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Innovation in services through learning in a joint venture

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Abstract

Innovation determines a firm's competitiveness and survival and a joint venture is a fast and effective way to acquire the missing knowledge that partners require to innovate. But "knowing how to cooperate" can be a determining factor in achieving the successful transfer of knowledge. Employing a sample of 81 service sector firms and using a structural equation modeling methodology, we found a positive and direct impact between the cooperative learning process and partners' commitment to innovation.

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Keywords: innovation; cooperative learning; knowledge; commitment; trust; joint venture

Introduction

Globalization coupled with frequent advances in technology means that firms have to adapt quickly and constantly improve, usually by innovating (Brown & Eisenhardt, 1995; Gilson & Shalley, 2004). Firms that have a greater capacity to innovate are able to respond better to competitive pressures by developing new capabilities that provide a competitive advantage (Montes *et al.*, 2004). This is especially true for service firms; but, unable to protect their innovation by patenting, imitation by competitors can quickly erode any advantage gained through an innovation (Sundbo, 1997; Miles *et al.*, 2000). This aspect of service companies helps explain why knowledge, particularly new knowledge, is such a key resource (Kandampully, 2002) for service innovation. Innovation results from an interactive process in which different specialized agents exchange, absorb and assimilate knowledge in a physical or socially shared context (Autio *et al.*, 2004). This process does not depend solely on the knowledge that a firm develops internally, but also depends on a firm's capacity to assimilate the knowledge of other firms (Cohen & Levinthal, 1989).

One context that offers possibilities for access to, and for the assimilation of, knowledge is a strategic alliance. Of course, some forms of alliance are more appropriate for simply accessing knowledge but others, such as joint ventures (JV) are well suited for learning and acquiring the knowledge provided by a partner (Grant & Baden-Fuller, 2004). Moreover, a joint venture can provide a suitable context where several learning processes can develop; for example, cooperative learning (Simonin, 1997; Tsang, 1999, 2002; Anand & Khanna, 2000; Kale & Singh, 2007). This learning process can provide the new knowledge which endows firms with the capacity to cooperate (Palmer, 2006) and, furthermore, to acquire the knowledge they need in order to innovate. The knowledge generated by the cooperative learning process is a unique, scarce and valuable resource,

one which is difficult to transfer or imitate and could therefore constitute a new competitive edge (Simonin, 1997; Shang, 2009)) and determine the success of the cooperation.

Consequently our research problem is that service firms need to acquire knowledge to innovate, but knowledge acquisition can be costly and ineffective (El Harbi et al, 2011). Joint ventures seem to offer a solution for pooling and developing knowledge, especially the tacit knowledge so essential for innovation because service innovation is argued to result from new combinations of knowledge (Amara, Landry and Dolereux, 2009). But joint ventures also appear to require commitment and trust if cooperative learning for innovation is to develop. Hence the objective of this paper is to analyze the relationship between the cooperative learning process and innovation through a JV in firms from the service sector.

The study offer a particular contribution because the few studies on cooperative learning process, such as those by Simonin (1997), Anand & Khanna, (2000) and Kale & Singh, (2007), have all centered on manufacturing firms. Furthermore, the relationship between the cooperative learning process and innovation for firms participating in an alliance, both in a manufacturing and services environment, is still to be explored. Similarly, the relationship between the contextual factors of the alliance, such as trust, commitment and the learning process have so far not been researched. In an effort to fill this gap in literature, we first analyze the relationships between cooperative learning and innovation. Secondly, we study the relationship between trust and commitment of partners for cooperative learning.

The study is presented in three sections. In the first section, we establish the hypothesis that connects the main variables that comprise our model: innovation, cooperative learning process, commitment and trust. In the second section, we explain the methodology used. Finally, in the third section, we analyze the results and implications of our study and present our conclusions.

Background and hypothesis

Innovation in service-sector firms

The service sector involves a wide range of diverse activities, but also shares particular characteristics that set it apart from manufacturing. Moreover, these characteristics determine the nature of innovation in service firms (Pires, Sarkar and Carvelho, 2008). Importantly, the interaction and inseparability between production and consumption in services means that much innovation is aimed at adapting the product to meet client's needs (Toivonen and Touminen, 2009). Taking into account these characteristics, it is possible to identify four different types of innovation in service firms: *product innovation*, which consists of presenting the client with new services or improved existing ones; *process innovation*, which includes not only new or improved production processes but also better service provisions (distribution and service delivery); *market innovation*, which means entering into a new market segment or a new business; and *organizational innovation*, which consists of a new way of organizing or managing a firm (Sundbo & Gallouj, 2000). This last factor can bring about a change in the structural organization (Marklund, 2000).

In general, service firms carry out organizational innovations alongside product and process innovation (Pattison *et al.*, 1995; Evangelista & Savona, 1998; Cainelli & Evangelista, 2004). Furthermore, these innovations are not usually preceded by any formal R + D investment (Sundbo, 1997; Kjellal & Gallouj, 2000). Nonetheless, innovations require knowledge.

Cooperative learning and innovation through a JV

Most often the sort of knowledge required is tacit knowledge, but tacit knowledge is difficult to communicate or share. Knowledge transfer is influenced by the organizational structure, culture and the shared values of the members in the organization (Nonaka, 1994; Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998). Transfer is thus highly dependent upon the staff who possess it (Teece, 1981) and on their organizational routines (Winter, 1987). Moreover, the greater the tacitness of the knowledge, the more difficult it is to transfer between organizations (Kogut & Zander, 1992; Hedlund, 1994; Simonin, 2004; Anh *et al.*, 2006). But cooperation, as in a JV, offers an suitable context for inter-organizational learning and for transferring of tacit knowledge (Kogut, 1988; Inkpen, 1997, 2000; Khanna *et al.*, 1998; Simonin, 2004). A JV is an association between

two or more independent organizations that decide to create a new firm with its own legal identity in which the control, decision-making, profits and risks are shared proportionally depending on the contribution of each partner (Harrigan, 1986).

Learning from partners in a JV is founded in the cooperation process (Simonin, 1997; Anand & Khanna, 2000; Kale *et al.*, 2002; Kale & Singh, 2007). This process is determined not only by the frequency with which the firm cooperates, but also by its intensity and longevity (Simonin, 1997). Whether this experience is positive or negative, it can, and should, be internalized and transformed into knowledge (Tallman & Shenkar, 1994; Simonin, 1997; Tsang, 2002; Kale & Singh, 2007). Evidence shows that firms that have more experience at cooperating reach greater performance levels in subsequent agreements (Barkema *et al.*, 1997; Simonin, 1997; Anand & Khanna, 2000; Tolstoy, 2010) and the impact of such learning in creating added value is greater in JVs than in other alliances (Anand & Khanna, 2000).

Therefore, a firm can innovate using the acquisition of knowledge contributed by its partner depending on its own ability and capacity to “know how to cooperate”. Thus our first hypothesis;

H1: Cooperative learning through a JV positively influences innovation

Cooperative learning and commitment

Commitment in an inter-organizational relationship can be best understood as the extent to which the firms involved actually engage (Anderson & Weitz, 1992). In a joint venture, as Kogut (1988) points out, the level of commitment needs to be high. This is because of high level of resource commitment to a JV. A high level of commitment reduces the risk of opportunistic behavior and motivates the partners into making the greatest possible effort in order to solve any problems that arise during the cooperation process which, at the same time, increases the possibility that their objectives can be achieved (Mohr & Spekman 1994). Commitment ensures that the partners maintain their high expectations (Doz, 1996), which, in turn, generates even greater commitment (Kumar & Nti, 1998) and guarantees the achievement of their objectives and the

success of the cooperation (Borys & Jemison; 1989). However, a lack of commitment causes the relationship between the partners to deteriorate and puts the ongoing cooperation in doubt (Ariño & de la Torre, 1998). Therefore, commitment is necessary to overcome the natural resistance to the assumption of risk and ensure that the partners can provide the resources necessary to guarantee the success of the cooperation (Ariño & Doz, 2000; Barners *et al.*, 2002).

This commitment becomes evident in willingness of the partner to learn what it is that others can provide and what they expect to receive in return (Doz, 1996; Ariño & de la Torre, 1998). It also generates an ability to cooperate that enables cooperative learning to be developed through trial and error (Benavides-Espinosa, 2007). Commitment among partners is vital from the outset of the relationship (Ring & Van de Ven, 1994; Ariño & de la Torre, 1998) because it acts to motivate the partners (Gulati *et al.*, 1994).

H2: The commitment of partners in a JV positively influences cooperative learning.

Cooperative learning and trust

One definition of trust is a willingness to be vulnerable (Anderson and Jack, 2002). Similarly trust has been defined in relational terms when parties are confident that none of them will cheat or exploit each other (Barney and Hansen, 1994), or that none will act opportunistically (Bradach and Eccles, 1989). Trust is important for coordination and control in institutions (Shapiro, 1987) and because it enhances people's willingness to act in a way that is beneficial to the organization (Tyler, 2001). Indeed, Crossman and Lee-Kelley (2004:380) argue, "without trust, no social, political or economic exchange is possible". Trust can also be expressed as an expectation of a partner's competence (Das & Teng, 1996).

Nevertheless, trust is built and reinforced in different ways and the common ground of a shared knowledge is the starting point from which the JV can develop (Doz, 1996; Inkpen & Currall, 2004). Trust requires a series of satisfactory interactions, repeated over time (Gulati, 1995; Ariño *et al.*, 2001, 2005) so that the partners can see that the levels of equality and reciprocity are

being maintained (Ring & Van de Ven, 1992). Trust influences the performance of the JV in different ways. During the cooperation process, it reduces the need to constantly supervise and introduce costly control measures (Gulati, 1995; Uzzi, 1997; Gulati & Singh, 1998; Dyer & Chu, 2003); it lessens the amount of conflicts (Ring & Van de Ven, 1994) and makes resolving them easier should they arise (Ariño *et al.*, 2001). Trust also reduces the costs of coordinating activities given that the partners have learnt how to work collectively (Doz, 1996) and it makes communication, the exchange of information and more specifically, the ability to take on board knowledge provided by the partner, much easier (Inkpen & Curral, 2004).

H3: Trust between partners in a JV positively influences cooperative learning

In figure 1 we model the relationships of our hypotheses.

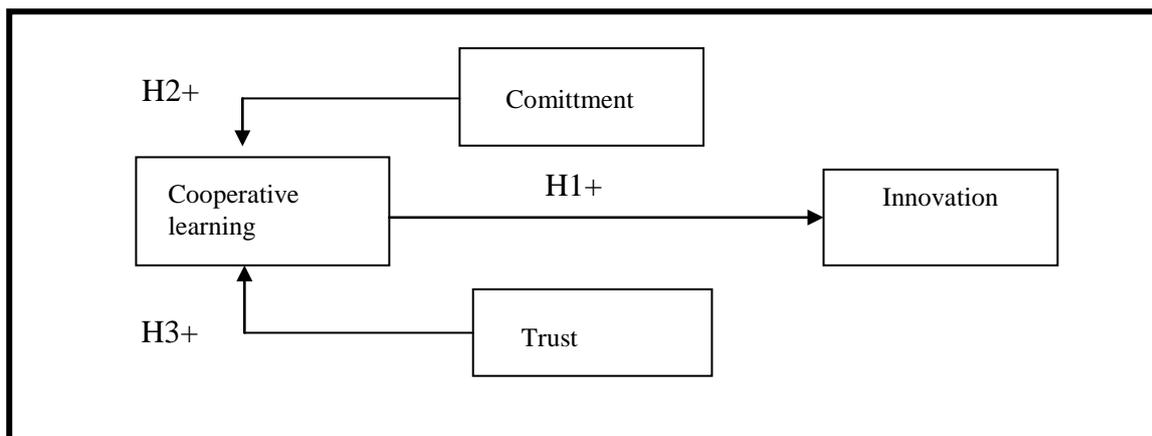


Figure 1. Model

Methodology

To select our sample population we used the ZEPHYR database which we filtered through the Amadeus and Thomson One Banker databases. We identified a population of 825 service sector firms that had taken part in a JV. We posted and emailed a questionnaire (in different languages) to these firms. From the original 825, 113 were returned because the address recorded on the database

was incorrect. A further 63 respondents, despite being part of the specific database had never participated in a JV. The final sample obtained consisted of 81 firms (See Table 1).

Table 1. Technical details of the empirical study

Scope and spread of the research	649 firms
Sample size	81
Level of trust	90 % $p=q=0.5$
Sampling error	$\pm 9\%$
Sampling procedure	Convenience sample
Geographical spread	International
Sampling unit	Firms that had carried out a joint venture
Data collected by-	Web-based and/or <i>Word</i> format questionnaire chosen by the interviewee
Person who completed the questionnaire	Manager of the firm involved in the joint venture

Analyzing the reliability of the measuring instrument

Our questionnaire, mirroring our theoretical model, employed several scales. (These are shown in the appendix.) We used *Cronbach's alpha* to calculate the reliability of each scale. For simplicity, Table 2 summarises our results after we removed the items that did not exceed 0.7. All of the scales are above 0.7.

To analyze the composite reliability, we carried out a Confirmatory Factor Analysis (CFA) with EQS 6.1. The CFA was calculated using a Maximum Likelihood Estimation (MLE). This analysis indicated the need to remove certain items to achieve a good fit. Using the remaining items, we calculated the composite reliability. We then calculated the Average Variance Extracted (AVE) which were satisfactory as all were above 0.5 (See Table 2).

Table 2. Scale reliability

Factors or scales	N° of items	Cronbach alpha	N° of items	CRI	VEI
Innovation	5	0.767	3	0.793	0.723
Cooperative learning	16	0.903	7	0.966	0.682
Partner commitment	3	0.861	3	0.879	0.679
Partner trust	4	0.823	2	0.857	0.725

Analyzing the validity of the measuring instrument

Validity has several dimensions which should be analyzed separately; content, the validity of the concept or construct (convergent and discriminant) and the validity of the criteria. To determine when a measurement had reached content validity, we analyzed several theoretical and empirical studies, especially the following, to establish the dimensions for each scale (See Table 3).

Table 3. Research carried out in constructing the scales

Scales	Works that formed the basis for the items in our scales
Innovation	Neill, Pfeiffer & Young-Ibarra (2001); Ireland, Hitt & Vaidyanath (2002); Fey & Birkinshaw (2005); Tang, Kreiser, Marino, Dickson & Weaver (2009)
Cooperative learning	Menguzzato (1995), Simonin (1997), Lane & Lubatkin (1998), Kale, Singh & Perlmutter (2000), Montes, Pérez & Vázquez (2002), Bontis, Crossan & Hulland (2002), Martínez & Ruiz (2003), Tippins & Sohi (2003), Colombo (2003), Cumming & Teng (2003)
Commitment	Mohr & Spekman (1994), Das & Teng (1998), Simonin (1999), Kale, Singh & Perlmutter (2000), Martínez & Briones (2004)
Trust	Mohr & Spekman (1994), Das & Teng (1998), Kale, Singh & Perlmutter (2000), Lane, Salk, & Lyles (2001), Carson, Madhok, Varman & John (2003), Martínez & Briones (2004)

For the validity of the construct, we had to check not only the convergent validity but also the discriminant validity. In terms of the convergent validity, we analyzed whether the factorial loads were statistically significant (Anderson & Gerbing, 1988). The results of the CFA model show some very good estimations with a high level of significance (all of the *t* statistics were greater than 3.291 and, subsequently, significant for $p < 0.001$) and high standardized λ values, which were all higher than 0.4 (See Table 4).

Furthermore, the goodness of fit statistics, on the whole, had values that were very close to 0.9 with the SMRS being above 0.05. In summary, we can say that the measurement model has an acceptable fit and, therefore, there is convergent validity.

Table 4. Confirmatory factor analysis of the model

Variable	λ	t	Standardised λ	Goodness of fit level
Cooperative learning (F1), commitment (F2), trust (F3) and innovation (F4)				
V1 F1	2.841***	11.232	0.902	χ^2 (10 degrees of freedom) = 10.167 BBNFI= 0.901 BBNNFI=0.882 CRI = 0.912 GFI= 0.962 AGFI = 0.887 SRMR = 0.051
V2 F1	3.154***	10.868	0.889	
V3 F1	3.053***	10.201	0.831	
V4 F1	2.112***	7.687	0.621	
V5 F1	2.587***	7.378	0.685	
V6 F1	3.023***	9.954	0.792	
V7 F1	2.874***	9.326	0.775	
V8 F2	3.365***	6.901	0.828	
V9 F2	3.923***	7.566	0.987	
V10 F2	3.045***	5.566	0.701	
V11 F3	3.508***	10.245	0.978	
V12 F3	3.147***	10.198	0.837	
V13 F4	1.987***	4.708	0.687	
V14 F4	1.581***	3.579	0.604	
V15 F4	1.664***	4.421	0.656	
Levels of significance: * p<0.5; **p<0.01; ***p<0.001; (based on t ₍₄₉₉₎ two lines) t _(0.05, 499) = 1.964; t _(0.01, 499) = 2.585; t _(0.001, 499) =3.291				

For discriminant validity, we present a comparison matrix between the correlations and the Cronbach alpha coefficient and the VEI values (See Table 5).

Table 5. Correlations matrix and the Cronbach alpha and VEI

	F1	F2	F3	F4
F1	1.000			
F2	0.443	1.000		
F3	0.327	0.624	1.000	
F4	0.573	0.523	0.298	1.000
alpha	0.903	0.861	0.823	0.767
VEI	0.682	0.679	0.725	0.723

The highest correlation in this matrix is that which corresponds to F3 and F2, with a value of 0.624. If we square this value, we obtain a figure of 0.389, which is less than the F2 VEI (0.679) and the F3 VEI (0.725). These results confirm the discriminant validity of the measuring instrument we are using.

Finally, in the structural model, we set out an analysis of the causal relationships which was determined by the formulation of the hypotheses. To carry out this analysis, we used the *Structural Equations Model* (SEM).

Details of the structural model

The goodness of fit indicators in our “theoretical model” did not reach the desired levels, which is why we continued with the model analysis (See Chart 1).

Chart 1. Goodness of fit indices for the “theoretical model”

	χ^2	gl	p	GFI	AGFI	SRMR
Theoretical model	20.975	3	0.003	0.911	0.685	0.067
GFI: close to 0.9 AGFI: close to 0.9 SRMR: less than 0.05						

When analyzing the “theoretical model”, we found that an additional relationship arose according to the Lagrange test. This indicated that commitment also has a direct influence on innovation. Given that this relationship is theoretically justified, we decided to include it in the model and readjust it, obtaining a re-specification which we will call the “revised model”.

Chart 2. Comparison of the goodness of fit indices for both models

	χ^2	gl	p	GFI	AGFI	SRMR
Theoretical model	20.975	3	0.003	0.911	0.685	0.067
Revised model	1.564	2	0.121	0.992	0.921	0.022
GFI: close to 0.9 AGFI: close to 0.9 SRMR: less than 0.05;						

As shown in Chart 2, the goodness of fit indicators have improved and can now be considered as acceptable. We have set out the “revised model” graphically in Figure 2 below.

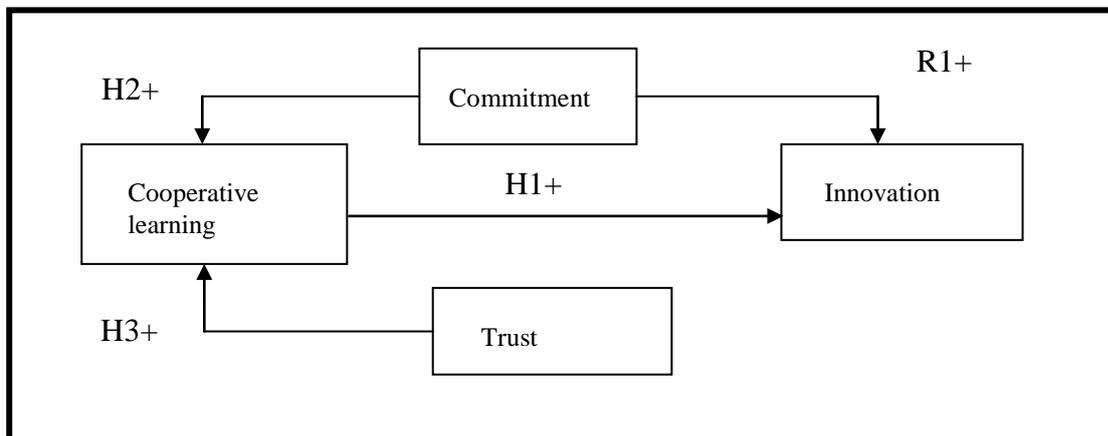


Figure 2. The revised model

Results and discussion

In Chart 3, we show the results obtained from the relationships set out in our hypotheses, as well as the unanticipated relationship between commitment and innovation.

Chart 3. Estimated parameters in the revised model

HYPOTHESIS	Influence	Standardized loads	t
H1. Cooperative learning through a JV positively influences innovation	Cooperative learning in innovation	0.431***	5.208
H2. The commitment of partners in a JV positively influences cooperative learning	Commitment in cooperative learning	0.383***	3.384
H3. Trust between partners in a JV positively influences cooperative learning	Trust in cooperative learning	0.173	1.531
RELATIONSHIPS			
R.1. The commitment of partners in a JV positively influences innovation.	Commitment in innovation	0.384***	4.436
<p>p* < 0.05; t > 1.964; p** < 0.01; t > 2.585; p*** < 0.001; t > 3.291;</p>			

For H1, we can confirm the direct, positive and significant influence cooperative learning has on innovation, given that t has a value of 5.208, and for which reason this hypothesis is accepted.

Also, H2, which measures the relationship between commitment and cooperative learning, is significant, with a t value of 3.384, which confirms the positive influence of commitment on cooperative learning.

Furthermore, we obtained a new direct relationship (R1) between commitment and innovation. Previous studies analyzed have shown an indirect relationship between both variables. We found only one study, by De Brentani & Kleinschmidt (2004), which measured the direct relationship between commitment and innovation. According to this study, in order for the partners to begin to innovate, it is not sufficient that they simply have the intention to do so, but that innovation was only possible when they had fulfilled their commitments and provided the necessary resources.

However, we have rejected H3. This result is in agreement by the findings obtained by Lane *et al.*, (2001) who could not find a significant relationship between trust and learning through a JV. On this matter, we agree with Robson *et al.*, (2006) who state that, in studies carried out on strategic alliances, the importance of commitment has been underestimated, whilst trust has been overestimated as a determining factor in development and cooperation results.

In the validated items, the question was asked as to whether managers were certain that their partners were going to demonstrate a satisfactory level of cooperative behaviour “before” and “during” the joint venture. The rejection of this hypothesis and the analysis of the items used lead us to believe that, in order to participate in a joint venture, the existence of “previous” trust is not as important as in other types of cooperation. This may suggest that the JV itself is a “trusted” institution.

According to the literature, trust between partners is vital in reducing the risk of opportunist behaviour in cooperation (Gulati, 1995). This risk diminishes if there is previous experience of developing cooperative agreements, especially between the same partners, as this past experience

generates mutual understanding and trust which fosters the creation of more flexible control structures in future cooperation (Ring & Van de Ven, 1992, 1994; Gulati, 1995). Van Aken & Weggeman (2000) state that informal cooperative agreements are based more on trust and a moral obligation than on legal obligations. Therefore, we believe that a certain amount of existing previous trust among partners is necessary in creating ways of cooperating that are more flexible than those found in JVs. We believe that the existence of trust can depend on the type of agreement chosen within which to cooperate (Langfield 2008).

Conclusions

The current economic climate has made innovation, especially for service firms, vital. But innovation rarely arises without the acquisition of new knowledge. The mechanism of learning in a JV seems to offer a solution, but it seems that a partner in a JV has also to learn how to cooperate. But surprisingly, given its apparent importance, the cooperative learning process has been rarely studied. Moreover when studied, the focus has been on manufacturing. This study thus addressed the relationships between cooperative learning and innovation within a JV. We also considered the influence of commitment and trust.

Our results allow us to conclude that cooperation through a JV creates an opportunity to access the type of knowledge required to innovate. Cooperation enables partner's stocks of knowledge to markedly increase. We note however that it is also important to learn how to cooperate. In this sense, cooperative learning is a key element in establishing innovation as it allows the full potential of acquiring knowledge to be taken advantage of in the shape of a JV. But we also found that in learning how to cooperate the relationship requires to be founded on strong commitment. Nonetheless, commitment alone does not directly influence the innovation of a partner. Provided that the partners fulfill their commitments dedicating efforts and resources as agreed, the transfer of knowledge and its inter-organizational exploitation will make it possible for them to innovate. Therefore, commitment is deemed to be a necessary element, but not sufficient

element for ensuring that innovation can develop. However, trust among partners is not especially relevant for this type of agreement, unlike in other forms of cooperation.

One limitation of our study is that it is specific to service firms and a particular type of cooperation, as is the nature of a JV. Replicating this study with firms from other sectors and involving other forms of cooperation opens up an interesting line of research. Sectoral differences and other forms of agreement could have wide-reaching repercussions on the cooperative learning process as well as its antecedents. Another limitation worth pointing out is that the data collected on JVs was supplied by just one of the partners that took part in this type of cooperation, a limitation that is common in Joint Venture studies and one that is difficult to overcome.

In the future, we will try to analyze any differences in innovation that might exist in the service sector when cooperating with other sectors and also, analyze whether different types of cooperation agreements have an influence on innovation.

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Notes

1. When at least one of the partners is based outside of the country where the JV operates, or when a significant amount of its operations is carried out in another country, it is considered to be an international joint venture (IJV) (Geringer & Hebert, 1989).
2. We found empirical studies on cooperation and learning where the sample size was similar to this study. These were published works in journals such as the *Strategic Management Journal* and included studies by Dyer & Singh (2002) using 78 firms, Colombo (2003) 67 firms, Lane, Salk & Lyles (2001) 78 joint ventures and Lane & Lubatkin (1998) 69 firms.

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Appendix

(1) strongly disagree; (2) disagree; (3) indifferent; (4) agree; (5) strongly agree

COMMITMENT
1. Your firm provided the necessary knowledge to enable the appropriate development of the JV
2. Your firm assigned competent and suitable personnel for the development of the JV
3. Your firm supplied the adequate attention and time of management that was necessary in ensuring the development of the JV
TRUST
4. Your firm was certain that your partner was going to display satisfactory cooperative behavior before the JV began
5. Your firm was certain that your partner possessed and was going to display satisfactory cooperative behavior throughout the entire activity of the JV
6. The existence of trust in your partner reduced the need for control on the part of your firm
7. The existence of trust in your partner ensured the activities undertaken in the JV ran smoothly
COOPERATION LEARNING
. Carrying out the JV enabled your firm to establish specific rules and regulations in order to be able to:
8. Identify and choose partners for future JVs
9. Negotiate and re-negotiate future JV agreements
10. Manage future JVs
11. Exit an agreement earlier than expected in future JVs
Carrying out the JV enabled your firm to better understand the cooperation process with regards to:
12. How the circumstances of the cooperation process change with time
13. Learning to adapt to changes in the agreement
14. The creation of communications systems with your partners
15. Detecting conflicts
16. The creation of Systems in order to detect any possible "opportunistic behavior" of a partner
After this experience, the behavior of the senior management team in a future JV would be:
17. More flexible to changes in the agreement
18. More understanding of the "strict fulfillment of the agreement"
19. More focused on the anticipation, detection and avoidance of conflicts
20. More careful in following the progress of the JV
21. More careful with knowledge that is not to be transferred through the JV
22. More careful in choosing the personnel involved in the JV
23. Mistakes from previous JVs would help you to solve unforeseen
INNOVATION
24. Your firm stresses the importance of research, development and innovation in technological products
25. Recently, your firm has started a new business and/or launched a new product
26. Your firm frequently carries out changes to the organization or in managing the business
27. Your firm undertakes actions so that it can enter new segments of the market
28. Your firm is a Pioneer in developing new products, administrative techniques or technologies