Performance evaluation of research joint ventures: An organizational learning perspective

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ABSTRACT

This paper focuses on organizational learning and knowledge management through research joint ventures (RJVs) and explores the conditions that influence RJV performance. Using data from 247 Europeans firms involved in RJVs we identified four groups of RJVs according to the perceived value of RJV and the RJV performance. The effect of the locus of RJV and the learning and knowledge management on the perceived value-performance relation (expectation-result relation) was studied to provide more in-depth analysis.

Keywords: Research joint ventures, knowledge management, learning organizations.

1. INTRODUCTION

Organizations that wish to maintain an edge in a globally competitive environment will be heavily dependent on their innovation capacities. Over the last couple of decades, corporate emphasis on innovation has stemmed from such pressures as shorter lead times, mass customization, and the growth of technological advances. Organizations that institutionalize innovation and adopt an open attitude to change are better positioned in this type of market.

New knowledge provides the foundation for innovation, change and sustainable competitive advantage. In *Managing in a time of Great Change*, Peter Drucker writes

that knowledge has become the key economic resource and the dominant –and perhaps even the only- source of comparative advantage. Some scholars believe that competition is becoming more knowledge-based and that the sources of competitive advantages are shifting to intellectually capabilities from physical assets (Subramanian and Venkatraman, 1999). It suggests that while the creation of knowledge is important, the conversion of this knowledge into new products is the foundation of superior performance (Leonard-Barton, 1995; Nonaka and Takeuchi, 1995). The consequent implications of this notion for organizational management and operations are far-reaching and dramatic, influencing everything organizational strategy to products and services offered, from business processes to the firm's structure. The term that has been applied to the early developments of this shift in perspective has been termed knowledge management (Ruggles, 1998).

Historically, firms organized research and development (R&D) internally and relied on outside contract research only for relatively simple functions or products (Mowery, 1983; Nelson, 1990). Today, global competition, along with the growth of technological advances and product complexity, are forcing firms to rethink about how new knowledge is acquired. In an era where information and knowledge is overtaxing many individual organizations and where these two items are increasingly entering center-stage, the task of developing, managing, and integrating knowledge has become more complex. It requires that an organization possess knowledge and skills in multiple intellectual fields that have to be upgraded constantly in order to meet changes in market conditions and customer expectations. Therefore, many companies cannot rely exclusively on their internal skills and knowledge in maintaining innovativeness and demand a range of intellectual and scientific skills that far exceed the capabilities of any single organization (George, et al., 2001; Iansiti and West, 1997). At the same time,

communication, collaboration and integration are required to maximize the synergy between the various interdependent parts (Moanert and Souder, 1990; Hitt et al, 1993). This tension between specialization and integration seems particularly salient to the problem of technological development.

To help address this problem, the literature on learning organizations sees research partnerships as mechanisms enabling firms to learn and enter new technological areas and to deal more effectively with technological and market uncertainties. Corporate response to this situation has also been immediate. In recent decades, there has been unprecedented growth in Research Joint Ventures (RJVs) in order to expand firms' knowledge bases and develop new skills. Drucker (1995) suggested that the greatest change in the conduct of business is the accelerating growth of relationships based not on ownership but on partnership.

Researchers, industrialists, and regulators have attributed Japan's early competitive advantages to greater corporate R&D collaboration. Some larger American companies are becoming increasingly reliant on external technology obtained from collaboration with both domestic and foreign entities. Weakening anti-trust regulations in the United States have allowed research consortiums and RJV's such as Sematech in the semiconductor industry to carry out research allowing them to compete globally on a domestic national basis against European and Japanese industries. Similarly, and given the importance of technological innovation, many governments, in order to help foster their country's competitiveness on a global scale, have been allocating an increasing amount of resources to inter-organizational collaboration for this purpose. In many situations these industrial collaborations have become de facto national industrial policies.

It is generally presumed that research partnerships result in positive outcomes for member firms and that the long-term success of this strategy depends on the appropriate integration of knowledge and learning developed during the R&D process. Sustainable competitive advantage for firms is derived from both the knowledge set that a firm possesses at single point in time and the dynamic capability to create, integrate and use such knowledge. In the light of this association it is surprising to find relatively few empirical investigations focusing on how knowledge management and learning are integrated and relate to the performance of these research partnerships. Establishing this link with the enhancement of competitiveness has been a difficult task for researchers (Sakakibara, 1997). The main cause of this limiting progress in developing a linkage is the lack of data and the unobservable nature of certain key variables highlighted in the theoretical literature. Even methods which are more refined quantitatively, are not perfect solutions (Luukkonen, 1998).

In this paper, using underlying theoretical foundations from learning and knowledge management literature on RJVs as our underpinning, we empirically explore the factors that stimulate and facilitate learning and understand how these factors influence RJV performance. The three major factors that we examine in this work are: (1) the perceived value of the RJV, (2) the locus of the RJV and (3) the learning and knowledge management process. The results show a number of significant findings that will help organizations consider learning and knowledge management practices and characteristics that may improve the performance of these research partnerships.

2. RESEARCH JOINT VENTURES, KNOWLEDGE MANAGEMENT AND LEARNING.

We define an RJV as a collaborative agreement in which two or more partner organizations (firms and/or public research organizations) decide to coordinate their R&D activities through a cooperative project and to share the knowledge generated from this joint effort. Each partner brings their own relative expertise to the newly created project in the hope that this combination of skills will produce benefits for all those concerned. By bringing together firms with different skills and knowledge bases, an RJV creates unique and usually synergistic learning opportunities for the partners (Inkpen, 1998). We can thus define an RJV as a complex agreement between organizations, whereby learning takes place[1].

RJVs are seen as mechanisms enabling firms to learn and enter new technological areas and to deal more effectively with technological and market uncertainty. Characterized by a network organization, its learning is described by a collective acquisition of knowledge among a set of organizations. This characteristic supports the concept that learning is a social construction process (Brown and Deguid, 1991). A synergistic characteristic of knowledge is that its value increases when it is shared and integrated with others. Consequently, other RJV members will enhance an individual firm's learning. Larsson et al. (1998) described this interorganizational learning as distinct from organizational learning by including the learning synergy or interaction effect between the organizations that would not have occurred if there had not been any interaction.

[1] In some cases, the shared resources are strictly financial, limiting partner-learning opportunities; but in this paper we focus on RJVs, collaborative agreements in which firms gain access to their partners' skill and knowledge.

With this foundational understanding, the question confronting us now is how the participant firms must act to create this collective knowledge and how the RJV knowledge can be transferred to their own organization in order to provide superior performance. The key factors that are the focus of this paper (the perceived value of RJV, the locus of the RJV and the learning and knowledge management process) are characteristics which firms have or may have strategic and operational control, through identification, management, and selection of projects. For example, firms can have some control over the type of learning process of the R&D project they wish to pursue. In the following sections we discuss the ways in which RJV performance is related to these RJV characteristics. The overall theoretical model is depicted in Figure 1. In this figure the hypotheses appear on the arcs.

[Insert Figure 1 about here]

2.1.The perceived value of the RJV

The formation of a RJV is an acknowledgment that a RJV partner has useful knowledge. If the knowledge were not useful, there would be no reason to form the alliance (Inkpen, 1998). Economic analysis of technological innovation would argue that the motivation leading private profit-oriented firms to enter into an RJV is to gain access to basic knowledge, especially when internal incentives to invest is low. However the benefits may be richer and more complex and the RJV knowledge can be viewed from different perspectives. To have access to scientific frontiers, to accelerate the innovation process, to reduce development cost by delegating selected phases of the development process to other partners, to utilize spill-overs of R&D within the consortium, to search new marketing opportunities, to increase of financial and human resources, could be some of the benefits or objectives for firms in forming research

partnerships (Hagedoorn and Schakenraad, 1990, Teece, 1992; Sakakibara). Crossan and Inkpen (1995) reported that managers use performance as a direct proxy for gauging learning occurrence. They observed that American parent companies frequently pointed to poor joint-venture financial performance as evidence that learning was either not occurring or could not occur. Accordingly, the perceived value of the RJV is measured through the expectations of performance. This idea is further supported by social cognitive theory (Bandura, et. al., 1977; Bandura, 1986; Compeau, et al. 1999), which notes for individuals, and extending it to the organizational level, that initial outcome expectations and intentions may impact the eventual level of performance for the RJV and determine how well a RJV fulfills the expectations.

In this study, performance refers to both tangible and intangible collaborative benefits. Tangible benefits are defined in technical and economic terms such as new product or process development and improvement, increasing market share or profitability. Intangible benefits are more applicable to situations with a high level of uncertainty such as the creation of scientific and technological knowledge. Intangible benefits are rather ill-defined, evolve continuously from unpredictable interaction by the partners over time and are made possible by new knowledge opportunities. Performance using intangible measures takes into account technological learning, learning specific skills or problem-solving approaches and learning about inter-firm collaborations.

With respect to the perceived value of RJV and its impact on performance, we argue that the larger the perceived value of the RJV the more likely that the RJV will be a successful revenue generator for RJV partners. Therefore we propose the following hypothesis.

Hypothesis 1. RJV performance will be related to the perceived value of the RJV.

2.2. The locus of the RJV

To investigate the maturity of the knowledge content and its relationship to other factors, we begin by defining the "locus of RJV" which refers to the stage of technical development at which the RJV operates. The main stages within this locus of technical development include: (1) *basic research* which searches for new concepts or scientific principles, although they do not present any direct application; (2) *applied research* which utilizes acquired knowledge by basic research, showing its potential practical contributions to solve known problems; and (3) *technological development* which focuses upon the design and production of a new product that will be the final output of the R&D process.

In terms of knowledge, these three stages involve different levels of "radicalness" of the learning process. While technological development lets knowledge develop from existing knowledge, basic research seeks to construct and acquire new knowledge. Viewed broadly, technological change occurs in two extreme forms. In the first form, the developing knowledge is derived from existing knowledge. In the second form, new knowledge is created with loose connections to existing knowledge. March (1991) expressed this idea of knowledge development and use in terms of exploration and exploitation. He argued that the essence of exploitation is the development firm's current competencies and the essence of exploration is experimentation with new alternatives.

Exploitation involves less radical characterizations defined by such terms as refinement, choice, production, efficiency, implementation and execution. It uses conservative and routine processes that maintain stable relationships. In contrast, exploration includes more radical characterizations such as variation, risk taking,

experimentation, flexibility, discovery and innovation (March, 1991). Likewise, exploration is characterized by the re-orientation of routines and process and the search for new rules and goals instead of developing existing routines in a more efficient way.

As outlined above, it seems that RJVs face a trade-off between focusing on existing knowledge, (exploitation) which may be more effective in the short term or focusing on new knowledge, (exploration) which is typically required to be successful in the long run (March, 1991). However, other researchers (e.g. Mezias and Glynn (1993) recognize that differentiation between exploration and exploitation can be rather ambiguous. That is, most R&D projects require both the generation of some new knowledge and the application of some pre-existing ideas.

Within this context, the firm's knowledge base is an important consideration. The reason for evaluating the existing knowledge base is that given the strong cumulative nature of scientific knowledge, the firm's base of knowledge prior to the RJV influences the effective acquisition and utilization of new knowledge (Cohen & Levinthal's, 1990). As Powell et al. (1996) argued, knowledge facilitates the use of other knowledge. What can be learned is affected by what is already known. With limited knowledge and resources, RJVs develop technologies in the later stages of development -exploitative RJVs- and focus on specific domains of knowledge. They have a greater ability to attract revenue signifying greater commercialization potential, than RJVs with technologies in early stages. These RJVs develop incremental innovations mainly oriented towards cost advantages or lead time improvements. This incremental profile shows a high rate of short-term oriented projects. Additionally, exploratory RJVs with greater R&D capabilities and resources may allow complementary knowledge research streams in early stages of development and superior collective knowledge.

Although radical change (associated with more exploratory R&D) generally leads to the depreciation of the firm technological value chain activities (Tushman and Anderson, 1986), the non-technological assets for partners firms may become more valuable when they are specialized with respect to commercializing the new technology (Leonard-Barton, 1992). The projects that explorers tackle are complex, showing long-term approaches and high levels of difficulty in the objectives. In these cases, Henderson and Cockburn (1994) and Pisano (1994) conclude that the ability to integrate different knowledge streams and competence in a discipline are linked to higher performance.

Given this foundation of the various characteristics of the locus of RJVs (exploitative versus explorative; incremental versus radical; developmental versus basic research), there will be differences in perceived value and performance outcomes because RJVs in later stages of technological development have a greater probability of being short-term successful and attaining tangible 'bottom-line' benefits. Although there are certainly possibilities where RJVs exposed to highly research intensive activities, where knowledge which is capable of being converted into new or improved products or processes, is developed and assimilated, could also be linked to higher performance. Yet, they must assemble the appropriate technological, financial and commercial assets. Following this notion, we argue that RJVs in early stages, rather than in the later stages, have larger perceived value and are more likely to be successful in both tangible and intangible performance. Thus we propose:

Hypothesis 2a: The perceived value of the RJV knowledge will be related to the locus of the RJV.

Hypothesis 2b: RJV performance will be related to the RJV locus.

2.3. Learning and knowledge management processes

The learning and knowledge management process enhances the potential for creating innovations as part of adaptive behavior necessary for responding to environmental demands (Von Krogh et al, 2001). The creation of knowledge by an RJV should be more than a collection of individual experiences. In order to avoid waste energy, Senge (1990) argues that group level learning requires an alignment of different individual learning processes. From an organizational learning perspective, it requires a high degree of mutual involvement in problem recognition and in problem solving processes. In the first step, partners must scan, notice and construct meaning about environmental changes. The recognition of the existence of a problem occurs when some stimuli indicate the need for new actions. This then leads to the second step, when partners jointly experience new work processes, tasks, technological characteristics etc. to solve a problem.

Von Krogh et al. (2001) propose an iterative and multistage process for knowledge management that obligate partners to spend considerable time together, discuss, and reflect upon their experiences, observe how their colleagues solve tasks and interact with technologies, explain and give sense to their own actions. RJV members must establish relationships via language and thought in order to coordinate their learning processes. Dialogue has been identified as a key aspect of this integrating process (Isaacs, 1993; Nonaka and Takeuchi, 1995), where dialogue has been defined as the language of learning. With dialogue each partner exhibits a perception or personal image of the world, and these perceptions will affect the other firms when they are shared during interaction. Individual knowledge needs to be disclosed, shared and legitimized until it becomes part of the group knowledge. RJV knowledge is the result of the construction and interaction of the numerous individual firm perspectives during

in the problem recognition and in the problem solving processes.

To accelerate such processes, three conditions should be satisfied (Nahapiet and Ghoshal (1998)). First, the parties are aware of the opportunity to exchange the knowledge. Second, the parties involved expect the knowledge transfer to prove worthwhile for both parties. Third, the parties must be motivated to pursue knowledge transfer.

Shrivastava (1983) pointed out that knowledge management varies in terms of systematization, normalization, complexity and relevance in the decision making process. Hansen et al. (1999) observed that firms employ two different knowledge management strategies, codification and personalization strategies. In some companies this strategy centers on computer information systems, where knowledge is carefully codified and stored in databases, where it can be accessed and used easily by anyone. In other companies, knowledge is closely tied to the person who developed it and is shared mainly through direct person-to-person contact. The chief purpose of information systems at such companies is to help people communicate knowledge, not to store it.

Underlying this classification is the idea that knowledge management involves (1) a "tangible" and structural aspect that integrates formal working factors and (2) an "intangible" social aspect that combine factors such as intuition, spontaneity and values or beliefs associated with human development. Jones and Handry (1994) argued that the development of the learning capacity demand both, structural or technical aspects related to explicit knowledge (hard learning), and social or human aspects more related to tacit knowledge and though styles, (soft learning).

As a natural extension of how firms manage knowledge, RJVs may not take a uniform approach. The social approach of knowledge management focuses on the processes of collective language development and joint understanding, without which no existing knowledge is disclosed and thereby cannot be received by the others or used collectively. The structural approach emphasizes the acquisition and distribution of the needed information to absorb the disclosed or generated knowledge.

Interorganizational learning is therefore a joint outcome of the interacting organizations' choices and abilities to more or less acquire and absorb information -structural perspective- and understand and use that information on the creation of new knowledge –a social perspective. Based on these arguments, especially the categorizations of social/structural and joint learning/dialogue knowledge management and learning processes concerning RJVs, the learning and knowledge management, the following hypotheses are developed:

Hypothesis 2b: The perceived value of the RJV knowledge will be related to the learning and knowledge management process.

Hypothesis 3b: RJV performance is related to the learning and knowledge management process.

3. RESEARCH METHODOLOGY

3.1. Sample characteristics and data collection

Data for this study has been drawn from a survey of over 240 European firms[2] involved in cooperative research projects[3] formed between 1990 and 1999. The analysis

[2] The countries included in this survey are as follows: Italy, Spain, France, Sweden, Greece, United Kingdom and Ireland.

[3] All the projects are grouped within the following European programs: EU Framework Program, EUREKA Program or National Programs.

of these RJVs[4] is based on two data sources. Firstly, an administrative database that supplied information on firms that participate in RJVs and their R&D projects. After the analysis of this information, a questionnaire was designed to gather additional qualitative and perceptual information that form a more complete picture of the dynamism of these RJVs. It was sent to the coordinator firm's manager responsible for the RJV. A company-based approach was adopted as the aim is to understand the knowledge and competencies created by each individual partner rather than for the R&D consortium as a whole.

3.2. Measures

The perceived value of the RJV

An independent Multiple Correspondence Analysis (MCA) was used to condense the information for the 26 RJV variables that show the benefits and objectives expected by the RJV. Table 1 describes the benefits and objectives sought by the RJV. The measures used here are based on previous evaluations of European R&D consortia. The result obtained is a set of 10 factors that condense the original nominal variable information to provide continuous variables.

[Insert Table 1 about here]

The locus of the RJV

The locus of the RJV focuses on the stage of technological development at which the RJV operate. Following Ansoff and Brandenburg (1973), the R&D in this specific project could be characterized as: (1) Basic research; (2) Applied research; or (3) Technological Development. Each respondent was asked to reply to this question, at

[4] This survey was managed by several teams of European researchers within the STEP to RJV program, financed by the European Commission.

what level they believed the research program addressed, with a "yes" or "no" for each of the three categories. Yes's were coded with a 1, No's were coded with a 0.

The stage of technological development of the R&D project is complemented by other variables that value the novelty of the developing knowledge in relation to the partner core business. Each respondent was asked to reply to the question: "To what extent is the cooperative R&D project related to the core business. (1) It is in a core activity area; (2) It is in a secondary area of activity; (3) It is in a quite new area of activity; (4) It is used for getting into a totally new area of activity".

The learning and knowledge management process

The major types of knowledge management practices used by firms to create collective knowledge and transform knowledge from the RJV context to a partner context are: (1) Implementation of joint research tasks; (2) Observing other partners' research facilities and practices; (3) Project meetings; (4) Informal communication among partners; (5) Undertaking similar R&D on your own (6) Training related to the specific cooperative R&D activity and (7) Codification of related information and data. Each respondent was asked to reply to this question with a "yes" or "no" for each of the seven categories. Yes's were coded with a 1, No's were coded with a 0. Based on Hansen et al (1999), it is easy to observe that the first four learning practices require more interactions between partners (socialization/personalization). They are more related to the social perspective than the last three practices that were more related to the structural (codification) perspective.

[Insert Table 2 about here]

Performance indicator

An independent Multiple Correspondence Analysis (MCA) was used to sift the exhaustive available information for the 26 RJVs variables that show the benefits and objectives achieved by the RJV (as described in Table 1.). The result of the MCA is a set of 10 factors that condense the original nominal variable information to give categorized continuous variables.

3.3. Evaluation techniques

Data analysis involved three steps. First, two independent Multiple Correspondence Analysis (MCA)[5] were used to sift the information for the perceived value of RJV variables and the RJV performance variables. The result obtained is a set of factors (20 in all) that condense the original nominal variable information providing continuous variables.

Second, a cluster analysis is applied to the RJV coordinates for the 20 factors obtained in the MCA. This cluster analysis enabled us to define an RJV typology in terms of the perceived value of RJV knowledge and its performance (Figure 2). Each of these groups was clearly identified by the original variables used for the MCA (Greenacre, 1984 and Benzecri, 1984). In order to provide this description with statistical rigor, tests were applied that validated the hypothesis of whether one group's reply was significantly different from what it would have been if the replies had been randomly distributed among the groups.

The third and final step of this work studies the relation between the perceived value of the RJV and the RJV performance. In this respect, as can be seen in Figure 1, the locus of the RJV and the knowledge management process are the factors used to explain

this relation. They have been analyzed by looking at the percentage of RJV replies in each group with the highest scores for these factors. Results are shown in Tables 3 and 4.

4. EMPIRICAL RESULTS

RJV typology

Cluster analysis enabled us to identify four groups of RJVs according to RJV level of expectations, i.e. the perceived value of RJV, and RJV performance (Figure 2). In groups 2 and 3, RJV results tend to be as expected and even stress the firm's initial opinion. That is, when there were high perceived values of the RJV, the performance results scored were better (supporting much of the outcome expectations theory) and when there were very low perceived values for the RJV, performance also lagged. Thus, group 2 consists of RJVs with a high level of perceived value of the RJV that were later fulfilled, and group 3 consists of RJVs that from the start thought that RJV perceived value was low and therefore, their performance results were also poor. Although groups 1 and 4 have RJVs with similar intermediate perceived values of the RJV, their eventual performance was different: in the first instance, the results were lower than the expectations and, in the second, the situation was the reverse, the expectations were better than the results. The association between the perceived value of RJV and RJV performance supports hypothesis 1.

[Insert Figure 2 about here]

The effect of the locus of RJV and the learning and knowledge management process on the perceived value-performance relation (expectation-result relation) was studied to provide more in-depth analysis. Thus, by comparing the replies from the firms in groups 2 and 3, it is possible to determine why, in group 3, the corporate expectations were not

fulfilled, although they were low, and why in group 2 high expectations were more than met.

[Insert Table 3 and 4 about here]

Group 2 vs. 3 perceived value and performance

The variables that describe the locus of RJV for these two groups of RJVs show some differences that can help describe these groups. In terms of the state of technological development only one major statistically significant difference was found. The RJVs in group 2 were significantly more focused on applied research than group 3. Additionally, it is observed that the R&D projects carried out by group 2 present a lower level of novelty than group 3. This result may be important in showing that the more synergies there are between the RJV and partner activity, the better performance the projects show for Group 2 type organizations. This evidence also emphasizes a positive relation between the previous knowledge base and the perceived value of the RJV. The lowest knowledge base about the cooperative R&D project, theoretically associated to exploitative RJVs and later stages of development, is related to the lower perceived value of the RJV and performance. Thus, hypotheses 2a and 2b are supported.

The analysis of the knowledge management process variables reveal that group 2 RJVs rate the inter-company relations better for channeling learning than group 3 does. Group 3 provides similar responses to group 2 only for "project meeting" and "codification of information and data" questions. From this comparison of groups 2 and 3, it can be seen that learning and knowledge management depend on the perceived value of the RJV, as established in hypothesis 3a. Similarly, hypothesis 3b is also confirmed, since greater effort in knowledge management is related to better performance.

The image conveyed in the analysis shows that, from the point of view of the locus of the RJV, Group 2 is involved in R&D projects with lower levels of radicalness of its learning process and uncertainty about the performance, since they have a knowledge base more associated to the R&D project Group 3 seeks development and acquisition of new knowledge, which may be more effective in the long term. The lack of links between the previous knowledge base and the R&D project explain group 3's lower expectations and lower fulfillment performance. Furthermore, group 2 RJVs have a higher level of knowledge integration. Good coordination and more efficient use of communication mechanisms between the partners generate higher levels of learning as indicated in the results.

Group 1 vs. 4

The lower performance of group 1 RJVs in comparison with group 4 is related to the increased focus on development research by Group 1 RJVs. Group 1 RJVs focus more on incremental learning and less on the development of radically new products or processes. It can be assumed that these RJVs spend great effort in maximizing benefits by finding new uses for existing ideas. However, their comparatively worse performances indicates that they are slow in applying new knowledge, and their science linkage is lower than Group 4. Group 1 RJVs are less aggressive learners than Group 4 RJVs, as indicated by lower levels of performance. This observation supports Hypothesis 2b, since the locus of RJV is related to performance.

Analyzing the differences for the knowledge management process, we see that in group 4 the exchange of knowledge and inter-partner learning are greater. The exception is training related to the specific cooperative R&D activity, where learning process effectiveness is lower, and for undertaking on similar R&D, where the result of

group 4 is similar to that of group 1. These results support Hansen et al.'s (1999) observations relating to how these two groups of RJVs follow different knowledge management strategies. In Group 1 the learning and knowledge management involves more structural and formal aspects than in group 4 where the learning and knowledge management practices tend to be more interactive and support the spontaneous exchange of knowledge. In addition, and due to the poor learning effort of group 1 one would expect that these RJVs tend to lose slightly more key knowledge. These results show that when the perceived value of RJV's is similar, the learning and knowledge management processes adopted by an organization produces differences in performance (hypothesis 3b).

These results tend to support the assertion that firms with greater awareness of the need to integrate knowledge are more concerned about designing coordination mechanisms that generate a more effective learning process. Thus, Group 1 can be viewed as more inefficient that Group 4 in the sense that even though the R&D projects that are completed are focused on existing knowledge and assume a lower level of risk, the management of the research tasks shows less integration of the work.

SUMMARY

In this paper, we proposed an examination of the factors that determine the relationship between the perceived value of RJV knowledge and RJV performance. Using data collected from a variety of European based research joint ventures and theory related to social cognitive theory's outcome expectations, using perceived values –expectations-, with performance results using fulfilled expectations, we evaluated a number of theorized relationships. We hypothesized that there are relationships between (1) perceived value and performance of RJV, (2) perceived value and locus of

RJV, (3) perceived values and knowledge management processes, (4) locus of RJV and performance of RJV, and (5) knowledge management processes and performance of RJV. Various groupings (clusters) were made based on multiple correspondence analysis (MCA). Four groupings were found. Those with high perceived value/high performance, those with low perceived values/low performance, those with moderate perceived value/low-medium performance, and those with moderate perceived value/medium to high performance. The extreme clusters were first evaluated to determine if there were any differences and some were found to support the various hypotheses. Similar findings supported the stated hypotheses for the analysis from the more closely aligned clusters (i.e. groups 1 and 4).

The major results of this work support some theories of expectation that many organizations that tended to have higher expectations tended to have higher performance, which supports social contract theory's outcome expectations suppositions The firm's knowledge base was found determinant of this relation. Those organizations that are more oriented towards building on current research may tend to have lower expectations and lower performance fulfillment (which should actually not be too disappointing to them since they did start out with lowered expectations). Thus, without a previous knowledge related to the R&D project, firms show more difficulties in correctly valuing benefits of the RJVs. Cohen and Levintal (1990) express this idea in terms of ability "absorptive capacity" which expresses the firm's ability to assimilate new knowledge and make use of the benefits of joint research. In discussing how it contributes to innovation, they argue that absorptive capacity tends to develop cumulatively and builds on prior related knowledge. Then, organizations that possess relevant prior knowledge are likely to have a better understanding of the new knowledge, can generate new ideas and develop new products. Organizations with a

high level of absorptive capacity are likely to harness new knowledge from an RJV to help their innovative activities. This research suggest that investments in absorptive capacity allows a firm to better value the RJV knowledge and effectively assimilate and apply RJV knowledge for its own use.

The relation between the state of technological development and performance is perhaps one of the most interesting findings of this study. Given a similar knowledge base (absorptive capacity), our study indicates that the RJVs in the latest stages of technological development are less successful, supporting the ideas of Henderson and Cockburn (1994) and Pisano (1994). Most likely, the explanation for this behavior is that firms unable to learn risk being left behind. History shows that the leading firms in one generation are rarely the leading firms in the next.

This research also identifies several knowledge management practices that RJVs use to create and transfer knowledge. Although all of the practices are potentially effective, we found that different learning mechanisms involve different locus of RJV and different performance. There seemed to be more socialization mechanisms that lead to better than expected performance when the locus of RJV is more radical than incremental. Practically, completing knowledge management processes that include close interaction through joint research tasks and encouraging more informal communications among partners may all help in improving research performance in RJVs as evidenced by the results.

Of course, there are certainly other possible configurations of RJVs, but four combinations which make-up the perceived value-performance relation (expectation-result relation) appear to display internal consistency. Each group appears to reinforce a locus of RJV and provide different approaches to the learning and knowledge

management processes. Generalizations of these findings to other scenarios must be made cautiously. Replications of this study with different samples stands to improve our understanding of the underlying research model.

As with any exploratory research, this investigation is subjected to a number of limitations. Perhaps the most significant is the data employed. There is still difficulty in measuring long term and qualitative performance measures. For example, improving "acquisition and creation of new knowledge" or "technological learning" is an efficiency measure that cannot be easily determined, nor measured, but clearly is something of great importance to RJVs. In addition, a number of internal and external issues such as cultural differences between the partners, differences in their products and nature of work, or some unexpected development such as reorganizations, mergers and acquisitions, and economic downturns, may all impact the cooperative relationships. Evaluating and relating these issues with performance is another direction to pursue. Generalizations to other countries and types cannot necessarily be made without further investigation.

In terms of other future study and applications, we can focus on the evaluation and use of multiple performance measures through various techniques. Also determination of which factors contribute most to explaining performance and the relationships to performance can be studied.

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Figure 1: Theoretical framework

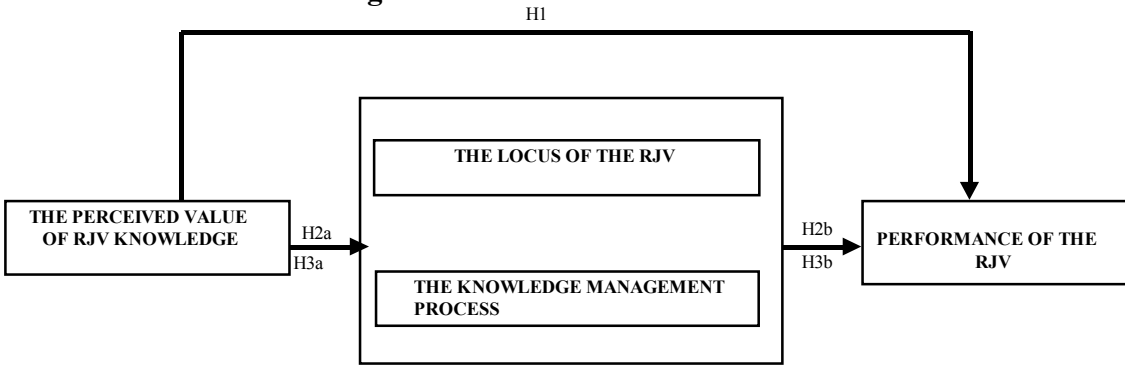

Figure 2: RJV typology

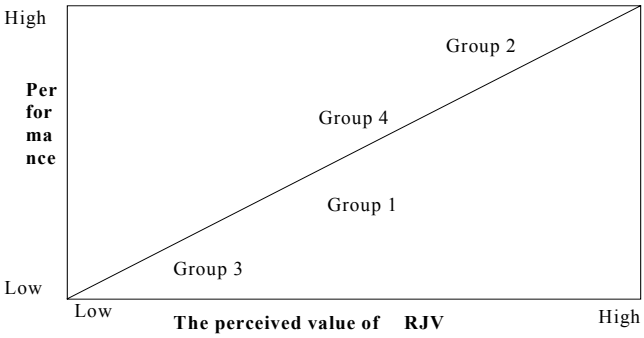

Table 1: Variables and definitions

EXPECTATIONS	BENEFITS FROM RJV	FULFILLMENT
To what extent does your business expect the following benefits from the RJV	1. New product development 2. New process development 3. Improvement of existing products 4. Improvement of existing processes 5. Continuation and acceleration of existing research 6. Exploitation of complementary resources 7. Acquisition/creation of new knowledge 8. Increased profitability 9. Increased market share 10. Improvement of unit's technological and organizational capabilities.	To what extent has your business achieved the following benefits from the RJV:
EXPECTATIONS	**OBJECTIVES FROM RJV**	**FULFILLMENT**
To what extent does your business have the following objectives from the RJV:	1.R&D cost sharing 2. Risk sharing-reduced uncertainty 3. Access to complementary resources and skills; 4. Reduced loss of information to competitors 5. Research synergy 6. Technological learning 7. Keeping up with major technological developments 8. Improving speed to market 9. Achieving critical mass in R&D 10 Joint creation and promotion of technical standards 11. Promotion of user/producer interactions 12. Control of future market developments 13. Creation of new investment options 14. Obtaining public funding 15. Establishment of new relationships 16. Access to external resources.	To what extent has your business achieved the following objectives from the RJV:

Note: In all the questions requesting a rating from the firm, the score was from 1 to 5, with 1 being the lowest score and 5 the highest.

Table 2. Description of learning and knowledge management practices

Practice	Description
Implementation of joint research tasks	Partners established joint research tasks. Research was shared among between the partners and knowledge was developed jointly. This way partners have a direct access to the RJV knowledge.
Observing other partners' research facilities and practices	Visits and tours of RJVs partners facilities and practices are an interactive mean to appreciate differences between partners and learn.
Project meetings	They provide the formal context for the discussion between researches of problems, new events and ongoing issues related to the R&D project.
Informal communication among partners	No organized interactions and more or less random conversation between RJV researches about their current work. It encourages the expontaneous exchange of knowledge.
Undertaking similar R&D on your own	Parents established non-joint research tasks. They carried out parallel research and defined and created the base for an exchange of information.
Training related to the specific cooperative R&D activity and	The RJV personal attend structured sessions where they are provided with instructional material designed to educate them about subject related to the R&D project.
Codification of related information and data	They are documents written by the RJV expert that attempt to capture the author expertise and insights on a subject related to the R&D project and databases with relevant information.

Table 3. Significant differences between groups 2 and 3

	Cluster	
	2	**3**
The perceived value of RJV	**Intermediate-High**	**Intermediate-Low**
Performance	**High**	**Low**
The locus of the RJV		
Basic research	18%	21%
*Applied research	76%	66%
Development	38%	36%
It is in your core activity area	28%	27%
It is in a secondary area of activity	78%	78%
*It is in a quite new area of activity	77%	88%
*It is in a specific project in order to enter a totally new area of activity	74%	84%
The Knowledge management process		
*Implementing joint research tasks	50%	36%
Observing other partners' research facilities and practices	26%	19%
Project meetings	73%	74%
*Informal communication among partners	76%	59%
Undertaking on your own similar R&D	27%	22%
*Training related to the specific cooperative R&D activity	30%	19%
Codification of related information and data	27%	27%

*Group 2's reply was significantly different from the reply of group 3 (90%)

Table 4. Significant differences between groups 1 and 4

	Cluster	
	1	**4**
The perceived value of RJV	**Intermediate**	**Intermediate**
Performance	**Medium-low**	**Medium-high**
The locus of the RJV		
Basic research	17%	21%
Applied research	72%	71%
*Development	45%	26%
It is in your core activity area	38%	34%
It is in a secondary area of activity	69%	74%
It is in a quite new area of activity	83%	79%
It is in a specific project in order to enter a totally new area of activity	83%	76%
The Knowledge management process		
*Implementing joint research tasks	24%	39%
*Observing other partners' research facilities and practices	17%	34%
*Project meetings	52%	79%
*Informal communication among partners	52%	71%
Undertaking on your own similar R&D	17%	16%
*Training related to the specific cooperative R&D activity	17%	5%
Codification of related information and data	17%	18%

* Group 1's reply was significantly different from the replay of group 4 (90%)