

THE LEARNING PROCESS IN INTERFIRM COLLABORATION

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INTRODUCTION

Organizational learning has been one of the most analyzed subjects in recent times. It has attracted specialists from different fields: Organizational Theory, Industrial Organization, Economic History, Management, etc, and it has been related to such important decisions as innovation and development (Coven and Levinthal, 1989, 1990), diversification (Ramanujan and Varadarajan, 1989; Pennings, Barkema and Douma, 1994) and internationalization of firms (Johanson and Vahlne, 1990). The purpose of this paper is to contribute to the development of organizational learning with theoretical reflections and empirical evidence about organizational learning in collaboration agreements among firms.

Prahalad and Hamel (1994) point out knowledge and collaboration as the two most interesting research areas in the near future. In fact, a huge literature exists about the role of collaboration agreements in the transfer of specific knowledge between organizations (Alter and Hage, 1993; Kogut, 1988; Badaracco, 1991; Hamel, 1991; Lyles, 1994; Parkhe, 1991; Powell, 1987; Prahalad and Hamel, 1990; Pucik, 1988; Westney, 1988). Polanyi (1962) considers that the idiosyncratic knowledge is tacit and is inside of the persons so it can only be transferred with very interactive and close relations between those who possess it (Aadne, von Krogh and Roos, 1996).

Our purpose in this paper is different because organizational learning is applied to the process of acquisition of knowledge and ability, by the firm, in everything related to the participation in a collaboration agreement with other firms. The principal assumption is that the different structures of accords (exchange agreements, cross share-holdings, joint-ventures, etc.) require different knowledge and abilities from participating firms, acquired through experience. Therefore, this work follows the line considering a learning-by-doing process for all of the firms, which lets them attain

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abilities, thereby improving their competitiveness (Chandler, 1962; Hamel, 1991; Lyles and Schwneek, 1992): “Learning from past events is a frequent way of increasing the ability for solving problems” (Lyles, von Krong, Roos and Kleine, 1996, p. 83).

A collaboration agreement has a preparation stage, where the meeting between the partners occurs and the lines of development are established; followed by a later stage of execution, where the projected activities are developed. Both stages require knowledge and abilities which can be difficult to define, systematize and transmit. So, these knowledge and abilities have to be acquired through experience. If this argument is correct, firms faced with agreements, will adopt an incremental strategy: they will start to acquire experience with the simpler agreements in terms of their planning and executing agreements for, in a progressive way, involving themselves in more exigent agreements in terms of preparation and management.

Qualitative and quantitative information about some Spanish firms with experience in collaboration accords is available to us. More precisely, the kind of structure which firms have used and some specific characteristics of the firm are known: for example, the export activity, who the owners are and the activity sector where they develop agreements. The collaboration structures considered are quite wide: from exchange agreements, easier to implement, to joint-ventures, more complex. It must be pointed out that not all the firms in the sample have participated in all possible structures for implementing a collaboration. So it is possible to divide them into two groups: those which have participated in all of the structures, including joint-ventures, and those which have participated in different structures except for the joint-ventures. The question which could be formulated would be: why do some firms participate in joint-ventures and others do not? Presumably the organizational learning will not be homogeneous for all the firms. Internal and external factors could be influencing the capacity for translating experiences into abilities. Precisely, the relation between the firm’s characteristics (size, export activity, ownership, sector where they develop accords) and the probability for a firm of implementing a joint-venture, the most complex structure as a consequence of the involvement of the partners, will be analyzed.

For accomplishing the purposes mentioned here, the study is organized in the following way: after presenting the generic theoretical frame around the organizational learning in the first section, and more precisely in the context of collaboration, in the second section the empirical study carried out for contrasting the hypothesis about the organizational learning with the data of a sample of Spanish firms which have participated in collaboration agreements is described. In the third section the

results of the estimation of a model which attempts to predict the probability of a firm of participating in all of the different structures, including joint-ventures, is presented. Conclusions, as a summary of the main results, close the study.

1. THEORETICAL FRAMEWORK FOR ANALYZING THE LEARNING PROCESS IN COLLABORATION AGREEMENTS

To initiate new activities and processes require the possession of specific abilities for implementing these activities. The internalization of new abilities, the readjustment of processes and/or structures constitute organizational learning. This learning is an essential aspect for a firm's survival and for maintaining competitive advantages over time (Lyles, 1988).

Organizational Learning Theory, whose principles can be found in the behaviorist school and can be related to bounded rationality and gradual acquisition of abilities (Simon, 1961; Cyert and March, 1963), establishes that initial knowledge facilitates the learning of new and related knowledge (Cohen and Levinthal, 1990). The more related new knowledge is, the easier it will be for the firm to assimilate and apply it for improving its benefits. This idea can be understood easily if technical advances in the environment of a firm are considered. These advances can be better understood when they are related to those known by the firm (Cohen and Levinthal, 1989, 1990, 1994).

The idea of gradual learning is complemented and/or reinforced with the research analyzing organizational capacities (Wernefelt, 1984). The results of this research sustain that the growing of the firm's capacities is a complex, gradual and idiosyncratic process where the previous capacities are a platform for acquiring new ones (Nelson and Winter, 1982; Prahalad and Hamel, 1990; Nelson, 1991).

To participate in collaboration agreements is not an exception. It also requires a new variety of abilities, procedures and concrete knowledge. However, the organizational learning related to collaboration between firms faces some difficulties and particular problems because, as Kogut (1988) points out, the abilities required are intangible and, furthermore, very difficult to define. So, organizational learning related to collaboration will be a learning-by-doing: the acquisition of knowledge and abilities starts when the firm participates in the first agreement. The structures requiring less compromise are going to allow the firms to acquire the needed abilities for managing

and starting future collaborations. Furthermore, these collaborations will be implemented with more and more complex structures.

At the same time, to acquire more knowledge related to collaboration will be possible. Then, firms will be able to take advantage of the opportunities related to and reducing the costs of using this mechanism. For example, the ability for working with other firms in an international joint-venture can be learned not only in previous international joint-ventures, but also from previous developed domestic joint-ventures (Barkema et al., 1995). In fact, the experience in domestic joint-ventures allows firms to learn how they have to internalize contingencies that appear when they are developing a collaboration with other firm. From a close and extended relation, a firm learns a lot about the other firm (Levinthal and Fichman, 1988; Gulati, 1995), and it is possible to develop a stable and successful relationship (Hill and Hellriegel, 1994).

Generalizing, it can be considered that firms with experience in collaboration relationships are more qualified for managing in a more efficient way more complex structures and problems related to these structures (Shetty, 1979; Lyles, 1988; Westney, 1988). Lyles (1987, 1988) suggests that experience in international joint-ventures improves the understanding of this mechanism and the problems related to it.

All these ideas induce us to postulate that firms starting to establish collaboration relationships with other firms, should implement the easiest structures. On the one hand, these structures allow them to acquire the basic abilities for managing their relation with other firms and, on the other, it will be easier for them to develop the needed abilities for developing future collaborations implementing more complex structures². As a conclusion, to apply the organizational learning theory to inter-firm collaboration establishes that the acquisition of needed abilities for cooperating with success is a complex and gradual process, where the previous capacities constitute the platform for acquiring new ones.

So, not participating in a concrete collaboration structure could make more difficult to complete, in an adequate way, all of the process of capacities acquisition. Furthermore, it could also make more difficult to take advantage of the inherent opportunities related to collaboration and facilitate the

²This does not mean that firms always follow the optimal itinerary for realizing a complete learning process. Firms can directly develop the most complex structure, meaning the greatest involvement among the participating firms, as a consequence of some external imposition; for example, a government imposition forcing firms to develop a joint-venture with an indigenous firm if it wants to work in a foreign market.

failure of a collaboration when it is implemented with a structure too complex for the firm's abilities. In fact, the differences between firms when we talk about their capacities for taking advantage of the experience with a concrete structure (to learn from this structure), depends upon the learning itinerary followed up to the moment they decide to use that structure (Barkema et al., 1995). Learning will happen when, as a consequence of the selected itinerary, firms go on from simple structures to more and more complex structures. This way facilitates the increase of the capacities of an organization³.

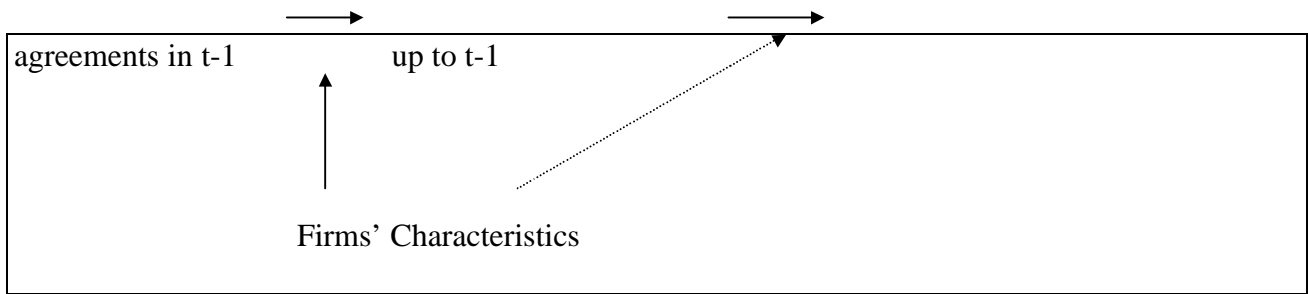
The conceptual argument for studying collaboration agreements from the perspective of organizational learning can be reflected in Figure 1. The previous experience, the sequence of cooperative structures where the firm has participated in, constitutes the principal source of acquired knowledge and abilities at any one moment. Taking this knowledge as the starting point, the firm will evaluate the opportunities and restrictions (benefits and costs) that can be attributed to a concrete agreement and will take the decision of participating or not. Figure 1 also establishes that the translation of experiences into knowledge and abilities is not homogeneous for all firms. It changes from one to another depending upon their characteristics and, possibly, the characteristics of the environment (market) where they act.

In this sense, great experience in inter-firm collaboration improve the possibility of managing new relations successfully (Westney, 1988). However, Westney also argues that the learning curves could be only accumulative in specific contexts, for example particular types of firms, kinds of organizations or industrial segments. In other words, the uniformity of learning capacities inside the firms cannot be assumed, because learning inside the firm is specific for each firm. It is limited by know-how and routines (Dodgson, 1993), and by the way knowledge, information and communication is produced (Marengo, 1992). In fact, not all the firms have the same capacity of recognizing the value of new information, assimilating it and applying it for their own benefit. In Cohen and Levinthal (1990) terminology, not all the firms have the same absorption capacity.

Figure 1. Model of organizational learning in inter-firm collaboration.

Experience in collaboration	Knowledge and abilities acquired	New agreements in t
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³It is necessary, furthermore, to find the adequate channels of information inside the firm for facilitating the diffusion of new knowledge (Hedlund, 1994).



Source: own elaboration.

2. EMPIRICAL MODEL

The static character of our information does not let us directly contrast the model postulated in Figure 1. The model of this figure needs to be reformulated with the objective of obtaining empirically verifiable hypotheses.

The first hypothesis can be formulated from the incremental character attributed to the process of knowledge and abilities acquisition for participating successfully in a collaboration agreement.

Hypothesis 1: Firms will acquire needed experience and knowledge for participating in collaboration agreements following a well-defined plan. First, they will use the easiest agreements and progressively they will amplify their experience participating in more complex ones.

This first hypothesis is based upon the postulate of learning theory establishing that learning is more effective when it implies the acquisition of knowledge and abilities near to those previously acquired. It is foreseeable that when firms amplify their experience from less to more complexity, each new agreement finds more proximity and relation to all the things learned until that moment.

The available data, defined in the next section, do not inform us about the moment when a firm develops a concrete agreement for the first time. The data only tell us whether a firm has participated in a concrete structure when the firm answers the questionnaire. As a consequence, the first hypothesis has to be reformulated and, furthermore, it has not been possible to contrast the established direct relation between the acquisition of knowledge and the characteristics of the firms. As can be seen in Figure 1, one discontinuous line has been drawn. With this line how the characteristics of the firms will influence on the concrete decision of participating in a new agreement is pointed out. It is difficult to specify the effect of the firms' characteristics upon the acquisition of knowledge; however, it is possible to examine the effect of the firms' characteristics

upon the adoption of a new collaboration structure after some previous experience with interfirm collaboration. Let us now see what the learning theory says about the factors that help or stop the learning process and how these factors can be approximate by the observable characteristics of the firms.

Following Nelson and Winter's (1982) vision of organizational capacities, the capacity of absorption of one organization is not only vested in one person; it depends upon the relations among different individual capacities and, as a consequence, the diversity of knowledge structures is seen as a robust base for learning because the probability of new information related with the current knowledge grows (Cohen and Levinthal, 1990; Simon, 1985; Bower and Hilgard, 1981; Lyles and Schwenk, 1992; Wathne, Roos and von Krongh, 1996). Therefore, it can be supposed that absorption capacity of bigger firms, with experience in the establishment of accords, is greater than the absorption capacity of the small firms because knowledge diversity is greater in the first.

Hypothesis 2: Bigger firms with experience in collaboration will have a higher probability of establishing more complex structures for cooperating than the smaller ones.

A similar argument can be elaborated relating the participation in collaboration agreements and the international orientation of the firms. An intensive participation in export activities is supposed to proportion a diversified base of knowledge and abilities to firms. This base should increase the absorption capacity in comparison to the firms without international experience. A firm, working in a new market, needs to learn how it has to work in this market. This necessity requires an important absorption capacity that can help the learning in other ground with some similitude later on. The experience in learning could influence and improve a posterior learning process (Ellis, 1965). This progressive improvement in the learning process is a way of transferring knowledge, which has been named "learning to learn" (Ellis, 1965; Estes, 1970). So, as Dodgson (1993) points out, the strategies adopted by firms also influence the learning process.

Hypothesis 3: Firms with a greater export orientation and with experience in collaboration will have a higher probability of establishing more complex structures for cooperating than the firms with a lower export orientation.

Another characteristic of the firms is known: the owner. It is known if it is a family-owned firm or a different type of firm. The family-owned firm, with a more unified property and a clearer

hierarchical line, could have a larger absorption capacity than the non-family-owned firms because these aspects could generate a more fluid communication process. If individual learning is basic in organizational learning (Dodgson, 1993; Cohen and Levinthal, 1990; Lyles, von Krogh, Roos, and Kleine, 1996; Aadne, von Krogh and Roos, 1996; Crossan and Inkpen, 1992), the group, as a whole, must also have a level of knowledge which is sufficient for operating in a correct way. As a consequence, the communication process between the members of the group is fundamental for establishing the level of knowledge of the group.

However, learning does not depend only upon the ability for assimilating new information on the part of the organization. It also depends upon the quantity and quality of the information that the organization receives from the external environment, the selection process of this information and the assimilation process. Literature about organizational learning recognizes the “gate-keeper” as a basic piece in the process of capturing relevant exterior signals. Family-owned firms, with a thin share structure, could have problems for presenting plural “gate-keepers”, who give important signals for getting a huge and deep stock of knowledge. As a consequence, family-owned firms present elements for helping and stopping organizational learning. So, it is quite difficult to formulate a precise hypothesis about the relation between family ownership of the firm and participation in collaboration agreements. In fact, the relation between ownership of the firm and experience in collaboration agreements must be determined from empirical evidence.

Hypothesis 4: Ownership of the firm, whether the firm is family-owned or not, has an indeterminate effect on the learning process.

The sector where the agreements is developed will influence the learning process if, as Westney (1988) points out, the experience curves determining the learning are transferable in unequal manner between some sector and others. On the other hand, the necessity of looking for opportunities of growing in different sectors will be unequal between sectors because the growing expectation of the demand will also be unequal, for example. Then, the participation of firms in collaboration agreements, and the lessons and experiences, will have an important sector component that should be controlled for correctly isolating the other explanatory variables.

3. EMPIRICAL EVIDENCE ABOUT LEARNING IN THE PRACTISE OF COLLABORATION AGREEMENTS.

3.1. GRADUALNESS OF THE LEARNING PROCESS.

In this section the empirical evidence shall be presented, from the collaboration practices of Spanish firms, which lets us contrast the hypothesis formulated about the gradualness of organizational learning derived from the participation of the firms in collaboration agreements. A data base was built, with more than one thousand registers, from the news in economic press about collaboration agreements during a three-years period (1990-1992), where one of the firms was Spanish. From this base a representative sample of 400 firms was extracted. A mail questionnaire was sent to them trying to collect information about their experience in the participation in collaboration agreements (85 firms returned the questionnaire). The posterior analyses are based upon the answers of these firms (the most relevant characteristics of these firms are presented in Annex 1).

The firms were asked about the collaboration agreements where they have participated in the last years. In Table 1, the number and the percentage of firms that affirm having participated in the types of agreements that are enumerated can be seen. As can be observed, the type of collaboration named most frequently is “accords for realizing joint-activities”, used by 78.8% of the firms that answered the questionnaire. This type is followed by joint-ventures (almost 51% of the firms affirm having participated in one) and “licenses and accords for transferring technology” (49.4% of the firms).

Table 1. Types of collaboration agreements⁴.

TYPES.		NUMBER	PERCENTAGE
Exchange Agreements	Contracts for supplying (for example, components).	30	35.3
	Contracts for distributing and doing post-sale services.	36	42.4
	License and accords of technological transference.	42	49.4
	License of manufacturing and distribution	18	21.2
	Subcontracting R+D activities	25	29.4
Cross share-holdings		36	42.4
Coalitions	Consortiums of technological development.	26	30.6
	Consortiums for holding public.	35	41.2
	Consortiums for diversify risks.	15	17.6
	Accords for realizing joint-activities.	67	78.8
	Accords for interchanging commercial webs.	23	27.1
	Joint-ventures.	43	50.6

Source: own elaboration.

⁴ Exchange agreements imply a client-supplier relation between participating firms. In cross shareholdings one participating firm takes a portion of the capital of the other, or a cross-share participation is produced (this type of agreement implies more involvement than interchange accords). Finally, coalitions imply the greatest involvement because firms decide jointly the use of their resources.

The first hypothesis, establishing that the acquisition of capacities for cooperating successfully is a gradual process where the previous capacities constitute a platform for acquiring new ones, needs information about the temporal sequence that each firm has followed for involving itself in the different types of agreements it has participated in, for being contrasted rigorously.

With a temporal perspective it could be contrasted whether, for obtaining the abilities and knowledge required for participating in more and more complex agreements, firms start to acquire experience in simpler and easier ones and, later, they involve themselves in more complex agreements as in planning or implementing. However, the moment in time when a firm starts to participate in a concrete agreement is very difficult to determine. So, in the context of the available evidence, the contrasting of this hypothesis must be done in an indirect way: we will contrast if the firms participating in more complex agreements, without participating in the simpler ones, are scarce in comparison with the cases where the firms participating in more complex agreements also participate or have participated in easier planning or implementation ones.

For carrying out this contrast, the types of agreements of Table 1 have been grouped into three large categories. They are grouped from less to more complexity and, then, from less to more specific abilities and knowledge required:

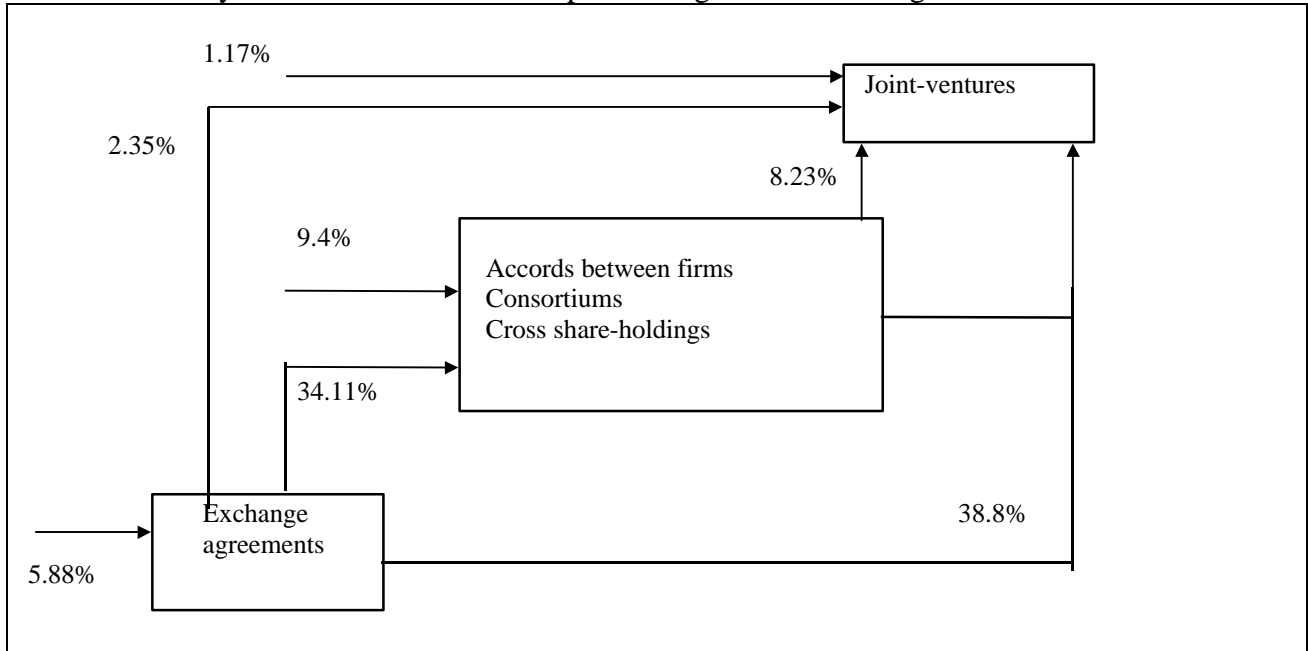
- Interchange agreements
- Cross share-holdings, consortiums and agreements
- Joint-ventures

Our hypothesis establishes that firms which have participated in joint-ventures when they answered the questionnaire have also participated in less complex collaboration agreements. In the same way, we also expect that firms with experience in cross share-holdings, consortiums and agreements, which have also participated in exchange agreements, are present in our sample in a larger proportion than firms which have participated in consortiums, agreements and cross share-holdings but not in exchange agreements.

In Chart 1 the information that allows us to prove these hypotheses is presented. Only one of 85 firms (1.2%) has participated in joint-ventures but has not participated in any other type of collaboration agreement. Almost 10% of the firms have started their experience in collaboration

with agreements, consortiums and/or cross share-holdings while more or less 6% of the firms are in the first step of collaboration, participating only in interchange agreements.

Chart 1. Itinerary with the structures for implementing collaboration agreements.



Source: own elaboration.

On the other hand, 34% of the firms have participated in the second level and have also participated in interchange agreements, while 38.8% of the firms have completed the cycle exchange agreements, cross share-holdings, consortiums, agreements and joint-ventures. Finally, only 2.35% of the firms have participated in joint-venture and exchange agreement without participating in accords of the second level of complexity, and 8.2% of the firms have participated in the second and third level of complexity without participating in the first (exchange agreements).

The numbers of Chart 1 imply that almost 77% of the firms participating in joint-ventures are participating or have participated in accords of the first and the second levels of complexity, 16% in joint-ventures and in accords of the second level of complexity, more than 4.5% in interchange agreements and joint-ventures, and 2% are participating or have participated in joint-ventures without participating in any other type of agreement. Of the firms participating in the second level of complexity, 78% have also participated in interchange agreements, so only 22% of the firms have participated or are participating in agreements of the second level of complexity without passing through the first.

As a consequence, the empirical evidence of our sample of firms is consistent with the hypothesis of organizational learning as an explanation of the process managing the decisions of participating in collaboration agreements between firms, although it must be remembered that this hypothesis has been expressed in an indirect way because temporal data were not available.

4. CHARACTERISTICS OF THE FIRMS AND DECISIONS FOR PARTICIPATING IN COLLABORATION AGREEMENTS

In the formulation of hypothesis, the possible influence of some firms' characteristics upon the learning process related to collaboration agreements has been estimated. More precisely, firms' characteristics, influencing the absorption capacity, have been related to the establishment of complex structures for cooperating, in firms with some experience in collaboration. Empirically contrasting the model relating characteristics of the firm and decisions about the participation in collaboration agreements (discontinuous line in Figure 1) is our purpose now.

Table 2 shows the first empirical evidence about the postulated hypothesis. In this Table we can see the contingency table relating some variables reflecting characteristics of the firms and the presence of the firm in Group 1 (in this group we find all the firms that have arrived at developing a joint-venture, so they have a vast experience in collaboration because they have been involved in the most complex agreements) or in Group 2 (firms with a less intense participation in collaboration agreements because they have not yet participated in joint-venture). The variables considered are ownership (family or non-family firm), international orientation (firm exports of less than 5% of its sales, between 5% and 15% and firms exporting more than 15% of their sales), size (firms with less than 250 workers, between 250 and 500 and firms with more than 500 workers), and the sector in which the agreement is developed. With last variable the environment of the firm is being considered because it can be influencing in the decision of participating in a collaboration agreement.

Table 2. Characteristics of the firms of the considered groups.

	Group 1 (%)	Group 2 (%)	Number	Chi square value
Ownership of the firms				
Family firms.	33.3	66.7	71	
Non family firms.	38	62	12	
TOTAL			83	0.097
International Orientation:				
Export less than 5%.	21.6	78.4	37	
Between 5% - 15 %.	46.7	53.3	15	
More than 15 %.	54.8	45.2	31	

TOTAL			83	8.3648**
Size:				
Less than 250 workers.	21.4	78.6	28	
Between 250 - 500.	41.2	58.8	17	
More than 500.	48.7	51.3	39	
TOTAL			84	5.2326*
Sector:				
Manufacturing.	37	63	27	
General services.	41.2	58.8	17	
Energy.	63.2	36.8	19	
Construction.	33.3	66.7	6	
Finance services.	12.5	87.5	16	
TOTAL			85	9.557**

Group 1: Have completed the itinerary with the structures.

Group 2: Have not completed the itinerary (they have not completely realized the learning process).

*Significance < 0.1; **Significance < 0.05.

Source: own elaboration.

The hypothesis establishing independence between international orientation, size, sector and the presence in one or another group of firms can be rejected. Furthermore, as can be seen, the higher the international orientation, the higher the percentage of firms in the first group is. Something similar happens with the size. In other words, we have detected a positive association among export activity and size and participation in collaboration agreements. These results were expected because export orientation and size improved the benefit-cost relation identified by the firms that had completed the learning cycle. Among the family-owned firms, the proportion of firms in the first group is less than in the non family-owned firms, but the observed differences are not statistically significant.

Finally, the activity sector where the accord is developed also seems to determine the participation in a collaboration agreement and, particularly, the participation in joint-ventures. Energy is the sector where the percentage of firms that have participated in all the modalities of agreements is highest, while in the finance services the percentage is the lowest. The rest of the sectors show intermediate values.

4.1. ESTIMATION OF THE PROBABILITY OF COMPLETING THE LEARNING PROCESS

The study of the relation between the characteristics of the firms and their participation in collaboration agreements is completed now with a multivariable analysis. With this analysis it is desired to determine the probability of one firm, with concrete characteristics, of completing the itinerary with the structures. The analysis is realized with a model of discrete selection because this model describes the behavior of the agents in terms of probability. More precisely, the estimation of

the model is realized with logit model. The dependent variable is the presence of the firm in Group 1 or 2, and the explanatory variables are the sector where the agreement is developed, the international orientation, the size and the ownership of the firm⁵.

The estimation of this first model fits the observed data quite well (the hypothesis establishing that the coefficients of the independent variables are 0 can be rejected). The coefficient for the first category of international orientation and size and the coefficient for the third category of the sector are significantly different from 0 (see Table 3).

In the logistic regression models, the estimated coefficients DO NOT show the effect upon the probability of occurrence of one event related with the unitary increment of one explanatory variable. In these models, the sign of the coefficient shows the direction of the change of the probability. If the sign is positive, the probability of the event will increase, while if the sign is negative the probability will decrease⁶. Furthermore, because of the categorical nature of the explanatory variables, the interpretation of the coefficients of the categories of one variable must be done in comparison with another category (it must be taken into account that the interpretation will depend upon the way followed for creating the new variables representing the categorical variables). For us, the coefficient represents the effect of each category upon the reference category. So, we are able to compare the effect of one concrete category with respect to the reference category.

Table 3. Models of discrete election estimated.

	Model 1.		Model 2.	
	Coefficient	Standard Error	Coefficient	Standard Error
SECTOR				
Manufacturing	1.3815	1.0512	1.4665	1.0115
General Services	1.5846	1.0422	1.5817	1.0389
Energy	1.9943**	0.9530	2.0682**	0.9503
Construction	0.9841	1.2017	1.0269	1.2003
INTERNATIONAL ORIENTATION				

⁵ Categorical variables were introduced creating binary variables representing the categories of each one. The number of binaries for representing a categorical variable is the number of categories minus one.

⁶ For interpreting the coefficients of a logistic regression we have to modify the equation. In this case, the log. of the probability of the firm for completing the itinerary over the probability of not completing it will be the dependent variable. Doing this modification we will be able to interpret the coefficients of the equation like the changes in the log. associated to an unitary change in the independent variable. However, it is easier to think about the relation of probabilities than about the log. of this relation, so “e” elevated to the coefficient will be the factor changing the ratio between probabilities when the independent variable increases by one. If the coefficient is positive the factor is greater than 1, so the ratio increases. If the coefficient is negative, the factor is smaller than 1, so the ratio decreases and, finally, if the coefficient is 0 the factor is 1, so the ratio does not change.

Less than 5%	-1.1734*	0.6353	-1.0727*	0.6262
Between 5% and 15%	-0.2152	0.7543	-0.0131	0.7211
SIZE				
Less than 250 workers	-1.3187*	0.7006	-1.4002**	0.6789
Between 250 y 500	-0.4044	0.7165	-0.4265	0.7176
OWNERSHIP				
Non family	0.4375	0.7970		
Constant	-1.2192	1.16	-0.9197	0.9335
Number of cases	82		83	
Model Chi Square	18.291**		18.871**	

*Significance < 0.1

**Significance < 0.05.

Source: own elaboration.

As can be seen, the coefficient for the first category of the variable reflecting the international orientation is significant and negative, so to be a firm exporting less than 5% reduces the probability of completing the itinerary with the available structures for implementing a collaboration agreement, with relation to the probability of the firms exporting more than 15%. Something similar happens with the coefficient for the first category of the variable reflecting the size of the firm: to be a firm with less than 250 workers reduces the probability of completing the itinerary with relation to the firms with more than 500 workers. Finally, the coefficient for the third category of the variable reflecting the sector where the agreement is developed is significant and positive, so to be a firm with collaborations in the energy sector increases the probability of completing the itinerary with the structures in relation to the firms with accords in the finance services. These results confirm the dependence that were found in the contingency tables (see Table 2).

However, as can be seen in Table 3, the variable reflecting ownership in this model is not significant. It must be remembered that no relation between ownership and to follow or not an itinerary with structures was found in the contingency tables. That is why a new model with the same dependent variable and the same independent variables less the ownership of the firm (Model 2) was estimated. This model, which also allows us to reject the hypothesis establishing that the coefficients of all the independent variables are 0, classify our observations better than the previous model (see Table 4).

Table 4. Classification tables of the estimated models.

	Model 1			Model 2		
	Non itinerary	Complete itinerary	% correct	Non itinerary	Complete itinerary	% correct
Non itinerary.	41	10	80.39	40	11	78.43
Complete itinerary.	11	20	64.52	8	24	75

% global	74.39	77.11
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Source: own elaboration.

The coefficients significantly different from 0 are the same as in the first model (the coefficients for the first category of the variables reflecting international orientation and size and the coefficient for the third category of the variable reflecting sector). Furthermore, the coefficients also present the same signs. Then, to be a firm with less than 250 workers, exporting less than 5% and with some agreements in the energy sector is going to affect the probability of following an itinerary.

The results of the best model (the second) imply that the learning process related to collaboration of the firms exporting more than 5% is more complete than the process of the firms exporting less than this percentage. It could be thought that their absorption capacity is higher because of the necessity of adding new knowledge previously. On the other hand, these results also demonstrate that in some sectors it is possible to accumulate knowledge in relation to collaboration, in the line of Westney's argument (1988). Furthermore, the absorption capacity in relation to collaboration is also favored by the larger size of the firm. The diversity of knowledge possessed by big firms increase their absorption capacity.

CONCLUSION

The purpose of this work is to analyze the development of collaboration agreements as a learning process, where the firms start their experience in collaboration with simple and easily manageable structures and, progressively, involve themselves in more complex structures taking advantage of the knowledge and abilities they have been acquiring. The available data did not allow us to establish the temporal sequence followed by each firm with the available structures for becoming involved in the developed agreements. As a consequence, the hypothesis about learning was contrasted by an indirect method: determining the structures used by each firm in its collaborations.

Firms that have arrived at establishing joint-ventures were expected to have also established exchange agreements and cross share-holdings, consortiums and/or accords; firms with structures

of this second block were expected to have also established exchange agreements. Few firms were expected to initiate their collaborations developing a joint-venture or arriving at joint-ventures with only experience in exchange accords.

The data confirmed these expectations: almost 77% of the firms participating in joint-ventures are participating or have participated in accords of the first and the second levels of complexity; among the firms participating in the second level, 78% have also participated in interchange agreements; only one firm has participated in joint-ventures but not participated in any other type of collaboration agreement, and only 2.35% of the firms have participated in joint-ventures and in interchange agreements without participating in accords of the second level of complexity. As a consequence, the empirical evidence of our sample of firms is consistent with the hypothesis of organizational learning.

On the other hand, the effect of some firms' characteristics upon the learning process related to collaboration has been approximated. Discrete selection models for establishing the probability of one firm, with some concrete characteristics, of developing the most complex structure for implementing a collaboration have been estimated. Concretely, we have established that the probability of completing the itinerary with the available structures of one firm exporting less than the 5% of its sales is smaller than the probability of one firm exporting more than 5% of its sales. In the same way, firms with less than 250 workers also present a smaller probability of completing the itinerary than the firms with more than 250 workers. Finally, firms developing collaborations in the energy sector have a higher probability of completing the itinerary than the firms developing their accords in other sectors.

Therefore, a higher international orientation improves the absorption capacity of knowledge related to collaboration because, previously, when the firm is acting in new markets, it has to develop its absorption capacity of new knowledge. In the same way, great size also favors absorption capacity because of the expected diversity of knowledge in these firms. Then, the probability of identifying new abilities and knowledge, and using them in the firm's benefit, goes up. The results also allow

us to conclude that in the energy sector it is possible to accumulate knowledge related to collaboration in a better way than in other sectors. Finally, no effect of ownership on the learning process is detected.

ANNEX 1. CHARACTERISTICS OF THE FIRMS THAT ANSWERED THE QUESTIONNAIRE.

The firms that answered the questionnaire, taking note of their sector , size, ownership, international orientation and also taking into account the sector where they have developed collaboration agreements, are going to be described.

With respect to sector distribution, in Table 1 the prevalence of manufacturing firms, and firms in finance and insurance can be observed.

Table 1. Classification of firms that answered the questionnaire in activity sectors.

SECTOR.	ANSWER	
	Nº	%
Agriculture, Forestry, Livestock and Fishing.	1	1.2
Mining.	2	2.4
Construction.	8	9.4
Manufacturing	25	29.4
Transports, Communications and Public Services.	9	10.6
Wholesaler.	5	5.9
Retailer.	2	2.4
Finance and Insurance.	18	21.2
Services.	15	17.6
TOTAL	85	100

Source: own elaboration.

Almost 50% of the firms that answered the questionnaire (46.4%) have more than 500 workers, and only 9.5% have less than 50 workers. In any case, 44% of the firms that establish collaboration agreements have between 50 and 500 workers, so they are medium sized.

Table 2. Classification of firms by size.

SIZE.	NUMBER	PERCENTAGE
Less than 50 workers.	8	9.5
Between 50 and 250.	20	23.8
Between 250 and 500.	17	20.2
More than 500 workers.	39	46.4
TOTAL.	84*	100

*One of the firms did not answer the question related to size.

Source: own elaboration.

The ownership of the firms participating in collaboration agreements, and answering the questionnaire, does not differ from the ownership in the whole population of Spanish firms if it is taken into account that firms establishing accords are big or medium size (Table 3).

Table 3. Types of firms with collaboration agreements.

TYPE OF FIRM.	NUMBER.	PERCENTAGE.
Minority foreign participation.	2	2.4
Majority foreign participation.	16	19.3
Equal foreign and domestic participation.	3	3.6
Family-owned firm.	12	14.5
Majority participation of Banking group.	5	6
Majority participation of another firm or national holding.	17	20.5
Others.	28	33.7
TOTAL.	83*	100

*Two firms did not answer the question referred to the type of firm.

Source: own elaboration.

As can be seen, the percentages of firms under the control of foreigners (19%) and the percentage of family-owned firms (14.5%) are quite similar to observed percentages in other surveys such as ESEE. Ownership does not condition the participation or not in collaboration agreements.

In talking about the export activity of the firms that answered the questionnaire, there is no relation between the export propensity of the firms and the participation in collaboration agreements. With the available evidence, specialization in the national market or internationalization does not influence the possibility of participating in collaboration agreements (see Table 4).

Table 4. Classification of firms by taking into account international orientation.

EXPORT %.	NUMBER	PERCENTAGE
No export.	17	20.5
Export less than 5%.	20	24.1
Export between 5% and 15%.	15	18.1
Export between 15% and 25%.	12	14.5
Export more than 25%.	19	22.8
TOTAL.	83*	100

*Two firms did not answer the question related to international orientation.

Source: own elaboration.

Finally, observing the sector where the firms have established accords, the firms answering the questionnaire are classified as follows (Table 5).

Table 5. Classification of firms according to the sector where they develop agreements.

SECTORS.	ANSWER.	%
Energy and water (3)	19	22.36
Construction (4)	6	7.06
Manufacturing (1+2+5+6+7+8+9+10+11+12+13)	27	31.76
General Services (14+15+16+18+19+20)	17	20
Finance Services (17+21)	16	18.82
TOTAL	85	100

Source: own elaboration.

A predominance of firms establishing agreements in the manufacturing sector and in the energy/water and general services sectors is observed.

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