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DETERMINING FACTORS IN THE SUCCESS OF R & D
COOPERATIVE AGREEMENTS BETWEEN FIRMS AND
RESEARCH ORGANIZATIONS *

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ABSTRACT

The purpose of this paper is to analyse the impact of a series of organizational and contextual factors on the success of 800 cooperative agreements between firms and research organizations, run between 1995 and 2000 by the CDTI. Findings show that the most outstanding factors are, in the case of firms, commitment, previous links, definition of objectives and conflict, whereas for research organizations previous links, communication, commitment, trust and the partners' reputation are more relevant. These study not only provides a comprehensive theoretical model to analyse the success of these agreements but is useful both for improving management of cooperation and for fostering international collaboration within the European Union as well.

KEY WORDS: R&D cooperation, cooperation between firms and research organizations, success in cooperative agreements, organizational and contextual factors.

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INTRODUCTION

The improvement in the relationship between science and technology, the integration of science and industry, the appearance of industries based on science, the use of science as a means to generate competitive advantages on the part of the firms, as well as the globalization of the economy and internationalization of technology, are some of the reasons which justify cooperative relationships between firms and research organizations (Ahn, 1995). This subject is analysed in several papers¹ (Chen, 1994; Ahn, 1995; Mansfield, 1995; Nieto, 1998; Bayona, 1999; Bayona *et al*, 2000; Cassier, 1999; Acosta & Modrego, 2000; 2001).

For the purpose of the present paper this kind of cooperation can be defined as the link which joins basic research (carried out at universities, laboratories and research centres) with applied research² (come to fruition in industries) in such a way that, as a result of a joint action by both parts, synergies can be created which lead to the improvement of the economic and technological potential of a country, and consequently, to increase its level of competitiveness.

Given the fact that every cooperative relationship is born with the aim of achieving specific objectives, the assessment of success in a cooperative agreement is basic in order to know to what extent the defined objectives have been attained. Thus, we consider that the success of a cooperative agreement is determined by the achievement of the pursued objectives, which were defined in the early stages of the relationship (Cukor, 1992; Ghoshal *et al*, 1992; Bonaccorsi & Piccaluga, 1994; Brockhoff & Teichert, 1995; Phillips *et al*, 2000). In the literature, success is measured objectively by means of stability, continuity, the survival of the relationship and the evolution of the relationship throughout time (Shamdasani & Sheth, 1995; Park, 1996; Cyert & Goodman, 1997; De Laat, 1997;

¹ Despite the fact literature uses the term 'firm-university cooperative relationships' to refer to this kind of agreements, we find it more appropriate to substitute the term 'university' for that of 'research organizations', the latter being a wider concept which includes different types of organizations such as state research centres, universities, research associations and innovation and technology centres.

² We define basic research as the one whose primary aim is not its future application, but the knowledge of the scientific basis of a problem, process or mechanism while applied research as the

Davenport *et al*, 1999a), whereas subjective measuring is done through the level of satisfaction of the partners (Mohr & Spekman, 1994).

Nevertheless, the multiple objectives aimed at in the relationships between firms and research organizations –let alone their complexity and diversity- make it difficult to analyze this phenomenon (OECD, 1984) and its success. On the one hand, a report by the *Scientific and Technological Committee* of the OECD (1990) revealed the lack of both qualitative and quantitative information about the general nature of the relationships between firms and research organizations; on the other hand, there is not a wealth of empirical work specifically focusing on the success of cooperative relationships between firms and research organizations. Some of the most common limitations in the literature on firm-research organization relationships are, in fact, the lack of homogeneity and integration regarding the variables, dimensions and measures employed, the definition of the unit of analysis and the shortage of empirical evidence (Cukor, 1992; Dodgson, 1993; Gee, 1993; Geisler & Furino, 1993; Bloedon & Stokes, 1994; Cyert & Goodman, 1997; Siegel *et al*, 1999; Mora & Montoro, 2001). Therefore, new studies must be carried out to test and evaluate this type of relationships (Mora & Montoro, 2001) and to identify the determining factors of success in this sort of cooperative relationships.

This study is intended to provide the necessary theoretical basis and empirical evidence to carry out an in-depth analysis of the success of cooperative agreements between firms and research organizations. With this aim, we have revised the main theoretical and empirical studies on this subject, selecting those factors with the greatest significance and relevance in the literature concerned. Hence, a series of key factors, relevant for the success of the cooperation, have been identified and clustered around two categories: contextual factors and organizational factors –this criterion being similar to the one applied in previous studies (Montoro, 1999; Ariño & Montes, 2001). The first include some of the features of the partners and of the agreement to be taken into account, both before the start of the relationship, that is, previous links, partners' reputation and proximity (Bloedon & Stokes, 1994; Häusler *et al*, 1994; Martínez & Pastor, 1995; Geisler, 1995; Cyert & Goodman, 1997; Jones-Evans & Klofsten, 1998), and to define the objectives clearly and make the relationship institutionalised at the time the collaboration begins (Geisler & Furino, 1993; Burnham, 1997; Jones-Evans & Klofsten, 1998; Davenport *et al*, 1999a). Ariño & Montes

one whose purpose is the development of a mechanism or process with a view to its future

(2001) define these factors as the initial conditions to the agreement that constitute the reference framework in which the future relationship between the partners is planned. Even though contextual factors are more relevant in the early stages or initial formation of the agreement, organizational factors are more closely related to the development of the agreement. In fact, they are organizational features that form part of the partners' behaviour and have an influence on the behaviour of the rest of the partners. We are referring to commitment, communication, trust, conflict and dependence (Gray, 1985; Escribá & Menguzzato, 1999; Child & Faulkner, 1998; Das & Teng, 1998; Gulati, 1998; Montoro, 1999).

All in all, the aim of this study is to contribute to the theoretical and empirical analysis of the literature on the success of cooperative relationships between firms and research organizations, taking the relationship between both parts as a unit of analysis and offering single findings for each partner. More specifically, we are interested in the effect that the two groups of factors mentioned above may have on the success of the agreement. For this particular purpose, we will first analyse the determining factors of success and formulate the hypotheses for further contrast. Then, the sample employed will be described, together with the measures used for each variable involved. Finally, the main results obtained will be shown and discussed, as well as the deriving conclusions, making reference to future lines of research.

DETERMINING FACTORS IN THE SUCCESS OF COOPERATION BETWEEN FIRMS AND RESEARCH ORGANIZATIONS

Organizational factors

To start with organizational factors, commitment must be defined as the extent to which the partners get involved in the interorganizational relationship (Anderson & Weitz, 1992). The literature on links between firms and research organizations deals with commitment from different points of view. Thus, we can distinguish several aspects to be considered in its analysis: the volume of resources contributed by the partners, support from senior executives and involvement of the personnel who take direct part in the relationship. Hence, the higher the contribution of resources, the managerial support and the involvement of the rest of the staff, the higher the partner's degree of commitment. On the other hand, and following the proposal suggested by Montoro (1999), this variable shows

application.

three different dimensions: emotional commitment, future prospects and intentions to invest. The emotional commitment of a partner involves a wish to carry on with the relationship, derived from the satisfaction with the other partner and an enjoyment of the relationship (Aulakh *et al*, 1996).

Bearing in mind that every cooperative agreement requires a high level of commitment by the partners involved in the project, there are many studies that measure the influence of each partner's commitment on the outcome of the agreement. These studies show that the higher the degree of participation and involvement of the parts (Gray, 1985; Geisler *et al*, 1991; Roessner & Bean, 1991; Gee, 1993; Klostern & Jones-Evans, 1996; Burnham, 1997; Escribá & Menguzzato, 1999) and of the senior executives (Geisler *et al*, 1991; Roessner & Bean, 1991; Ghoshal *et al*, 1992; Gee, 1993; Bonaccorsi & Piccaluga, 1994; Randazzese, 1996; Cyert & Goodman, 1997; Davenport *et al*, 1999a; 1999b) the more effective the cooperative relationship will be. For Aulakh *et al* (1996), mutual perspectives of continuity have a positive effect on the outcome of the relationship. All this points to the formulation of the first hypothesis of our paper, which shows there is a positive link between commitment and success of the agreement.

Hypothesis 1: Commitment has a positive influence on the success of cooperative agreements between firms and research organizations.

The process of communication between two or more different organizations must be taken into high consideration within the context of interorganizational relationships. In this respect, communication can be defined as a process of exchanging information, concepts and ideas between individuals that belong to different organizations. Mohr & Nevin (1990) define communication as the process through which information is transmitted, participatory decision-taking is prompted, activities are coordinated, power is executed and the existence of commitment and loyalty between the organizations involved in the cooperative agreement is encouraged.

There is a large number of papers which emphasize the importance of communication in cooperative agreements; what is more, it stands for influential factor in their success. The creation of an appropriate communication system which leads to a regular exchange of information between partners is fundamental for the success of the agreement (Geisler & Furino, 1993; Gee, 1993; Bonaccorsi & Piccaluga, 1994; Chisholm, 1996; Child & Faulkner, 1998; Gulati, 1998; Davenport *et al*, 1999a). Frequent communication allows

individuals to develop common purposes and concepts about their situation, thereby facilitating cooperative relationships since these concepts act in a similar way (Van de Ven & Walker, 1984). On the basis of these assumptions we can put forward the second hypothesis, which establishes a positive relationship between the communication and the success reached in the agreement.

Hypothesis 2: Communication has a positive influence on the success of cooperative agreements between firms and research organizations.

Trust can be defined as the willingness to believe in the other part within a context where the actions taken by one part make the other vulnerable (Doney *et al*, 1998). Zaheer *et al* (1998) define trust as the prospects of one of the parts committing itself to comply with its obligations, behave in a predictable way and negotiate and act fairly in case of margin for opportunistic behaviour.

Integrity and benevolence are two basic aspects in interorganizational trust (Montoro, 1999). Integrity means acting in the belief that the partner will keep his word and will act honestly (Anderson & Narus, 1990; Zaheer *et al*, 1998). Benevolence refers to the extent one part believes his partner will behave honestly in the case that new conditions, for which no commitment has been established, might arise (Zaheer *et al*, 1998), adapting to the new situation if unexpected changes occur (Aulakh *et al*, 1996). The idea is for the parts to keep a positive attitude to the grounds of the other parts (Das & Teng, 1998). It assumes the belief that the partner is interested in the well-being of the firm and that no unexpected actions will be taken that may result in damage for the partner (Hosmer, 1995; Madhok, 1995).

Trust is a deciding element to achieve success in cooperative relationships (Aulakh *et al*, 1996; De Laat, 1997; Child & Faulkner, 1998; Gulati, 1998; Zaheer *et al*, 1998), as organizations, apart from having to trust in the performance of the partners, are vulnerable to their actions or behaviours (Kumar, 1996; Ring, 2000). Meanwhile, trust also contributes to the success of the relationships between firms and research organizations (McDonald & Gieser, 1987; Dodgson, 1993; Martínez & Pastor, 1995) by fulfilling their corresponding aims (Santoro & Chakrabarti, 1999), increasing the chances for the survival of the relationship (Geisler, 1995). In fact, trust between firms and cooperating research organizations is a matter of vital importance in the development of the relationship and contributes to its success (Klofsten & Jones-Evans, 1996; Davenport *et al*, 1999a; 1999b).

All these arguments permit the establishment of a link between trust and the success of the cooperation.

Hypothesis 3: Trust has a positive influence on the success of cooperative agreements between firms and research organizations.

Interorganizational conflict can be defined as the lack of harmony and agreement between the cooperating organizations (Alter, 1990). Thus, we consider conflict as a process of legitimate work, necessary and beneficial in the long run (Alter, 1990), which should not be eliminated but controlled (Van de Ven & Walker, 1984; Oliver, 1990). In the particular case of cooperation between firms and research organizations, conflicts may emerge due to disagreements in objectives, to cultures or each part's *modus operandi* (Campbell, 1997; Cyert & Goodman, 1997). The presence of tensions, arguments and certain acts intended to deteriorate or eliminate the other part are warning signs (Alter, 1990). However, owing to the extremely subjective character of the conflict, what one organization might consider a conflict might not be seen as such by another organization. It seems quite clear that those conflicts that create an obstacle for the achievement of the expected results are considered negative.

Most of the literature focusing on the influence of conflict on cooperative relationships notes a negative relationship between the agreement and the level of conflict. Thus, a high degree of conflict is detrimental to success both in interorganizational relationships (Alter, 1990; Child & Faulkner, 1998; Gulati, 1998) and in firm-research organization relationships (Bonaccorsi & Piccaluga, 1994; Liyanage & Mitchell, 1994; Campbell, 1997; Cyert & Goodman, 1997; Davenport *et al*, 1999a). This leads us to formulate the following hypothesis.

Hypothesis 4: Conflict has a negative influence on the success of cooperative agreements between firms and research organizations.

In a cooperative relationship, dependence refers to the extent the actions carried out by each partner are linked to the actions carried out by the rest of the partners participating in the cooperative agreement (Gray, 1985). Taking into account that the level of dependence relies on the resources of the cooperating parts, two organizations are said to be interdependent when one of them has resources and power which are beneficial for –but not owned by– the other part (Horton & Richey, 1997; Gulati, 1995b; 1998), or which can facilitate the achievement of specific objectives (Emerson, 1962; Andaleeb, 1996).

In accordance with the resource dependence theory, the level of dependence between two organizations is considered to be related to the volume of resources of the other part: the partners have had access to information about this volume to carry out the cooperative research, something which had been unthinkable but for the cooperative agreement. According to the transaction costs theory, dependence is the outcome of the type of investment made by the partners for the development of the alliance (Ganesan, 1994). In this case, dependence is the result of changing costs, which emerge as a consequence of the investments in specific assets (Williamson, 1985). As investments in specific assets drop in value if applied to another relationship, partners investing in this type of assets will find themselves “trapped” in the existing relationship (Levinthal & Fichman, 1988).

With regards to the link between dependence and satisfaction of the parts, there does not seem to be a general consensus. While some studies show a negative relationship (Kotter, 1979), other authors have demonstrated that high dependence does not necessarily mean lower satisfaction (Gray, 1985; McDonald & Gieser, 1987; Blankenburg *et al*, 1999). These latter studies consider that organizations with a high dependency will mainly ascribe the outcomes of the relationship to their partners, which leads to a higher level of satisfaction (Gray, 1985; McDonald & Gieser, 1987; Blankenburg *et al*, 1999; Escribá & Menguzzato, 1999). Bearing in mind all these arguments, we can formulate hypothesis 5.

Hypothesis 5: Dependence has a positive influence on the success of cooperative agreements between firms and research organizations.

Contextual factors

Secondly, as for contextual factors, previous cooperative links refer to prior cooperative relationships of the cooperating partners (Gulati, 1995a). This factor refers to what we could call learning in a cooperative relationship, so those organizations which have collaborated in the past will have some experience in cooperation (Levinthal & Fichman, 1988; Hamel, 1991; Menguzzato, 1992).

This factor presents a two-fold dimension: the nature of the prior cooperative agreement, that is, the type of activities carried out within the relationship, and the characteristics of the cooperating partner (Simonin, 1999; Reuer *et al*, 2002). So we can say there are previous links when, in the past, there has been some collaboration in similar activities or when the partners have previously collaborated on other occasions.

There are several studies which postulate that the outcome of the cooperative relationships would be better if the partners have had previous cooperative experiences, both in the framework of interorganizational relationships in general (Levinthal & Fichman, 1988; Hakanson, 1993; Saxton, 1997; Rialp, 1999; García & Valdés, 2000), and in that of cooperation between firms and research organizations (Goldhor & Lund, 1983; McDonald & Giesler, 1987; Dill, 1990; Geisler *et al*, 1990, 1991; Cukor, 1992; Häusler *et al*, 1994; Geisler, 1995; Cyert & Goodman, 1997; Davenport *et al*, 1999a). So we think that the agreement will have a greater level of success if the activities involved in previous cooperative relationships are related to those of the current cooperative agreement, or if there has been some kind of positive collaboration in the past between the parts cooperating at the present time. This leads us to propose the sixth hypothesis:

Hypothesis 6: Previous cooperative experiences have a positive influence on the success of cooperative agreements between firms and research organizations.

Reputation is a factor related to the particular features of the partners who are going to cooperate. It is concerned with information about the mentioned partners which is public knowledge, that is, it is known by the rest of the agents taking part in a given sector or activity. This information may reveal features of the organizations concerning their management, the quality of their products or their financial status (Dollinger *et al*, 1997). If this information is positive the image of a partner will be positive and, as a consequence, its reputation too. However, when the information about a partner is negative, his image, and consequently his reputation, will be harmed. All this being considered, both the firm and the research organization need to hold good industrial and research credentials respectively (Geisler *et al*, 1991; De Laat, 1997). But the reputation of a given partner depends equally on prior achievements and on the prestige of the people involved in the organization. Thus, while organizational reputation refers to past achievements and performances of the organization as a whole, that is, its technological, productive or commercial excellence (Gray, 1985; De Laat, 1997), personal reputation is marked by the professional experience of the members working for the organization (Goldhor & Lund, 1983; Gee, 1993; Bloedon & Stokes, 1994; Martínez & Pastor, 1995; De Laat, 1997).

The partners' reputation is a key factor that influences both the success of the cooperative relationships (Gray, 1985; De Laat, 1997; Saxton, 1997) and the success of the cooperative agreements between firms and research organizations (Goldhor & Lund, 1983; Geisler *et*

al, 1990, 1991; Bloedon & Stokes, 1994; Martínez & Pastor, 1995). Taking the mentioned studies as a starting point, we can propose a positive link between the partners' reputation and the success of the cooperative agreement.

Hypothesis 7: *The partners' reputation has a positive influence on the success of cooperative agreements between firms and research organizations.*

A clear definition of objectives means to plainly and accurately formulate the aims pursued in the cooperative agreement, both individually –for each of the partners involved- and comprehensively, for the relationship itself (Häusler *et al*, 1994; Klofsten & Jones-Evans, 1996). Several studies have shown that the objectives specified in the framework of interorganizational relationships must be known and accepted (Chisholm, 1996), clear (Geisler *et al*, 1990, 1991; Häusler *et al*, 1994; Klofsten & Jones-Evans, 1996; Burnham, 1997; Jones-Evans & Klofsten, 1998), accurate (Geisler *et al*, 1990), flexible (Ghoshal *et al*, 1992), well-defined, real and relevant (Cukor, 1992). Furthermore, there are two reasons why an accurate definition of the tasks and responsibilities of the cooperating parts is needed (Cukor, 1992; Gee, 1993; Davenport *et al*, 1999a, 1999b). On the one hand, the fulfilment of objectives requires a correct identification of the tasks and responsibilities for each partner. On the other hand, in the event the objectives are not achieved, the reasons can be analysed by checking if the participants have failed to comply with their tasks or not, something for which the identification and definition of those tasks appears as basic.

A clear definition of objectives comes up as a vital factor in cooperative relationships (Gray, 1985; Chisholm, 1996). More specifically, the flexibility in the formulation of objectives (Ghoshal *et al*, 1992), the clear definition of responsibilities, objectives and tasks by the parts, as well as the existence of objectives and common targets, contribute to the success of cooperative relationships between firms and research organizations (Geisler *et al*, 1990, 1991; Cukor, 1992; Gee, 1993; Burnham, 1997; Jones-Evans & Klofsten, 1998; Davenport *et al*, 1999a; 1999b). Based on the above mentioned studies, hypothesis 8 proposes a clear definition of objectives as influential in the success of cooperative agreements between firms and research organizations.

Hypothesis 8: *A clear definition of objectives has a positive influence on the success of cooperative agreements between firms and research organizations.*

Although there is a high number of firm-research organization collaborations carried out informally and without any sort of regulation, other agreements show a great level of

formalization. A relationship is said to be institutionalized if it is defined in terms of objectives, place and time (Dierdonck & Debackere, 1988), or if extensive negotiations and countless approvals are required (Bonaccorsi & Piccaluga, 1994).

In this paper, we propose a level of systematization, planning and organization as the main dimensions of this factor. Thus, the higher the number of rules, policies and procedures regulating the relationship and shared by the parts (Ranson *et al*, 1980), and the higher the amount of arrangements, legal issues and administrative procedures (Bonaccorsi & Piccaluga, 1994), the more institutionalized the cooperative relationship will be.

Our revision of the literature has allowed us to identify studies which find a positive relationship between the degree of institutionalization of the relationship and the success achieved by the cooperative agreement. To be precise, Geisler & Furino (1993) and Geisler (1995, 1997) have shown that the better planned, organized and institutionalized the cooperation is, the better will be the results attained in the process of technological transfer. Taking these contributions into account, we can suggest a positive relationship between the degree of institutionalization and the success achieved by the agreement, which is illustrated in the following hypothesis:

Hypothesis 9: Institutionalization has a positive influence on the success of cooperative agreements between firms and research organizations.

Proximity between partners refers to the physical distance between cooperating partners (Mansfield & Lee, 1996), that is, to the location of one of the parts with respect to the other (Fritsch & Schwirten, 1999). In the literature analysed, this factor is usually identified with the term ‘geographic proximity’, in such a way that, if the parts are physically near each other, their geographical proximity will be closer (McDonald & Gieser, 1987).

Three aspects or dimensions can be mentioned relating to this factor in particular: location or geographical point where the cooperative partners are placed (McDonald & Gieser, 1987; Landry *et al*, 1996; Vedovello, 1997; Westhead; 1997; Fritsch & Schwirten, 1999), physical distance between the partners (Katz, 1994; Mansfield & Lee, 1996; Beise & Stahl, 1999) and the travel time spent by the partners (Katz, 1994; Mansfield & Lee, 1996). Nevertheless, regardless of the defined dimensions of proximity, it cannot be forgotten that this is a relative concept, as it depends on several factors such as the transport infrastructure of a country. This can be seen in the studies by Mansfield & Lee (1996) and Beise & Stahl (1999), Fritsch & Schwirten (1999) and Katz (1994).

Geographic proximity contributes to the development and establishment of cooperative relationships between several partners (Gray, 1985). If partners are geographically close, contacts and communications between parts will be more effective, and better results will be achieved (McDonald & Gieser, 1987; Dill, 1990; Katz, 1994). This higher effectiveness in the relationships between partners is a consequence of a reduction in travelling, communication and information expenses, and in the time consumed (Katz, 1994; Landry *et al*, 1996; Fritsch & Schwirten, 1999). In addition, proximity between partners has a positive effect on the productivity of the firm-research organization collaboration (McDonald & Gieser, 1987; Cukor, 1992; Geisler & Furino, 1993; Bonaccorsi & Piccaluga, 1994; Vedovello, 1997). Taking the above-mentioned studies into consideration, we regard proximity as relevant in the success of cooperative relationships, so when partners are close the outcome of cooperative relationships is more satisfactory. This relationship is materialized in hypothesis 10.

Hypothesis 10: *Proximity between partners has a positive influence on the success of cooperative agreements between firms and research organizations.*

METHODOLOGY

Sample

Bearing in mind that the majority of cooperative agreements between firms and research organizations take place mostly within the technological field or research and development areas, the universe of our research is national cooperative agreements in research and development where at least two partners are involved: a firm and an external organization specialized in the research and provision of technological services. In order to carry out our analysis, we have chosen a sample that is indicative enough of the phenomenon to be studied. In this way, the chosen agreements are the national projects run by the Centre for Technological and Industrial Development (CDTI)³ which meet the following requirements: (1) the establishment of the agreement took place between January 1995 and December 2000; (2) two types of partners participating: a firm and at least a research organization.

³ CDTI is a state agency, dependant on the Ministry of Science and Technology, which aims at helping Spanish companies to improve their technological level by supporting R&D projects financially, by promoting firms taking part in international programs of technological cooperation and by backing technological transfer within the business world.

Thus, by December 31st, 2000, the number of projects fulfilling the requirements was 800. As a firm is allowed to take part in more than one project, the overall number of firms making up the sample amounts to 574. The number of different research organizations that collaborated within the framework of the CDTI projects was 150. In most cases, these agreements involve two or three partners (projects with more than four partners are rare). Regarding the kind of partner that collaborates with the firm, 60% correspond to universities, 18% to centres for innovation and technology, 16% to state agencies, with research associations rarely being the target of collaboration. Finally, these agreements, running for an average period of two years, involve the performance of activities linked to new materials, information and communication technologies and leading-edge technology⁴.

In order to collect information, taking into account the fact that the unit of analysis of this study is the collaborative relationship and that the participating partners differ in nature, two questionnaire surveys were elaborated, similar in their structure but adapted to the specific features of each kind of partner⁵. The valid return rate was 36.37% for the firm sample and 24% for the research organization sample. This way, we can offer the results of the statistical analysis carried out for each sample in a parallel way. This two-fold approach, which takes into consideration information about both the firm partner and the research-organization partner, constitutes, in our view, one of the most original contributions in this study, as most papers analysing this type of relationships use information solely about one of the parts.

Measure of variables

In order to gauge the variables that constitute our model of analysis, we have used different types of measures. While in most cases we have elaborated scales made up by a set of items that assess at a range from 1 to 7, in other cases categorical variables have been employed. As table 1 shows, the results deriving from the reliability analysis carried out

⁴ A more detailed analysis of cooperative agreements between firms and research organizations run by the CDTI between 1995 and 2000 can be seen in Mora & Montoro (2001).

⁵ The survey was sent in two phases. First, it was sent to all the firms and second to the research organizations identified by the firms that answered in the first phase.

with the Cronbach Alpha statistical test have turned out to be quite satisfactory, both for dependent and independent variables⁶.

As for the dependent variable, that is, the success of the relationship, two measures have been used: the evolution of the relationship and partner's satisfaction. As for the *evolution of the relationship*, there are several studies that rate the success of cooperative agreements by means of indicators, such as survival (Geisler, 1995; Davenport *et al*, 1999a) or the continuity of the cooperative relationship (Shamdasani & Sheth, 1995). In short, and following Montoro (1999), we have formulated five items that describe the different situations that may occur in the development of the agreement. The second proposed measure refers to the level of *global satisfaction* of the parts of the agreement. Most studies consider satisfaction as an acceptable indicator of the achievement of objectives in a cooperative agreement. We will identify satisfaction with the partners' perception regarding certain aspects of the cooperative relationship (Mohr & Spekman, 1994). So five items have been proposed, referring to specific global aspects of the project such as the partner's performance, the development of the agreement and the global results of the project (Montoro, 1999).

As for organizational factors, commitment has been measured by five items which rate the commitment expressed by the senior executives and by the rest of the participants in the organization (Geisler *et al*, 1991; Randazzese, 1996; Davenport *et al*, 1999a; 1999b), as well as the emotional commitment, prospects of continuity and the wish to invest (Kumar *et al*, 1995; Burnham, 1997; Montoro, 1999). Taking the measures suggested by Mohr & Spekman (1994), Medina (1996) and Olk & Young (1997) as a starting point, our proposal consists of a four-item scale to measure the frequency and content of the communication. From the studies by Sullivan & Peterson (1982), Ganesan (1994), Mohr & Spekman (1994), Kumar *et al* (1995), Geyskens *et al* (1996) and Montoro (1999) we have measured trust by using a four-item scale representing integrity and benevolence. In order to gauge conflict, most studies have opted for questioning about the existence of conflict or disagreement with the partners within the organization itself (Anderson & Narus, 1990;

⁶ Despite the fact that the correlation rate of the previous links variable is not very high, it is quite significant in both cases. The answer to this lower correlation may lie in the fact that, although both items represent the existence of previous links, in one case it refers to previous links in R&D/technological agreements, whereas in the other case it refers to cooperative experiences with the same partner, two aspects which do not necessarily occur simultaneously. Something similar is stated in the study by Saxton (1997).

Bucklin & Sengupta, 1993; Cullen *et al*, 1995). Our measure for conflict is made up of a four-item scale and refers both to the conflict between cooperative organizations and the conflict arising at one of the organizations as a consequence of its collaborative activities (Campbell, 1997). The measure for dependence is formed by four items referring to the resources of the other partners to which the organization has had access, the cost of changing partner and the investments made in specific assets as a result of the agreement (Ganesan, 1994; Mohr & Spekman, 1994; Andaleeb, 1996; Montoro, 1999).

With regards to contextual factors, previous experiences are measured through prior links, common prior business or previous cooperations in specific projects (Rialp, 1999; García & Valdés, 2000; Reuer & Ariño, 2002). To measure this variable we have proposed two items related to the nature of the prior agreement and to the features of the partner the collaboration took place with (Reuer *et al*, 2002). The partners' reputation varies depending on the type of partner being referred to. While the reputation of an organization is usually measured in terms of intellectual and academic excellence (Geisler *et al*, 1990, 1991; Martínez & Pastor, 1995), measures for the reputation of the firm revolve around its business excellence (Gee, 1993; Martínez & Pastor, 1995; De Laat, 1997). Our measure is a three-item scale which rates organizational reputation and the reputation of those people taking part in the organization. Taking the studies by Gray (1985), Geisler *et al* (1991), Cukor (1992), Chisholm (1996) and Jones-Evans & Klofsten (1998) as reference, the measure for the definition of objectives is made up of three items which rate whether the objectives are clear and precise, whether they are known and accepted by the partners and, lastly, whether the tasks and responsibilities of the parts are known and accepted by the partners. To measure the degree of institutionalization we have used a two-item scale which stems from the measures proposed in the studies by Bonaccorsi & Piccaluga (1994), Dierdonck & Debackere (1988) and Ranson (1980). Finally, taking as reference the studies by Katz (1994), Mansfield & Lee (1996) and Beise & Stahl (1999), we have proposed a scale made up by two indicators (distance and time) in order to measure the effect that distance between partners has on the success of the cooperative agreements.

To make the proposed measures operative, the arithmetical means have been calculated. Table 1 shows the results of the descriptive statistics for each variable. Furthermore, the Kolmogorov-Smirnov statistical test has been used so as to check the normality of our data. The results obtained revealed that the assumption of normality was fulfilled in every

case. Finally, the tests relating to the non-response bias let us assume its absence in our study.

INSERT TABLE 1 ABOUT HERE

RESULTS

As a previous step to the contrast of hypotheses, the correlations between all the variables have been analysed, not only in the firm sample but also in that of research organizations. As shown in tables 2 and 3, results reveal that the highest correlations with the variable for the global satisfaction of the firm sample are those corresponding to commitment and trust, followed by definition of objectives, partners' reputation, communication and conflict. In the particular case of the sample for research organizations, the strongest correlations are with communication and commitment, followed by trust, partners' reputation and definition of objectives. As for the evolution of the relationship variable, in the firm sample the highest correlations correspond to the organizational factors of commitment and trust, followed by conflict, communication and the contextual factors reputation and previous experiences. Nevertheless, in the sample for research organizations, the highest correlations are associated to commitment and trust, followed by reputation and previous experiences.

INSERT TABLES 2 AND 3 ABOUT HERE

As consequence of these high correlations between the independent variables, relationships were contrasted with a model of structural equations for the purpose of identifying direct and indirect effects of the independent variables on success⁷. Table 4 shows values of the estimations of parameters of the model of structural equations. It is worth mentioning that standardized regression weights represent the direct effects between the dependent and independent variables in each relationship. As it can be observed, fitting indexes show the goodness of fit of the model. Results of the parameters corroborate those previously obtained and confirm that the factors causing a higher effect on global satisfaction in the firm sample are those of commitment, definition of objectives and conflict. Regarding the evolution of the relationship variable, we must point out the role of commitment, previous experiences and conflict. As for the sample of research organizations, communication, commitment and reputation play a key role in global satisfaction, whereas previous links,

trust and commitment have a deeper effect on the evolution of the relationship. In our model, the relationships between the independent variables (bidirectional) have been introduced in order to analyse the behaviour of each factor on the success of the agreement more accurately. Hence it can be affirmed that even though some independent variables of the model have a direct effect on the dependent variable, in most cases there are relationships between the independent variables themselves and these, in turn, influence the success of the agreement.

INSERT TABLE 4 ABOUT HERE

All these results have allowed us to contrast the hypotheses stated in this study. Thus, commitment is significant in the two samples, both in the case of global satisfaction and in the evolution of the relationship. This leads to the confirmation of hypothesis 1, that is, commitment has a positive influence on the success of cooperative agreements between firms and research organizations. If focusing on the sample made up by research organizations, communication greatly influences global satisfaction but not the evolution of the relationship. However, the model of structural equations has revealed the presence of an indirect relationship between communication and evolution of the relationship through commitment. A similar case is that of the firm sample, where there is a relationship between communication and success through commitment. All this considered, the second hypothesis is accepted in both samples. The relationship between trust and success is confirmed in the sample for research organizations, both in global satisfaction and in the evolution of the relationship. While we can observe a direct relationship with the latter, the analysis let us confirm that trust has an influence on the former through commitment, communication and reputation. In the case of the firm sample, we can have found some indirect effects on success through commitment, conflict and definition of objectives. As for conflict, its negative influence on the success of the agreement is confirmed, in a direct way in the firm sample and, in an indirect way (through communication, reputation and trust), in that of research organizations. In spite of the fact that dependence has no direct effect on success, it shows links with other independent variables (commitment in the firm sample and communication, commitment and reputation in that of research organizations) which certainly can answer for part of the success. So, hypothesis 5 can be confirmed albeit in an indirect way.

⁷ Although the high correlations among independent variables, we proceeded to use a multiple

The sixth hypothesis, or link between previous experiences and success, is confirmed with the evolution of the relationship in both samples. Although there are no direct effects between previous links and global satisfaction with the agreement, in the case of the sample for research organizations an indirect relationship between both variables through commitment has been found. No indirect relationship has been detected in the firm sample. Structural equations only confirm this relationship in the sample for research organizations and for the global satisfaction measure. In addition, there are indirect relationships between both success measures and reputation in the two samples. On the other hand, our results have revealed a direct relationship between a clear definition of objectives and the global satisfaction of the firms. Moreover, we can observe some indirect effects of the clear definition of objectives in success through commitment and conflict –in the case of the firm sample- and through communication, commitment and reputation –in the case of that of research organizations-. Finally, regarding hypotheses 9 and 10, results make us reject the relationship between the variables of institutionalization and distance between partners, on one hand, and success, on the other. Thus, these two variables do not seem to have importance in the success of cooperative agreements between firms and research organizations.

Our results confirm that organizational factors are very relevant in the success of cooperative agreements highlighting the importance of the behaviour of partners during the implementation stage. And these findings are congruent with empirical evidence of previous studies. Contextual factors are important too especially those that have been identified more precisely in the literature. With respect to the institutionalisation of the relationship, our results have proved to be not significant. This can be explained because of the nature of our sample where the CDTI has a central and institutional role in the formation and development of the agreements. Finally, although a lot of previous studies have identified proximity as a success factor, our results have shown that this is not a significant variable. In fact, the existence of succeeding R&D projects in the context of international programmes where two or more partners coming from different countries collaborate, gives support to our results.

regression analysis as an exploratory and preliminary test. Results are shown in the Appendix.

CONCLUSIONS

Due to the short number of studies which show empirical evidence about the success of cooperative agreements between firms and research organizations, and the lack of integration in the use of variables, dimensions and measures, the purpose of this paper has been the identification of the factors which have an influence on the success of this kind of cooperative relationships. To do so ten factors were selected, grouped under two categories. The organizational factors chosen were commitment, communication, trust, conflict and dependence. The contextual factors, basic for the establishment of the relationship, have been previous links, reputation, and a clear definition of objectives, institutionalization and distance between partners. With this revision we have achieved our aim: to provide theoretical evidence which allows us to have a more integrative and homogeneous vision of those factors which have proved to be the most relevant in the analysis of the success of cooperative relationships between firms and research organizations.

With the aim to corroborate the formulated hypotheses, a sample of cooperative agreements in R&D run by the CDTI were selected, where a firm and at least a research organization were involved during the period 1995 and 2000. Bearing in mind that partners who take part in this type of agreements show different features and behaviours, the proposed relationships were contrasted separately both in the firms sample and in the research organizations one.

Unlike other previous studies, where research is limited to success considering just one partner, our study analyses the success of cooperative agreements from both parts, that is, firm and research organizations. Results let us observe that the factors with the highest effect on success of this type of agreements are, in the case of firms, commitment, previous links, definition of objectives and conflict, whereas in the case of research organizations previous links, communication, commitment, trust and the partners' reputation must be highlighted. These results constitute an empirical contribution to the study of the success of cooperative agreements between firms and research organizations.

In this way, we have obtained a series of conclusions and implications that can be of great use, both in the academic world and while trying to lead and manage cooperative agreements. First of all, we have elaborated and tested a comprehensive theoretical model that identifies the determining factors of success of cooperative agreements between firms

and research organizations. Factor grouping under two categories (contextual and organizational) makes a novel contribution to the study of the success of cooperative relationships as a way to organize and integrate previous studies. In this sense, we consider that our model allows overcoming the heterogeneity and fragmentation of that specialized literature.

Equally interesting is the way in which outcomes have been presented. Taking into account that the relationship of cooperation between both parts constitutes the unit of analysis, we have collected data from both types of partners involved, that is, firms and research organizations. For this particular purpose, two different questionnaire surveys were elaborated, each adapted to the nature of each partner making up the sample. As expected, results have revealed that the importance that each factor has in the success of the agreement varies depending on the type of partner analysed. This aspect gives us a more comprehensive and detailed perspective of this kind of collaborative agreements and can be considered an original –there are no precedents in the literature- and relevant contribution due to the different nature of partners and the importance of this kind of technological cooperation for the development of countries.

Another contribution of this paper is the rate of success of the cooperative agreement by means of two measures. Besides, the success achieved has been measured, both that of the firm-partner and in the case of the research organization-partner. The sort of sample selected is also a novel contribution to the analysis of relationships between firms and research organizations. Lastly, the use of structural equations as a statistical technique represents an important novelty, at least in the field of cooperative relationships between firms and research organizations.

In addition to this, our results cast a series of practical recommendations that may be really useful for the running and management of cooperative agreements. More specifically, the initial stages of the agreements are basic to develop agreements with a clear definition of objectives and with partners who enjoy a good reputation. Moreover, accumulation of previous links increases the chance of success. During the establishment and development stages, it is recommended to design managerial and organizational mechanisms which facilitate a high degree of commitment, trust, dependence, good communication and a reduced level of conflict. What is more, we think this information can be very helpful for the future formulation and establishment of state and private programs whose objective is

the encouragement of cooperation between firms and research organizations. This is especially true not only at a national level but at an European one as well in order to foster international cooperation within the European Union.

To conclude, it must be said that this study represents a starting point for future research studies intended to widen theoretical and empirical evidence about the success of cooperative agreements between firms and research organizations. As a research agenda, we suggest to try making an in-depth analysis of the identified factors for success, as well as identifying new factors which might have, somehow, influence on success. We also think that the consideration of the project or cooperative agreement as a unit of analysis, comparing and confronting the collected data for the two partners in the project, might offer more specific results about each agreement. In this sense, it would be interesting to measure success individually for each partner involved by assuming their expectations, that is, comparing the expected objectives by each part with the ones really achieved at the end of cooperative relationship.

Taking into account that the sample for research organizations is made up of different types of partners, it might be interesting to carry out a comparative analysis of the results obtained here, depending on the type of research organization the firm cooperates with. Finally, with an aim to generalize the results obtained, we also find it interesting to contrast our theoretical model in other samples of cooperative relationships in which partners are featured differently (firm-firm, provider-client...), as well as in other samples of technological international cooperative agreements because of the increasing relevance of this kind of cooperation in the context of the European Union fostered by its Framework Programme.

APPENDIX: Multiple regression analysis

Firms Sample

VARIABLES	Global satisfaction			Evolution of the relationship		
	Mod. 1	Mod. 2	Mod. 3	Mod. 1	Mod. 2	Mod. 3
Commitment	0.456***		0.480***	0.356***		0.340***
Communication	-0.008		-0.036	-0.007		-0.021
Trust	0.133**		0.105	0.051		0.047
Conflict	-0.217***		-0.198***	-0.175***		-0.169***
Dependence	-0.015		-0.005	-0.058		-0.047
Previous links		0.099**	0.062		0.205***	0.173***
Partners' reputation		0.298***	0.069		0.234***	0.017
Definition objectives		0.325***	0.222***		0.065	-0.026
Institutionalization		-0.045	-0.046		-0.003	0.007
Distance partners		-0.065	-0.046		-0.094*	-0.071
Summary of the model						
R	0.672	0.539	0.696	0.445	0.319	0.477
R ²	0.451	0.291	0.485	0.198	0.102	0.228
Adjusted R ²	0.446	0.284	0.479	0.193	0.096	0.219
Stand. error of estim.	0.6750	0.7674	0.6542	0.6813	0.7210	0.6699
Durbin – Watson	1.784	1.737	1.788	1.894	1.850	1.927
F	78.712***	39.252***	89.942***	35.567***	16.331***	28.175***

Correlation is significant at level *** p < 0.01 ** p < 0.05 * p < 0.1

Beta predictor variables: figures in bold
Beta excluded variables : figures not in bold

Research Organizations Sample

VARIABLES	Global satisfaction			Evolution of the relationship		
	Mod. 1	Mod. 2	Mod. 3	Mod. 1	Mod. 2	Mod. 3
Commitment	0.263***		0.241***	0.282***		0.149*
Communication	0.379***		0.335***	-0.116		-0.113
Trust	0.224***		0.126*	0.240***		0.276***
Conflict	-0.062		-0.071	-0.005		0.019
Dependence	-0.004		-0.029	0.081		0.107
Previous links		0.071	-0.027		0.305***	0.270***
Partners' reputation		0.416***	0.219***		0.327***	0.123
Definition objectives		0.406***	0.128**		0.018	-0.133
Institutionalization		0.007	-0.068		-0.031	-0.095
Distance partners		0.006	0.006		-0.033	0.019
Summary of the model						
R	0.768	0.705	0.778	0.478	0.499	0.538
R ²	0.590	0.497	0.606	0.229	0.249	0.289
Adjusted R ²	0.583	0.491	0.598	0.221	0.241	0.278
Stand. error of estim.	0.6792	0.7501	0.6673	0.7113	0.7017	0.6847
Durbin – Watson	1.703	1.552	1.621	2.145	2.232	2.143
F	90.009***	93.275***	71.899***	28.034***	31.391***	25.486***

Correlation is significant at level *** p < 0.01 ** p < 0.05 * p < 0.1

Beta predictor variables: figures in bold
Beta excluded variables: figures not in bold

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TABLES

Table 1. **Reliability of the measures and descriptive statistics**

VARIABLE		FIRMS			RESEARCH ORGANIZATIONS		
Organizat. Factors	items	Alpha C	Average	St. Devi.	Alpha C	Average	St. Devi.
Commitment	5	0.8485	5.88	0.81	0.8620	6.15	0.94
Communication	4	0.7880	5.73	0.85	0.7936	5.86	1.04
Trust	4	0.9241	6.17	0.78	0.9366	6.16	1.03
Conflict	4	0.8184	1.63	0.81	0.9353	1.47	0.98
Dependence	4	0.7129	4.75	1.04	0.7247	3.91	1.29
Contextual factors	items	Alpha C	Average	St. Devi.	Alpha C	Average	St. Devi.
Previous links	2	0.279***	0.74	0.34	0.122**	0.87	0.23
Partners' reputation	3	0.8706	5.76	0.90	0.8933	5.62	1.17
Definit. of objectives	3	0.8410	6.06	0.73	0.8952	6.15	0.99
Institutionalization	2	0.637***	4.20	1.24	0.714***	3.70	1.48
Distance partners	2	0.931***	1.72	0.86	0.931***	2.32	0.83
Success of agreem.	items	Alpha C	Average	St. Devi.	Alpha C	Average	St. Devi.
Global satisfaction	5	0.9080	5.59	0.91	0.9492	5.81	1.05
Evolution relation	1	NA*	4.51	0.76	NA*	4.49	0.81

NC: The reliability analysis is not applicable

***Correlation coefficient ($p < 0.01$)

**Correlation coefficient ($p < 0.1$)

Table 2. Correlation between variables Firms Sample

VARIAB	Commit	Communi	Trust	Conflict	Dependen	Prev links	Reputat	Defin obj	Institutio	Proximity	Glob satisf	Evol relat
Commit												
Communi	0.666***											
Trust	0.718***	0.568***										
Conflict	-0.329***	-0.259***	-0.456***									
Dependen	0.432***	0.423***	0.425***	-0.110*								
Prev links	0.101*	0.114*	0.091	-0.062	-0.010							
Reputat	0.458***	0.396***	0.475***	-0.398***	0.435***	0.055						
Defin obj	0.350***	0.359***	0.358***	-0.322***	0.183***	0.062	0.410***					
Institutio	0.067	0.102*	0.016	0.151**	0.110*	-0.009	0.031	-0.057				
Proximity	-0.044	-0.081	-0.089	-0.022	-0.037	-0.127**	0.063	-0.063	-0.105*			
Glob satisf	0.623***	0.431***	0.559***	-0.427***	0.266***	0.136**	0.437***	0.453***	-0.055	-0.077		
Evol relat	0.413***	0.278***	0.357***	-0.292***	0.126**	0.217***	0.245***	0.163***	0.002	-0.103*	0.383***	

Table 3. Correlation between variables Research Organizations Sample

VARIAB	Commit	Communi	Trust	Conflict	Dependen	Prev links	Reputat	Defin obj	Institutio	Proximity	Glob satisf	Evol relat
Commit												
Communi	0.662***											
Trust	0.662***	0.673***										
Conflict	-0.279***	-0.307***	-0.479***									
Dependen	0.419***	0.328***	0.316***	-0.020								
Prev links	0.405***	0.233***	0.200***	-0.142**	0.089							
Reputat	0.564***	0.572***	0.689***	-0.368***	0.371***	0.248***						
Defin obj	0.620***	0.661***	0.561***	-0.267***	0.262**	0.136*	0.469***					
Institutio	0.262***	0.203***	0.120*	0.057	0.358***	-0.056	0.061	0.179**				
Proximity	0.043	-0.018	0.002	-0.066	0.088	0.010	0.174**	-0.108	0.089			
Glob satisf	0.666***	0.704***	0.657***	-0.345***	0.302***	0.225***	0.607***	0.601***	0.105	0.034		
Evol relat	0.444***	0.294***	0.430***	-0.198***	0.261***	0.386***	0.403***	0.209***	-0.028	0.029	0.289***	

*** Correlation is significant at level $p < 0.01$ ** Correlation is significant at level $p < 0.05$ *Correlation is significant at level $p < 0.1$

Table 4. Results from the Structural Equation Model

VARIABLES	FIRMS		RESEARCH ORGANIZATIONS	
Global satisfaction	Std. R. Weig.	Critic. Ratio	Std. R. Weig.	Critic. Ratio
Commitment	0.440	6.496	0.240	3.301
Communication	-0.054	-0.927	0.322	4.520
Trust	0.100	1.547	0.093	1.240
Conflict	-0.154	-3.074	-0.044	-0.856
Dependence	-0.030	-0.576	-0.001	-0.013
Previous links	0.058	1.337	-0.034	-0.683
Partners' reputation	0.084	1.561	0.155	2.419
Definition of objectives	0.203	4.191	0.123	1.873
Institutionalization	-0.053	-1.222	-0.070	-1.415
Distance between partners	-0.050	-1.162	0.019	0.405
Evolution of the relationship	Std. R. Weig.	Critic. Ratio	Std. R. Weig.	Critic. Ratio
Commitment	0.330	4.027	0.210	2.188
Communication	-0.017	-0.240	-0.084	-0.894
Trust	0.051	0.650	0.248	2.497
Conflict	-0.156	-2.572	0.016	0.230
Dependence	-0.071	-1.126	0.127	1.816
Previous links	0.164	3.128	0.245	3.688
Partners' reputation	0.054	0.841	0.108	1.282
Definition of objectives	-0.042	-0.710	-0.115	-1.325
Institutionalization	0.000	0.006	-0.121	-1.855
Distance between partners	-0.078	-1.495	-0.017	-0.274
Relations between variables	Correlat.	Critic. ratio	Correlat.	Critic. Ratio
Commitment-Trust	0.683	10.048	0.594	7.679
Trust-Communication	0.629	9.280	0.608	7.541
Trust-Partners' reputation	0.398	6.631	0.455	6.225
Commitment-Dependence	0.396	6.495	0.218	3.939
Commitment-Definition of objectives	0.253	4.613	0.576	7.253
Commitment-Conflict	-0.176	-3.852	-	-
Communication-Trust	0.490	7.990	0.605	7.529
Communication-Dependence	0.389	6.351	0.140	2.617
Communication-Partners' reputation	0.300	5.263	0.495	6.430
Communication-Definition objectives	0.240	4.438	0.642	7.527
Trust-Partners' reputation	0.423	7.030	0.644	7.918
Trust-Dependence	0.381	6.520	0.194	3.333
Trust-Conflict	-0.350	-6.511	-0.301	-5.244
Trust-Definition objectives	0.268	4.842	0.482	6.354
Dependence-Partners' reputation	0.375	6.508	0.294	4.478
Conflict-Partners' reputation	-0.333	-5.845	-0.219	-3.575
Conflict-Definition of objectives	-0.265	-4.504	-	-
Partners' reputat.-Definition object.	0.333	5.817	0.371	5.140
Commitment-Previous links	-	-	0.271	5.022
Dependence-Institutionalization	-	-	0.312	4.407
Indexes of adjustment to the model				
FIRMS		ORGANIZATIONS		
Chi-squared = 72.083 $\chi^2/df = 2.57$		Chi-squared = 98.149 $\chi^2/df = 3.50$		
CMC Satisf.= 0.455 CMC Rel evol = 0.203		CMC Satisf.= 0.587 CMC Rel e = 0.282		
GFI = 0.962 AGFI = 0.895 CFI = 0.956		GFI = 0.926 AGFI = 0.795 CFI = 0.925		

