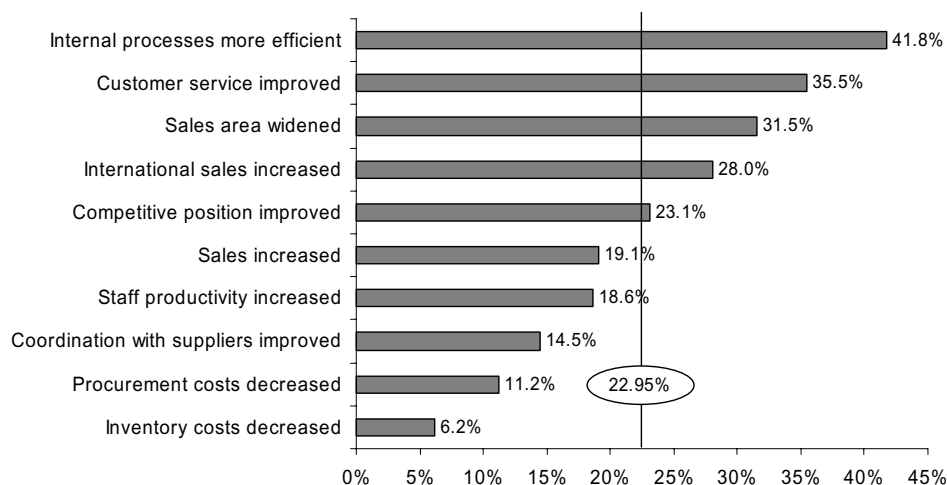
Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

The results provided in Figure 16 and 17 are tested by using Pearson’s chi-square significance tests. A strong deviation between the observed and the expected number of valuations is indicative of a close relationship between the tested attributes “efficiency” and “IT usage” in the cross-classified table. For the operational focus, the hypothesis that there is no significant correlation between the efficient usage of IT and the strategic orientation to reduce costs can be denied with an error probability of 0.004%. For the market focus, the hypothesis that there is no significant correlation between the efficient usage of IT and the strategic orientation to enter new

markets can be denied with an error probability of 0.001%. Thus, efficient establishments reported more often that IT has a high importance for their strategic goals than inefficient ones.

Online business has different impacts on German firms, as Figure 18 indicates. Important impacts (above average) are the improvement of internal processes (41.8%), the external improvement of customer service (35.5%), and widened sales at the national (31.5%) and international levels (28%). Comparatively low impact is reported for cost-oriented improvements, e.g., inventory costs decreased (6.2%) or procurement costs decreased (11.2%). In total, positive impacts of online business are reported with 22.95%.

FIGURE 18 Impact of Doing Business Online; Percent Indicating Impact is a Great Deal



Source. CRITO Global E-Commerce Survey, 2002; weighted by the total number of establishments.

As Table 25 indicates, the number of distribution channels increased significantly in all industries in comparison to the global sample, with the greatest difference being observed in the retail/wholesale sector. Most establishments use online business not as a substitute, but as a complement to existing channels. While the number of suppliers or competitors increased less than the global sample in the manufacturing and retail/wholesale industries, a significant increase is observable in the banking/insurance industry. Again, the finance sector seems to be more affected by increasing competition and changing customer requests than other industries. Due to this, the German finance sector is, in contrast to the global finance average, even more affected by increasing competition than other countries.

TABLE 25 Impact of Doing Business Online; Percent Indicating Impact is a Great Deal

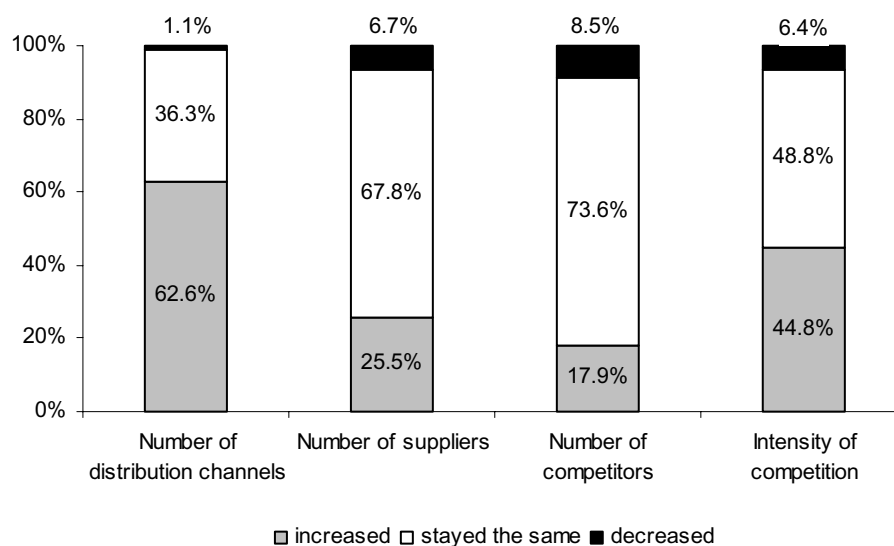
Percent indicating increase in:	Manufacturing ^a		Wholesale/Retail Distribution ^a		Banking/Insurance ^a		Total ^a	
	GER	Global ^b	GER	Global ^b	GER	Global ^b	GER	Global ^b
Distribution channels	41.7	36.6	69.4	42.1	47.4	39.8	62.6	40.2
Number of suppliers	27.9	37.7	22.8	26.1	44.2	29.9	25.5	29.9
Number of competitors	11.2	28.9	17.2	27.3	38.0	28.8	17.9	27.9
Intensity of competition	44.5	40.4	42.8	42.0	63.1	42.3	44.8	41.5

Notes: ^a Responses were weighted based on the total number of establishments by employee size within the sector for each country.

^b Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan.

Source: CRITO Global E-Commerce Survey, 2002

The overall e-commerce impact on German industry, as reflected in Table 25, is provided in Figure 19. While a large percentage felt that the number of distribution channels and the intensity of competition had increased, the number of competitors and suppliers has stayed more or less the same. Relatively unimportant are benefits deriving from suppliers or through reductions by competitors. A multitude of reasons might explain the relatively low rate of changes accompanied by the introduction of e-commerce in Germany. One already mentioned above is the concentration process and disintermediation, which started before e-commerce enjoyed its increasing importance in Germany. The efficiency slacks in most supply chains are therefore not as large as in other countries. Consequently, e-commerce shows only slight impacts on the cost side. The importance of e-commerce on the sales-oriented market side is undoubtedly high. The impact of e-commerce use is thus greatest in terms of increasing the number of distribution channels and, to a lesser extent, the intensity of competition.

FIGURE 19 E-Commerce Impact on Competition and Distribution-channel Strategies in Germany

Source: CRITO Global E-Commerce Survey, 2002; weighted by the total number of establishments.

To test the claim made in Proposition Four, the correlations between the number of e-commerce applications deployed (e-commerce deployment) and the positive impact or efficient use on the industry level (impact of doing business online) based on a Spearman significance test is provided (Table 26). For calculation only, the values for SMEs in four countries analyzed are considered (Denmark, France, Germany, and the US). The correlations between the number of e-commerce applications used per firm in an industry in the rows and the efficiency increase, represented as positive impacts in the columns, are calculated.

TABLE 26 Number of e-commerce solutions deployed correlated with positive impacts and efficiency gains for SMEs in Denmark, France, Germany and the US

	E-commerce deployment Manufacturing (N=152)	E-commerce deployment Retail/ Wholesale (N=151)	E-commerce deployment Banking/ Insurance (N=155)
Internal processes more efficient	.299**	.114	.273**
Staff productivity increased	.371**	.091	.319**
Sales increased	.263**	.397**	.486**
Sales area widened	.474**	.357**	.390**
Customer service improved	.378**	.251**	.321**
International sales increased	.381**	.095	.303**
Procurement costs decreased	.432**	.207*	.366**
Inventory costs decreased	.389**	.233**	.241**
Suppliers coordination improved	.424**	.300**	.414**
Competitive position improved	.469**	.211*	.449**

Legend: ** p<.01, * p<.05

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

CONCLUSION

The survey data have shown that the diffusion of “state-of-the-art” e-commerce technologies has reached a high level. Analogous to the broad usage of e-commerce applications, the importance of inhibiting factors in Germany was reported to be below the global average. This seems to be an excellent prerequisite for the implementation and usage of forthcoming technologies such as m-commerce and location-based services, web services and others to overcome former manual processes towards machine-to-machine-based services or decentralized supply chain management to avoid bull-whip effects.

Although broad diffusion of e-commerce technologies was observed, the intensity of usage must be widened to make additional manual fax or telephone-based transactions obsolete. As stated in Proposition One, the close international trade connections of all investigated German industries is an important driver for the diffusion of standardized electronic transactions, especially to overcome language barriers. On the other hand, e-commerce was overall not such an important driver due to the already competitive and efficient international market position of German enterprises when compared to the results of the global survey.

Moreover, as Proposition Two projected, SMEs play an important role for the diffusion of e-commerce at the industry level. Due to the large number of SMEs, especially in the retail/wholesale sector, the benefits deriving from e-commerce would not be achievable if only large establishments used it. SMEs have shown that they are an innovation-friendly group implementing new technologies just as fast as large enterprises. Using the given definition of SME (25 to 249 employees) and large firms (250 employees and more), size does not predetermine the relative efficiency of e-commerce usage. In each cluster both “efficient” as well as “inefficient” implementations and usages may be observed.

In contrast to the size of firms, the affiliation to a special industry sector strongly influences the diffusion of e-commerce solutions (Proposition Three). While the manufacturing industry has been using ERP systems and EDI standards for a number of years, as has the banking/insurance sector, the availability of Internet-based services opens the way for automated business processes to be used in the retail/wholesale sector for the first time. Furthermore, the implementation of e-commerce to improve internal as well as external processes was mentioned as having a significant impact in the retail/wholesale sector, while in the banking sector e-commerce is seen as part of the current problems this sector is laboring under.

As Proposition Four indicates, there is a significant but weak correlation between the number of e-commerce applications deployed for establishments per industry, and the perceived efficiency increases as provided for SMEs. The use of the rank order correlation coefficient reveals a monotonic relationship among ordinaly scaled data. While the results are very significant in the manufacturing and banking and insurance industry, the retail and wholesale industry are insignificant in terms of internal processes and staff efficiency, as well as with increasing international sales. Nevertheless, the efficient use of e-commerce applications seems to be positively correlated with the number of technologies deployed, as has already been revealed by the DEA analysis.

The impacts gained, measured on a five-point scale, revealed that efficient usage of e-commerce increases with (and depends on) the increasing complexity of the integrated e-commerce technology. Although most firms are using e-mail or web advertising, the satisfaction, or level of impact perceived, depends on the implementation of higher-order solutions. This contributes to the assumptions formulated in Proposition 2. The DEA analysis, as well as the four quadrant model, has shown that the consistent realization of e-commerce applications is a necessary prerequisite to develop the full benefit of such applications. It may be tempting to cherry-pick certain applications, but true benefits are gained from the widespread and consistent application of all kinds of e-commerce technologies. The satisfaction with e-commerce as enabling technologies relates directly to the complexity of deployed solutions.

In contrast to other countries, the Internet and with it, the deployed e-commerce solutions, are used as a complementary channel to distribute products and services and not as a subsidiary channel cannibalizing other distribution channels. Therefore, the multi-channel strategy to infiltrate markets in Germany seems more important than in other countries included in this survey.

The assumed role of government as a driver of e-commerce by offering subsidies or using active e-commerce technologies itself does not hold true for Germany. In fact, government and administration seems to be an impeding factor of electronic data transfer, such as in the area of call for proposals and quotations procedures. Although public administration and social systems play an important role for the GDP, the public sector is still far behind in e-commerce diffusion compared to the other sectors studied in this survey.

In summary, German firms adopted fast e-commerce solutions after a certain time lag. Many of those firms implementing e-commerce technologies in a consistent way have benefited through process improvements and increasing efficiencies. The e-commerce diffusion race has reached a maturity and international competitive stage which seems to be an excellent base for subsequent developments such as mobile commerce in the near future.

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APPENDIX

RETAIL BANKING SUB-SECTOR STUDY IN GERMANY

The weak world economy together with a high level of company insolvencies (equivalent to U.S. Chapter 11 bankruptcy) and a declining stock market has led to serious cost and profitability problems in the German finance system. To meet the challenges of temporary economic problems and structural weaknesses, the German bank system has restructured itself in a remarkable way to increase its productivity by establishing lean processes and smarter administration. On the other side of the coin, these process changes are accompanied by large layoffs in the banking sector, especially among employees in small establishments in the customer banking or retail area.

The service sector (of which banking is a subset) is, in comparison to other industry sectors, characterized by low increases in productivity growth. PCs are mainly used in administration or for non-physical, intermediate goods such as in the finance industry. If PCs truly raised the output in the finance sector in unmeasured ways, then the benefits should appear in the output of the ICT industry. Such a spillover, however, is not observable.

The finance and banking business products are mainly information goods which can easily be provided in digital form. The underlying ICT-driven processes are subject to steady changes not due to new distribution channels such as online banking. Changing customer preferences towards online banking and online services together with decreasing loyalty are a new challenge banks have to cope with. Internet customers are better informed and more price-sensitive than offline, i.e. traditional, customers. The usage of PCs and the Internet has doubtlessly created consumer surpluses, especially with regard to online banking and brokerage services (Gordon, 2000). The benefits of these inventions are not as large on the bank side, because they cannot reduce the fixed costs mainly deriving from physical branches in the same way.

The German finance industry is heavily involved in IT and e-commerce developments and an extensive user of these developments in comparison to other German industries. The challenges of developing and implementing a robust and durable IT architecture are of importance for sustainable growth in the future; e-commerce has become especially important. On the other hand, German banks have to cope with a number of difficulties. The IT challenges of introducing e-commerce successfully are considerable and need to be seen from an overall perspective of corporate development. Most banks, especially small savings and loan banks, are not able to identify new customers in their systems, nor are they able to calculate the revenue per customer or product. Not knowing exactly how much their actual internal cost is for pre-products is also a widely distributed problem among small banks. But banks have realized that they need more control and better internal costs and activity accounting processes based on new IT infrastructure. A more industry-oriented production approach should help to calculate products and services just as the manufacturing industry has been doing for a long time. The so-called “finance factory” concept should solve these problems in the business processes, mainly enabled with new ICT systems. But most financial institutions are becoming careful after numerous bad

investments in IT. E-commerce integration failures in the past lead to expensive reorganization projects, e.g., at the Deutsche Bank or Dresdner Bank, two of the leading top five banks.

IT spending was at a high level compared to other German firms over the last few years. As Prof. Clemens Jochum, CIO consumer banking at the Deutsche Bank AG told us, Deutsche Bank paid \$3.04 billion in 1999 and \$2.83 billion in 2000, respectively. For 2001 and 2002 Deutsche Bank decreased its overall IT budget. Significantly, 69% of the IT budget in 1999 was spent on baseline maintenance; in 2000 this was still over 61% despite an effort to reduce such costs. The banking business is therefore strongly technology-driven.

After the Internet bubble burst, German banks are now looking more carefully for the return on investment in IT spending. The costly integration of new technology into an old environment has not yet shown significant efficiency or cost reduction results. Most IT projects developed into a value trap with high cash burn rates. Today, banks are focusing on small, applied projects using open standards. Also, more standardized products have been introduced into the corporate environment with minimal adaptation. The main objective and focus are on smoothing integration.

Most banks have had to reduce their IT budgets dramatically, accompanied by a consolidation of vendors and large numbers of layoffs. Many promising e-commerce projects were not really successful. Micro-payments were expected to become an enormous economic factor in the financial market. Smart cards and digital certificates are still important areas, but actual implementations are often premature. In traditional B2C areas, a chicken-and-egg question emerged in the market with regard to lower than expected numbers of customers and merchants' reluctance to invest, which has led to even lower numbers of smart card and micro-payment users among the customer base.

The German Bank Landscape

Most German banks are so-called universal banks, offering all kinds of financial products and services. This includes credit banks (or private banks), publicly owned savings banks and cooperative credit associations. The savings and loan banks are owned by municipalities or county governments or even federal states.

Most banks follow multi-channel distribution strategies in a more or less consistent way. The small savings and loan banks do not encourage customers to use the Internet consistently, such that branches remain exceptionally important. A lower risk communication and customer-oriented channel synchronization are possible solutions for banks to decrease costs. In spite of online success, banks want price incentives in order to get out of the cost trap.

Due to the creation of the European Single Market in financial services and financial market liberalization, the volume of mergers and acquisitions (M&As) in the German financial service sector has accelerated and a higher concentration level has resulted. Consequently, the number of banks has declined in Germany, while over 800 M&As were counted in the second half of the 1990s. Despite these widespread M&A activities, Germany still has the lowest level of concentration in Europe (e-Business, 2002).

The traditional distribution channel for retail banks is largely based on their stationary, physical branch networks. Germany has so many branches that it can be described as “over-branched.” Although the number of domestic branch offices declined during the 1990s to about 18%, Germany still had 2,695 banks with 43,834 branches in 2001. The banking density in Germany (number of inhabitants per bank branch) has increased to around 1,880 inhabitants (excluding Postbank, a unit within the German Postal Service) but is still lower than, for example, the number of bakeries per inhabitants. In 1992, there was one bank office for every 1,510 inhabitants. This still makes Germany a country with one of the most closely-meshed banking networks in the European Union. If the branches of Postbank are included, there are around 1,450 inhabitants per bank office in Germany (AGB 2002).

Innovation Enablers in the German Finance Sector

Most financial services are based on intangible products and services. For this reason, it is important to customers that a bank signals trust, reliability and a positive image. Trust was a unique selling point of banks in the past. Since non-banks such as the automotive industry or catalog companies have entered this market national and international competition has increased. On the other hand, globalizing markets are important for German banks to acquire new customers from abroad due to the saturated national market (Pilat, 2001). Another cost-driver is the over-capacity in the finance sector, which leads to declining prices and concentration pressure, resulting in M&As. Gaining profits by reducing the number of branches after a merger, together with the reduction of personnel, is one of the observable results today (Mihm, 1999, pp. 1-2). Declining profit margins, especially in the retail-banking sector, have made structural and organizational changes necessary, mainly based on new technology.

International competition, together with declining margins, has increased the speed of implementing process innovations in the entire finance industry. Large financial institutions are at the forefront, followed by smaller public and private banks, due to IT-intensive improvements. The finance sector is traditionally the largest customer of ICT products in Germany (Triplett et al., 2000).

E-commerce-driven banks have developed more innovative products instead of reorganizing internal operations through process innovations (Janz et al., 2001). To solve the remaining internal problems as described in the last section, joint selling initiatives offering standard products through existing distribution channels may help to concentrate on the core competencies of banks and enable them to improve their business processes. The targeted goal is the increased separation of existing value chains. Traditional bank models involve the integration of all product processing phases. This will lead to a more efficient distribution of processing phases inside business units with special core competencies to deploy products and services in a factory-like style.

Innovation Inhibitors in the German Finance Sector

Several inhibitors prevent the fast adoption of IT and e-commerce inside financial institutions. Aside from the departmentalized structure of banks and the lack of project experiences among employees, the professional tradition together with relatively conservative behavior slow down

innovation, as well as implementation processes. In the following, we address the two most important areas:

Departmentalized structure: Large German banks enjoy a large number of different and predominantly independent departments. Consequently, friction among different organizational units is observable, especially when resources and budgets are allocated. IT investment, e.g., in online banking activities, is often confronted with objections of the traditional retail banking department. Since the Internet bubble burst, it has been difficult for CIOs to implement new IT projects, even when they might be successful or profitable.

Lack of project-oriented employees and conservative structure: Due to the rigid and almost bureaucratic structure and behavior of bank employees, most of them tend to be inefficient team players (Vermeulen, 2001, p. 214). One consequence of these circumstances is the high number of outsourcing examples in the past and the extensive use of consulting companies to manage internal projects. The conservative culture of bank employees is beginning to change toward a more innovative and IT-friendly atmosphere.

A common way to implement innovations in the finance sector is the so-called “reverse product cycle.” In the first stage, new software or IT equipment is implemented to support existing business processes. After the software has proven successful, it is used to transform existing or create new products, services or business models (Johne et al., 2000, p. 346).

Key Environmental and Policy Factors Influencing Diffusion

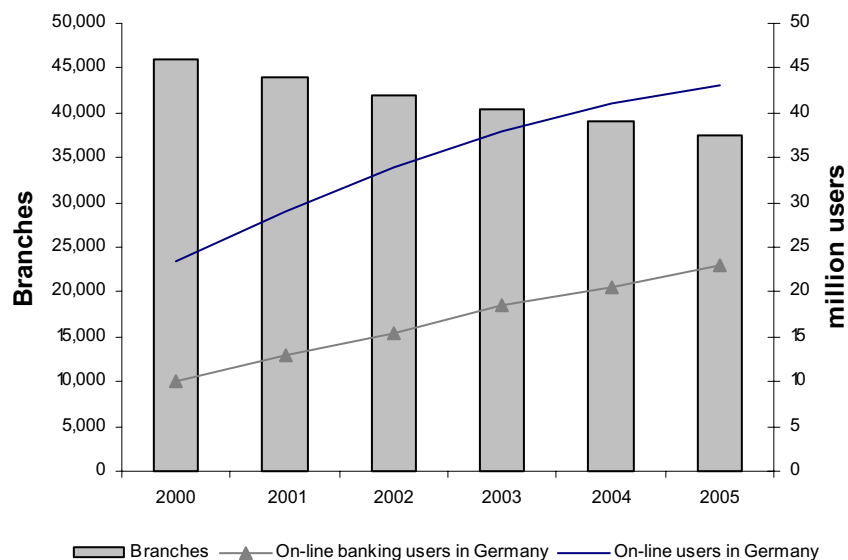
German banks need to regard national and European legislation in the field of e-commerce. For example, the long distance sales law emphasizes the necessity of providing sufficient information to customers on the Internet. Banks have to support information about cancellation possibilities, general terms and business conditions, information about online products and considerations to a variety of laws protecting the rights of customers, such as the customer credit law and securities trading act. Financial institutions have to provide paper-based liability information, which may be replaced by permanently storable electronic data to assure that customers have permanent access to it. The submission of e-mails stating the liability information is allowed but problematic in that the bank has to prove that the customers have received and read the information. Due to the lack of an electronic signature infrastructure on the customer’s end, most banks send paper-based information material to acknowledge the receipt.

Diffusion of B2C E-Commerce in the Retail Banking Sector

Aside from the large variety of online e-commerce solutions available, e-commerce has also changed the traditional over-the-counter business inside bank branches. Since the introduction of automated teller machines and the broad consumer acceptance of standardized IT-based processes, additional services have increased retail-banking productivity, such as automatic bank transfers using scanner technologies or the current development of installing automatic teller machines or computer-based agent systems (so-called robot or bot systems) deciding immediately whether or not to grant small credits without any manual interaction by bank clerks.

Online banking in Germany has become a firmly established channel offered by virtually all banks. It should be noted that this is true online banking, not just electronic bill payment with bank-selected merchants. The number of online banking clients is projected to increase further, whereas the number of branches has decreased and will continue to do so in the future. But, there is no doubt that branches will remain important for customers (Figure 20).

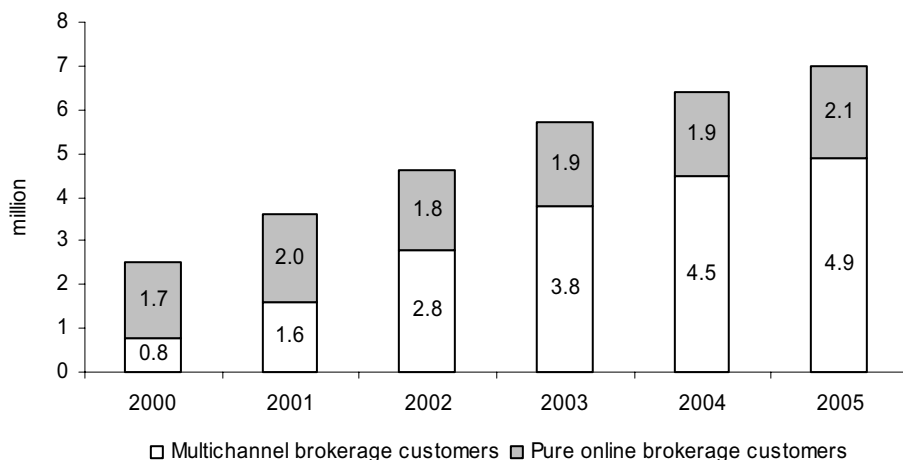
FIGURE 20 Online and Offline Trends in the German Banking Sector



Source: DB Research September 2002, with forecasts for 2003 to 2005.

In spite of the huge number of online banking users, German financial institutions, just as in many other industrialized nations, have difficulties migrating their customers towards “pure” online users. Multi-channel approaches, therefore, will play an important role in banking even in the future. This means an overall increase of costs instead of the expected cost reduction. This is also valid for brokerages where the number of multi-channel clients will grow faster than the number of pure online brokerage clients (Figure 21).

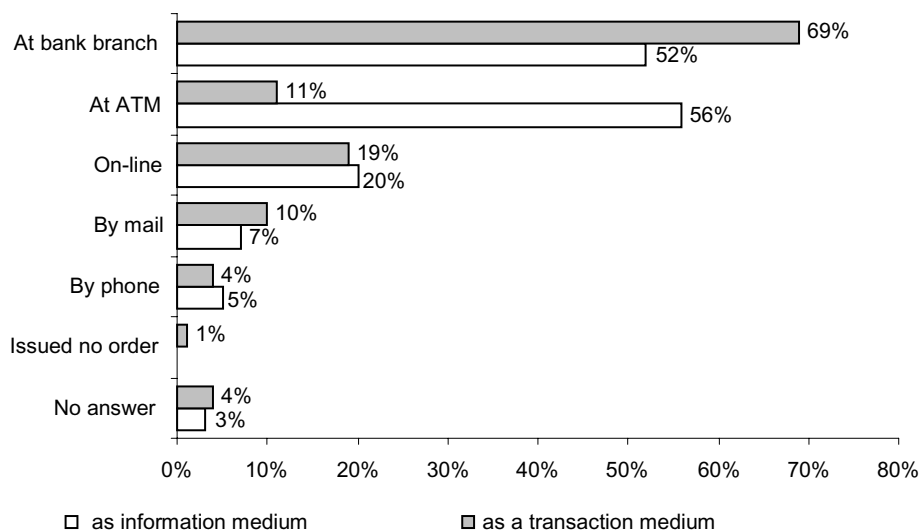
FIGURE 21 Development of Online Brokerage and Multi-Channel Brokerage Customers in Germany



Source: DB Research September 2002, Forrester 2001

Online banking has become firmly established in Germany as a medium for financial service transactions and its further development is still dynamic. Forecasts expect that the market potential for Germany will range from 20 to 25 million online banking users in 2005 (Figure 20). But the Internet is only one of several access channels customers use to get in contact with their bank. While online banking is the second most important channel for banking transactions, in the area of information gathering online banking is third place, behind traditional ways of getting information such as account statements at ATMs or directly at the bank counter (Figure 22).

FIGURE 22 Types of Banking Usage in Germany

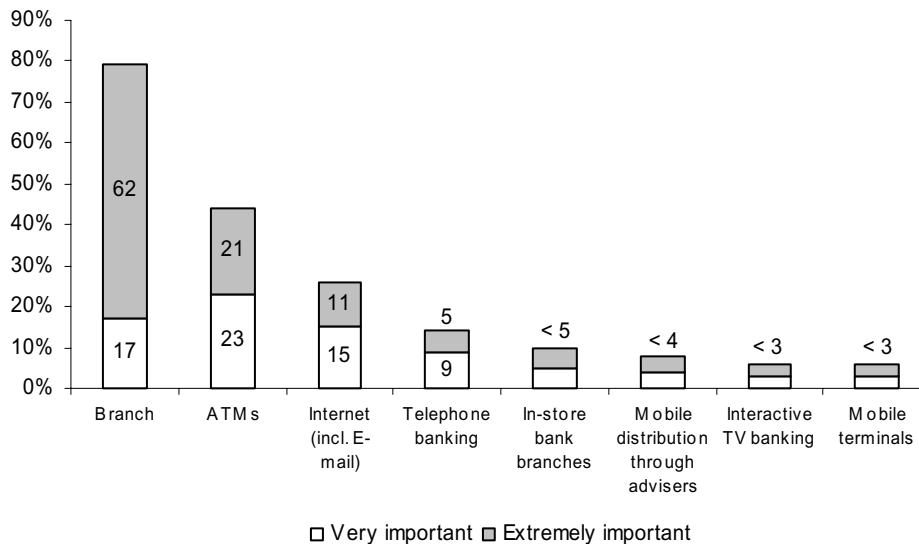


Source: DB Research February 2002, Forrester 2002

Financial services customers in Germany consider many different channels to be of high importance to them, with bank branches, ATMs and the Internet being the major ones. Multi-

channel banking is therefore state-of-the-art (Figure 23). As typical Internet users, customers of financial service providers have raised their requirements; they have also become less loyal to their banks. If banks want to exploit the efficiency potential of the online channel, they have to make it relatively more attractive.

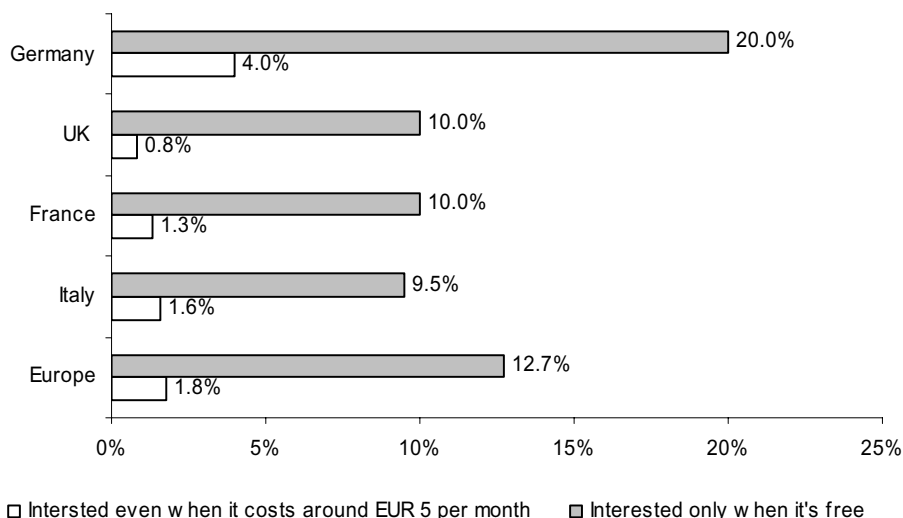
FIGURE 23 Importance of Access Channels for Bank Customers



Source: DB Research, September 2002, Context, 2001

The existing infrastructure makes mobile phones by far the widest-reaching interactive electronic distribution channel. Still, mobile banking is currently hardly used. This is to a large extent the result of the underlying technical limitations. In addition to low bandwidth, long transmission times, and offline connections, it is frustrating for GSM-based WAP-users. Technological progress will probably lead to an increasing usage of mobile phones to access the Internet. Mobile banking might profit from this development if banks offer services for free (Figure 24). Electronic payment and mobile cash could be other successful business models. Although such business models at present are not widely accepted, there is business potential if the diffusion of such technologies can attract a critical mass.

FIGURE 24 Mobile Financial Transactions



Source: DB Research September 2002, Forrester 2002

Diffusion of B2B E-Commerce

Companies increasingly use Internet-based applications for financial transactions. As the CRITO Global E-Commerce Survey data has shown, even SMEs in Germany have adopted electronic funds transfer technologies to conduct bank-related transactions online.

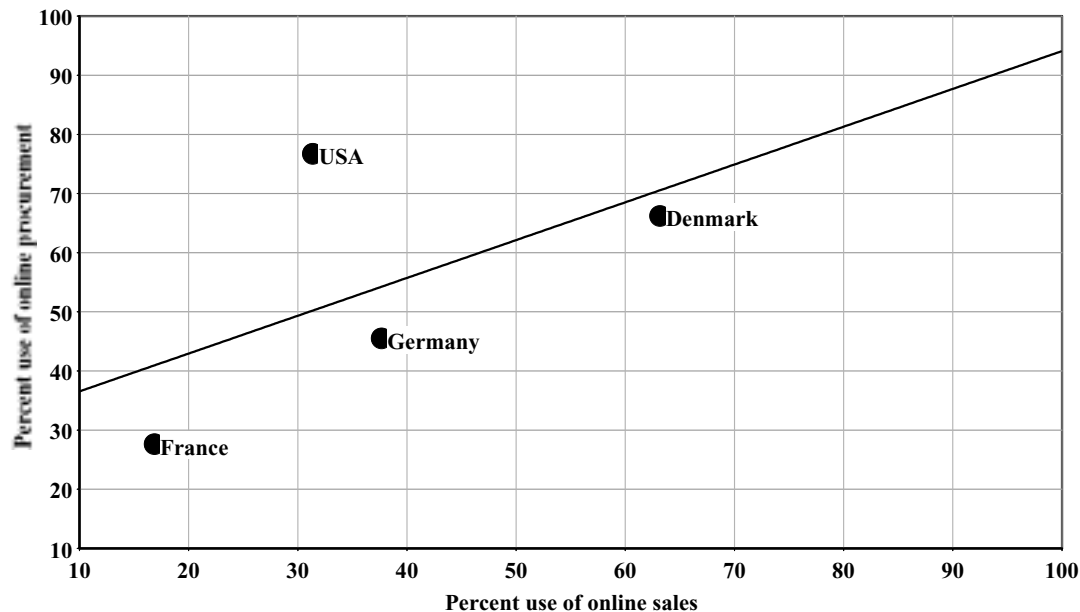
Banks themselves have created B2B digital markets in Germany for non-financial firms to expand their role as intermediaries and to open new markets as sources of business. The creation of online marketplaces for SMEs enables financial institutions to offer their products and services closely linked to their customers, customizing financial products and increasing the client's loyalty. A pioneer in the area of B2B marketplaces for indirect goods was Dresdner Bank's Allago venture, launched in 2000 as Germany's first B2B marketplace for indirect goods. By aggregating their customers' procurement needs through automated processes, Allago is able to provide low prices ranging from office supply to IT equipment.

Although e-commerce technologies made their way into European financial institutions, remarkable differences still remain. As Figure 25 indicates, Danish banks are leading in the field of online sales and procurement. Sixty-six percent of Danish financial institutions sampled reported the active usage of online sales and 77% reported usage of e-procurement. At the same time, banks in larger European economies such as France or Germany use these possibilities less often. Only 49% of German banks use online sales, while online procurement is only used by 40%. Trailing in both e-commerce activities is France, where only 26% use online sales and 31% use online procurement.

While the stage of diffusion of these technologies is more or less equally developed in European countries, US banks implement and use online procurement much more often (75%) than online sales (39%). In fact, online sales in the banking sector are primarily characterized by online banking and brokerage services, which are based on an effective backbone funds transfer system

with clearing centers or stock markets. While the bank transfer system in Europe is nationally standardized, in the US it is more difficult to transfer money online from a customer's account to another account which is not at the same bank or at least certified by it. In terms of online banking and brokerage services, German banks can hardly learn from best practice cases in the US, but they may learn more from the better performing banks in Denmark.

FIGURE 25 Use of Online Sales and Procurement in the Finance Sector



Source: CRITO Global E-Commerce Survey, 2002; results are weighted by total number of establishments in banking/finance sector by size of firm.

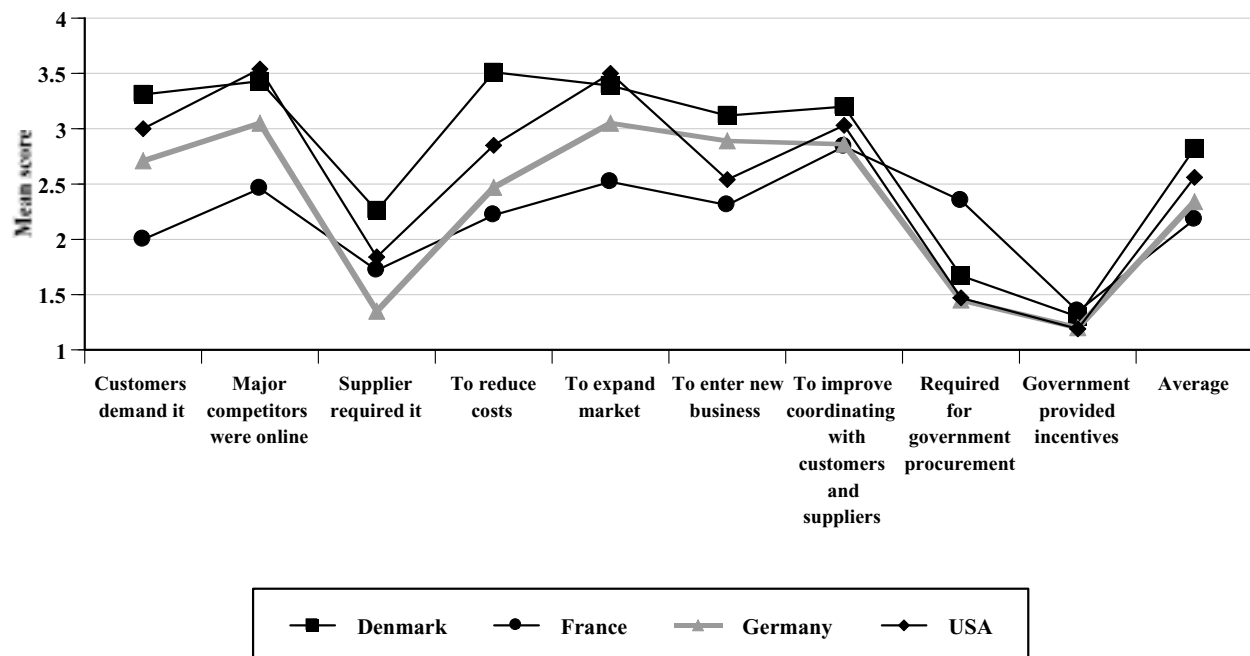
The reasons for implementing e-commerce technologies also vary among the surveyed countries, depending on the time-lag in innovation diffusion behavior in each country, as well as on the different drivers and inhibitors, which are also closely related to national tradition and mentality. Figure 26 depicts the resulting drivers of e-commerce, using a five-point scale, where 1 corresponds to “not a factor at all” and 5 to “a very significant factor.” While the demand of customers may be identified as an important driver in most countries, especially Denmark, the usage of online banking does not seem as widespread in France on the customer side. The same holds true for online competition with major competitors. While in the US, the adoption of e-commerce is strongly driven by competition issues, in Denmark and again in France this factor seems to be less important in the banking sector.

One of the less important drivers of e-commerce, for economic reasons, is the necessity to be integrated in Internet-based electronic supply chains. Due to the low degree of vertical fragmentation—in general, banks develop, create and distribute their products themselves—needs of integrating suppliers are not as important as, for example, in the manufacturing industry. But again, Denmark is on the forefront and ranks the highest in this field, which may indicate the beginning process of using pre-configured and standardized products and services to reduce costs, as described in the introduction as one of the most important management tasks at the moment. The cost issue or, vice versa, the return on investment orientation is therefore an

important driver for banks which have left the e-commerce trial phase at the beginning of e-commerce diffusion. Banks in Denmark, the US and even Germany assess the benefits of e-commerce in the field of automation and increasing efficiency by using economy of scale effects as an important driver of e-commerce investments. E-commerce as an enabler to expand markets, to enter new business areas or to improve the coordination with suppliers and customers are also seen as important drivers, especially by Danish and American banks. In these areas, German and French banks rank these factors also as very important in comparison to other factors, but still below the leading nations.

The governmental contribution to the diffusion of e-commerce does not seem to be important in all the surveyed countries. With the exception of France, where online business with the government seems to require e-commerce standards, banks do not assess the impact of the government as a driving factor.

FIGURE 26 E-banking-Related Drivers in the Banking Sector



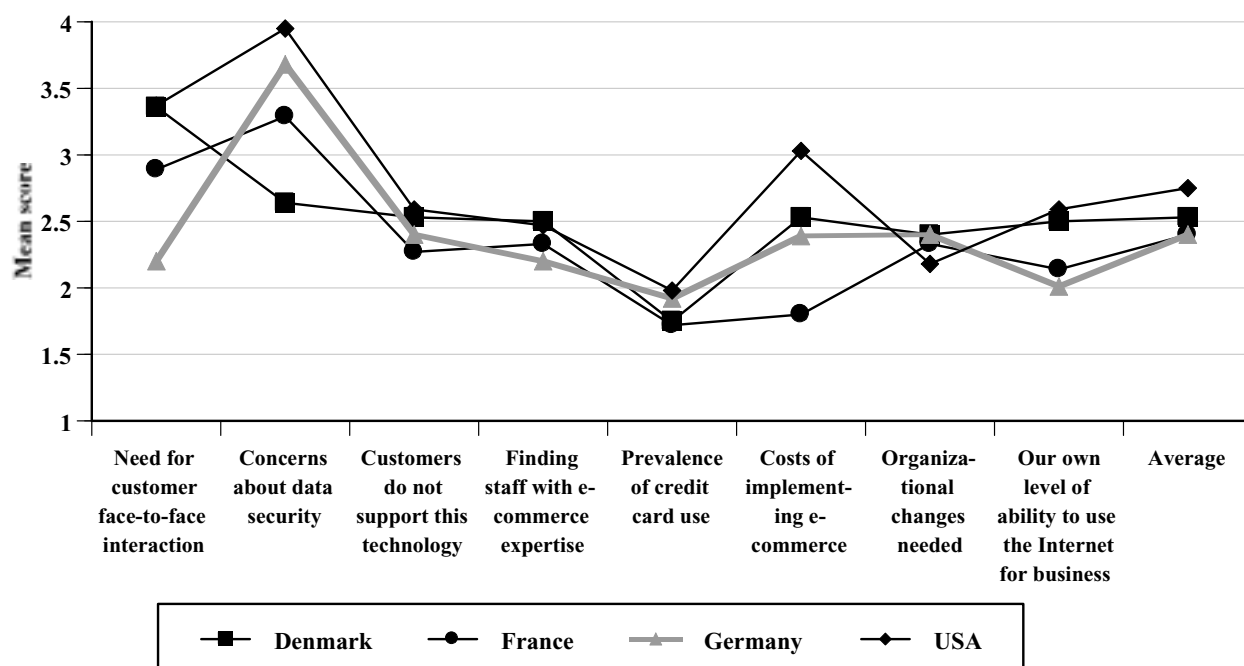
Source: CRITO Global E-Commerce Survey, 2002; results are weighted by total number of establishments in banking/finance sector by size of firm.

Aside from the e-commerce drivers, the questionnaire also investigates the most important barriers to doing business online (Figure 27). Analogous to Figure 26, a five-point scale was used, where 1 corresponds to “not an obstacle” and 5 to “a very significant obstacle.”

Interestingly, banks in the US rated the obstacles highest on average. While the need for customer face-to-face interaction is not an important obstacle in Germany or France, American and Danish banks rate this obstacle as an important barrier. American banks, followed by French and German ones, regard security reasons as an important obstacle. While the obstacles in the field of customer support and a lack of e-commerce skilled staff are more or less equal in these

four countries, the prevalence of credit cards for online shopping is seen as an important obstacle in Germany, while other countries, especially Denmark, regard this factor as less important. An often mentioned obstacle is the costly integration of e-commerce solutions into the existing IT infrastructure. US banks regard this as an important barrier, followed by Danish, German and French banks. On average, US banks believe they are confronted with more obstacles than European banks, as the average indicates.

FIGURE 27 E-banking-Related Obstacles in the Banking Sector

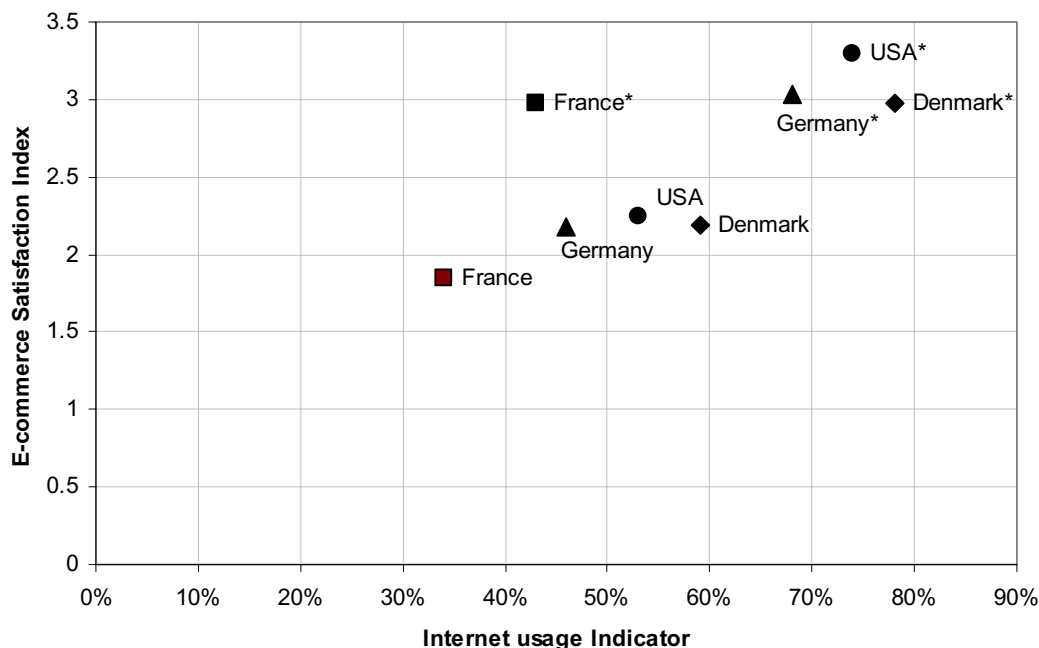


Source: CRITO Global E-Commerce Survey, 2002; results are weighted by total number of establishments in banking/finance sector by size of firm.

E-commerce output and, therefore, the impact of e-commerce on business processes depend directly on the intensity and variety of implemented applications. As input variables for the DEA model, the results of seven questions are used, measuring the number of e-commerce technologies in place as a binary variable. The variables are coded as 0 when an establishment uses a given e-commerce technology, and 1 if it does not. The coding is equivalent to higher spending on the input side when e-commerce is not available or the other way around: firms using e-commerce gain benefits by reducing their processing costs. The ten output variables of the model are measured on a five-point scale from 1 (no impact at all) to 5 (a great deal). For each bank, the DEA model uses a linear program to analyze the ratio between low costs of input (using e-commerce) and the resulting output, measured as perceived impact of e-commerce on different processes. As a result, the DEA identifies the best practice cases or the most efficient establishments within the sample. Firms on the so-called “efficient frontier line” are relatively efficient users when compared to other firms below the frontier line. For a better explanation of the results, the average of “efficient” and “inefficient” banks is calculated. The seven input variables are aggregated to an Internet usage indicator, while the ten output variables are represented as an average e-commerce impact index.

The DEA uses the 301 data points as decision making units (DMU). Afterwards, the results can be used to select the efficient (marked by *) from the inefficient ones. In Figure 28 the results of DEA are provided. On average, the efficient banks in the US use 74%, in Denmark 78% and in Germany 68% of the seven asked for e-commerce technologies (i.e. the usage of online advertising, online sales, after sales customer service, online procurement, EDI with suppliers, EDI with customers, and Internet-based supply chain management). The impact on business improvement is measured as the impact index between 2.97 (Denmark), 3.03 (Germany) and 3.29 (US). Although efficient finance institutions in France are only using 43% of all available e-commerce solutions, the resulting output of 2.97 is as high as in Denmark. Relatively inefficient banks in the sample used, as expected, less e-commerce solutions, resulting in a lower rate of impact.

FIGURE 28 Results of the DEA Analyses



Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

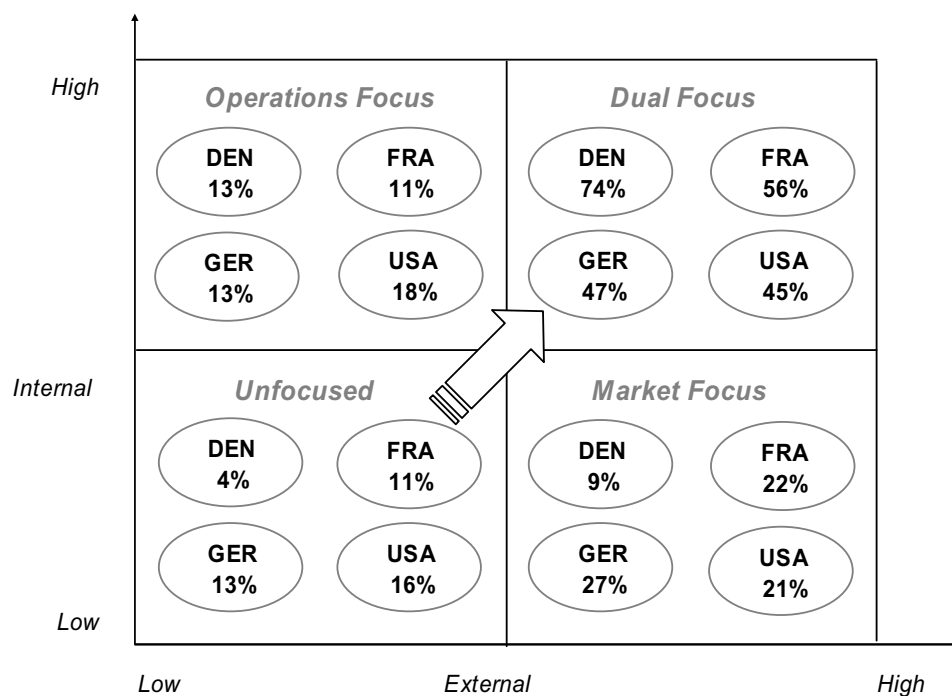
The percentage of efficient banks per country, identified by the DEA method, is provided in Table 27. The results verify the data provided in Figure 25 to Figure 27, in which German and French banks are also not at the forefront with regard to the usage of e-commerce technologies. Only 14.5% of French and 23.1% of German banks are efficient users of e-commerce, gaining nearly as much process improvement and impact from these technologies as Danish or US banks. Not least due to the broad diffusion and longer history of e-commerce in the two latter countries, these banks may gain more profits from sophisticated and mature solutions in comparison to German and French banks.

TABLE 27 Percentage of Efficient Banks in the Sample Per Country

	Denmark	France	Germany	USA
Efficient	38.3	14.5	23.1	41.3

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Aside from the impact on the efficiency of banks within the sample, e-commerce may also be used to achieve and have an impact on strategic goals. According to a model developed by Ken Kraemer (Kraemer et al., 1999), firms are asked about the impact and usage of e-commerce in two different ways: the impact on internal process optimization (operational focus) and external market penetration (market focus). The results for the efficient banks of the sample are provided in Figure 29. While 74% of Danish banks regard e-commerce as having a great deal of impact for both foci, only 4% use e-commerce without a specific focus. Only 47% of German banks follow a dual focus when implementing e-commerce solutions, with approximately 13% of them invested strategically without focal attention.

FIGURE 29 The Strategic Orientation of Financial Institutions

Source: CRITO Global E-Commerce Survey, 2002; unweighted sample.

Impact on the finance industry

Many banks are dealing with the challenge of decentralized systems, data redundancies, and non-standardized applications across non-integrated platforms, especially after the M&A wave of the last decade. Forthcoming investments will have to be carried out in the area of intra-group and multi-channel integration. Moreover, being information-intensive organizations with complex information systems, banks will have to continue investing in IT upgrading. Enhancing process

efficiency requires further investments in “end-to-end” automation, knowledge management and collaborative applications. The development of e-commerce in the financial sector is a challenge for business regulation on national and international levels. The European Union has been issuing new regulations to promote harmonization across financial markets. Outsourcing will continue in the areas of technological support and non-core activities.

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