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The use of ICT and the joint activity of the enterprises acting in partnership.

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Abstract: The aim of this paper is the evaluation of the effects of Information and Communication Technologies (ICT) used by enterprises on the partnership.

In order to realize this objective, an analysis has been undertaken by using data collected in 2003 in 2000 enterprises installed in Luxembourg, enterprises which cover almost all economic branches.

The results show that different kinds of ICT have not the same effect on the probability to work in partnership relative to not working in partnership. Only some ICT have a positive effect on collaborative work.

Introduction

With the development of the Information and Communication Technologies (ICT), the relations between enterprises have been widely studied. In particular, many economists have tried to analyse the incidence of the ICT on the work in partnership.

These studies could be justified by the fact that the technologies tend to remove the spatial and temporal boundaries between the actors [Me03] and, consequently, they enable to strengthen the links existing between them. It is globally admitted that ICT have changed the way of being of the firm and therefore its organization. ICT make the internal organization of the firm more flexible and facilitate its exchanges with external actors [DM02]. They also give the firm the opportunity to externalize a part of its activities, to develop partnerships [KK03], to modify its relations with its customers, its suppliers and also the subcontractors [Pa98].

In the consequence of these works, where the ICT relocate activity [BC01], our issue focuses on the effect of the ICT on the partenarial work. The main question we would like to answer is: have the enterprises using ICT a bigger probability to work in cooperation or in a partnership with another organization than other enterprises?

In order to answer this question, we are going to carry out an empirical analysis on the effects of the ICT on the probability to make a partnership. We will therefore use the data collected in 2003 by the survey of the SICOV project¹, financed by the National Research Fund. The data collected from approximately 2000 enterprises in Luxembourg, representing the quasi-totality of the economic sectors, give us the opportunity to study the technologies used by enterprises, the main characteristics of enterprises and finally the existence of a partnership or collaboration with another organization. The term of "partnership", in our study, is used for any type of relation between actors. We shall not distinguish partnerships according to their intensities as [Pe91] or [BK00] can make it. We consider that a firm has already constituted a

¹ System based on the new Information and the Communication Technologies facilitating the electronic business of Virtual Organizations

partnership when it has already shared information (cooperation) and/or shared activities (coordination) and/or shared objectives (collaboration) with another firm. The first part of our paper will focus on the description of the joint work of enterprises established in the Grand Duchy of Luxembourg. The second part will present the characteristics of the enterprises, characteristics which have an influence on the probability, for a firm, to have constituted collaborations with another organization.

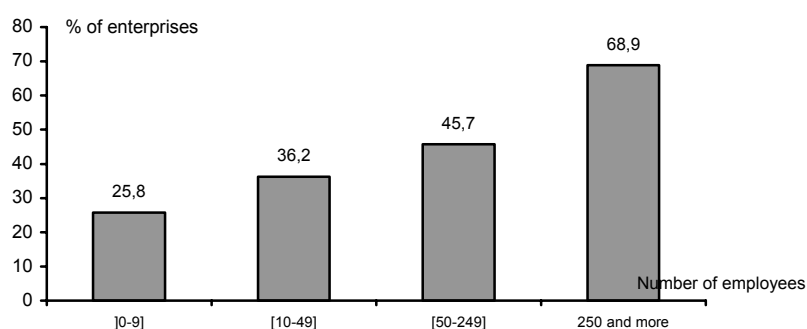
A description of the joint work of enterprises acting in partnership established in the Grand Duchy of Luxembourg

This section will describe successively the characteristics of the enterprises which have already made a partnership, the characteristics of the partners of enterprises, the communications used between the partners and finally, the expectations, the advantages and the difficulties of the partnerships they use to constitute.

The characteristics of the enterprises having already constituted partnerships

Among 1814 enterprises having participated in our survey, 624 (34.4 %) attest to have already made an alliance or a collaboration with another firm. An analysis by size and by activity sector shows that there is a positive and significant relation (test of chi2 significant at 5%) between the fact of making partnerships and the number of employee in the firm and, between the fact of making partnerships and the economic sector of the firm.

A ventilation of enterprises by their number of employee shows that the proportion of enterprises having already formed partnerships is most important for enterprises of 250 employees and more. Indeed, 68.9% of enterprises of 250 employees and more attest having already collaborated with another firm (Fig. 1), while they are only 25.8% among enterprises having less than 10 employees, 36.2% among those having from 10 to 49 employees and 45.7% among the enterprises from 50 to 249 employees.

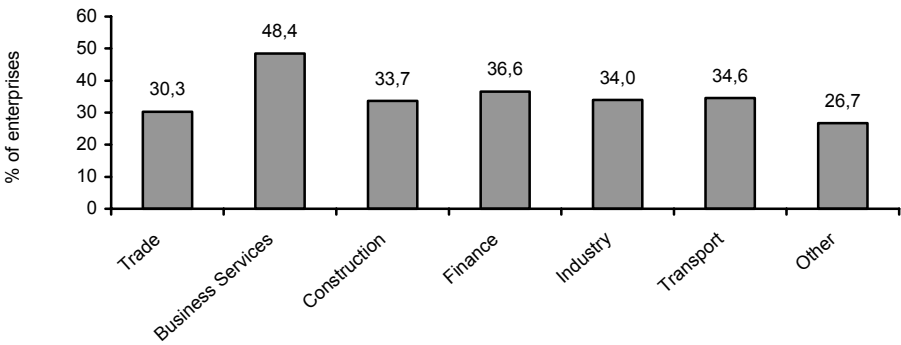


Source: CEPS/INSTEAD, CRP-GL, STATEC, Survey "ICT Usage by Enterprises 2003"

Fig. 1: Proportion of enterprises having already created a partnership or a collaboration with another firm, by size

When we examine the distribution of enterprises having already formed partnerships according to the activity sector, we notice that the service sector stands out because about 50% of the enterprises of this sector (48.4 %) have already collaborated with

another structure (Fig. 2). In all other sectors, approximately one third of the enterprises reply that they have already collaborated with other enterprises.



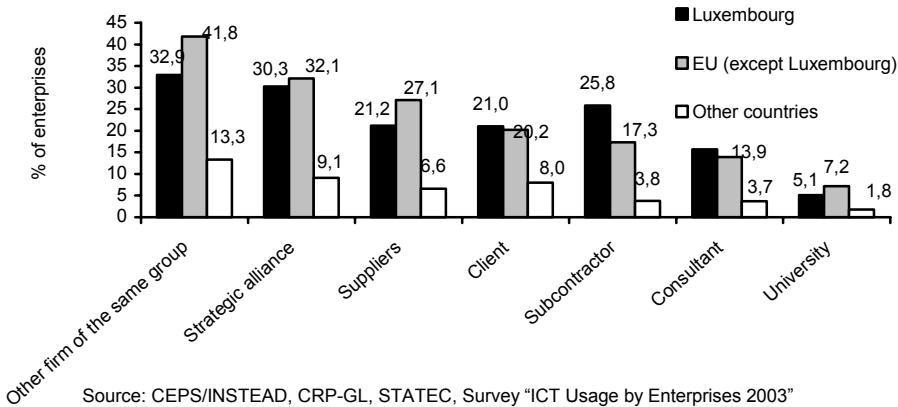
Source: CEPS/INSTEAD, CRP-GL, STATEC, Survey "ICT Usage by Enterprises 2003"

Fig.2: Proportion of enterprises having already created a partnership or a collaboration with another firm, by economic sector

The characteristics of the partners

When we study the type of structures with which enterprises, having participated in our survey, have formed partnerships, we notice that partnerships are mostly created with a firm situated in a country of the EU (excluding Luxembourg) belonging to the same group. More exactly, for 41.8 % of enterprises having formed partnerships, the partner is a firm in another country of the EU, belonging to the same group (Fig. 3).

The second type of the most common partnership is the collaboration with strategic partners (called like that for their specific skills contribution). The strategic partner is, indeed, mostly (32.1 %) established in another country of the EU.



Source: CEPS/INSTEAD, CRP-GL, STATEC, Survey "ICT Usage by Enterprises 2003"

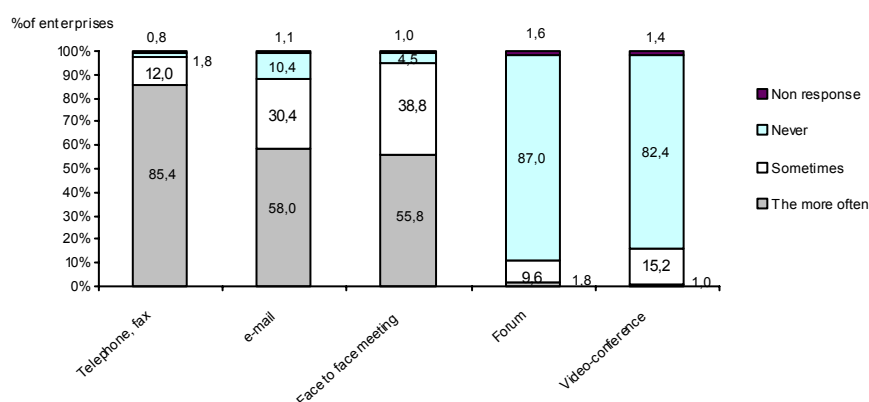
Fig. 3: Distribution of enterprises according to the kind of their partners

To a lesser extent, enterprises form partnerships with Luxembourg consultants or councillors (15.7 % of cases), with consultants or councillors from EU except Luxembourg (13.9 % of cases), with Luxembourg universities and/or research centres (5.1 % of cases) and with universities and/or research centres from another country of the EU (7.2 % of cases).

The means of communication used between partners

When we analyze the means of communication used by enterprises having formed partnerships, we notice that the telephone/fax is the mean of communication the most frequently used. More than eight enterprises out of ten (85.4%) declare to use mostly the telephone/fax to communicate with their partners (Fig. 4).

On the contrary, the other means of communication, like the newsgroup and the videoconference, are not so often used by enterprises having already formed partnerships. Indeed, 87.0 % of these enterprises declare to have never used the forum, 82.4 % to have never used the videoconference.



Source: CEPS/INSTEAD, CRP-GL, STATEC, Survey "ICT Usage by Enterprises 2003"

Fig. 4: Distribution of enterprises having already constituted a partnership according to the means of communication used and the frequency of their use

Advantage expected and effectively obtained during the partnerships

When we analyze the reasons which have encouraged enterprises to form partnerships (Fig. 5), we notice that the fact to take better advantage of commercial opportunities is put forward by more than three-quarters of questioned enterprises (77.4%).

To improve the quality of goods and services, to face the competition and to reduce the costs are, in descending order of importance, the other motivations the most often quoted by enterprises. Indeed, about two thirds of enterprises (64.6 %) have collaborated in order to improve the quality of goods and services, 62.8 % think they can better face the competition if they create a partnership and 54.3 % hope they can reduce costs by collaborating.

To a lesser extent, (42.9 %), enterprises wish to collaborate in order to innovate.

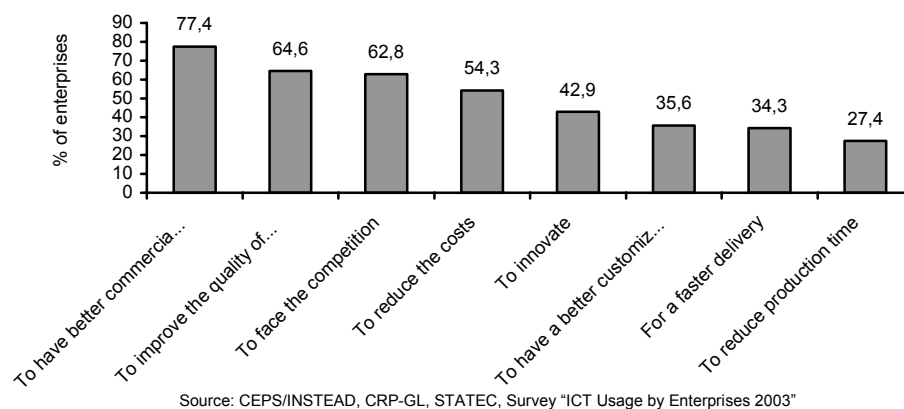


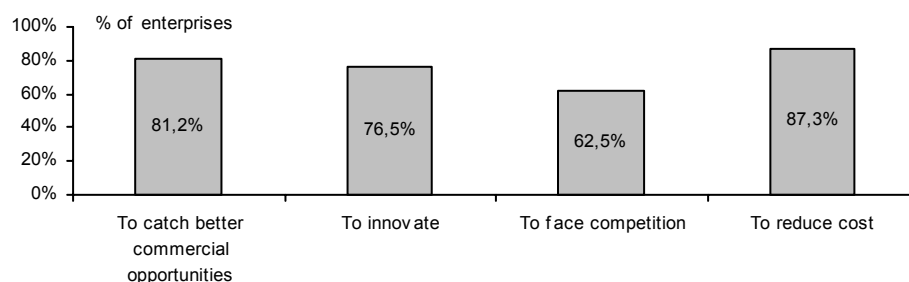
Fig. 5: Distribution of enterprises having already constituted a partnership according to their reasons to collaborate

When we try to know if the benefits gained from the joint work correspond to the expected benefits, we notice that, for the majority of enterprises, the outcome is satisfactory. Indeed, among the enterprises which wanted to collaborate to catch better commercial opportunities, approximately eight enterprises out of ten (81.2 %) have indeed either found new markets, or managed to contact new customers (Fig. 6).

For the enterprises which tried to face the competition by collaborating with the other structures, the outcome is also encouraging because 62.5 % of them consider that they were able to react more quickly to the hazards of the market.

Other objectives seem globally reached. Indeed, 76.5 % of enterprises which wanted to collaborate in order to innovate have effectively created new products and concepts, and 87.3 % of enterprises wanting to reduce their costs by forming a partnership with an other firm have really benefited from this advantage.

Finally, globally, about three quarters of enterprises (72.6 %) have answered that their collaborations have helped them to better meet the needs of their customers.



Source: CEPS/INSTEAD, CRP-GL, STATEC, survey "ICT Usage by Enterprises"

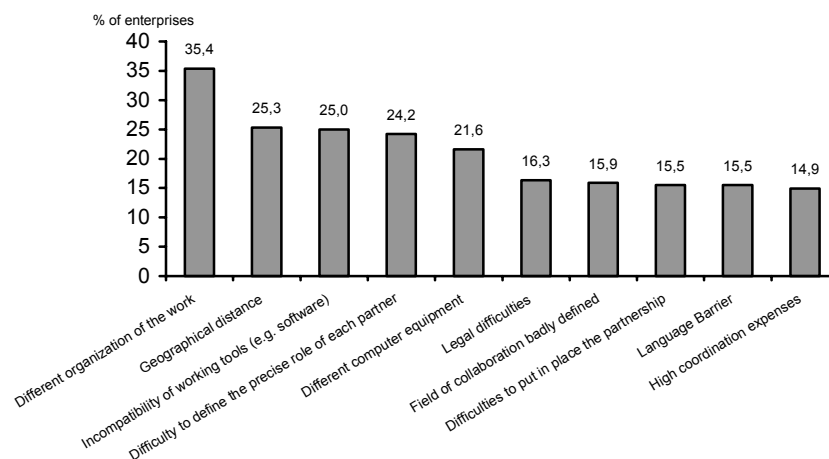
Fig. 6: Distribution of enterprises (having already constituted a partnership) according to the advantage they were expected and that they have effectively obtained by working in a partnership.

However, if the work in partnership enables most enterprises to reach their objectives that they set, it was not without some difficulties. Enterprises can encounter four big categories of difficulties. They can have communication problems because of the geographic distance and/or because of the language barrier. They can also have

organizational problems: organization can differ between partners, the precise role of every partner is difficult to define, and/or the field of collaboration is badly defined. They can also meet technical problems: different computer equipment, incompatible working tools. Finally, administrative problems can appear: difficulties to put in place the partnership, the high expenses of coordination, and legal difficulties.

Among the quoted difficulties, the different organization of work is the most important difficulty met during a partnership. Indeed, a little more than one firm having formed a partnership out of three (35.4 %) has already met this difficulty (Fig. 7). The geographic distance is mentioned by about one quarter (25.3 %) of enterprises having already formed a partnership and, the incompatibility of working tools by 25.0 % of enterprises. Less than one quarter (24.2%) of enterprises declare to have some difficulties to define the precise role of each partner during their collaboration. 21.6% of enterprises also met problems of a technical order, as for example, the use of different computer equipment and 15.9% state that the field of collaboration was badly defined.

The administrative problems (legal difficulties, difficulties to define the partnership, high coordination expenses) are less frequent. 16.3 % of enterprises having already formed partnerships were confronted to legal difficulties, 15.5 % had difficulties in formalizing a partnership and 14.9 % had problems because of the high expenses of coordination.



Source: CEPS/INSTEAD, CRP-GL, STATEC, Survey "ICT Usage by Enterprises 2003"

Fig. 7: Distribution of enterprises having already constituted a partnership, according to the problems they encountered during their collaborations

Analysis of the effects of the characteristics of enterprises on the probability for a firm to have formed a collaboration with another organization

With a sample of 1814 enterprises, we are going to look for the factors which have an impact on the probability for a firm to have formed collaborations with another organization. Before presenting the results of this analysis *ceteris paribus*, we are going to expose the factors that we will use and their expected effects on the probability to have formed partnerships.

Available explanatory factors and expected effects on the probability to have formed a collaboration with another organization

To make such an analysis *ceteris paribus*, we have about thirty explanatory variables. These variables can be grouped in three categories. A first category of variables concerns the variables that we are interested in: the computer equipment of the firm and the usage of ICT. The second category of variables collects the characteristics of the firm: size of the firm, the economic sector, the membership in a group. Finally, the third category of variables considers the participation of enterprises in a program of promotion of the work in collaboration.

■ The **ICT** taken into account in our model can be grouped in two categories (table 1).

- Five dichotomous variables enable us to know if enterprises are using the LAN, the Extranet, the Intranet, the Internet, and the EDI. Among these networks used by enterprises, Internet is the network the most opened to the outside. On the contrary, the Intranet is a private network, which is open only to the persons working within the organization. However, it enables a firm to share some of its information with its customers or the other enterprises. The third type of network, the Extranet is the local area network, which gives information via Internet. The access to the servers of the enterprises is protected by a password.

When we look at the characteristics of these networks, we believe that to have an Internet connection shows the will of the firm to open up to external actors (such as their suppliers, customers...). For that reason, we think that to have an Internet connection has a positive influence on the probability to have formed partnerships while to use another network will have no impact on this probability. Moreover, many companies have already started using Web services as a common tool for collaborating with their key partners [U103] and Web services occur across public networks – the Internet [MS04].

- Seven variables describe the usage of ICT: use of the e-mail, use of the video conference, the participation in newsgroups, use of a group calendar software, use of a group's project managers software, and doing online purchases and sales. If we examine the usage of the ICT, we notice that certain tools, such as the group calendar software and the group's project managers software, are used with the objective of facilitating the joint work. On the other hand, the usage of other ICT does not pursue exclusively this objective: they facilitate the communication or offer a new method to market their goods and services. For these reasons, we can make the hypothesis that group calendar software and the group's project managers software will have a positive effect on the probability to have formed partnerships and that to use one of the other quoted technologies will have a very weak effect or even no effect on this probability.

■ Concerning **the economic characteristics of the firm** (size of the firm, the economic sector, the membership in a group), we have built twelve dichotomous variables. Four variables are taking into account the size of the firm. It is possible to distinguish enterprises counting from 1 to 9 employees, from 10 to 49 employees, from 50 to 249 employees and 250 employees and more. Seven variables describe the economic sector of the firm: industry, construction, trade, transport, finance, business services, and finally other economic sectors. Finally, one variable enables us to know if the firm belongs to a group of enterprises.

We can make the hypothesis that the size of enterprises is negatively linked to the probability to form partnerships and this for two reasons. We think that large companies are not flexible enough to form partnerships because we know that a small number of hierarchical levels lead to a better organizational ability to react [DLS90]. Furthermore, the companies of small size (SMEs) are often concentrated on one activity, which

enables them to develop a complementarity of skills by working with other enterprises [PP93].

Among the economic sectors, we can make the hypothesis that the fact to belong to the construction sector will have a positive effect on the probability to make partnerships because the professionals of this sector work closely with each other. On the contrary, the fact to belong to the financial sector will have a negative effect on the probability to form partnerships because the enterprises of this sector do not traditionally work with skills of external actors. For all the other economic sectors, it is difficult to formulate any hypothesis on the supposed effect on the probability to form partnerships.

We assume that the membership in a group of enterprises has a positive effect on the probability to have formed a partnership because, within a group, the several subsidiaries are brought to work closely together. These enterprises thus have some experience of the joint work, which can encourage them to form collaborations with other organizations.

■ If they like, enterprises can participate in a program whose aim is **to promote the work in partnership**: appeal to one or several enterprises specialized in the strategic advices to enterprises, participate in technological meetings, in seminars of creativity and/or in meetings. Because of this objective (to promote the work in partnership), we assume that to have participated in one of these quoted programs will have a positive effect on the probability to have formed partnerships or collaborations.

Table n°1: Explanatory variables inserted into the model and their supposed effects

Independent Variables (binary variables, Yes = 1, No = 0)	Number of enterprises according to the value of the variable (1 / 0)	Supposed effect on the probability to form partnership
<i>Economic sectors:</i>		
Industry	243 / 1571	?
Construction	311 / 1503	+
Trade	473 / 1341	?
Transport	142 / 1672	?
Finance	275 / 1539	-
Business services	293 / 1521	?
Other sectors	77 / 1737	?
<i>Size of firm:</i>		
From 1 to 9 employees	515 / 1299	+
From 10 to 49 employees	990 / 824	+
From 50 to 249 employees	262 / 1552	-
At least 250 employees	47 / 1767	-
<i>To Belong to a group</i>	720 / 1094	+
<i>The Information and Communication Technologies</i>		
To have the le LAN	798 / 1016	0
To have the Intranet	742 / 1072	0
To have the Extranet	430 / 1384	0
To have the Internet	1490 / 324	+
To use EDI	197 / 1617	0
To use e-mails	1221 / 593	0

.../...

Table n°1 (*continued*): Explanatory variables inserted into the model and their supposed effects

Independent Variables (binary variables, Yes = 1, No = 0)	Number of enterprises according to the value of the variable (1 / 0)	Supposed effect on the probability to form partnership
To use videoconference	145 / 1669	0
To use newsgroup	116 / 1698	0
To use group calendar	409 / 1405	+
To use the group's project managers	206 / 1608	+
To do online purchases	222 / 1592	0
To do online sales	166 / 1648	0
Having participated to technological meeting	351 / 1463	+
Having participated seminars of creativity	273 / 1541	+
Having participated in meetings	323 / 1491	+
To appeal to one or several enterprises specialized in strategic advices to enterprises	369 / 1445	+
<p><u>Reading note:</u> +: The variable will have a positive expected effect on the probability to have formed partnership. -: The variable will have a negative expected effect on the probability to have formed partnership. 0: The variable will not have any expected effect on the probability to have formed partnership. ?: The expected effect of the variable on the probability to have formed partnership would be uncertain.</p>		

Source : CEPS/INSTEAD - STATEC, (2003), Eurostat survey "ICT Usage by Enterprises"

The characteristics of enterprises having an effect on the probability for a firm to have formed a collaboration with another organization

In order to analyse the effects of the many characteristics of enterprises on the probability to make partnerships, we have decided to run a Logit model².

Concerning the variables of interest (equipment and usage of ICT), we notice (Table n°2) that to have an Intranet network, the LAN, the Extranet, to use the e-mail, the videoconference, the newsgroup, and a group calendar software has no effect on the probability ratio.

On the other hand, to have **Internet**, to use a **group's project managers software**, to make **online purchase** and **sales** have a positive effect on the probability to have formed the partnerships. This probability is multiplied by 1.97 for enterprises having Internet, by 1.59 for enterprises using a group's project managers software, by 1.65 for the enterprises which are making online purchases and by 1.55 for the enterprises which are doing online sales.

² Considering that we try to explain the fact for an enterprise to have formed partnerships or not to have formed one, our dependant variable is also dichotomous. It will take the value 1 when the company has already formed a partnership and 0 if not. Because of this binary variable, some requirements of the ordinary linear regression, using ordinary least squares (OLS), are not any more satisfied. Consequently, to analyse this dichotomous dependent variable, we will use the logistic regression, called also the Logit Model. For a presentation of the logit model, we can refer to the works of [AI99].

This model also shows that the enterprises of the **construction sector** have a probability to have formed partnerships in comparison with the probability not to have formed one which is 1.59 times superior to the enterprises of the industrial sector. On the contrary, compared with the enterprises of the industrial sector, belonging to the **financial sector** divided by almost three (coefficient of 0.37) the probability ratio.

We notice that the size of enterprises has no impact on the probability ratio.

The fact **to belong to a group of enterprises** has a positive effect on the probability to have formed collaborations in comparison with the probability not to have formed one. More exactly, the enterprises which are a member of a group have a probability to have formed collaborations in comparison with the probability not to have formed it which is almost nine times superior to the one of the enterprises which are not a part of a group.

Finally, the model shows that the enterprises which need the help of enterprises specialized in strategic advice, which have already participated in technological meetings or seminars of creativity, don't have a bigger probability to have formed partnerships. On the other hand, for the enterprises which have participated in **meetings**, the probability to have formed collaborations, in comparison with the probability not to have formed one, is multiplied by 1.38.

Table n°2: The variables having an effect on the probability for a firm to have formed a collaboration with another organization in comparison with the probability not to have formed collaboration.

Dependent variables	Probability to have formed collaborations, in comparison the probability not to have formed one
	Multiplication coefficients
Industry	Ref.
Construction	1.59**
Finance	0.37***
To belong to a group	8.85***
To have an Internet connection	1.97***
To use the group's project managers	1.59***
To do online purchases	1.65***
To do online sales	1.55**
Having participated in meetings	1.38*
Number of observations:	1814
Number of enterprises according to the terms of the dependent variable: Probability to have formed collaborations/ Probability not to have formed one	624 / 1190
Concordant	83.4%

Comment: * coefficient significant at 10%, ** coefficient significant at 5%, *** coefficient significant at 1%, Ref. : Reference variable

Reading note: Making online purchases have a significant effect at 1% on the probability ratio. To buy via Internet multiplied by 1.65 the probability to have formed a partnership in comparison with the probability to not have formed.

To illustrate the effect of the many variables on the probability to have formed partnerships, we are going to calculate this probability for different cases. In particular, we are going to estimate the probability to have formed partnerships when the value of three variables is changing (belong to a group, have an Internet connection, to do online purchases) and the others are the modal values of the sample (Table n°3).

Table n°3: Probability for different enterprises to have made partnerships, depending on the fact they belong to a group, they have an Internet connection and they made online purchases

To belong to a firm group	To be connected to Internet	To make online purchases	Probability to have made a partnership
No	No	No	0.06
		Yes	0.09
	Yes	No	0.11
		Yes	0.16
Yes	No	No	0.35
		Yes	0.47
	Yes	No	0.51
		Yes	0.64

Note: The typical firm belongs to the business sector. It has between 1 and 9 employees. It does not possess either the Intranet, or the LAN, or the Extranet. It uses e-mail but it does not use the videoconference, the newsgroup, a group calendar, the management computerized by project and the EDI. It owns a Web site, and does not make online sales. It has never needed a firm specialised in strategy advice, and hasn't participated in technological meetings, seminars of creativity and in newsgroups.

We note that the company that we are studying has a probability to have created a partnership equal to 0.64 when this one belongs to a group of enterprises, and when it is connected to Internet and makes purchases online. On the other hand, when the firm is not a part of a group, this probability is about 0.16, *ceteris paribus*.

3. Conclusion

With the data collected in the framework of the SICOV project, we noticed that, among the enterprises which have answered our survey, one out of three reports to have already created a partnership or collaboration with another structure in January 2003. It appears that the partners of these companies are mostly a part of their working environment (such as supplier, customer or another firm of the same group) and are established in the Grand Duchy of Luxembourg or in another country of the European Union.

During the implementation of partnerships, enterprises declare to have reached the main objectives that they had fixed. Nevertheless, they encounter difficulties at the organizational, technical and relational level. Concerning the ways to communicate between partners, the phone and the fax are the main ways of communication, even if the electronic mail becomes widespread.

An analysis of the effects of the ICT on the probability to have set up a partnerships shows that all ICT don't have the same incidence on the joint work. To have an Internet connection, to make online sales, to make online purchases and to use the group's project managers have a positive influence on the probability to have created partnerships compared to the probability not to have created a partnership. It is interesting to note that among the various technologies more particularly used for the collaborative work, such as the videoconference, the group calendar and the group's project managers softwares, our analysis shows that only the exploitation of the group's project managers has a positive effect on the probability to have created partnerships compared to the probability not to have.

While this contribution confirms the positive effect of the usage of some technologies on the joint activity of enterprises, pointed out by the literature, we however have to

mention some limits in our work, limits which can constitute some future research possibilities. The main limit lies in the definition of the explained variable "to have formed partnerships or collaborations with another organization". This variable does not enable to differentiate the kind of partnerships while it seems that the usage of technologies can be different from one kind of partnership to another [Cu04a]. Finally, it would be really interesting to appreciate with more precision the usage of the ICT. In particular, it would be interesting to integrate into our analysis the intensity of usage of the several means of communication, in order to use this indicator as a measure of the intensity of the cooperation [Cu04b].

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