

Integration of ICT in firms: what impact on their partnerships?

An analysis of firms established in Luxembourg

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Abstract: The aim of this paper is to analyse whether the strategic choice of making a partnership for a firm is influenced by the number of Information and Communication Technologies (ICT) the enterprise owns and uses for its activities.

In order to realize this objective, an analysis has been undertaken by using data collected in 1400 firms installed in Luxembourg. We have surveyed these enterprises about their usages of ICT on one hand, and on the partnerships they have made with their main partner(s) on the other hand.

The results of our model show that firms which use many ICT have a higher probability to make a partnership in comparison with firms which use only few ICT.

1 Introduction

With the increasing number of new information and communication systems, the interest for the study of relationships between economic actors, and the one of organizational strategy directed to outsourcing, have grown.

The integration of Information and Communication Technologies (ICT) has indeed changed the relationship between the firms and their partners. By reducing progressively the spatial and temporal constraints by the digitalization of the organisational coordination and communication systems, the share of information or transactions between the employees of the same firm and/or between the many external structures seem to be facilitated [KK03] [DM02].

New forms of organizations appear, the extended firms, giving the enterprises new views and new opportunities in the strategic choice of the collaborative work. Henceforth, the firm can, at a lower cost thanks to the ICT, choose to outsource part of its activity and thus create preferential relationships with its suppliers and its subcontractors [Pa98]. As the firm does not have any temporal and spatial constraints, it can also choose to share a common project with partners which are

not necessarily located in the same region or country and use other means of communication than face to face meetings to communicate.

If it is thus clear that new forms of collaboration appear thanks to the ICT, in this paper, our problem will focus on the use of the ICT in terms of intensity or degree of ICTs' usages and the influence of this intensity on the decision for firm to collaborate with another structure. We mean by intensity or degree of ICT usages, the number of ICT used (1, 2...) by firms and not the frequency of use (sometimes, often...). The question we would like to answer here is: has the more or less intensive use of ICT (from 1 to n ICT use) by the firm an influence on the fact for this firm forms a new partnership?

In order to analyze this, a survey on 1400 enterprises established in Luxembourg has been made in 2005 on their equipment and usages of technologies and on the characteristics of their collaboration with other organizations (other enterprises, university...). After a first part which describes the main characteristics of the partnerships made in Luxembourg, we will focus, in the second part, on the link between the fact to make a partnership and the degree of ICT usages.

2 Subcontracting and partnership: the main characteristics

The notion of partnership is quite difficult to define. In our survey, to help firms, the partnership was defined as a more or less formal and organized relationship between the firm and one or more structures (other firms, university, research centers...) in order to achieve a common objective. The usual relationships between customers / suppliers, the financial relationships as well as the ones with a temporary employment agency were excluded from our definition¹.

2.1 Less than 20% of firms outsource some of their activities

Among the firms of our sample, 15.7% declare to outsource some parts of their activities outside of their corporate body. Big enterprises are more inclined to outsource activities. If, among firms of 50-99 employees or more than 100, respectively 22.6% and 26.4% appeal to subcontractors for some of their activities, there are 15.0% among the ones which employed between 20 and 49 persons and 10.8% for the ones of less than 20 persons employed. Concerning the economic sectors, the financial sector (32.7%) and the business services sector (22.7%) are the ones which are more likely to outsource parts of their activities.

Most of firms have outsourced activities concerning the information technology or telecommunications (68.5% of firms - see appendix 1). This is certainly due to the

¹ Are also excluded of the definition: usual relationships with the same service providers of the firm, to administration, trade association, chamber of commerce as well as the relationships for purchases of licences.

fact that the firms do not always have the time to adapt to the fast changes and updates in such technologies besides their main activities.

In addition, a little less than 1 firm out of 2 appeal to subcontractors for the following fields: distribution, logistics and transport. It concerns indeed 43.0 % of firms. Finally, approximately one third of firms do outsourcing for administrative tasks or financial work (37.1 % of companies), for marketing or communication services (36.2 %), for services (35.4 %) and finally for the management of human resources (32.8 %).

2.2 Less than one fifth of firms has a relationship with another structure

In 2004, among the 1400 respondents of our survey, we have noticed that about 20% (17.1%) of them have formed a partnership with either a university or another firm or research center..., which is not a very high proportion. Here, as in the outsourcing, the firms that have most often collaborated are big firms and firms from the business services and financial sectors.

By size, the small firms are 12.6% (less than 20 persons employed) and 16.9% (20-49 persons employed) to have a partner in 2004 whereas there are 21.4% of firms of 50-99 persons employed and 27.6% of big firms (more than 100 persons employed) that have made such a partnership.

Concerning the economic sectors, 36.0% of firms belonging to the business services sector have at least one partner in 2004 and it is also the case for 30.4% of the firms of the financial sector.

Most of the firms which have not formed a partnership declare that they do not feel the need for such relationships with other structures (78.5%). In the same way, two firms out of five (41.0%) consider their enterprise too small to be able to create partnerships with other economic actors. Moreover, these collaborations are considered not to be very profitable or too constraining for respectively 29.3% and 26.5% of enterprises. Finally, less than one tenth of firms, which have not collaborated, declare that it is due to not very conclusive previous experiences (9.7%) or because they never found partners (8.2%).

2.3 About 25% of firms which have made partnerships collaborate with 3 main partners

Our questions about the main characteristics of partnerships concentrate on the three main structures² with which they have created these partnerships to achieve a common goal. Thus, in 2004, approximately one quarter of firms (25.3%) collaborate with three partners.

² Main structures means structures that firms consider as the most important on an economic and strategic level.

The type of partners varies according to whether we observe the relationship with the first partner (P1) or the two other partners (P2 and P3). Indeed, concerning the partnerships with P1, it seems like P1 is the most often another firm of the same group (57.5%) whereas P2 and P3 are most often suppliers and customers (42.0%) and university or research centers (37.9%) (see appendix 2).

Concerning the location of the main partners, most of them are established either at a national level or European level (France, Belgium or Germany or other country of the European Union) and very few relationships are formed with partners located in the United States or others. A little less than 50% of firms (46.1%) collaborate with their first partner located in Luxembourg³ (see table 1). For collaborations with the two other main partners, these latter are more often established in another European Union country than in Luxembourg or other countries (47.9% of the companies for P2 and 52.0% for P3).

Table 1: Distribution of firms which have made partnerships in 2004 according to the country where their main partners are located.

	P1	P2	P3
Luxembourg exclusively	46.1%	41.3%	30.0%
Other countries of European Union exclusively	38.1%	47.9%	52.0%
Other cases	15.8%	10.8%	18.0%
Total	100.0%	100.0%	100.0%

Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

The location of the partners depends on the reputation of the firm. Thus, most of the enterprises having a local or national reputation would tend to carry out more partnerships with structures in Luxembourg.

On the contrary, firms whose reputation is international will collaborate more with companies located far from Luxembourg, even from the European Union.

For example, P1 is established in Luxembourg for nearly two thirds of the companies known at the local level (66.7%) or national level (60.4%) whereas this is the case only for 30% of the companies known at the international level.

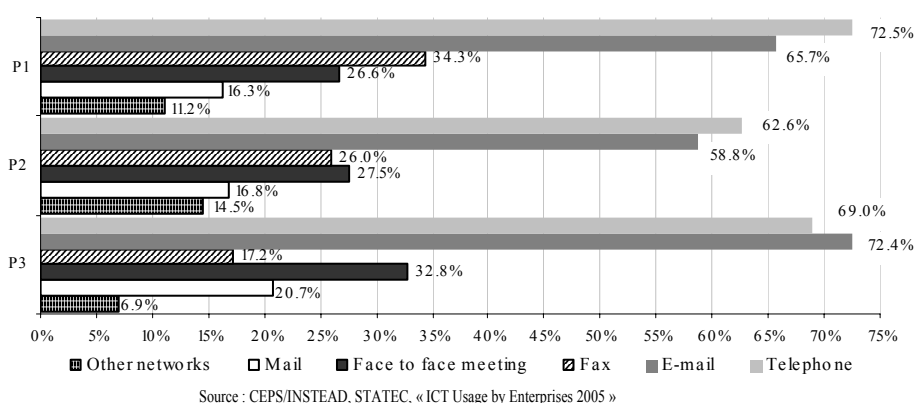
Finally, 68.7% of the companies whose reputation is international form partnerships with companies only located in the European Union (48.7%) or in the rest of the world (20.0%)⁴.

³ It concerns 41.3% of firms for P2 and 30.0% for P3.

⁴ It concerns respectively 33.3% and 39.6% of firms known at a local and/or a national level.

2.4 The phone and the e-mail are the main means of communication used between partners

If we look more precisely at the means of communication between our enterprises and their partners, we notice that whatever the partner, the telephone and the e-mail are the means most often used to share information. Thus, among the firms which have formed a partnership with P1, 72.5% use the telephone and 65.7% share information by e-mail (respectively 62.6% and 58.8% for P2, 69.0% and 72.4% for P3 - see graph 1). To a lesser extent, between 20% and 30% of firms collaborating communicate with their partners via the traditional means of communication like the fax, the mail or face to face meeting. On the contrary, few enterprises first use other networks such as the Internet, EDI⁵ or the videoconference and the group's project manager to communicate: only 11.2% of firms are using such technologies with P1, 14.5% with P2, and 6.9% with P3.



Graph 1: Distribution of firms which have made partnerships in 2004 according to the means of communication used between partners to share information.

The means of communication are not chosen “by chance” but often depend on the geographic distance between the two partners. More precisely, if we look at the relationships between firms and P1 exclusively, we notice that the phone is more often used if P1 is established in Luxembourg (80.0% of firms) than if P1 is located in United-States or another country except the ones in the European Union (55.6%). Contrary to that, firms use more often the e-mail if their partners are not established in Luxembourg (the effect is less obvious but still significant): 63.8% of firms whose partner is in Luxembourg share information via e-mail, whereas it concerns 70.0% of firms whose partners are located in another country.

⁵ Electronic Data Interchange.

2.5 The firms which have formed partnerships seem to have more ICT than other firms

Almost all of the firms of our sample, with a partner or not, have facilities such as a computer, the Internet, and LAN. For instance, 99.6% of firms with a partner have the Internet compared to 94.8% of firms which do not have a partner (see appendix 3).

Furthermore, we have noticed significant differences as for the usage of other technologies whether the firm has partners or not. Thus, if almost all the firms with a partner are using the e-mail in January 2005, there are 86.2% of the firms with no partner. More obviously, we have also noticed that 63.8% of firms which have partners are using technologies such as visioconference, the group calendar, and the group's project manager (VO in the table) whereas this proportion knows a 50% drop for firms which do not have a partner (34.1%). Nevertheless, these results are quite logical since these last technologies have been created for partners located far apart partner to communicate more easily (virtual organization for exemple).

3 Partnership and degree of ICT usage

The emergence and the usage of ICT these last years lead to significant changes in the management patterns of the firm and allowed to facilitate the sharing of information between the different economic actors by reducing the spatial and temporal constraints [Me03]. The type of relationship between firms tends to change and, therefore, new forms of cooperation between firms and other structures appear.

3.1 The changes

The changes due to the appearance of the new technologies have an impact on the internal management as well as on the management with external partners.

At first, at the internal level, the integration of ICT changes the management of the firm, firm which becomes more flexible thanks to the faster sharing of information between the different actors of the firm [DM02], wich enables therefore the openness of information at all the hierarchical levels [JK04]. The intranet, among others, gives the possibility to members of the same firm to work together without hierarchical or organizational constraints [Bla00].

Then, at the external level, the ICT usage modifies and strengthens the current links between the firm and its closer collaborators. The Extranet, but also the EDI, facilitate the sharing of information and the transactions between the firm and its customers and suppliers [WB03] [Ka03]. Another type of collaboration is also

possible: some firms may choose to focus on their particular know-how and to outsource a part of their activities for which they have no specific skills [KK03].

Finally, the digitalization of information systems and the communication technologies give the opportunity to the firm to appeal to more partners located further away (geographically) from them (which was almost impossible without these technologies). Given that these spatial and temporal constraints slowly disappear, the increased number of ICT enable firms to develop new forms of partnerships between different firms and/or between firms and other structures. There can be partnerships between companies whose skills are complementary, or strategic alliances between competitors. For example, for their collaborations with their key partners, many firms already have and use services of the Internet [UI03] [MS04]. There is even an extreme case where several structures, which do not care about their geographic location and that share a common purpose, use only and in a very extensive way ICT, as the visioconference, the group calendar, and the group's project manager. Without any face to face meetings, all these structures work on a common project and thus form a virtual organization [Mei00].

As the integration of the ICT in the economy have modified and increased the number of relationships existing between them, we can wonder if, once the ICT are settled in the firm, their degree of usage by firms influences the fact of making a partnership or not. In other words, has a firm using only few ICT fewer chances to form a partnership than a firm using a lot of ICT? Studies have already shown that the adoption and the use of these technologies have led to profound changes within the enterprise both at the managerial and the strategic level (essentially concerning sharing of information) [AK04] but what is their impact on the decision-making of collaborations with external partners?

3.2 Has the degree of ICT usages an influence on the decision for firms to collaborate?

The aim of this part is to analyze the characteristics, the number of ICT used in particular, that lead a firm to make a partnership or not. In order to realize this study, we will run a "logit" model where the dependent variable "partnership" contrasts: having a partner (value 1) against having no partner (value 0). In order to estimate this model, we have two categories of explanatory variables: some variables on the ICT used (variables of interest) and some variables on the economic feature of enterprises and on their security facilities. We will use the collected data of 1400 enterprises located in Luxembourg which have participated in our survey.

3.2.1 The explanatory variables

In order to analyse our topic of study, a variable on the degree of ICT usages has been created. In our survey, firms are questioned about their usages of ICT in January 2005, and the aim for us is to distinguish the ones which use an important

number of ICT from those which use only a few or none of them. We take into account the following ICT: the usage of wireless LAN, other LAN, the Intranet, the Extranet, the e-mail, the Internet, the visioconference, the forum, the group calendar, the group's project manager, the IT systems to manage the placing or receipt of orders, a web site, and finally the EDI. We have summed up all these ICT used by the enterprises. This variable varies from 0 (none ICT used) to 12 (for 12 ICT used) and from this we have built four classes (see table 2).

Table 2: Distribution (%) of firms according to their degree of ICTs' usages in January 2005.

	All firms	<u>Firms which have made partnerships</u>	<u>Firms which have not made any partnership</u>
Do not use or use only few ICT [0-3]*	22.4%	8.1%	25.5%
Use a medium number of ICT [4-5]	33.6%	24.4%	35.4%
Use many ICT [6-7]	26.6%	33.1%	25.3%
Very intensive usage of ICT [8 or more]	17.4%	34.4%	13.8%
Total	100%	100%	100%

Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

*: number of ICT used by the firm

We notice that firms which have made partnerships tend to use much more ICT than firms which do not have a partner. A little more than one third of firms with partners (34.4%) use indeed more than 8 ICT during their job time while they represent only 13.8% among those which have not made a partnership. On the contrary, few firms with partners use none or only few ICT (8.1%), while they are a little more than 25.0% among those which have not made any collaboration with other structures.

As part of the estimation of our model, and as we suspect a potential endogeneity of this variable and thus important bias in the estimation of the behavior of firms, we applied the method of the instrumental variables to estimate the model. However, the null hypothesis of exogeneity (test of Wald⁶) of the variable has not been rejected and we present, therefore, in this paper "the logit model".

The decision to form a partnership can also depend on other variables such as variables on the economic feature of the firms. Indeed, the size of the firm [DLS90] [PP93], its sector of activity, its position on the market (leader, challenger...), or its reputation (local, national, international) can all have an impact on the decision to make collaborations with other structures. The intensity of the competition in its sector can also have an effect on the forming of

⁶ Wald test of exogeneity ($\theta=0$) : $\chi^2(1) = 2,51$ Prob> $\chi^2 = 0.1128$

partnerships. The growth of the competition at the world level leads firms to think about their organizational strategy and therefore to collaborate. More exactly, the intensity of the competition induces firms to form strategic alliances to enable them to specialize in a field, to share risks and costs and especially to make economies of scale [Ma96].

Explanatory variables on the security facilities were also included in the model. We think indeed that the more an enterprise has a secure system, the more it will be prepared to make partnerships with other structures without being afraid to be confronted with computer viruses, or attacks resulting in loss of information or working time and/or blackmail or threats to the enterprise data or software. The security facilities that a firm can have are, among others, virus checking (or protection software), firewalls (software or hardware), secure servers (support secured protocols) or other security facilities used to communicate such as data encryption for confidentiality⁷.

3.2.2 The results

Concerning the economic features, we have observed some differences in the probability to form a partnership according to the size and the economic sectors of enterprises.

Big enterprises (more than 100 persons employed) seem to make more partnerships than small firms (0-19 persons employed - cf. appendix 4). In order to evaluate more precisely each impact of the variables on the dependent variable, we have calculated the probability to make a partnership for a classic firm⁸ and then we calculate again a probability with only one change in one of our variables. The classic firm (small size) obtains thus a probability of 12.1% to form a partnership, all other thing being constant, whereas this probability is equal to 20.8% for big firms.

Our model also highlights the differences between the sectors. Compared to the sector of industry, the sector of trade has a negative effect on the probability to collaborate with other structures whereas the fact to belong to the financial and the business services sectors has a positive impact on the fact of making a partnership. Therefore, in descending order, the firms of the financial and of the business services sectors have a probability of 26,6 % to realize a partnership, and this

⁷ More precisely, enterprises were surveyed about 8 kinds of security facilities: virus checking or protection software, firewalls, secure servers, off-site data backup, electronic digital signature as customer's authentication mechanism, other authentication mechanism (e.g. PIN code), data encryption for confidentiality, electronic digital signature with the e-mail whose date is authenticated by a third party.

⁸ Small firm (0-19 employees) from the industry sector, leader on the market and having a national reputation. The competition in its sector is intense. This firm have an average number of security facilities (3-4 facilities) as well as it uses an average number of ICT (4-5 ICT). The probability for this firm to form a partnership is about 12.1%.

probability falls respectively to 12.1 % for the enterprises belonging to the sector of industry (classic firm) and 4.4 % for those of the trade sector.

On the contrary, neither the position on the market of the firm, nor its reputation, nor the intensity of the competition in its sector seem to have an effect on its collaboration with external actors.

Concerning the security facilities (firewalls, digital electronic signature), a little secured firm have a lower probability to collaborate with other structures than a firm which is moderately secured (our classic firm). More exactly, if our classic firm (with 3-4 security facilities) has 12,1% chance to form a partnership, this probability falls to 6,4 % for enterprises which are little secured or not secured at all.

If we look now at our main explanatory variable and given the previous descriptive results, we expect some effects of the degree of ICT usages on our dependent variable. Indeed, if it's true that the more a firm uses ICT to work and communicate, the more its chances to create a partnership with another structure increase then, on one hand, the expected effect from our variable "degree of ICT usages" on our variable "partnership" must be significantly positive and, on the other hand, this effect must be much more significant at every level of ICT usages.

The results of our "logit model" are in agreement with our expectations. If there is no significant difference concerning the decision of collaboration between firms which do not use ICT and firms which use an average number of ICT (our classic firm), we observe nevertheless that the more a firm uses ICT, the more its chances to form a partnership increase (cf. appendix 4). An enterprise using 6 or 7 technologies has a probability to form a partnership, compared to the probability not to have formed it, which is 1.7 times higher in comparison with the classic firm using an average number of ICT. The difference is even more obvious if we compare our classic firm (use a medium number of ICT) to a firm using an important number of technologies (more than 8): the probability ratio is indeed multiplied by 2.6. These results thus confirm our hypothesis from the descriptive analysis. On one hand, the number of ICT used influences positively and in a significant way the fact for a firm to collaborate with other structures and it seems, on the other hand, that the more the number of technologies used increases, the more important is this effect.

To illustrate more clearly these results, we have calculated the probability to form a partnership for our classic firm (which uses an average number of technologies) by changing only the number of ICT this firm used (for the classes whose difference is significant - see table 3).

Table 3: Probability, *ceteris paribus*, for a firm to form a partnership according to the number of ICT used for its activities

	Probability to have a partner
<u>The classic firm :</u>	
Use an average number of technologies [4-5]	12,1%
Use many [6-7] technologies	18,7%
Very intensive usage of technologies (<u>more than 8 TIC</u>)	26,2%

Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

The probability for our classic firm, using an average number of ICT, to form a partnership is therefore equal to 12.1 %. As we have noticed it before, this probability increases significantly at every level of usage of the technologies. Therefore, all other thing being constant and in comparison with the classic firm, an enterprise using between 6 and 7 technologies have 18.7 % chance to form a collaboration. And the chances increase for the ones using more than 8 technologies: their probability to collaborate with the other structures is equal to 26.2 %.

4 Conclusion

We have noticed, thanks to the data collected in 2005, that a little less than one enterprise out of five in Luxemburg has formed a partnership with other structures (other firms, research centers, university) in a more or less formal and organized way to reach a common goal. The partners are often located in Luxemburg or in another country of the European Union. Partners are usually firms of the same group or structures from their close professional environment such as their suppliers and customers (except usual relations).

Still very often used, the telephone is the main mean of communication between the partners, even though the e-mail has taken a significant place in the sharing of information and is, in 2004, the second mean of communication the most used between partners. Furthermore, comparing the firms forming partnerships to those which do not form one, we notice that the first ones always use more Information and Communication Technologies than the others.

The results of our model “all other thing being constant”, which analyze the influence of, among others, the degree of ICT usages on the fact to make a partnership, reinforce the trend we have observed at the descriptive level (firms with partners seem to use more ICT than firms with no partner). Not only enterprises appear to have more chances to form a partnership if they use a lot of technologies but these chances seem to increase with the number of ICT used.

There are however some limits in this study, limits which could be the subject of future researches. On one hand, besides the number of ICT usages, it would be

interesting to survey enterprises about their frequency of use of these ICT (often, never ...) in order to be able to distinguish firms that use ICT more often within their organization (sharing of information via the Intranet for instance) from firms that use ICT to collaborate with external actors (visioconference, the group calendar, and the group's project manager). On the other hand, concerning the dependent variable "partnership", it would be interesting to distinguish more exactly the different kinds of partnerships by studying only firms that have partners. The different kinds of partnerships can be : partnership according to the number of partners, to the location of the partners, to the type of partners (other firms, universities etc.). Unfortunately, because of the small size of our sample, we couldn't run any significant model in this paper, but if, in the future, we succeed in surveying more companies, maybe we could find the same results as Cucchi A. [Cu04] that is to say that ICT usage also change according to the different kinds of partnerships.

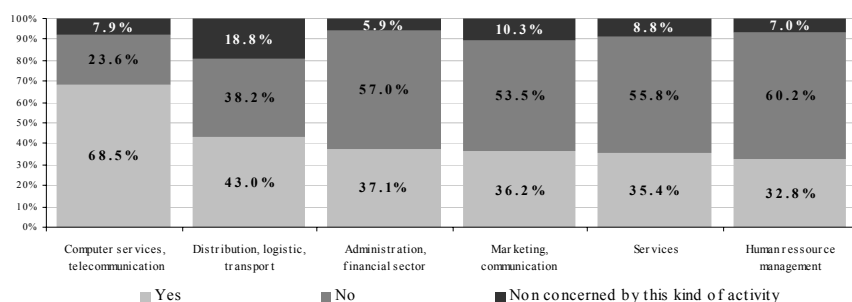
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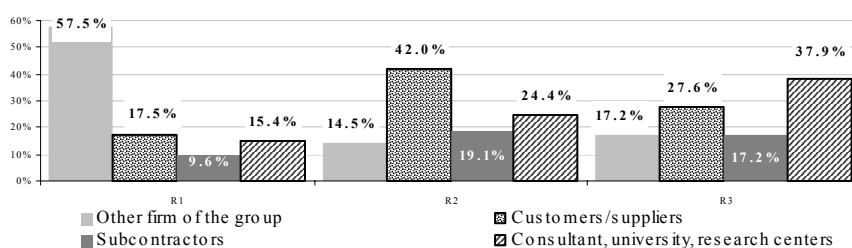
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Appendix



Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

Appendix 1: Distribution of firms which have outsourced some parts of their main activity according to the kind of activities.



Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

Appendix 2: Distribution of firms which have made partnerships in 2004 according to the kind of partners.

Appendix 3: Distribution of firms which have or have not made partnerships in 2004 according to the ICT they have in January 2005.

	Firms with partners	Firms with no partner
Computer	99.6%	97.2%
Internet	99.6%	94.8%
email	98.3%	86.2%
Other LAN	96.6%	93.7%
Web site	75.4%	60.1%
Intranet *	70.6%	52.5%
VO ⁹	63.8%	34.1%
Extranet	49.3%	31.8%
Wireless LAN	20.7%	14.1%
EDI	7.7%	6.6%

Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »

⁹ VO means ICT used for Virtual Organizations such as : the visioconference, the forum, the group calendar, and the group's project manager

Appendix 4: Determinants of the probability to make a partnership

Dependant variable: to make a partnership or not Yes=1 – No=0	Estimate	SE	Pr > ChiSq	OR
Size				
0-19 employees	ref.			
20-49 employees	0.344	0.248	0.165	1.411
50-99 employees	0.496	0.308	0.108	1.642
>=100 employees	0.652	0.298	0.029	1.919
Sector				
Industry	ref.			
Construction	-0.242	0.326	0.458	0.785
Trade	-1.079	0.338	0.001	0.340
Hotel, restaurant	0.504	0.587	0.390	1.656
Transport and communication	-0.225	0.403	0.577	0.799
Business services and financial sector	0.972	0.287	0.001	2.644
Position on the market				
Market leader	ref.			
Market challenger	-0.207	0.208	0.322	0.813
Market follower	-0.304	0.253	0.230	0.738
Developing a new gap on the market	-0.034	0.229	0.882	0.967
Intensity of the competition				
Very intense	0.075	0.210	0.721	1.078
Intense	ref.			
Limited or even very limited	0.432	0.306	0.159	1.540
Reputation				
Local	0.223	0.318	0.484	1.249
National	ref.			
International	0.076	0.224	0.733	1.079
Level of security facilities				
Not very secured [0-2]	-0.691	0.303	0.023	0.501
Moderately secured [3-4]	ref.			
Very secured [5 et plus]	-0.052	0.248	0.833	0.949
Degree of ICT usages				
Do not use or use only few ICT [0-3]	-0.414	0.366	0.258	0.661
Use an average number of ICT [4-5]	ref.			
Use many ICT [6-7]	0.515	0.255	0.043	1.674
Very intensive usage of ICT (more than 8)	0.952	0.282	0.001	2.592
Constant	-1.988	0.388	<.0001	
Max-rescaled R-Square	0.232			

Source: CEPS/INSTEAD, STATEC, « ICT Usage by Enterprises 2005 »