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The Impact of Information Technology Capability on Alliance Design and Performance

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THE IMPACT OF INFORMATION TECHNOLOGY CAPABILITY ON ALLIANCE DESIGN AND PERFORMANCE

Abstract

Many changes in the forms of interfirm cooperation have been attributed to advances in information and communication technologies that allow firms to exchange a large amount of information at low cost. However, few studies have attempted to examine these relationships. The primary goal of this paper is to investigate the impact of firms' information technology (IT) capabilities on (i) the design of strategic alliances and (ii) alliance performance. Two aspects of the alliance design are examined: the governance structure and the alliance scope. Contrary to the received wisdom from transaction cost economics, the results show that IT capability leads to alliances with more hierarchical governance structures. Results also show that IT capability either shrinks or expands the alliance scope depending on the nature of the alliance task, and in particular on task analyzability. Finally, firms derive greater benefits from an alliance when they design the alliance so as to leverage their IT capability. Two broader theoretical implications are derived: The first has to do with the boundaries between the contractual and competence perspectives. The second extends the resource-based view by suggesting how alliances can be designed to leverage a certain class of resources and capabilities.

INTRODUCTION

Recent advances in information technology (IT) have enabled firms to process a large amount of information at low cost. This has led to a decrease in coordination costs, both external (the costs of coordination *between* firms) and internal (the costs of coordination *within* the firm). The empirical evidence suggests that IT reduces external coordination costs more than internal (e.g., Brynjolfsson et al. 1994, Hitt 1999). This implies that various forms of interorganizational collaboration, such as strategic alliances and joint ventures, should be the ones benefiting the most from the advances in IT (Bensaou 1997).

Some beneficial effects of IT on strategic alliances have been illustrated by anecdotal evidence and case studies. For example, Argyres (1999) studied the construction of the 'invisible' B-2 Stealth bomber, a highly advanced military aircraft. In this case, information technology served to establish a technical grammar which helped four firms to carry out the project in a vertically disintegrated way, without the need for a single hierarchical authority. Another example, described by Malhotra et al. (2001), is the development of a rocket engine by Boeing-Rocketdyne. The engine was developed by a virtual team of eight people from four different firms. Such an innovative project would normally require collocation in order to work out, but teleconferences and net-meetings allowed the team to carry out the project without collocation.

Notwithstanding the above examples, empirical research on the relationship between IT and strategic alliances is scanty. As a result, there are few, if any, reliable generalizations that can be made. The principal aim of this paper is to examine the impact of firms' IT capabilities on (i) the design of strategic alliances and (ii) alliance performance. We examined two key aspects of the alliance design: the governance structure and the alliance scope. To preview our results, we find evidence contrary to the received wisdom that IT capability leads to alliances with less hierarchical governance structures. We also find evidence that IT capability either shrinks or expands the alliance scope depending on the nature of the alliance task. More specifically, IT capability expands the alliance scope at low levels of task analyzability but shrinks the alliance scope at high levels of task analyzability. Finally, firms derive greater benefits from an alliance when they design the structure and scope of the alliance so as to leverage their IT capability.

The above findings have two broader theoretical implications. First, they contribute to identifying the boundaries between the contractual and competence perspectives. There has been great debate about the relative strength of these two perspectives (e.g., Conner and Prahalad 1996, Kogut 1988, Colombo 2003), especially in theories of the firm (e.g., Conner and Prahalad 1996, Williamson 1985). Yet, we know little about the boundaries of the applicability of each of these perspectives. In this paper we show that competence perspectives dominate at low levels of task analyzability whereas contractual perspectives take over at high levels of task analyzability. Second, the findings also have implications for the resource-based view of the firm. By focusing on a certain class of resources and capabilities (in particular IT capabilities), we identify how alliances can be designed to further exploit these capabilities.

IT CAPABILITY AND ALLIANCE DESIGN

In order to understand the relationship between IT capability and alliance design, it is important to first clarify the concept of IT capability. Depending on how it is conceptualized, IT capability may influence as well as be influenced by the alliance design. If, however, IT capability is conceptualized as an organizational capability in the resource-based view (Barney 1991), the possibility that the alliance design is the determinant rather than the outcome of IT capability (reverse causality) is ruled out.

Drawing on the resource-based view, Mata et al. (1995) investigated the potential of several IT resources (access to capital for IT investments, proprietary technology, technical IT skills, and managerial IT skills) to generate sustainable competitive advantage. They concluded that only managerial IT skills can be a source of sustainable competitive advantage because, unlike other IT resources, they are not subject to low-cost imitation. The development of managerial IT skills or knowledge is a time-consuming and socially complex process because it depends on close interpersonal relationships between IT managers and managers in other business functions. As Mata et al. (1995) argued, it can take years before these interpersonal relationships develop to a point where IT managers can conceive and implement novel IT applications that are customized to the needs of managers in other business functions.

Ray et al. (2004) tested empirically this argument in the customer service function and found that managerial IT knowledge enhances the performance of the firm's customer service unit, whereas other technology resources that have become commodities do not. In fact, Mata et al.'s (1995) argument is also consistent with Clemons and Row's 'strategic necessity hypothesis', according to which IT creates sustainable advantage by leveraging or exploiting complementary human and business resources (Clemons and Row 1991, Powell and Dent-Micallef 1997).

In view of the discussion above, it is important to conceptualize IT capability as managerial IT skills. This conceptualization rules out the possibility that IT capability is the outcome rather than the determinant of alliance design (reverse causality). The central question that arises, then, is how IT capability influences the alliance design. We summarize our arguments in two basic categories: (a) *contractual* perspectives, and (b) *competence* perspectives.

Contractual perspectives examine safeguards that protect a firm from appropriability hazards stemming from the opportunistic behavior of the partner (e.g., Williamson 1985, Jensen and Meckling 1976). For example, appropriability hazards can be mitigated by monitoring the partner's contributions to the alliance so as to make sure that contributions are balanced, in the sense that each firm receives benefits that are proportional to its contributions (e.g., Oxley 1997, Jensen and Meckling 1976). In contrast, competence perspectives emphasize coordination costs that arise from the execution of complex and interdependent tasks (Gulati and Singh 1998). These costs do not rely on any assumptions about opportunism but rather on the assumption that alliances may be characterized by high degrees of coordination complexity.

Empirical evidence suggests that IT can reduce both coordination and monitoring costs (Brynjolfsson et al. 1994, Dewan et al. 1998, Hitt 1999). An example of the role of IT in coordination is the use of email to take advantage of differences in time zone. An example of the role of IT in control is the exchange of funnel spreadsheets by net-meetings or teleconferences in order to keep track of the sales progress of the partner.

Governance Structure: Contractual and Competence Perspectives

The governance structure of an alliance can typically include various elements, some of which are more hierarchical and others less hierarchical. Prior research has generally classified the governance structure of alliances in terms of the presence or absence of equity, with alliances involving equity investments considered to be more hierarchical than those that do not (e.g., Hennart 1988). However, equity is only one of the hierarchical elements of governance structure. Joint ventures, for example, are defined not only in terms of shared equity but also in terms of the creation of a common legal entity. Considerably less effort has been made in explaining the presence or absence of this entity as a hierarchical element of the governance structure of alliances.

Ignoring entity and treating equity as a synonym for hierarchical governance may lead to two types of problems. The first is a misspecification issue resulting from the fact that alliances with varying degrees of hierarchical controls are combined within one single category (Gulati and Singh 1998). For example, joint ventures are classified together with alliances that do not involve the creation of a separate legal entity, such as minority equity investments and equity swaps. The second problem, which, in our opinion, is more fundamental, is that equity and entity may in fact be explained by different theoretical perspectives. Thus, aligning them together on a linear continuum ranging from markets to hierarchies can sometimes be misleading because it overlooks important differences between these two hierarchical elements. These differences may introduce nonlinearities in the hierarchical continuum.

Most existing research on the governance structure of alliances is informed by economic theories of the firm, especially transaction cost economics (e.g., Hennart 1988, Williamson 1985). From this perspective, the major difference between hierarchical alliances such as joint ventures and contractual alliances such as licensing agreements is that the former provide a superior monitoring mechanism and achieve superior alignment of incentives. Superior monitoring is achieved through the creation of an autonomous administrative hierarchy that oversees the day-to-day functioning of the alliance. Superior alignment of incentives is achieved through mutual hostage positions that take the form of shared equity (Kogut 1988).

More recently, however, attempts have been made to explain the governance structure of alliances from a perspective based on organizational theories of the firm (e.g., Gulati and Singh 1998). From this perspective, the major difference between joint ventures and contractual alliances is that the former achieve superior coordination. The administrative hierarchy facilitates task coordination by providing standard operating procedures that simplify decision making and a command structure that addresses contingencies as they arise (Gulati and Singh 1998).

In summary, the administrative hierarchy of the joint venture economizes on both monitoring and coordination costs. These costs, however, can also be reduced by IT (e.g., Brynjolfsson et al. 1994, Dewan et al. 1998, Hitt 1999). Thus, it seems that erecting governance structures that minimize monitoring and coordination costs is less critical for firms with high IT capability and more critical for firms that lack such a capability. In this sense, we should observe that firms with IT capability are more likely to form alliances with less hierarchical governance structures. In fact, this is what one would expect to observe given the proliferation of studies showing that IT favors markets over hierarchies (e.g., Gurbaxani and Whang 1991, Brynjolfsson et al. 1994, Hitt 1999), such as those linking IT to a decrease in firm size (Brynjolfsson et al. 1994) and vertical disintegration (Hitt 1999). Most of these studies are informed by economic theories of the firm, especially agency theory and transaction cost economics.

However, the autonomous administrative hierarchy should be seen as more than an entity that minimizes transaction costs. Organizational theories of the firm also posit that firms exist as communities within which information can be interpreted and ambiguities resolved by a common language and organizing principles (Weick 1979, Daft and Weick 1984, Kogut and Zander 1992). For example, employees of the same firm can understand each other better because they share the same organizational culture.

Firms with high IT capability can exchange a large amount of information, which can serve either for monitoring or for coordination purposes (or for both). However, this information needs to be interpreted in order to become valuable. According to media richness theory (Daft and Lengel 1986), IT serves to increase the amount of available information but cannot be used to interpret that information. This is because interpretation requires information richness rather than information amount. In this sense, the IT capabilities of firms can be seen as potential monitoring and coordination capabilities. In order to realize the potential of these capabilities, firms need to interpret the information that they receive.

The value that a firm derives from interpreting the information that it receives increases with the amount of information received. Thus, firms with greater IT capability are more likely to seek ways of exploiting their capability by designing alliances in a way that facilitates the interpretation of information. After interpreting the information within the joint venture, the representatives of the firm in the top management team or the board of directors of the venture can transfer the information back to the parent company. The existing research on the impact of information technology on markets and hierarchies has failed to recognize the importance of interpretation. This is somewhat curious given that the interpretation of information has been analyzed by a theory that belongs to the information systems field, notably the media richness theory (Daft and Lengel 1986).

Hypothesis 1. Firms with greater IT capability are more likely to design their alliances with more hierarchical governance structures.

Designing the alliance in a way so as to facilitate interpretation is more important when the information is ambiguous. According to Daft and Lengel (1986) and Rice (1992), the extent of ambiguity depends on the nature of the alliance task. In particular, ambiguity is greater at low levels of task analyzability. In contrast, at high levels of task analyzability, information can be easily interpreted and thus it is not necessary to design the alliance in a way so as to facilitate interpretation.

Hypothesis 1a. The impact of IT capability on the governance structure of alliances will be stronger at low levels of task analyzability.

Hypotheses 1 and 1a make predictions contrary to the ones made by arguments based on pure cost-minimization. For example, transaction cost economics would argue that IT capability favors alliances with less hierarchical governance structures because it reduces transaction costs (substitution effect). Based on transaction cost reasoning, we should also expect that the impact of IT capability on governance structure is stronger at high rather than low levels of task analyzability (e.g., Afuah 2003). Hypotheses 1 and 1a make different predictions than the above because they are not based on pure transaction cost arguments.

Alliance Scope

Relative to the bulk of research on the scope of firms (the literature on diversification and multinationals), there is a dearth of research on the scope of alliances (for exceptions see Khanna 1998 and Oxley and Sampson 2004). Yet, as Khanna (1998) noted, agreeing on the scope of the alliance is in practice one of the most important tasks the partners will undertake.

Contractual Perspectives. Broadening the scope of the alliance creates monitoring problems. For instance, widening the geographic area that the alliance covers, or expanding the range of products and technologies that the alliance involves, will raise the difficulty and cost of monitoring partners' actions (Oxley 1997). In this respect, broad-scope alliances are more likely to suffer from severe appropriability hazards than narrow-scope alliances.

However, increases in the alliance scope will also lead to increases in the relative scope of the partners in the alliance (for each partner, relative scope is defined as the ratio of the markets covered by the alliance to the total set of markets in which the partner is active) (Khanna et al. 1998). Moreover, the increase in relative scope generated by expansion of the alliance scope in one more market will be greater when the partners are already active in that market. According to Khanna et al. (1998), such increase in the relative scope of each firm will reduce the incentive of the firm to learn its partner's know-how in order to apply it to private operations unrelated to the alliance. In other words, as the scope of the alliance increases, the incentive for opportunistic behavior diminishes. Of course, the above scenario may not apply to all kinds of alliances. As Khanna (1998) recognized, it holds only insofar as we refer to learning alliances in which common benefits accruing to alliance participants from the markets covered by the alliance are at least as great as any temporary private benefits that may arise when one firm is able to serve the markets covered by the alliance sooner than its partner (see Khanna 1998 for a detailed discussion).

Yet there is also a more general reason why broadening the scope of the alliance may lead to superior alignment of incentives. Widening the scope of cooperation can be seen as an act of internalizing within the alliance activities in which partners are competing. Such activities generate conflict between the partners and constitute a major reason of alliance failure (Park and Russo 1996). By bringing these activities inside the alliance, firms align their incentives and increase the stability of the alliance. The alliance between GE and SNECMA is a typical example. Although its initial scope covered only the 'mid-range' engine, the partners quickly found it necessary to expand the alliance scope to their entire range of civilian engines. This expansion was driven by the need to prevent conflicts between the partners (Doz and Hamel 1998).

In summary, while broad-scope alliance partners encounter monitoring problems, they also benefit from reduced incentives to behave opportunistically. Firms entering narrow-scope alliances need to rely on monitoring to control each other's behavior because their incentives are misaligned. In contrast, broad-scope alliances achieve superior alignment of incentives that obviates the need for significant monitoring. This is a fundamental tradeoff that has not been elucidated in the existing literature on strategic alliances. This tradeoff can be seen as part of the general debate between behavior-based and outcome-based approaches to dealing with agency problems. Behavior-based approaches are based on monitoring the agent's behavior whereas outcome-based approaches focus on coaligning the agent's preferences with those of the principal (Eisenhardt 1989).

Monitoring-based control requires greater information amount (therefore more IT) than control by incentives (e.g., Dewan et al. 1998). When incentives are misaligned and firms rely on monitoring to control each other, each firm must constantly struggle against its partner's incentives to shirk. Therefore, for monitoring to work out as a control mechanism, partners should have continuously updated information about each other's actions. On the other hand, incentives are determined by factors other than information technology, and, as discussed above, factors that are often exogenous to the alliance. In fact, Kumar and van Dissel (1996) showed that IT systems cannot avoid conflicts of interest between the partners. Thus, firms with IT capability will tend to form alliances that rely on monitoring rather than incentives as a control mechanism. This is consistent with the agency theory argument that information systems are positively related to behavior-based contracts and negatively related to outcome-based contracts because they allow the principal to discover information about the agent's behavior (Eisenhardt 1989). Thus, from a contractual perspective, IT capability will shift the tradeoff between narrow-scope and broad-scope alliances in favor of the former, effectively shrinking the alliance scope.

Hypothesis 2. Firms with greater IT capability are more likely to design their alliances with narrower scope.

Competence Perspectives. Another factor that may influence the alliance scope is coordination complexity. For example, decisions involving multiple geographic areas are inherently more complex than decisions for one single geographic area. This argument does not rely on any assumptions about opportunism. Even when the partners have complete confidence in each other and face no appropriation concerns whatsoever, expanding the alliance scope will increase coordination costs. Given that firms have different knowledge endowments, coordination costs include, for example, the costs of pooling together distributed knowledge and making decisions collectively using the pooled knowledge.

From a competence perspective, the ability to exchange a large information amount not only mitigates appropriability hazards but also facilitates coordination. Each additional product or geographic area that is added to the alliance increases the amount of information that needs to be processed in order to make decisions about the alliance. This is because each product or geographic area is unique and thus requires a different set of information to deal with its particularities. As a result, managing a broader range of products or a wider spectrum of geographic areas requires more information amount than managing only one single product or geographic area.

Firms that can exchange a large amount of information at low cost may also create routines in the communication process because they can exchange information more frequently. Such routines facilitate the coordination of complex activities (Nelson and Winter 1982), such as the management of broad-scope alliances. Thus, from a competence perspective, firms that can exchange a large amount of information with their partners are more likely to enter broad-scope alliances than narrow-scope alliances.

Hypothesis 3. Firms with greater IT capability are more likely to design their alliances with broader scope.

Hypotheses 2 and 3 make opposite predictions and thus can be used to test the contractual and competence perspectives. In Colombo's (2003) study, which was the first to test these two perspectives, the prediction made by the contractual perspectives was unclear and thus contractual and competence perspectives did not necessarily make opposite predictions. We provide a neater way of testing these two perspectives.

Hypotheses 2 and 3 also make a more specific contribution to the IT literature by distinguishing between the coordination and control effects of information technology. Existing research suggests that information technology facilitates both coordination and control (e.g., Dewan et al. 1998). However, evidence as to which of the two effects is stronger, for example whether IT reduces coordination costs more than monitoring costs, is inconclusive. There is only evidence that IT reduces external costs (e.g., the costs of coordination between the firm and outside entities) more than internal costs (e.g., the costs of coordination within the firm) (e.g., Brynjolfsson et al. 1994, Hitt 1999).

Contingency Perspectives. The perspectives presented so far allow us to predict either kind of impact of IT capability on alliance scope: According to the contractual perspectives, IT capability should shrink the alliance scope, while, according to competence perspectives, IT capability should expand the alliance scope. A contingency view, however, would argue that neither of the two perspectives (contractual and competence) dominates the other in a universal manner, but rather the relative strength of these two perspectives depends on contingencies that need to be specified. In this section, we argue that ambiguity surrounding the alliance task is an important contingency factor that determines whether IT capability will shrink or expand the alliance scope.

At high levels of ambiguity, alliance partners need to collaborate closely with each other in order to make some sense of the information that is required in order to accomplish the alliance task. The fact that this information is ambiguous implies that it cannot be appropriated easily by any of the transacting parties. Thus, the risk of opportunism is curbed and the learning race argument of Khanna et al. (1998) fails. In addition, at high levels of ambiguity, the causal mechanisms by which several factors interact to produce a certain outcome are unclear (Lippman and Rumelt 1982). Thus, it is not possible for a firm to isolate the alliance activities in which it needs to engage so as to reap private benefits from the alliance. Because it is not clear what these activities are and how they interact with each other to produce the benefits, it is not possible for the firm to focus more on some of the alliance activities and do others with the minimum level of effort. By doing so, the firm would risk destroying the causal logic by which the private benefits are generated. Thus, at high levels of ambiguity, opportunistic behavior is self-defeating and monitoring the partner is not necessary. Because ambiguity serves as a self-enforcing safeguard against opportunistic behavior, firms will use their IT capability mostly for collaborative reasons, that is, in order to coordinate with their partner more effectively.

In a similar vein, Kogut (1988) examined the relative strength of transaction cost and knowledge-based perspectives on joint venture formation. He argued that tacit knowledge favors the latter because it can be described in a contract without effecting a transfer. Given that causal ambiguity is frequently caused by tacit knowledge (Simonin 1999), Kogut's argument seems to support the notion that, at high levels of ambiguity, knowledge-based perspectives dominate contractual perspectives.

As ambiguity decreases, however, it becomes easier to appropriate the partner's know-how in order to use it in ways that do not serve the goals of the alliance. In such situations, IT is more likely to be used for monitoring purposes, i.e., in order to mitigate appropriability hazards. Thus, contractual perspectives gradually take over and eventually dominate at low levels of ambiguity. As argued by Daft and Lengel (1986), ambiguity is low at high levels of task analyzability.

Hypothesis 4a. *At high levels of task analyzability, firms with greater IT capability are more likely to design their alliances with narrower scope.*

Hypothesis 4b. *At low levels of task analyzability, firms with greater IT capability are more likely to design their alliances with broader scope.*

IT CAPABILITY AND ALLIANCE PERFORMANCE

Another prediction made by contingency perspectives is that performance improves when alliances are designed in a way so as to leverage the IT capabilities of firms. At high levels of task analyzability, firms can leverage their IT capability by shrinking the alliance scope in order to benefit from superior monitoring. In addition, a certain amount of information can be easily interpreted and leveraged for monitoring purposes because there is high task analyzability, i.e., low ambiguity. Thus it is not necessary for the firms to invest in hierarchical governance structures in order to exploit the monitoring capabilities that IT provides.

In contrast, at low levels of task analyzability, firms can leverage their IT capability by expanding the alliance scope in order to exploit the coordination capabilities of IT. However, a certain amount of information needs to be interpreted in order to be used for coordination purposes and interpretation is not easy at low levels of task analyzability. Thus, firms will also choose a hierarchical governance structure in order to facilitate interpretation. In brief, another prediction made by contingency perspectives is that, at low levels of task analyzability, firms can leverage their IT capability by choosing a hierarchical governance structure while at the same time expanding the alliance scope.

The above predictions were based on contingency perspectives, according to which firms can benefit more from their IT capability by designing the alliance in an appropriate way. However, based on the contractual and competence perspectives, there should also be a direct link between IT capability and alliance performance. In particular, IT capability should enhance alliance performance because, as a capability in the resource-based view of the term, it provides the firm with superior monitoring and coordination that other firms cannot replicate.

Hypothesis 5. *IT capability increases alliance performance.*

Hypothesis 6a. *At high levels of task analyzability, IT capability increases alliance performance more when firms design the alliance with narrow scope.*

Hypothesis 6b. At low levels of task analyzability, IT capability increases alliance performance more when firms design the alliance with broad scope and hierarchical governance structure.

METHODS

Data

A survey was sent to two groups of people. The first group consists of alumni participants of the INSEAD executive program Managing Partnerships and Strategic Alliances (MPSA) (promotions 1997/98 till Dec. 2004). The April 2004 promotion was used in the pretest phase and thus was excluded from the survey population. The participants of the MPSA program represent companies from all over the world, although European countries are represented more than others. The second group consists of members of the Association of Strategic Alliance Professionals (ASAP), the largest association of alliance professionals in the world. Only full members were considered. In their great majority, ASAP members represent US companies.

Special care was taken in selecting the people who were surveyed. Due to the nature of the phenomena studied, it was very important that these people are not selected based on some IT-related contact information such as their email address. Instead, the selection criterion for including a person in the survey sample was the availability of other contact information, notably the person's telephone number and postal address. The overwhelming majority of people who reported this contact information also reported their email address. For those few exceptions where the email address was not available, a phone call was made and the email address was obtained either from the person directly or from his/her private assistant. After eliminating some people because of wrong contact information or because they did not meet the criteria for participating in the survey, we ended up with a final sample of 426 potential respondents (194 MPSA and 232 ASAP). Both MPSA participants and ASAP members who were included in the survey population hold senior positions in strategic alliances, most of them having the title of partnership director, alliance manager, or business development manager.

The survey was conducted online. While there were no major technical hitches, a few respondents were unable to complete the survey online and a hard copy was administered to them either by post or as an attachment by email. This ruled out the possibility that alliance managers who are not comfortable or familiar with IT are under-sampled in the survey. Such under-sampling, if present, would be especially problematic given that the construct of IT capability, which is central to our theory, is conceptualized as managerial IT skills.

The people included in the survey population were asked to select one agreement, either a joint venture or a strategic alliance, and to fill the relevant survey, following certain selection criteria which ensured that the respondent was very knowledgeable about the agreement and in a position to answer the questions of the survey as accurately as possible. After at least two rounds of follow-up calls per person, 229 completed the survey for a 53.8% response rate. More specifically, 127 MPSA participants (65.5% response rate) and 102 ASAP members (44% response rate) filled the survey. In order to alleviate the problem of retrospective reporting, we decided to focus on agreements that were formed within the last six years. Thus, we ended up with 206 agreements. Item response rates were generally over 95%. Having respondents from both the MPSA and ASAP samples increased our confidence in the study’s external validity. Furthermore, the pooling tests that we conducted failed to reject the homogeneity of slopes and intercept and thus we pooled the data to increase the efficiency of the estimation.

Special care was taken to mitigate any biases resulting from the use of a single key informant for each alliance. According to Kumar et al. (1993), this problem can be alleviated by selecting competent informants. First, the criteria by which respondents selected an alliance ensured that the respondents held key roles in the alliance and were in a position to provide accurate answers. Second, as an additional check for their competence, respondents were asked to report the percentage of working hours that they allocated to the alliance and, on average, percentages were found significantly high (mean 40.36%). Finally, the web-based survey automatically kept track of the time that each respondent took in filling the survey. On average, respondents took one hour to fill the survey, which is very satisfactory given their seniority and time constraints. All these precautions were taken in accordance with Kumar et al.'s (1993) prescriptions that alliance-specific measures of the informant's competence are preferable to company-specific measures and that multiple measures of the informant's competence should be used to increase the reliability of the answers.

We were also able to alleviate any concerns for common method bias that arise when the same respondent serves as a data source for both the dependent and independent variables. This concern was mitigated by the fact that the dependent variables related to the alliance design can be objectively assessed and thus are not open to the subjective interpretations and judgments of the respondent.

Variables

We adopted most of the survey items from preexisting scales in the literature (see appendix). All constructs had satisfactory reliability levels, with Cronbach alphas above 0.70. Multi-item variables were based on an unweighted average of relevant items. Simplicity in scoring was achieved using 5-point Likert type scales (Sheatsley 1983).

Outcome Variables. Two outcome variables related to the initial alliance design were used in the course of this study. As discussed above and consistent with our theory, we focused on explaining the entity dimension of governance structure. Thus *governance structure* is a dummy variable that distinguishes joint ventures (coded 1) from contractual alliances (coded 0). The variable *alliance scope* was measured as the number of continents covered by the alliance. To measure *alliance performance* we assessed the extent to which the firm achieved the objectives it had for entering the alliance. The achievement of each objective was weighted by the relative importance of the objective in the firm's decision to form the alliance (see appendix).

Predictor Variables. As discussed above, *IT capability* was operationalized as managerial IT knowledge because, according to Mata et al. (1995), this is the only IT-related resource that is not subject to low-cost imitation. The items that measure this variable were adopted from Ray et al. (2004) and Boynton et al. (1994). The reliability coefficient (0.78) is in fact comparable to that of the previous studies from which the scale was borrowed (0.75). Finally, *task analyzability* was measured with a scale adopted from Withey et al. (1983) and Bensaou and Venkatraman (1995).

Control Variables. Following an extensive search of the alliance literature, we controlled for all possible factors that may influence coordination and appropriation concerns in strategic alliances (e.g., Gulati and Singh, Oxley 1997). Thus, we controlled for the following: *Asset specificity*, *uncertainty*, the presence of *R&D* component, *prior ties*, whether the alliance is *international*, i.e., it involves participants from different nations, the *average size* and *relative size* of the partners, the *number of partners*, the *alliance experience* of the firm, and whether the firm has an *alliance function*. In the alliance scope equation, we also controlled for the geographic scope of the firms involved in the alliance (*average scope*). Information about the measurement of these variables is provided in the appendix.

Estimation

It is likely that the choices of governance structure and alliance scope are coupled. Previous studies have found that the alliance scope may influence the choice of governance structure (Oxley 1997). Econometrically, this suggests a model where governance structure and alliance scope are simultaneously determined, so that an endogeneity problem appears. A consistent estimator in the presence of endogeneity can be obtained using instrumental variables estimation. The instrument for alliance scope in the governance structure equation is the average scope of the partners. The rationale is that multinational firms are more likely to form alliances that cover a broader scope of countries. The instrument for governance structure in the alliance scope equation is asset specificity, since, according to transaction cost economics, these two should be positively related.

In order to check for endogeneity, we performed the Hausman specification test (Hausman and Wise 1978). In the first step, the alliance scope was regressed directly on all the instruments and the residuals from this regression were plugged into the governance structure equation. The coefficient of the residuals was not found significant ($b=0.06$, $p=0.65$), which implies that there is no endogeneity and thus we can estimate the governance structure model using a probit regression. Similar results were obtained for the alliance scope equation, which implies that the alliance scope model can also be estimated separately from the governance structure model.

The absence of endogeneity of the alliance scope variable in the governance structure model contradicts the empirical findings of Oxley (1997). However, it remains consistent with the theory presented in this paper, according to which an increase in the alliance scope does not necessarily increase contractual hazards, but only changes the relative effectiveness of monitoring and incentives as ways of dealing with these hazards.

RESULTS

Table 1 reports variable means, standard deviations, and correlations. It appears from the table that there are no serious multicollinearity effects among the variables.

Insert Table 1 about here

Table 2 shows the results of the probit regression of governance structure on IT capability as well as on a number of controls. The coefficient of IT capability is positive and significant at the 1% level. Thus hypothesis 1 is supported.

Insert Table 2 about here

After splitting the sample in two parts using the median value of task analyzability as the cutoff point, we find that the positive effect of IT capability on governance structure is significant only in the subsample of low task analyzability (see Table 3). Thus, the significant result of Table 2 seems to be driven mostly by alliances with low task analyzability, consistent with hypothesis 1a.

Insert Table 3 about here

In order to test hypotheses 2 and 3 it suffices to do ordinary least squares because the alliance scope is a continuous dependent variable. Table 4 shows the results of the OLS regression of alliance scope on IT capability and several controls.

The coefficient of IT capability is insignificant. Thus neither hypothesis 2 nor hypothesis 3 is supported by the data.

However, it may well be that the insignificant results are due to the fact that the effects of the contractual and competence perspectives cancel each other out. According to our theory, a contingency variable that can tease out the relative effect of the contractual and competence perspectives is the analyzability of the alliance task. In order to test for this possibility, the IT capability of the firm was interacted with task analyzability. As Table 4 shows, after this interaction is included, the main effect of IT capability becomes positive and significant, while the interaction term is negative and significant. This seems to support hypotheses 4a and 4b. It seems that for low levels of task analyzability, the positive effect of IT capability on alliance scope dominates the negative effect of the interaction term. However, as task analyzability increases, the negative effect of the interaction term becomes stronger and may eventually dominate the positive effect of IT capability. Indeed, simple calculations show that this happens when task analyzability is equal to 2, which is well within the range that task analyzability can vary. It is important to note that in order to obtain the correct interpretation of the main effect after the inclusion of the interaction term, we recoded the task analyzability variable so that its value ranges from 0 to 4 rather than from 1 to 5.

<u>Insert Table 4 about here</u>

As an additional check, the sample was split in two parts using the median value of task analyzability as the cutoff point. After splitting the sample, we find indeed that the positive effect of IT capability prevails on the subsample of low task analyzability, while the negative effect prevails on the subsample of high task analyzability (see Table 5). This provides further support for hypotheses 4a and 4b. In addition, as shown in Table 5, IT capability explains a larger percentage of variance in alliance scope when task analyzability is high. This result is consistent with the media richness theory, which argues that IT has a greater impact at high levels of task analyzability.

Insert Table 5 about here

Tables 6 and 7 present the results for the performance model. We used a treatment effects regression because governance structure is endogenous in the alliance performance model. As shown in Table 6, IT capability increases alliance performance. Thus hypothesis 5 is supported. However, the alliance scope does not have any significant moderating effect on the relationship.

Insert Table 6 about here

It is possible, however, that the absence of a moderating effect can be due to the fact that the contractual and competence perspectives make opposite predictions. To test this possibility, the sample was split again in two parts (low and high task analyzability). The results are shown in Table 7.

Insert Table 7 about here

Table 7 shows that shrinking the alliance scope increases the positive impact of IT capability on alliance performance only at high levels of task analyzability. This supports hypothesis 6a and suggests that, at high levels of task analyzability, firms derive greater benefits from an alliance when they exploit the monitoring rather than the coordination capabilities of IT.

DISCUSSION AND CONCLUSION

In summary, this paper examined the impact of information technology capability on alliance design and performance. Two aspects of the alliance design were examined: the governance structure and the alliance scope. Regarding the former, a significant impact was found; however, the findings challenge the conventional wisdom that information technology and hierarchy are substitutes (e.g., Brynjolfsson et al. 1994, Hitt 1999). Rather, we find that information technology favors more hierarchical governance structures, in particular those that involve the creation of an autonomous entity. It appears that such structures help the firm to exploit the potential of information technology.

In order to reach the above conclusion, we departed from prior research in two ways. First, contrary to prior IT research which views hierarchies as transaction-cost minimizing entities (e.g., Brynjolfsson et al. 1994, Hitt 1999), we adopted an organizational perspective which argues that firms exist as interpretation systems (Daft and Weick 1984) and as communities within which knowledge is shared by a common language and organizing principles (Kogut and Zander 1992). Second, contrary to prior alliance research (e.g., Hennart 1988, Oxley 1997), we focused on explaining the presence of an entity rather than equity as a hierarchical element of the governance structure of alliances. Such a focus justifies also the reliance on organizational theories of the firm.

The paper also examined the impact of information technology capability on the alliance scope. The findings indicate that IT capability expands the alliance scope at low levels of task analyzability but shrinks the alliance scope at high levels of task analyzability. This implies that contractual perspectives dominate at high levels of task analyzability whereas competence perspectives take over at low levels of task analyzability. This finding contributes to transcend the debate between the contractual and competence perspectives and to demarcate the boundaries between these two perspectives. This stands in contrast to existing research on the theory of the firm and organizational boundaries which argues in favor of one perspective or the other (e.g., Conner and Prahalad 1996, Williamson 1985).

Finally, we also examined implications for alliance performance. The findings suggest that the impact of IT capability on alliance performance can be enhanced by designing the alliance in a way so as to exploit the potential of IT. This offers guidelines to alliance managers as to how to design their alliances in order to leverage the IT capability of their firm. In particular, managers are advised to treat each alliance as a different case depending on the nature of the alliance task. At high levels of task analyzability, firms should shrink the alliance scope in order to exploit the monitoring capabilities of IT. In contrast, at low levels of task analyzability, the best strategy is to choose a hierarchical governance structure and at the same time expand the alliance scope in order to leverage the coordination capabilities of IT.

The above findings also have implications for the resource-based view of the firm. They suggest that superior performance depends not only on the existence of idiosyncratic resources and capabilities but also on the extent to which the firm will be able to leverage these resources. By focusing on a certain class of resources and capabilities, in particular IT capabilities, we were able to identify how alliances can be designed so as to further exploit these capabilities.

APPENDIX

IT Capability: It was measured by managerial IT knowledge because, according to Mata et al. (1995), this is the only IT-related resource that is not subject to low-cost imitation. Adopted from Ray et al. (2004) and Boynton et al. (1994). It is the average of the following 5-point Likert type items (Cronbach alpha = 0.78):

- Managers who worked for the alliance knew the potential of IT as a tool to improve their interaction with managers of the partner firm(s)
- Managers who worked for the alliance knew the potential of IT as a tool to increase their own efficiency
- IT managers understood and appreciated the business needs of the managers who worked for the alliance
- IT managers knew how they could improve the business operations of the alliance

Alliance Performance: Performance was measured as the extent to which the firm achieved the objectives it had for entering the alliance. To obtain the score for alliance performance, each objective was weighted by its relative importance in the firm's decision to form the alliance. The relative importance of each objective was measured on a 5-point Likert type scale (0=Not at all important, 1=Somewhat important, 2=Important, 3=Very important, 4=Extremely important). Alliance performance was measured by the formula:

$$\frac{1}{4}\sum_{i=1}^{6} w_i r_i$$

where w_i is the importance of objective i in the firm's decision to form the alliance, and r_i is the extent to which objective i was achieved. The objectives were identified from an extensive review of the alliance literature and represent all the potential value creation logics that may push a firm to form an alliance (reduce costs, increase product quality, learn new skills and know-how, build intangibles such as reputation and brand name, expand customer base, increase bargaining power vis-à-vis customers/suppliers).

Governance Structure: Dummy variable that distinguishes joint ventures (coded 1) from contractual alliances (coded 0).

Alliance Scope: It was measured as the number of continents covered by the alliance.

Task Analyzability: Adopted from Withey et al. (1983) and Bensaou and Venkatraman (1995). It is the average of the following 5-point Likert type items (Cronbach alpha = 0.77) describing the nature of the job of the managers who worked for the alliance:

- Their job was well-defined
- There was a clearly known way to do their job
- There were established procedures and practices for doing it

Asset Specificity: It was measured as the extent to which the firm made investments specifically for the alliance that had little value outside the alliance. Two 5-point Likert type items measured investments in:

- Physical assets
- Personnel

Alliance Experience: Number of previous alliances that the firm had formed (with any partner) prior to the alliance in question. The scores are: none (coded 0), one (coded 1), two (coded 2), 3-5 (coded 3), 6-10 (coded 4), 11-20 (coded 5), 21-50 (coded 6), 51-100 (coded 7), more than 100 (coded 8).

Average Size: The average size of all the firms involved in the alliance. The size of each firm was measured by the order of magnitude of the number of employees of the firm.

Relative Size: It was measured as the absolute difference in the size of the firms involved in the alliance.

International Alliance: Dummy variable indicating whether the alliance partners have the same nationality.

Prior Ties: Number of previous alliances that the firm had formed with the same partner(s) prior to the alliance in question.

R&D Component: Dummy variable indicating whether basic research or new product development were among the project activities that the alliance encompassed.

Average Scope: The average geographic scope of all the firms involved in the alliance. Each firm's geographic scope was classified as national (coded 1), international but limited to one continent (coded 2), or global (coded 3).

Uncertainty: Adopted from Kumar and Seth (1998). It was measured as the average of five 5-point Likert type items capturing the degree to which environmental factors were unpredictable. The environmental factors were the following:

- Customer demand
- Competitive climate
- Technological trends
- Supply of raw materials and equipment
- Government policies and regulation

Respondents were also asked to allocate 100 points among the above factors based on their importance for the success of the alliance. The unpredictability of each environmental factor was weighted by the importance of the factor. Uncertainty was calculated by the formula:

$$UNC = \sum_{i=1}^{5} w_i f_i$$

where w_i is the weight and f_i the unpredictability of environmental factor i.

Number of Partners: Dummy variable indicating whether two or more partners were involved in the alliance.

Number of Products: Dummy variable indicating whether two or more products were covered by the alliance.

Alliance Function: Dummy variable indicating whether the firm had an alliance function at corporate level dedicated to handling all alliance-related issues.

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TABLE 1

Descriptive Statistics and Correlations among Variables

Variable	**Mea**	**s.d.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Performance (firm-level)	10.34	4.26	1.00								
2. IT Capability	2.91	0.81	0.21**	1.00							
3. Governance Structure	0.19	0.39	-0.01	0.16*	1.00						
4. Alliance Scope	2.02	1.34	0.15*	-0.01	-0.16*	1.00					
5. Task Analyzability	2.00	0.81	0.09	0.14†	0.08	0.02	1.00				
6. Asset Specificity	1.97	0.96	0.10	0.04	0.08	-0.07	-0.00	1.00			
7. Alliance Experience	4.19	2.50	-0.09	0.11	-0.06	0.16*	0.18*	-0.08	1.00		
8. Average Size	3.82	1.24	-0.03	-0.02	-0.30***	0.28***	0.12†	-0.09	0.30***	1.00	
9. Relative Size	0.98	1.00	0.04	-0.02	-0.07	0.04	-0.07	0.01	0.05	0.01	1.00
10. International Alliance	0.37	0.48	0.03	-0.01	0.14*	0.12†	-0.05	0.26***	-0.13†	-0.11	-0.04
11. Prior Ties	0.49	0.93	-0.03	-0.01	-0.05	0.05	0.08	-0.01	0.19**	0.19**	0.02
12. R&D Component	0.49	0.50	0.10	0.04	-0.11†	0.13†	0.01	0.35***	0.12†	0.06	0.14*
13. Average Scope	2.47	0.63	-0.05	0.02	-0.24***	0.46***	0.03	0.04	0.32***	0.38***	-0.09
14. Uncertainty	2.33	1.18	-0.34***	-0.02	0.01	-0.14*	-0.17**	0.36***	0.02	0.02	0.01
15. Number of Partners	0.11	0.32	0.14*	-0.00	0.03	-0.04	-0.05	0.12*	0.08	-0.04	-0.15*
16. Number of Products	0.37	0.48	0.14†	0.11	-0.12†	0.16*	-0.02	-0.07	0.13†	0.20**	-0.10
17. Alliance Function	0.46	0.50	0.09	0.06	-0.12†	0.16*	-0.00	0.33***	0.19**	0.21**	0.14†

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 1 (cont'd)

Variable	10	11	12	13	14	15	16	17
10. International Alliance	1.00							
11. Prior Ties	-0.08	1.00						
12. R&D Component	0.30***	0.05	1.00					
13. Average Scope	0.02	0.14*	0.08	1.00				
14. Uncertainty	0.25***	0.03	0.34***	0.04	1.00			
15. Number of Partners	0.17**	0.09	0.14*	-0.08	0.12*	1.00		
16. Number of Products	-0.10	0.05	0.03	0.13†	-0.08	0.03	1.00	
17. Alliance Function	0.17**	0.03	0.39***	0.12†	0.28***	0.10	0.07	1.00

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 2

The Impact of IT Capability on Governance Structure

	Governance Structure	
Variable	Model I	Model II
Intercept	-0.05	-1.43†
Asset Specificity	0.08	0.09
Uncertainty	0.12	0.13
R&D	-0.40†	-0.44†
Prior Ties	0.02	0.06
International Alliance	0.32	0.32
Average Size	-0.37***	-0.36**
Relative Size	-0.06	-0.05
Alliance Experience	0.04	0.02
Number of Partners	0.10	0.09
Number of Products	-0.01	-0.07
Alliance Function	-0.15	-0.19
IT Capability		0.47**
χ^2	24.97**	34.06***
Log Likelihood, L(β)	-80.17	-75.63
$-2[L(\beta_I)-L(\beta_{II})]$		9.08**
N	192	192

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 3

The Moderating Effect of Task Analyzability on the Relationship between IT Capability and Governance Structure

	Governance Structure			
	Low Task Analyzability		High Task Analyzability	
Variable	Model I	Model II	Model I	Model II
Intercept	-0.22	-1.72	0.36	-0.95
Asset Specificity	-0.05	-0.06	0.26	0.29
Uncertainty	0.12	0.08	0.11	0.13
R&D	-0.19	-0.15	-0.88*	-0.98*
Prior Ties	0.01	0.04	-0.07	-0.03
International Alliance	0.52	0.50	-0.02	-0.03
Average Size	-0.30*	-0.31*	-0.49**	-0.48**
Relative Size	-0.06	-0.07	0.01	0.06
Alliance Experience	0.03	-0.02	0.05	0.05
Number of Partners	0.20	0.14	0.14	0.21
Number of Products	-0.09	-0.13	0.27	0.22
Alliance Function	-0.21	-0.24	-0.15	-0.21
IT Capability		0.61*		0.40
χ^2	12.92	20.33†	17.42†	20.01†
Log Likelihood, L(β)	-46.67	-42.97	-30.64	-29.35
$-2[L(\beta_I)-L(\beta_{II})]$		7.4**		2.58
N	115	115	77	77

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 4

The Impact of IT Capability on Alliance Scope

	Alliance Scope		
Variable	Model I	Model II	Model III
Intercept	-0.41	-0.22	-2.77**
Uncertainty	-0.27*	-0.27*	-0.34**
R&D	0.20	0.20	0.24
Prior Ties	-0.01	-0.01	-0.00
International Alliance	0.42*	0.42*	0.46**
Average Size	0.14†	0.14	0.10
Relative Size	0.10	0.09	0.09
Alliance Experience	-0.01	-0.01	-0.01
Average Scope	0.84***	0.84***	0.86***
Number of Partners	-0.07	-0.07	-0.16
Number of Products	0.27	0.28	0.31†
Alliance Function	0.16	0.17	0.22
IT Capability		-0.06	0.96**
Task Analyzability			1.29**
IT Capability*Task Analyzability			-0.48**
R^2	0.28	0.29	0.33
Adjusted R^2	0.24	0.24	0.28
F	6.50***	5.97***	6.35***
N	192	192	192

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 5

The Moderating Effect of Task Analyzability on the Relationship between IT Capability and Alliance Scope

	Alliance Scope			
	Low Task Analyzability		High Task Analyzability	
Variable	Model I	Model II	Model I	Model II
Intercept	-0.49	-1.28†	0.07	1.53
Uncertainty	-0.36*	-0.38*	-0.30	-0.35†
R&D	0.30	0.32	0.18	0.19
Prior Ties	-0.09	-0.08	0.23	0.16
International Alliance	0.40	0.39	0.53†	0.57*
Average Size	0.13	0.14	0.21	0.14
Relative Size	0.11	0.11	-0.02	-0.03
Alliance Experience	-0.00	-0.02	-0.00	0.01
Average Scope	0.95***	0.97***	0.60*	0.60*
Number of Partners	-0.22	-0.26	-0.12	-0.17
Number of Products	0.51*	0.50*	-0.33	-0.16
Alliance Function	0.22	0.21	0.09	0.21
IT Capability		0.30*		-0.42**
R^2	0.36	0.39	0.26	0.34
Adjusted R^2	0.29	0.31	0.14	0.22
F	5.26***	5.35***	2.10*	2.74**
N	115	115	77	77

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 6

The Impact of IT Capability on Alliance Performance

	Alliance Performance	
Variable	Model I	Model II
Intercept	10.45***	8.42***
Alliance Scope	0.30	1.26†
IT Capability	0.98*	1.74**
IT Capability*Alliance Scope		-0.34
Asset Specificity	0.55†	0.56†
Uncertainty	-1.97***	-1.97***
R&D	0.78	0.75
Prior Ties	-0.14	-0.12
International Alliance	0.30	0.33
Average Size	0.00	-0.04
Relative Size	0.10	0.04
Alliance Experience	-0.28*	-0.26*
Number of Partners	1.85**	1.83**
Number of Products	1.24*	1.30*
Alliance Function	0.32	0.28
Governance Structure	0.31	-0.08
χ^2	66.16***	69.18***
N	189	189

†p<0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 7

The Moderating Effect of Task Analyzability on the Relationship between IT Capability and Alliance Performance

	Alliance Performance			
	Low Task Analyzability		High Task Analyzability	
Variable	Model I	Model II	Model I	Model II
Intercept	10.99***	11.13**	10.54**	5.07
Governance Structure	-1.57	-1.57	2.19†	2.00
Alliance Scope	0.24	0.18	0.62	3.39**
IT Capability	0.93†	0.88	1.16*	3.39**
IT Capability* Alliance Scope		0.02		-1.07*
Asset Specificity	0.75†	0.75†	0.09	0.09
Uncertainty	-1.98***	-1.98***	-2.26**	-2.32**
R&D	1.25	1.26	0.23	0.54
Prior Ties	-0.09	-0.09	-0.32	-0.30
International Alliance	0.51	0.50	-0.17	-0.43
Average Size	-0.05	-0.05	0.02	-0.15
Relative Size	0.17	0.17	-0.06	-0.43
Alliance Experience	-0.27	-0.27	-0.27	-0.14
Number of Partners	1.77†	1.77†	1.64	1.22
Number of Products	0.61	0.60	2.17*	2.35*
Alliance Function	-0.23	-0.23	0.93	0.66
Adjusted R^2	0.16	0.15	0.24	0.30
F	2.47**	2.28**	2.65**	3.15***
N	113	113	76	76

†p<0.10, *p<0.05, **p<0.01, ***p<0.001