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8-03

ICT Diffusion and Firm-level Performance:

Case Studies For Belgium



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Federal Planning Bureau

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Foreword

This paper is part of the research program “Transitie naar de informatiemaatschappij: perspectieven en uitdagingen voor België” financed by the SSTC–DWTC (S 2/64/01). Important funding was also provided by FPS Economy, SMEs, Self-employed and Energy. The research would not have been possible without the active cooperation and the inspiration of TNO-Delft, OECD in Paris and the Belgian Institute of Statistics (INS-NIS).



Executive Summary

In the empirical literature, the missing link between ICT investments and increases in firm performance is organisational change. This paper aims to assess the impact of ICT at firm-level in Belgium, by means of case studies with 220 firms in four sectors: banking, machinery, printing/publishing and transport. The chosen sectors were ICT-intensive in 1995, have enjoyed productivity growth during the 1995-2000 period and were probably ready for reorganisation at the time of the interviews.

Half of the firms interviewed reported that the adoption of ICT has primarily impacted their internal organisation and that some effects of ICT on internal organisation have been detected, specifically upskilling of the workforce and electronic communication of information between firms' different departments; this kind of communication is a precondition for interaction between workers and departments within the firm.

The distinction between tangible and intangible, with respect to the diffusion of ICT, is not very sharp in the sample. True, the intangible service sectors (banking and transport) use ICT network technologies more intensively, but machinery, as a physical and tangible sector, is the most intensive user of CAD/CAM (Computer-aided design/Computer-aided manufacturing) and of the so-called ERP, i.e. Enterprise Resource Planning, the best-known example of which is the German software SAP.

Process innovation has been studied through the interaction between ICT use and twelve different business functions. Rates of diffusion along the value chain have been computed for eight ICT technologies. The results suggest that process innovation due to ICT is likely in the sample.

The responding firms report that ICT use has a positive impact on sales and product innovation (new products and customisation). The relevance of these answers has been examined. As regards product innovation, the correlation with ICT use seems to be robust, since process innovation is likely in the sample, and since half of firms attribute the launching of new products over the last few years to their electronic capability. This raises hopes of increased efficiency in the future for firms using ICT in the four sectors that were studied.

As regards sales, more than half of the firms in the sample increased their sales, of which 29% attribute it to ICT. This may explain why we observe an increase in costs for about 60% of the firms in the sample.

There are indications of switching costs and lock-in in the sample, leading to virtual integration.

Firms were also asked about the factors which hampered the diffusion of ICT, in view of the policies to be adopted to foster ICT use. The most frequent answers from firms were:

- The lack of competence within the company and the cost of training in ICT (1 in 4 firms).
- Concerning infrastructure and technology: the high set-up cost (1 in 9 firms) and the inadequate level of ICT equipment used by customers and suppliers (1 in 7 firms).
- The price of telecommunications services (1 in 11 firms).
- Certain failures of the firm's internal organisation (1 in 20 firms).

Firms said that they were expecting some policy measures, specifically further liberalization of the telecommunication sector (1 in 6 firms), e-government actions (1 in 7 firms) and better standardisation and safety of B2B transactions (1 in 15 firms).



Introduction

The scientific interest in the effects of diffusion of ICT is to assess whether economies which are not strong producers of ICT-goods and services, could nevertheless enjoy a rise in productivity and stronger growth due to the use of ICT. The diffusion is important not only for ICT-using firms but even more for those firms' customers which benefit from lower transaction costs (OECD, 2002b).

The objective of this paper is to provide an empirical assessment on the impact of ICT diffusion at firm-level, with a sample of Belgian companies.

This paper is part of the project on the role of ICT in the Belgian economy. In a "companion paper" of this project, Kegels, Van Overbeke and Van Zandweghe (2002) estimate the impact of ICT investment on economic and productivity growth, both at the macroeconomic and at the sectoral level. They a.o. observe that, even for sectors which intensively use ICT, the behaviour in terms of productivity growth and employment is not so clear cut: one of their puzzling observations is that some – especially manufacturing – sectors which are classified as intensive users of ICT display a surprisingly low increase in productivity. According to the most common explanation in the literature, ICT investment does not per se lead to growth in productivity, but organisational changes are needed and a rather lengthy period of 5 to 10 years is required to allow those organisational changes to produce their effect on the firm's performance, especially on total factor productivity, i.e. on TFP (Brynjolfsson and Hitt, 2000 and 2001).

This paper aims at studying those missing links between ICT investment and performances at the firm level by means of an ad-hoc economic and technological questionnaire and a sample of more than 200 Belgian firms from four sectors, specifically two intangible ones, banking and transport, and two industrial sectors, machinery and printing-editing.

The paper is organized as follows. Part II gives the theoretical scheme underlying the relations from ICT investment and adoption to different dimensions of the firms' performances as innovation, sales, costs and productivity. We draw from that scheme the hypotheses to be tested.

Part III presents the sample and the features of the four chosen sectors. Part IV proposes a measure of ICT diffusion and discusses the possible occurrence of process innovation in the sample. Part V presents and discusses the results. The conclusions with a mention of the impediments to ICT diffusion are given in the Executive Summary.

In a nutshell, our survey's results tend to support the hypothesis that ICT use in the selected sectors has a positive impact on sales and innovation. The increase in sales might explain the increase in total costs which accompanies ICT use in those

four sectors, although they enjoyed a rather strong productivity growth during the period 1995-2000.



Theoretical Overview and Hypotheses to be Tested

A. Theoretical overview

The literature states that the use of ICT may help firms:

- increase their turnover through gains of market share at the expense of non-ICT using, less productive firms;
- innovate by expanding their product range through the launch of new goods and services, by customising and by bundling existing products;
- increase the efficiency of their logistics, control their delivery and invoicing process, reduce their inventory costs and more generally improve their information management;
- establish ICT networks, generating spill-over effects, a.o. leading to greater efficiency in the innovation process and the creation of knowledge. The analysis of those spill-over effects goes beyond the scope of this study and can be found elsewhere for the case of Belgium (see e.g. Larosse and al., 2001).

For some industrialised countries, firm-level evidence has been gathered on the positive effect of ICT use on labour productivity and technical efficiency. Those empirical studies at firm-level are reviewed in Pilat (2003). We also refer to a multi-country study called EBIP (Electronic Business Impact Project) led by TNO-STB (Delft) and OECD. The project included 217 case studies on the diffusion of ICT, mainly in manufacturing firms, for 11 OECD countries (OECD, 2002b). However, those case studies include neither Belgium nor some countries far advanced in ICT diffusion like the USA, Finland and Japan.

That kind of study is still missing for Belgium. The aim of this paper is to fill that gap.

The theoretical underpinning is the following scheme of hypothesized relationships linking ICT adoption and use to the firms' efficiency:

1. Through diffusion of ICT along the value chain, ICT fosters process and product innovation and therefore raises total factor productivity, i.e. TFP (Bogaert, 2001; Kegels and al., op.cit., 2002).
2. ICT investment may go along with intangible investments in reorganisation of the firm and in human capital. According to Brynjolfsson and Hitt (op. cit., 2001), each dollar invested in ICT requires 9 \$ in those complementary intangible investments. As regards human capital, ICT adoption may increase labour productivity through two channels. First, ICT may go

hand in hand with upskilling of the employed people and thereby increase labour productivity (Dekkers and Bogaert, 2001). Second, greater interaction between agents and departments within the firm fosters organisational innovation characterized by integration of tasks, learning across tasks and more versatile work and thereby might raise productivity (see e.g. Lindbeck and Snower, 2000).

3. After some possible time-lag, those ICT and complementary intangible investments can lead to a decrease in transaction and communication costs with the market and so lead to an increase in turnover through gains in market share by customers acquisition. That effect is reinforced by product innovation (launching of new products, customisation, bundling). The combination of increase in turnover and of process innovation can bring about growth and increase in productivity. The increase in turnover, together with the accompanying intangible investments in reorganisation and human capital, might explain that most empirical studies at firm-level did not find any convincing evidence of a decline in costs, but rather of increases in costs for a period of up to 5 to 10 years after the ICT investment
4. If ICT investments can bring about a decline in costs, it would be after a while, i.e. 5 to 10 years after the investment. The decline in costs allowed by process innovation would be realized e.g. through a decline in inventory costs. ICT may also foster outsourcing through lowering the communication costs with the suppliers. Outsourcing may then contribute to greater efficiency. This raises the question of the main reason behind the gains in market share enjoyed by ICT-using firms at the expense of the other firms (Pilat, op.cit., 2003): are these gains related to price competitiveness, i.e. to lower selling prices or higher profitability made possible by productivity increases and the ensuing decrease in unit cost? Or are they related mainly to non-price competition advantages, like product innovation and better communication with the market, with the ensuing ability to seize the opportunities of new niches and to satisfy the changing needs of the customers?
5. ICT use may have an impact on market structures through the creation of switching-costs and henceforth of a lock-in effect in the firms' relations with their suppliers and customers. The effect on market structures might explain that case studies made for other countries found that firms using ICT reported an increase in turnover and/or in profitability (Huveneers, 2001; OECD, 2002b).

B. Overview of the hypotheses to be validated

The main hypotheses we are going to test with our questionnaire are based on the review of the literature which we have just summarized.

1. What are the objectives and the incentives of firms when they invest in ICT?

Do they aim primarily at an effect on cost reduction, through process innovations? Does the objective of cost reduction also concern labour costs through ICT investments which would be labour-saving?

Or does ICT adoption aim primarily at an increase in sales, through product innovation and gain in market share?

2. Are the effects of ICT use internal or are they external?

As regards the effect on internal organisation of the firms, we want first to verify the hypothesis of upskilling as a result of the introduction of ICT. Second, the hypothesis of larger interaction between agents and departments within the firm due to ICT will be verified through questions on electronic transfers within the firm.

As regards the effect of ICT on the firms' relations with their external environment, the starting point is the hypothesis that ICT decrease communication and transaction costs with the customers and the suppliers. This can have thorough consequences which we try to disentangle hereafter.

3. What are the factors of differentiated effect of ICT?

The size of the plant and of the firm has a positive effect on ICT adoption. This effect has been well documented in the empirical literature (see a.o. Pilat, op. cit., 2003; OECD, 2002a; Eurostat, 2002) and will not be tested again in this study.

Industry mix is a most important factor of differentiated effect in the empirical literature (Pilat, op. cit., 2003).

A first sectoral feature is the distinction between tangibles and intangibles or, more broadly speaking, the distinction between manufacturing industry and services: intangible activities are more prone to ICT diffusion (OECD, 2002b).

A second sectoral distinction is the one between standardised and complex goods: as stressed a.o. by the empirical work of TNO-STB (Delft), complex goods would always require face-to-face contacts while standardised goods would be more liable to be tailored to the needs of individual customers by the use of ICT (OECD, op.cit., 2002b).

A third distinction is the classification of the Scandinavian model between open and sheltered sectors. Open sectors include the activities which are exposed to international competition and are price-takers. Sheltered sectors sell only their products on the domestic or even on the local markets which are deemed less competitive, so that firms belonging to sheltered sectors are price-setters and can roll over their cost increases onto their selling prices. Therefore firms of open sectors would have stronger incentives to adopt ICT if it can raise their profitability.

C. ICT and the firms' relationships with customers and suppliers

As regards the relationships with the customers, the literature summarized above states that firms using ICT can gain market share at the expense of other firms:

- Either due to the increased efficiency and lower unit costs (Pilat, op.cit., 2003).
- Or, in a context of non-price competition, the gains in market share also stem from the quality of the supply of the firm's products, which is itself influenced by intangible investments (Huveneers, 1996 and 2000). In the case of ICT investments, the increased quality of the supply may take the

form of the launching of new products, the customization of existing products and the bundling.

The hypothesis on the gain of market share has been verified through questions on customer acquisition, i.e. questions on the link between ICT and a possible increase in both the number of customers and of turnover per customer.

The distinction between open and sheltered sectors is here relevant: the incentive for ICT adoption and the impact of ICT on customer acquisition should be stronger for the acquisition of foreign customers than for the case of domestic or local ones. Therefore, firms of the sample have been questioned on the geographical distribution of their customers, in particular on the increase in both the number of foreign customers and the turnover per customer.

As regards the relationships with the suppliers, the starting point of the formulation of hypotheses is the importance of transaction and coordination costs along the supply chain: according to the theory of Industrial Organisation, the higher those costs, the stronger the incentives to engage in vertical integration. If we assume that ICT decrease those transaction and coordination costs with the suppliers, one may posit the assumption that ICT will increase outsourcing, i.e. will cause vertical disintegration. Therefore, the firms have been questioned on the link between ICT use and the increase in both the number of suppliers and the amount of purchases per supplier.

Through their effects on the relationships with customers and suppliers, ICT may also have deep effects on the external environment of the firms by affecting market structures. We now discuss that aspect which includes the well-known switching-costs and lock-in hypotheses.

D. ICT and Market Structures

Concerning the impact of ICT on market structures, the empirical literature - especially empirical work by TNO-STB (Delft) - uses the concept of market systems. The concept describes the degree of intermediation by the market, i.e. the relations between sellers and corporate buyers. Two polar cases can be distinguished:

- The market system is labelled internalised if the firms make in house a large amount of inputs. This gives rise to vertical integration, as e.g. the petrochemical industry.
- The market system is labelled distributed, if the firms buy on the market the inputs they need (outsourcing), as has been the case e.g. for the car industry those last years. This market system may also take the form of networking or cluster, as e.g. for the 3G mobile phones.

It is not easy to formulate hypotheses as to the effect of ICT on the type of market system.

On the one hand, if ICT increase the firms' ability to coordinate, they can create new dependencies by increasing switching costs for the buyers and by developing ICT technologies which lock the customers in their technological choices. This would create a "virtual" vertical integration, which would materialize in the importance of repeat suppliers and retained customers. Cases of virtual integra-

tion have been observed in the case studies made in the framework of the EBIP project.

On the other hand, if ICT use lowers the costs of coordination, they should bring about a tendency towards a distributed market system. This would mean an increase in the number of suppliers and/or in the amount of purchases per supplier; and the relations with the suppliers would be transaction-based rather than relations with repeat suppliers.



The Sample of Belgian Firms

The 220 Belgian firms were interviewed in September and October 2002.

The sample has been drawn for 4 sectors: banking, construction of machinery, printing and editing, transport.

Those sectors were chosen on basis of the following criteria:

- their high intensity in ICT investment, as measured by the share of ICT investment in total gross capital formation in 1995.
- their high growth of labour productivity over the period 1995-2000 (Kegels and al., 2002).
- the distinction between tangibles and intangibles.
- the distinction between standardised and complex products.

Combining all those criteria, we obtain the following typology:

TABLE 1 - Typology of sectors

Type of product	Tangible	Intangible
Standardised	Printing/Editing	Transport/Logistics
Complex	Machinery	Banks

The population from which the sample was drawn is limited to firms employing more than 10 people. The representative character of the sample can be evaluated on ground of the table below which gives the number of responding firms as a percentage of the number of firms in the population per sector (appendix 1 gives the detailed sector NACE classification at the 4-digit level).

TABLE 2 - Sample and Population

Sectors (NACE codes)	Number of responses	Population (firms employing > 10)	Number of responses in % of population
1. Banking (65)	29	75	38.7
2. Machinery (29)	65	454	14.3
3. Printing-Edition (22)	83	420	19.8
4. Transport (63-64)	43	305	14.1
Total 4 activity classes	220	1254	17.5

Source: INS-NIS, 2002. Own calculations.

Such a sample will allow us to draw conclusions on those four sectors because the responding firms represent fairly high percentages of the population. However,

the sample does not allow to draw general conclusions for the whole Belgian economy, as shown by the table below.

TABLE 3 - The four sectors in the Belgian economy

Sector	Share in total value added of the Belgian economy (2000)
1. Banking	0.99%
2. Machinery	1.16%
3. Printing - Editing	4.17%
4. Transport - Logistics	1.32%
Total	7.64%

SME's are very well represented: table 4 below shows that the sample was drawn from a population where only 24% of the firms employ more than 250 people.

TABLE 4 - Size distribution in the population (in %)

Size-class 10 - 49	Size-class 50 - 249	Size-class 250 and more	Total
35.5	40.27	24.2	100

The interpretation of the results is also influenced by the distribution of the firms of the sample according to their intensity in ICT investment. The interpretation of the answers of the responding firms is indeed based on the attribution method, which determines the percentage of firms which attribute some of their performances, e.g. the increase in the number of customers, to ICT. That percentage of attribution is computed with reference to the number of responding firms, and not to the number of ICT intensive firms. Therefore, the percentages of attribution will underestimate the actual impact of ICT, especially if the firms in the sample are not ICT intensive.

This is the reason why one has to take into account the distribution according to the ICT intensity, which is measured by ICT investment as a percentage of total investment over the period 1995-2000. We stress that the firms were interviewed at the end of 2002 so that a time-lag of 2 to 7 years elapsed between the ICT investment and the observed effects.

The table below gives the distribution of the sample.

TABLE 5 - Distribution of the sample according to average ICT intensity over 1995-2000 (in % of responding firms)

ICT intensity (in % of total investment)	1. Banking	2. Machinery	3. Printing/Editing	4. Transport	5. Total 4 sectors
No answer	31.0	9.2	8.4	0.0	9.5
< 5%	13.8	33.8	19.3	29.5	25.0
5-10%	10.3	13.8	18.1	27.3	17.7
10-14%	20.7	15.4	19.3	11.4	16.8
>15%	24.1	27.7	34.9	31.8	30.9

Source: EBIS enquiry. Own calculations.

It appears that the ICT intensity in the sample drawn at random is low. For all four sectors taken as a whole, while the share of ICT investment in total investment for all Belgian private companies amounted to 15% in 1995 (Kegels and al., op. cit., 2002), a mere 30.9% of our sample reached that threshold. When we look at the four sectors, it appears that the differences of ICT intensity are not sharp between the sectors in the sample, whereas those differences are not negligible for the entire population of firms, as table 6 shows.

TABLE 6 - ICT intensity per sector

Sector	ICT share in investment in 1995
1. Financial Activities	46.5%
2. Machines and Equipment Manufacture	42.6%
3. Cardboard & paper industry, Edition and printing	24.0%
4. Transport & Communications	31.5%
All sectors (private enterprises)	15.2%

Source: Kegels and van Overbeke, 2002.

We have data for those firms a.o. on the use of ICT technologies for several business functions, ranging from design to marketing and billing. The information on the use of ICT technologies has allowed us to compute a rate of diffusion of ICT along the value chain of the sample's firms. We now turn to the computation and interpretation of such an index of diffusion.



ICT Technology Profile and Diffusion

The value chain is described by 12 business functions or business activities:

1. Promotion and advertising
2. Catalogues and stock lists
3. Quotations and negotiations
4. Procurement
5. Billing and Payment
6. Logistics and fulfillment
7. Management Information Systems
8. Production management
9. Performance monitoring
10. Customization
11. Collaborative product and/or service design
12. Market analysis.

For each of those 12 business functions, the firms have been asked which technology is used actively and regularly. The obtained information is used in two important ways:

1. To compute the ICT intensity for each business function.
2. To compute the diffusion of each ICT technology for all 12 business activities, i.e. the diffusion of each ICT technology along the value chain.

A. The ICT intensity per business function

The method of computation of ICT intensity per business function is exposed in appendix 3.

Table 7 below gives a summary of the results of the computation, specifically the ranking of the business functions in decreasing order of their ICT intensity both for Belgium and for foreign countries.

TABLE 7 - ICT intensity of each business activity

Business activity	Belgian cases:	Foreign cases:
	Ranking in decreasing order of ICT intensity	ranking in decreasing order of ICT intensity
Procurement	1	2
Promotion-advertising	2	4
Management Information Systems	3	1
Logistics and fulfilment	4	7
Quotations:Negotiations	5	5
Billing and Payment	6	6
Customisation	7	n.a.
Production Management	8	n.a.
Performance Monitoring	9	8 (Finance)
Design	10	n.a.
Catalogues/Stock lists	11	3
Market analysis	12	n.a.

Sources: Belgium: EBIS. Own computations.
Foreign countries: EBIP.

The ranking is rather similar in both cases, with the exception of the business function “Catalogues/Stock lists”. Were it not for that exception, the ranking could be interpreted as an indication that business functions related to transaction preparation are more ICT intensive than the business functions related to transaction completion.

B. The diffusion along the value chain of each technology used

The table below presents the rates of diffusion of 8 ICT technologies, both per sector and for the total of all 4 sectors. We have expressed the rate of diffusion of a technology as the number of “yes” answers in % of the total “yes” + “no” answers. Appendix 2 discusses the limitations of that measure.

TABLE 8 - ICT diffusion along the value chain

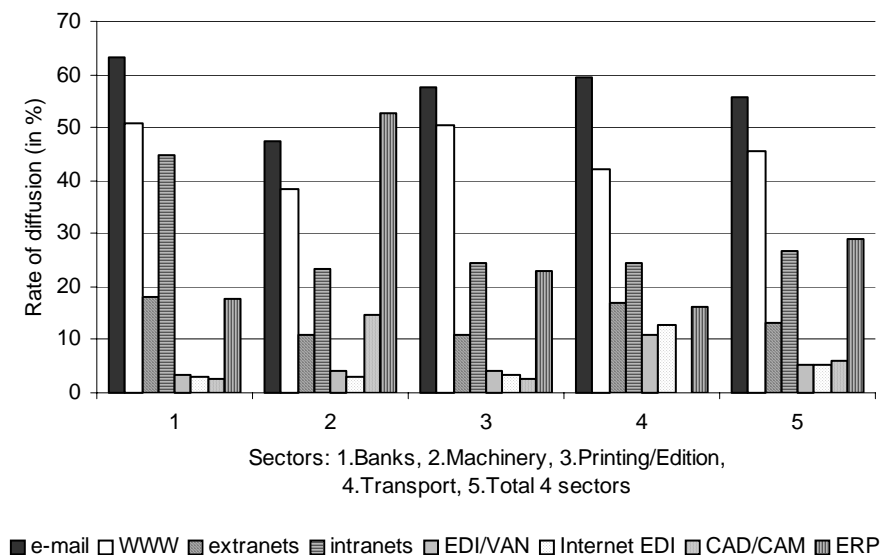
	Banks	Machinery	Printing - editing	Transport	Total
e-mail	63.2%	47.3%	57.7%	59.3%	55.6%
www	50.7%	38.5%	50.5%	42.3%	45.4%
extranet	18.0%	11.0%	11.0%	16.9%	13.0%
intranet	44.7%	23.5%	24.3%	24.3%	26.7%
EDI	3.3%	4.1%	4.16%	10.92%	5.25%
Internet EDI	3.0%	3.0%	3.4%	12.8%	5.1%
ERP (SAP)	17.7%	52.7%	22.9%	16.2%	29.0%
CAD/CAM	2.75%	14.8%	2.6%	0.4%	6.1%

Source: EBIS enquiry. Own calculations.

As stated above, the literature reports that intangible activities are more prone to ICT diffusion. Thus, the banks appear as the most intensive users for e-mail, Internet, extranet and intranet. Transport is the most intensive user for EDI and Internet EDI. However, the manufacturing sector “machinery” ranks first for the use of both ERP and CAD/CAM. Globally, differences of ICT diffusion across sectors are

not great. This is displayed in figure I, where the rates of diffusion are taken from table 8.

FIGURE 1 - Diffusion of ICT technologies by sector



Relying on the figures of table 8, we have also computed the average, over all the ICT technologies, of the rates of diffusion per sector. The results are shown in table 9. Again, intangibles do not appear more open to ICT than tangibles¹.

TABLE 9 - Average rate of diffusion (in %) over all ICT technologies, by sectors

Sector	Rate of diffusion (yes answers as % of "yes"+"no")
1. Banks	25.4%
2. Machinery	24.4%
3. Printing/Edition	22.1%
4. Transport	22.9%

Source: EBIS enquiry. Own calculations.

According to the empirical literature, such a rate of diffusion measures adequately the interaction between business functions thanks to ICT and catches the impact of ICT on process innovation and firms' efficiency (Colecchia, 2002).

1. The differences in ICT diffusion across sectors could also be influenced by the relative importance of start ups, which might have been created for the purpose of conversion to ICT technology. As shows the table below, only the sector "transport" is characterized by a high rate of new entries (new entries are firms set up after 1996).

Table: Importance of start ups by sector (in % of the sample)

1. Banks	21%
2. Machinery	20%
3. Printing-Edition	11%
4. Transport	84%

Source: EBIS enquiry. Own calculations.

Thus, the foreign case studies of the EBIP project conclude that, especially for the large firms, ICT have led to process innovations, on which product innovations depend (OECD, op. cit., 2002b). If ICT diffusion in Belgian firms appears similar to ICT diffusion in foreign firms, it would reinforce the likelihood of the occurrence of process innovation in our sample.

In order to discover possible differences between Belgium and foreign countries, ICT technologies are ranked by decreasing order of diffusion in both the foreign and the Belgian case studies. The comparison of both rankings is given in table 10 below.

TABLE 10 - Diffusion of ICT technologies in Belgium and abroad

Technology	Foreign cases (years 2000-2001): rank of the technology in decreasing order of diffusion	Belgian cases (year 2002): rank of the technology in decreasing order of diffusion
internet (www)	1	2
e-mail	2	1
EDI	3	7
extranet	4	5
Internet EDI	5	8
ERP (Enterprise Resource Planning)	not available	3
intranet	not available	4
CAD/CAM	not available	6

Sources: Foreign cases: EBIP;

Belgian cases: EBIS enquiry. Own calculations of table 8.

It appears from the figures of table 10 that the Belgian firms of the sample are not lagging behind their foreign counterparts, except for EDI. This is confirmed when the rates of diffusion of table 8 are compared with the results of EBIP. This comparison is discussed in appendix 4.

It can be concluded from this part of the analysis on the Belgian firms' ICT profile that ICT-related process innovations are likely in the sample, owing to the rather high diffusion observed for some ICT technologies. It is stressed again that, in the foreign case studies, process innovations appear themselves correlated with product innovations so that product innovations may be hypothesized in the Belgian firms of the sample.



The Main Results of the Statistical Enquiry

A. Effect of ICT on Costs or on Sales

1. Non conclusive effects on the costs

a. The business process costs

The following question has been raised to the firms: “How are total business process costs different than they were 3-5 years ago?” and “Changes in business process costs are due:

- mainly to the firm’s electronic transaction capability;
- to the firm’s electronic transaction capability *and* several other factors;
- entirely to other factors – the firm’s electronic transaction capability played no significant role”.

It appears that 63% of the responding firms registered an increase in total business process costs, and that 34% of those increases are attributed – mainly or partially – to the firm’s electronic transaction capability. Business process costs decreased for only 25 firms, i.e. 12% of the sample, of which 16 firms attribute the decrease to their electronic capability.

The foreign case studies of the EBIP project also reveal that about half of the interviewed firms report an increase in costs.

This points out the relevance of the argument that ICT use requires accompanying intangible investments in reorganisation and human capital, which increase the costs for some period after the ICT investment (cf infra table 12 and Brynjolfsson and Hitt, op.cit., 2001). We remind that the time-lag of 10 years, quoted by the literature as necessary for the ICT investments to complete their effects on productivity, had not yet elapsed at the time of interview.

As we shall see below, another straightforward explanation of the increase in total business process costs in 63% of the firms of the sample is the increase in sales of nearly 60% of the firms.

b. The wage costs

To check whether ICT investments were of the labour-saving type, the following question was raised: “was labour-cost reduction an incentive for ICT investments?”. The affirmative answers amounted to 33% of responding firms, negative answers amounting to 67%. Though, only 13% of responding firms were actually able to reduce their labour costs, as table 11 below shows.

We observe that wage costs have increased for 69% of the cases, but table 11 does not show that this is due to ICT: only a tiny fraction of the firms attributes the increase to ICT. More generally, only 20% of the firms attribute to electronic factors the changes in wage costs (the amount of 20% is the sum of 6.3% and 14.6%)¹.

TABLE 11 - ICT and labour costs (in % of responding firms)

How are labour costs different than they were 3-5 years ago?	Changes in labour costs are due:				Total
	Mainly electronic capability	Electronic capability & others	Entirely other factors	Not applicable	
Equal	1.0	2.0	4.4	10.7	18.0
Higher	2.4	9.7	51.0	5.8	68.9
Lower	2.9	2.9	6.3	1.0	13.1
Total	6.3	14.6	61.6	17.5	100.0

In order to verify whether ICT investments were bringing about organisational changes rather than cost decreases, firms have been asked to point to the main effect of ICT adoption. The results are shown in Table 12. It appears that 56% of the interviewed firms report that ICT adoption has mainly impacted their internal organisation, whereas only 23% of the firms report that the main impact lies on the costs.

TABLE 12 - Main impact of ICT (in % of responding firms)

On sales	On costs	Simultaneously on costs and sales	On organisation within the firm	Total
5	23	16	56	100

This confirms that ICT investments go hand in hand with organisational changes. Those changes could eventually lower the costs when they will be totally completed.

2. The noteworthy effect of ICT on sales and product innovation

a. Introduction

In foreign case studies, one in three firms reports a positive effect of ICT either on turnover or on profitability.

1. The figures are somewhat different for the banking sector: wage costs have increased in 62% of the cases and have decreased in 24% of the cases.

Table 13 below confirms the positive effect of ICT on sales for the Belgian firms.

TABLE 13 - Effect of ICT on gross revenue from sales (in % of responding firms)

How are total gross revenues different than they were 3-5 years ago?	Changes in total gross revenue are due to:				Total
	Mainly electronic capability	Electronic capability & others	Entirely other factors	Not applicable	
Equal	1.0	0.5	4.0	13.9	19.3
Higher	1.5	15.3	35.1	5.4	57.4
Lower	0.0	2.0	20.0	3.5	23.3
Total	2.5	17.8	56.9	22.8	100.0

The table shows that about 20% of the responding firms attribute – mainly or partially – to ICT the changes in total gross revenue. Most importantly, within the group of firms enjoying an increase in gross revenue, i.e. 57.4% of the total sample, 29% of those firms attribute the increase to electronic factors¹. We try to analyse that impact of ICT on sales through questions on customer acquisition in order to shed light on possible gains in market share.

b. Customer acquisition

The impact of ICT on customer acquisition has been disentangled into two questions: first, firms have been questioned on the change in the number of customers and the role of ICT in that change; second, the firms have been questioned on the sales distribution in their customer base, i.e. on the value of sales per customer.

The results for the question on the number of customers are shown in table 14. More than half (55.1%) of the firms of the sample report an increase in the number of customers, while about 10% admit a decline in that number. It appears that 20% of the responding firms attribute to ICT, mainly or partly, the changes in the number of customers. In the case of increases, i.e. in the case of customer acquisition, the attribution rate even reaches 30%². There are differences between sectors: 75% of the responding banks and 60% of the transport companies increase their number of customers with an attribution rate of, respectively, 40% and 30%; while for machinery, less than half (48%) of the firms report an increase, with an attribution rate of 25%.

1. The amount of 29% is given by the computation: $1.5 + 15.3 = 16.8 = 29\%$ of 57.4%. The amount of 16.8 is the percentage, *in the total sample*, of firms which attribute, mainly or partially, to electronic factors the increase of their gross revenues.

ICT may also exert an impact by allowing the firms to merely keep its income from sales. Thus, it appears also from table 13 that the firms attribute the increase or the stability of income, mainly or partly to their electronic capability, represent a bit more than 23.8% of those firms which experienced an increase or a stability in gross revenue (over 3-5 years ago).

2. The amount of 30% is given by the computation: $2.2 + 14.3 = 16.5 = 30\%$ of 55.1%. The amount of 16.5 is the percentage, *in the total sample*, of firms which attribute, mainly or partially, to electronic factors the increase in the number of customers.

TABLE 14 - Change in the number of customers and factors of change (in % of responding firms)

Compared to 3-5 years ago, my company now deals with:	Change in the number of customers is due:				
	Mainly electronic capability	Electronic capability & other factors	Other factors	Not applicable	Total
More customers	2.2	14.3	32.7	5.8	55.1
Fewer	0.5	0.9	7.6	1.8	10.8
About same number	1.3	0.9	8.1	22.4	32.7
Not applicable.				1.3	1.3
Total	4.0	16.1	48.4	31.4	100

Source: EBIS enquiry. Own calculations.

We now turn to the results regarding the value of sales per customer, in table 15.

TABLE 15 - Sales distribution in the customer base (in % of responding firms)

Compare the value of sales per customer to 3-5 years ago:	Change in the value of sales per customer is due to:				
	Mainly electronic capability	Electronic capability & Other factors	Other factors	Not applicable	Total
More sales per customer	2.3	11.2	21.4	6.1	41.0
Less sales per customer	1.4	1.4	19.5	0.9	23.2
Not changed		0.5	8.8	14.9	32.6
Not applicable			0.5	2.8	3.3
Total	3.7	13.0	50.2	33.0	100.0

Source: EBIS enquiry. Own calculations.

The firms which experienced an increase in sales per customers and attribute – mainly or partly – the increase to electronic capability represent only 13.5% (i.e. 2.3%+11.2%) of responding firms but represent 33% of that group of firms (which increase their sales per customers). The service sectors are again more prone to ICT diffusion than the industrial sectors: 70% of the banks and 45% of the transport companies increase their sales per customer, with an attribution rate of, respectively, 33% and 52%.

Combining tables 14 and 15, we observe that, out of those firms which increase the number of their customers and/or their sales per customer, about one third attribute the increase – mainly or partly – to electronic factors.

Summarizing, electronic capability appears to have a positive effect - especially for the service sectors - on the number of customers and on the sales per customer. In other words, ICT may have played a role in gains of market share of the sample's firms.

The pressure of customers, i.e. of the demand side, to invest in ICT and to acquire electronic capability may be relevant. In that respect, one wonders whether the pressure is stronger in the case of foreign (international) demand, i.e. in the case of foreign customers, than in the case of domestic (national, or even local) demand, i.e. in the case of domestic or local customers.

One has in mind the so-called old Scandinavian model, with a view to the distinction between open (exposed) and sheltered sectors. We hypothesize that the pressure for ICT adoption is stronger for exposed sectors (or firms), than for sheltered ones, so that economic policy measures in favour of ICT adoption should focus on sheltered sectors to overcome their possible reluctance to ICT.

In order to verify that hypothesis, the geographical distribution of the customer base is now examined.

c. The geographical distribution of the customers

The following questions have been raised:

- “Compared to 3-5 years ago, has the number of foreign customers increased, decreased or remained stable?“, the same question being raised for domestic and local customers.
- Is the change in the geographical distribution of the customers due to mainly your electronic capability, or to your electronic capability and other factors, or entirely to other factors?”.

Those questions were not designed primarily to verify the hypothesis of the Scandinavian model – that seems a far-sighted objective – but to evaluate whether the firms’ electronic capability allowed them to reach foreign customers and to engage more in international competition or instead whether it allowed the firms to strengthen their local or domestic customer base.

The results can be summarized as follows.

- About half of the firms report that the geographical distribution of their customer base has been stable over the last 3 to 5 years.
- For the firms having experienced a change in that geographical distribution, there is a clear tendency towards more opening to international competition:
 - the number of foreign customers is rising in 40% of responding firms, and declining in only 5%;
 - the number of domestic customers is rising in only 25% of the responding firms, and declining in 16% of the cases;
 - the number of local customers is rising in only 17% and declining in exactly the same percentage of responding firms.
- However, the percentage of attribution of those changes is only 15%; i.e. 14.73% of the responding firms attribute – mainly or partly – to electronic capability the changes in the geographical distribution of their customer base.

Per sector, the percentage of attribution is notably higher for the intangible sectors: 27% and 24% for banking and transport respectively; while it amounts only to 8% for machinery and 11% for printing-editing.

d. ICT, the quality of supplied products and product innovation

In the literature reviewed above, we had seen that firms using ICT can gain market share either due to lower unit costs and higher price competitiveness or due to a better quality of the supply in a context of non-price competition.

The results of the enquiry do not allow to conclude that ICT use led to lower unit cost in the sample's firms.

Therefore, the link between ICT and gains in market share is studied through the effect of ICT on the quality of the supply through product innovation (customisation and bundling of existing products, launching of new products).

A first observation is the impact of ICT on customisation. In the sample, 174 firms report to sell customized products; as table 16 shows, 22.6% (the sum of 8.7% and 13.9%) attribute – mainly or partly – to electronic factors their ability to increase or to stabilize the share of their customized products. The results are noteworthy for the cases of increased share of customized products: 39.9% of the 174 responding firms have increased that share and the rate of attribution exceeds 50%¹. At the level of the sectors, for which the figures are not shown here, banking and transport are outstanding: more than half of the responding firms have increased the share of customized products.

TABLE 16 - ICT and customization (in % of the responding firms)

Compared to 3-5 years ago, has the value of sales of customised products as a percentage of total sales revenue:	Changes in the value of sales of customised goods and services are due to:				
	Mainly to electronic capability	Electronic capability and other factors	Entirely to other factors	Not applicable	Total
Increased	8.1	12.7	14.4	4.1	39.3
Decreased			2.3	0.6	2.9
Remained about same	0.6	1.2	9.8	46.2	57.8
Total	8.7	13.9	26.6	50.9	100.0

Source: EBIS enquiry. Own calculations.

A second observation is the impact of ICT on the launching of new products which seems spectacular. In the sample, 115 firms report to have sold new or different products over the last 3 to 5 years. In that group of innovating firms, 109 were able to quantify the share of new or substantially different products in their total sales. The answers are summarized in table 17.

TABLE 17 - Share of new products in total sales (number of responding firms)

		What is the present value of sales of new or different products/services as a percentage of total sales revenues?						Total
		None	Up to 5%	Up to 10%	Up to 25%	Up to 50%	Over 50%	
Have you placed new or substantially different products and/or services in the market during the past 3 to 5 years?	Yes	5	28	20	23	24	9	109

Source: EBIS enquiry. Own calculations.

1. The exact percentage of attribution to electronic factors is equal to: $(8.1+12.7)/39.3 = 52.1\%$.

We also observe that the share of new or substantially different products does not differ much across sectors.

TABLE 18 - Share of new products in total sales by sector

Sector	Number of responding firms	Number of firms (as a % of responding firms) reporting share of new products above 10% of sales
1. Banks	18	33.0%
2. Machinery	27	55.0%
3. Printing/Editing	43	53.5%
4. Transport	21	57.1%
Total 4 sectors	109	51.4%

In the group of 115 innovating firms, Table 19 shows that 80% declare an increase in the share of new products in their total sales, of which about half attribute the increase to their electronic capability.

TABLE 19 - Share of new products and the factors of changes (in % of responding firms)

Compared to 3-5 years ago, has the value of sales of new or different products/services as a % of sales:	New product and/or service developments are driven:				Total
	Mainly electronic capability	Electronic capability & others	Entirely other factors	Not applicable	
Increased	17.4	27.0	33.0	2.6	80.0
Decreased	0.9	0.9	2.6		4.3
Remained about the same	3.5	2.6	6.1	3.5	15.6
Total	21.7	30.4	41.7	6.1	100.0

Source: EBIS enquiry. Own calculations.

Those noteworthy effects of ICT on product innovation¹ are supported by the observation made above on process innovation. Product innovation proved to be correlated with process innovation in the foreign case studies and process innovation is plausible in our sample in view of the rate of diffusion of ICT in the value chain. Process innovation due to e-commerce has also been observed in another empirical study of Belgian firms – at least for firms with a turnover larger than 10 million Euro - by Konings and Roodhooft (2000).

B. ICT diffusion in the firms: internal or external effects

1. Effects of ICT on internal organisation

This proved the trickiest hypotheses to verify. As reported in the literature, the positive effect of ICT on labour productivity through changes in internal organisation may materialize in at least two ways: the increase in skills when the firm

1. As regards the bundling of products, no impact of ICT has been observed in the sample.

hires new staff to implement ICT and the greater interaction between workers and departments within the firm.

First, the hypothesis of upskilling is validated in our sample: 50% of responding firms said that a dividing line between ICT skilled workers and other workers would appear as a result of ICT introduction in the firm.

Second, the hypothesis of increased interaction owing to the use of ICT is also supported by the sample: 75% of the responding firms have made information, generated by electronic transactions, accessible electronically to different departments within the firm. This confirms the rather high diffusion of intranet in our sample, which was shown above in table 8.

2. Effects of ICT on the firm's external environment

The objective is to study the hypothesis that ICT decrease communication and transaction costs with the clients and the suppliers.

We have seen earlier that, for increases in the number of customers and in the turnover per customer, 30% of the cases are attributed, mainly or partially, to the firm's electronic capability. This supports the hypothesis that ICT lower transaction costs and allow the firms to reach new markets.

As regards suppliers, the answers of the firms support to some extent the hypothesis that ICT lower coordination costs and allow the firms to decrease their degree of vertical integration by increasing outsourcing.

Thus, 50% of the firms have increased their purchases per supplier, of which 32% attribute it to the firm's electronic capability.

As regards the number of suppliers, table 20 below shows that 30% of the responding firms see an increase in the number of their suppliers, and 21.5% a decrease of that number. For almost half of the total sample, the number of suppliers is stable.

TABLE 20 - ICT and the number of suppliers (as a % of responding firms)

Compared to 3-5 years ago, my company now deals with:	Change in the number of suppliers is due:				Total
	Mainly electronic capability	Electronic capability & others	Entirely other factors	Not applicable	
More suppliers	3.1	4.9	20.2	1.8	30.0
Fewer suppliers	0.5	2.7	16.6	1.8	21.5
About same number	0.5	1.8	8.1	35.0	45.3
Not applicable	0.0	0.0	0.0	3.1	3.1
Total	4.1	9.4	44.9	41.7	100.0

The rate of attribution is low, but ICT is more prone to an increase in the number of suppliers than to a decrease:

- in the cases of increases in the number of suppliers, about 27%¹ of the firms attribute it to ICT;
- in the case of decrease, the rate of attribution is only 14.6%.

3. Effect of ICT on market structure

Despite the tendency to a decrease in vertical integration, it is not allowed to conclude that ICT generate a more distributed market system, because there are indications of switching costs and lock-in.

First, the lock-in phenomenon is widespread in the sample: retained customers account for more than half of the turnover for 88% of responding firms. More importantly, ICT have reinforced the trend over the last 3 to 5 years: thus, the share of retained customers has increased for 26% of the firms, of which 40% attribute the increase to electronic factors² (see table 21).

TABLE 21 - ICT and share of retained customers

Compared to 3-5 years ago, the share of retained customers has:	Change in the share of retained customers as a % of customers is due to:				Total
	Mainly electronic factors	Electronic factors & others	Entirely other factors	Not applicable	
Increased	0.9	9.4	13.1	2.7	26.1
Decreased	0.0	0.5	5.0	0.5	6.0
Remained about same	0.0	5.0	11.3	48.6	64.9
Not applicable	0.0	0.0	0.5	2.7	3.1
Total	0.9	14.9	29.9	54.5	100

Second, ICT also play some role in increasing the value of sales per retained customer. It appears from the answer that firms attributing - mainly or partly - the increase in the sales per retained customer to their electronic capability represent 26% of the firms which have increased the value of sales per retained customer over the last 3 to 5 years.

Third, the purchases per repeat supplier have increased for 45% of the responding firms, and have decreased for only 10% of the firms.

Combining those observations on retained customers, repeat suppliers and outsourcing, we conclude that ICT use have led to some form of virtual integration in our sample.

1. That percentage is the result of the following computation: $(3.1+4.9)/30.04 = 26.63\%$.

2. The figure of 40% is given by the computation: $(0.9+9.45)/26.1 = 39.66\%$.



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Appendix 1: Sector Classification

1. Banking (65)

65: Financial intermediation, except insurance and pension funding

67201 Activities auxiliary to insurance and pension funding (one observation)

2. Industry making industrial equipment (mainly in 29)

29.1 Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines

29.21 Manufacture of furnaces and furnace burners

29.22 Manufacture of lifting and handling equipment

29.23 Manufacture of non-domestic cooling and ventilation equipment

29.24 Manufacture of other general purpose machinery n.e.c.

29.32 Manufacture of other agricultural and forestry machinery

29.40 Manufacture of machine-tools

29.51 Manufacture of machinery for metallurgy

29.52 Manufacture of machinery for mining, quarrying and construction

29.53 Manufacture of machinery for food, beverage and tobacco processing

29.54 Manufacture of machinery for textile, apparel and leather production

29.56 Manufacture of other special purpose machinery n.e.c.

29.60 Manufacture of weapons and ammunition

29.71 Manufacture of electric domestic appliances

3. Printing, edition

22-1: publishing

22-2: printing

4. Transport

63.40 Activities of other transport agencies

64.12 Courier activities other than national post activities



Appendix 2: Diffusion Rates of ICT Technologies and Possible Statistical Bias

In the computation of the diffusion rates of both tables 7 and 8, we only consider the “yes” and “no” answers. The other answers (not available – refusal – do not know) are not taken for granted. Thus, for firms which do not know, we can safely assume that, if they actually used ICT technologies, they should know and should be able to give an answer. On the contrary, for the answers “not available” and “refusal”, we cannot posit that those firms do not use ICT technologies. Therefore, we propose not to take into account those other answers. E.g., when we get 10 “yes” answers, 5 “no” answers and 3 “other” answers, the proportion of “yes” answers is 10/15 and not 10/18.

One could of course object that this introduces a statistical bias, especially for the technologies which are not well known and are not intensively used.

To check for such a bias, the rate of diffusion of some ICT technologies has also been computed as the number of “yes” answers in % of the total possible answers. “Total possible” means the number of total possible answers = 12 (business activities) x number of observations. (e.g. for banking, total possible = 12x29 = 348). This allows us to take into account the “yes” answers to the question “do you use actively and regularly any other (ICT) technology?” (of course the firms never responded “no” to that question).

The result of the computation of that second rate of diffusion is given, in the table A-1 below, in the row “Yes as a % of total possible”. This can be compared with the rate of diffusion which was presented in table 8, i.e the number of “yes” answers in % of the total “yes” + “no” answers. This percentage is given in the row “yes in %”.

TABLE A-1 - ICT diffusion along the value chain

Technologies	Sectors	1. Banks	2. Machinery	3. Print-editing	4. Transport	Total
	Total possible answers	348	780	996	516	2640
e-mail	Yes in %	63.2%	47.3%	57.7%	59.3%	55.6%
	Yes as % of total possible	38.5%	31.54%	38.8%	41.3%	37.1%
www	Yes in %	50.7%	38.5%	50.5%	42.3%	45.4%
	Yes as % of total possible	31.6%	25.3%	33.3%	27.9%	29.7%
extranet	Yes in %	18.0%	11.0%	11.0%	16.9%	13.0%
	Yes as % of total possible	9.8%	7.1%	6.6%	9.7%	7.8%
intranet	Yes in %	44.7%	23.5%	24.3%	24.3%	26.7%
	Yes as % of total possible	26.7%	14.9%	15.0%	14.3%	16.4%
EDI/VAN	Yes in %	3.30%	4.10%	4.16%	10.92%	5.25%
	Yes as % of total possible	1.72%	2.44%	2.31%	6.01%	2.99%
internet/EDI	Yes in %	2.98%	3.02%	3.45%	12.85%	5.07%
	Yes as % of total possible	1.44%	1.79%	2.01%	7.17%	2.88%
CAD/CAM	Yes in %	2.75%	14.79%	2.58%	0.4%	6.08%
	Yes as % of total possible	1.44%	9.1%	1.5%	0.2%	3.48%
ERP	Yes in %	17.7%	52.7%	22.9%	16.2%	29.0%
	Yes as % of total possible	8.6%	23.3%	11.9%	7.56%	14.02%
Other	Yes as % of total possible	10.1%	9.36%	8.33%	12.02%	9.58%

Source: EBIS enquiry. Own calculations.

We first check to what extent the ranking of technologies is affected by the choice of the indicator.

TABLE A-2 - Diffusion of ICT Technologies: Ranking In Decreasing Order of Diffusion

Technology	Ranking Yes as % of total possible	Ranking Yes in % (of "yes"+"no")
e-mail	1	1
internet (www)	2	2
intranet	3	4
ERP	4	3
Other	5	Not relevant ^a
Extranet	6	5
CAD/CAM	7	6
EDI	8	7
Internet EDI	9	8

a. The measure based on the number of "yes" answers in % (of "yes" + "no" answers) is not relevant because the firms never responded "no" for the question about the use of "other (ICT) technology".

It is reassuring to see that both computations give almost the same ranking of ICT intensities for the technologies. So the statistical bias - if there is any - may not be very harmful.

We then look at the ranking of the sectors with regard to their average rate of diffusion of ICT technologies. The average of the diffusion over all ICT technologies is computed according to both measures shown in table A-1.

TABLE A-3 - Average diffusion of ICT technologies by sector (in %)

Sector	Average diffusion (yes in % of "yes" + "no" answers)	Average diffusion (yes in % of total)
Banks	25.4	14.43
Machinery	24.4	13.9
Printing/Edition	22.1	11.6
Transport	22.9	14.0

It appears from table A-3 that, with the method based on "yes answers as a % of total possible answers", transport ranks second; this confirms at least the positive effect on ICT diffusion of producing intangibles and of a high rate of entry.



Appendix 3: ICT Intensity of Business Functions

The method of computation of ICT intensity can be explained by way of an example, specifically for the business function “Promotion and Advertising”. We start with table A-4 below, which gives for each ICT technology the number of “yes” and “no” answers to the question: “indicate which technology is actively and regularly used”.

TABLE A-4 - ICT Intensity For Promotion And Advertising

Technologies used	Yes answers	No answers	Total Yes + No answers
e-mail	88	67	155
www	142	33	175
extranets	23	111	134
intranet	37	101	138
EDI/VAN	9	120	129
internet EDI	10	121	131
CAD/CAM	9	120	129
ERP	11	213	224
Total	358	886	1244

Source: EBIS enquiry. Own calculations.

The most straightforward measure of ICT intensity for the business function is the number of “yes” answers as a percentage of both “yes” and “no” answers, i.e.: $358/1244=28.8\%$.

However, the other answers (not available – refusal – do not know) are not taken into account in that measure. This explains that the sum of “yes” and “no” answers is not the same for every technology.

An alternative measure of ICT intensity is the number of “yes” answers as a percentage of the highest possible number of answers, i.e. 220 (observations) x 9 (ICT technologies) = 1980: $358/1980 = 18.1\%$. Notice again that the answers to the question “other” are only taken into account in the “yes” answers.

The computations have been made for all 12 business functions to rank them according to their ICT intensity for Belgium; the result is compared with the ranking of the business functions in the foreign countries of the EBIP project.

The comparison is given in table A-5. Column 6 gives the ranking for Belgium based on the first measure, i.e. the number of “yes” answers as a percentage of “yes” + “no” answers (in short: Yes as %). Column 7 gives the ranking for Bel-

gium, based on the second measure (in short: Yes as % of total). Column 8 gives the ranking for the foreign countries, based on the number of firms using ICT technologies for their relations with the customers.

TABLE A-5 - ICT intensity of each business activity

Business activity	1 Yes	2 No	3 Yes+no	4 Yes as %	5 Yes as % of total (1980)	6 Ranking in decreasing order of ICT intensity (yes as %)	7 Ranking in decreasing order of ICT intensity (yes as % of total)	8 Foreign cases (EBIP): ranking in decreasing order
Procurement	377	864	1241	30.38%	19.04%	1	1	2
Promotion-advertising	358	886	1244	28.8%	18.1%	2	2	4
Management Information Systems	307	824	1131	27.14%	15.51%	4	3	1
Logistics and fulfilment	305	810	1115	27.35%	15.40%	3	4	7
Quotations: Negotiations	290	900	1190	24.37%	14.65%	7	5	5
Billing and Payment	286	961	1247	22.94%	14.44%	9	6	6
Customisation	283	793	1076	26.3%	14.29%	6	7	n.a.
Production Management	246	830	1076	22.86%	12.42%	10	8	n.a.
Performance Monitoring	241	904	1145	21.05%	12.17%	12	9	8 (Finance)
Design	240	663	903	26.58%	12.12%	5	10	n.a.
Catalogues/Stock lists	219	752	971	22.55%	11.06%	11	11	3
Market analysis	218	723	941	23.17%	11.01%	8	12	n.a.

Sources: Belgium: EBIS. Own computations.

Foreign countries: EBIP.



Appendix 4: An Attempt of International Comparison of Rates of ICT Diffusion at Firm Level

A genuine statistical comparison with the results of the EBIP project for foreign firms is questionable. First, the EBIP project is a qualitative survey and the figures are not as representative as in the EBIS survey: the EBIP sample contains 217 reporting firms across 14 broadly defined sectors, while the Belgian sample of 220 firms is concentrated in 4 sectors.

Second, the EBIP project has not produced a genuine index of diffusion along the value chain as the one which is computed in tables 8 and A-1.

EBIP merely computes the percentage of firms in the sample which use each technology either with customers or with suppliers, without any distinction according to the business function, i.e. without taking into account the interaction between business activities along the value chain. We have taken the percentages of use with the customers which are higher than the percentages of use with the suppliers.

We posit that it can be matched with the business function “promotion and advertising”, so that we use the figures from Table A-4. We also compare with the rates of diffusion along the whole value chain (i.e. for all 12 business functions) computed in table A-1 where the figures “Yes in %” are taken as higher bounds and the figures “Yes as a % of total possible” are taken as lower bounds of the rate of diffusion.

The results of the comparison show that only for EDI are Belgian firms lagging behind although the smaller size of the Belgian firms and the use of a rate of diffusion along the whole value chain – especially the use of the lower bound – biases the comparison against the Belgian firms.

We also stress that the distinction between tangibles and intangibles does not introduce any important bias in the comparison: thus, 70% of foreign reporting firms are in manufacturing-tangibles sectors and 30% only in services-intangibles sectors; in the Belgian sample, 67% of firms are in manufacturing-tangibles (machinery and printing) and 33% are in services-intangibles (banking and transport).



Appendix 5: Electronic Business Impacts Study (EBIS)

Survey instrument

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A. Section A - Background

General note: Section A can contain as many informational questions as practical concerning the particulars of the individual responding company. The information in the following questions is nevertheless essential as baseline information against which the survey results as a whole will be calibrated and various correlation hypotheses tested.

Implementation note: Any text in curly brackets {...} in this version will appear on screen in the electronic implementation of the survey as additional information upon request, i.e. for clarification. Hence, the electronic BETA version will look 'tidier' than the ALPHA version.

A0 Identification section + {Product code to be determined before the interview is taking place} { pop-up menu}

A1 What are the products and/or services that are sold in the market directly by your enterprise. If your enterprise is part of a larger conglomerate, only mention the products and/or services produced by your local enterprise.

Manufactured products:.....

Services:.....

By "enterprise" one means a firm: it is neither a plant nor a group of companies

[If enterprise produces more than one product and/or service, the interviewer, must clearly state the main product/service group]

{check here with the interviewed person whether the product/NACE code in A0 is correct}

Please note that from now on, this interview will only take into consideration activities relating to

Note also that there will be questions, if applicable, on new or related products/ services later on in the survey.

Notes about the product group orientation of the EBIS instrument:
[not to be included in questionnaire, will be stated in the guidelines for interviewers]

- It is essential that the whole questionnaire be interpreted in a 'product group' context.
- A 'product group' is a range of goods and/or services that have similar characteristics and identical or equivalent use value to a clearly identifiable group of customers.
- Product groups can in some cases be identical with industry sector classifications as used in statistical nomenclatures (usually at 2 - 3 digit levels), but not all product groups correspond in this way. Services, for example, are generally not defined specifically enough in sector nomenclatures to illustrate product group characteristics.
- Product groups must be defined according to the characteristics of the user as well as those of the producer. For example, 'automotive products' would be more a sector classification whereas 'passenger cars' would describe a product group.
- Product group classifications should be pre-selected using the highest level definition that is practical.
- Pre-selection allows for general known historical characteristics of the product group (including official statistical information where available and relevant) to be programmed into the analytical routine.
- Product group classifications should be presented to the respondent in the form of menus in order to facilitate the product group identification process.

A2

Which of the following terms best describes the type of activities of your enterprise with respect to this product/service group?

For goods:

Materials supplier {provides materials for manufacturing components, sub-assemblies according to intermediate and/or final product specifications}	
Component producer {produces specific components and parts for sub-assemblers and/or prime contractors}	
Assembler {assembles systems from various components and materials}	
Prime contractor {integrates components and sub-assemblies into finished products that are sold directly to customers}	

don't know

not applicable

[...] refused

For services:

Design services {undertakes and/or contributes to the design of goods and/or to the content of services}	
Management services {includes all forms of professional and/or consultant services required for the management of an enterprise}	
Support services {includes all outsourced technical and maintenance services}	
Intermediary services {includes all retail, financial, brokerage, marketing, and agency services related to the production and distribution of products and services}	

don't know

not applicable

[...] refused

A3

How much of your primary activity, that is directly related to the production of your main product is performed in-house and how much is done by others? Express your response as a percentage of production costs.

Provided by the company	Procured from wholly owned subsidiaries	Procured from partly owned subsidiaries or through joint ventures	Procured in the open market
%	%	%	%

don't know

not applicable

[...] refused

A4 How much of your secondary activity - accounting, administration, communication etc. - is performed in-house and how much is done by others? Express your response in percentage of costs.

Provided by the company	Procured from wholly owned subsidiaries	Procured from partly owned subsidiaries or through joint ventures	procured in the open market
%	%	%	%

- don't know
- not applicable
- refused

A5 How frequently do enterprises appear or disappear in your line of business? (check as many of the boxes as apply)

	Rarely	Often	Don't know	Na	Refused
Intermediaries enter the market {an intermediary facilitates the purchase or the sale rather than producing itself}					
Intermediaries exit the market					
Suppliers enter the market					
Suppliers exit the market					
Customers enter the market					
Customers exit the market					

A6 The turnover of my enterprise during the past financial year was _____ EURO
{The turnover of each firm of the sample to be looked after in a national databank before the interview - the objective of this question is to check the figure}

- don't know
- not applicable
- refused

A7 As compared with the last 3 to 5 years, the gross revenue from product/service sales that my enterprise earned, has:

- increased [amount excess _____ %]
- decreased [amount shortfall _____ %]
- remained about the same

- don't know
- not applicable
- refused

{explain here the difference between turnover and gross revenue from sales}

A8

What % of total capital investment do ICTs (information and communication technologies) represent on average for your company?

[give figure _____%]

B. Section B - Technology Profile

For each of the following business activities, indicate which technology is actively and regularly used (check as many items as apply for each activity):

Business Activities	Technologies used
1. Promotion and advertising	e-mail
2. Catalogues and stock lists	www
3. Quotations and negotiations{i.e. interactive information services with customers and/or suppliers}	Extranets Intranets EDI/VAN
4. Procurement {i.e. of products and services from suppliers}	Internet EDI CAD/CAM ERP
5. Billing and payment	other (specify)
6. Logistics & fulfilment{including logistics monitoring facilities}	other (specify) don't know Not available
7. Management information systems{i.e. using transaction generated information in general management processes}	Refusal
8. Production management{i.e. using transaction generated information to guide and/or control production processes}	
9. Performance monitoring{i.e. using transaction generated information to assess the efficiency and/or profitability of relationships with specific suppliers or customers}	
10. Customisation{i.e. using transaction generated information to alter product and service characteristics according to demand}	
11. Collaborative product and/or service design{i.e. in co-operation with other firms}	
12. Market analysis{i.e. using transaction generated information to monitor markets and predict trends}	

C. Section C - Relationships with customers and suppliers

1. Part 1 - Customer relationships

C1

Compared to 3-5 years ago, my company now deals with:

more customers [give figure _____ %

fewer customers [give figure _____ %

about the same number of customers

don't know

not applicable

[...] refused

C2

Change in the number of customers is due:
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- mainly to other factors - our electronic transaction capability played no significant role

- don't know
- not applicable
- [...] refused

C3

Compare the sales distribution in your customer base to 3-5 years ago:
(select only one scenario and only one item in that scenario)

- the value of sales per customer has increased
- the value of sales per customer has decreased
- the value of sales per customer has not changed significantly

- don't know
- not applicable
- [...] refused

C4

Change in the total value of sales per customer is due:
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- mainly to other factors - our electronic transaction capability played no significant role

- don't know
- not applicable
- [...] refused

C5

At the present time, the share of retained customers is:

- less than 20% of customers
- between 21% and 50%
- more than 51% [give figure ____%]

- don't know
- not applicable
- [...] refused

-
- C6** Compared to 3-5 years ago, the share of retained customers has:
- significantly increased
 - significantly decreased
 - remained about the same

 - don't know
 - not applicable
 - [...] refused
- C7** Change in the share of retained customers is due:
(check only one)
- mainly to our electronic transaction capability
 - to our electronic transaction capability and several other factors
 - entirely to other factors - our electronic transaction capability played no significant role

 - don't know
 - not applicable
 - [...] refused
- C8** Our retained customers generate _____% [give approximate figure] of total sales.
If figure unavailable, check don't know.
- C9** Compare the sales distribution among retained customers to 3-5 years ago:
- the value of sales per retained customer has increased
 - the value of sales per retained customer has decreased
 - the value of sales per retained customer has not changed significantly

 - don't know
 - not applicable
 - [...] refused
- C10** Change in the value of sales to retained customers is due:
(check only one)
- mainly to our electronic transaction capability
 - to our electronic transaction capability and several other factors
 - entirely to other factors - our electronic transaction capability played no significant role

 - don't know
 - not applicable
 - [...] refused
-

C11 What is the geographical distribution of your customer base? Express the distribution as a % of the total amount of customers.

Local customers ____% don't know
Domestic customers ____% don't know
Foreign customers ____% don't know

C12 Compared to 3-5 years ago how has the geographical location of customers changed

Number of local customers has:

[...] increased
 [...] decreased
 [...] remained stable

[] don't know
 [] not applicable
 [...] refused

Number of domestic customers has

[...] increased
 [...] decreased
 [...] remained stable

[] don't know
 [] not applicable
 [...] refused

Number of foreign customers has:

[...] increased
 [...] decreased
 [...] remained stable

[] don't know
 [] not applicable
 [...] refused

C13 Change in the geographical distribution of the customers is due:
(check only one)

[] mainly to our electronic transaction capability
 [] to our electronic transaction capability and several other factors
 [] entirely to other factors - our electronic transaction capability played no significant role
 [] don't know

2. Part 2 - Suppliers relationships

- C14** Compared to 3-5 years ago, my company now deals with
- more suppliers [give figure _____ %
 - fewer suppliers [give figure _____ %
 - about the same number of suppliers

 - don't know
 - not applicable
 - [...] refused
- C15** Change in the number of suppliers is due:
(check only one)
- mainly to our electronic transaction capability
 - to our electronic transaction capability and several other factors
 - mainly to other factors - our electronic transaction capability played no significant role

 - don't know
 - not applicable
 - [...] refused
- C16** Compare the distribution of the value of purchases from your suppliers to 3-5 years ago:
(select only one scenario and only one item in that scenario)
- the value of purchases per supplier has increased
 - the value of purchases per supplier has decreased
 - the value of purchases per supplier has not changed significantly

 - don't know
 - not applicable
 - [...] refused
- C17** Change in the total value of purchases per supplier is due
(check only one)
- mainly to our electronic transaction capability
 - to our electronic transaction capability and several other factors
 - mainly to other factors - our electronic transaction capability played no significant role

 - don't know
 - not applicable
 - [...] refused
-

C18 At the present time, the share of repeat suppliers is:

- less than 20% of suppliers
- between 21% and 50%
- more than 51% [give figure ____%]

- don't know
- not applicable
- [...] refused

C19 Compared to 3-5 years ago, the number of repeat suppliers has

- significantly increased
- significantly decreased
- remained about the same

- don't know
- not applicable
- [...] refused

C20 Change in the number of repeat suppliers is due:
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- entirely to other factors - our electronic transaction capability played no significant role

- don't know
- not applicable
- [...] refused

C21 Our repeat suppliers represent ____% [give approximate figure] of the total value of purchases.
If figure unavailable, check don't know.

C22 Compare the distribution of the value of purchases among repeat suppliers to 3-5 years ago:

- the value of purchases per repeat supplier has increased
- the value of purchases per repeat supplier has decreased
- the value of purchases per repeat supplier has not changed significantly

- don't know
- not applicable
- [...] refused

C23

Change in the value of purchases per repeat supplier is due:
(check only one)

- mainly to our electronic transaction capability
 to our electronic transaction capability and several other factors
 entirely to other factors - our electronic transaction capability played no significant role
- don't know
 not applicable
 refused

C24

What is the geographical distribution of your supplier base? Express the distribution as a % of the total amount of suppliers.

- | | | |
|--------------------|--------------------------------|-------------------------------------|
| Local suppliers | <input type="checkbox"/> ____% | <input type="checkbox"/> don't know |
| Domestic suppliers | <input type="checkbox"/> ____% | <input type="checkbox"/> don't know |
| Foreign suppliers | <input type="checkbox"/> ____% | <input type="checkbox"/> don't know |

C25

Compared to 3-5 years ago how has the geographical location of suppliers changed?

Number of local suppliers has:

- increased
 decreased
 remained stable
- don't know
 not applicable
 refused

Number of domestic suppliers has:

- increased
 decreased
 remained stable
- don't know
 not applicable
 refused

Number of foreign suppliers has:

- increased
 decreased
 remained stable
- don't know
 not applicable
 refused

C26

Change in the geographical distribution of the suppliers is due:
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- entirely to other factors - our electronic transaction capability played no significant role
- don't know

D. Section D - Business processes

D1

Is the information required to initiate and execute a transaction electronically accessible to one or more customers or suppliers?

{e.g. each enterprise has access to the product database, price specifications, etc.

- Yes No Don't know

D2

Does your enterprise keep in electronic form any of the information that is generated by electronic transactions with customers and/or suppliers?

D2.1 ...information received from customers is kept in electronic form:

- Yes No Don't know

D 2.2 ...information received from suppliers is kept in electronic form:

- Yes No Don't know

<< if NO in both categories then GO TO D5 - D10 and skip section E. >>

D3

Is any of the information generated by electronic transactions accessible electronically to different departments within the enterprise?

D3.1 ...information from transactions with customers is accessible:

- Yes No Don't know

D3.2 ... information from transactions with suppliers is accessible:

- Yes No Don't know

[only if answer to D3.1 or D3.2 = Yes]

D4 Is any of the information generated by electronic transactions also accessible electronically to one or more of your suppliers or customers?

D4.1 with customers:

Yes No Don't know

D4.2 with suppliers.:

Yes No Don't know

D5 How are total business process costs different than they were 3-5 years ago?

[...] Equal [...] Higher [...] Lower

[for higher and lower, present drop down menu with list of these options:]

up to 5%
 up to 10%
 up to 25%
 up to 50%
 over 50%
 don't know

D6 Changes in business process costs are due:
(check only one)

mainly to our electronic transaction capability
 to our electronic transaction capability and several other factors
 entirely to other factors - our electronic transaction capability played no significant role

 don't know
 not applicable
 refused

D7 How are labour costs different than they were 3 - 5 years ago ?

[...] Equal [...] Higher [...] Lower

[for higher and lower, present drop down menu with list of these options:]

- up to 5%
- up to 10%
- up to 25%
- up to 50%
- over 50%
- don't know

D8

Changes in labour costs are due
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- entirely to other factors - our electronic transaction capability played no significant role

- don't know
- not applicable
- [...] refused

D9

How are total gross revenues different than they were 3-5 years ago?

- [...] Equal [...] Higher [...] Lower

[for higher and lower, present drop down menu with list of these options:]

- up to 5%
- up to 10%
- up to 25%
- up to 50%
- over 50%
- don't know

D10

Changes in total gross revenues are due:
(check only one)

- mainly to our electronic transaction capability
- to our electronic transaction capability and several other factors
- entirely to other factors - our electronic transaction capability played no significant role

- don't know
- not applicable
- [...] refused

E. Section E - Products and services

- E1** Do you offer customised products and/or services to your customers?
- Yes No Don't know
- << if NO then go to E7 >>
- E2** What percentage of customers electronically specify individualised product and/or service requirements to your company?
- none
 up to 5%
 up to 10%
 up to 25%
 up to 50%
 over 50% [give figure ____%]
 don't know
- E3** What is the present value of sales of customised products and/or services as a percentage of total sales revenue?
- none
 up to 5%
 up to 10%
 up to 25%%
 up to 50%
 over 50% (specify ____%)
 don't know
- E4** Compared to 3-5 years ago, has the value of sales of customised products as a percentage of total sales revenue
- [...] increased
 [...] decreased
 [...] remained about the same
- E5** Changes in the value of sales of customised goods and services are due... (check only one)
- mainly to our electronic transaction capability
 to our electronic transaction capability and several other factors
 entirely to other factors - our electronic transaction capability played no significant role
 don't know

E6 In which ways is information generated from transactions with customers used to exploit the commercial potential of customisation?
(check as many as apply)

- through customer profiling
- through procurement efficiencies
- through co-ordinated design, production and distribution processes with suppliers and distributors
- other(specify _____)
(specify _____)
- don't know

E7 Have you placed new or substantially different products and/or services in the market during the past 3 tot 5 years?

- Yes
- No
- Don't know

<< if NO then go to E12 >>

E8 What is the present value of sales of new or different products/services as a percentage of total sales revenues?

- none
- up to 5%
- up to 10%
- up to 25%%
- up to 50%
- over 50% (specify ____%)
- don't know

E9 Compared to 3-5 years ago, has the value of sales of new or different products/services as a percentage of total sales revenue

- [...] increased
- [...] decreased
- [...] remained about the same

E10 New product and/or service developments are driven ...
(check only one)

- mainly by our electronic transaction capability
- by our electronic transaction capability and several other factors
- entirely by other factors - our electronic transaction capability played no significant role
- don't know

E11 In which ways is information generated from transactions with customers used in support of new product and/or service development?

- contributes to customer profiling
 contributes to assessments of market potential
 helps co-ordinate design and production processes with other companies
 other(specify _____)
(specify _____)
(specify _____)
 don't know

E12 Check as many of the following as apply.
During the past year, my firm offered customers...

- new bundled product offerings
(i.e. linked the purchase of one product to the purchase of another)?
 new bundled service offerings
(i.e. linked the purchase of one service to the purchase of another)?
 new bundled product-service offerings
(i.e. linked the purchase of a product to the purchase of a service)?
 no new bundled product or service arrangements
 don't know

<< if NO then END SURVEY HERE>>

E13 Do these links involve collaboration and/or procurement from other companies (i.e. providers of complementary goods and/or services)

- Yes No Don't know

E14 What proportion of gross revenues comes from the sale of complementary products and/or services as provided by your own company?

- none
 up to 5%
 up to 10%
 up to 25%%
 up to 50%
 over 50% (specify _____%)
 don't know

E15 What proportion of gross revenues comes from the sale of complementary products and/or services as procured from other companies?

- none
- up to 5%
- up to 10%
- up to 25%%
- up to 50%
- over 50% (specify ____%)
- don't know

E16 Product and service bundling are driven ...
(check only one)

- mainly by our electronic transaction capability
- by our electronic transaction capability and several other factors
- entirely by other factors - our electronic transaction capability played no significant role
- don't know

E17 In which ways is information generated from transactions with customers used in support of bundling products, services, or product and services?

- customer feedback
- assessments of market potential
- co-ordination of bundling process with other suppliers
- other(specify _____)
- (specify _____)
- (specify _____)
- don't know

E18 Compared with 3 - 5 years ago has the value of sales of complementary products and/or services as a proportion of gross revenues

- [...] increased
- [...] decreased
- [...] remained about the same

<< END of SURVEY >>