EXPERIENCE TRAJECTORIES, GOVERNANCE DESIGN, AND THE PERFORMANCE OF HIGH-TECH ALLIANCES

Maurizio Zollo

Strategy and Management Department
INSEAD
Boulevard de Constance
77305 Fontainebleau Cedex, France
Tel.: (33) 1 60 72 44 74
Fax: (33) 1 60 74 55 00
E-mail: maurizio.zollo@insead.fr

Jeffrey J. Reuer

Strategy and Management Department
INSEAD
Boulevard de Constance
77305 Fontainebleau Cedex, France
Tel.: (33) 1 60 72 44 73
Fax: (33) 1 60 74 55 00
E-mail: jeffrey.reuer@insead.fr

Harbir Singh

Management Department
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104
Tel.: (215) 898-6752
Fax: (215) 898-0401
E-mail: singhh@wharton.upenn.edu

April 15, 1999

EXPERIENCE TRAJECTORIES, GOVERNANCE DESIGN, AND THE PERFORMANCE OF HIGH-TECH ALLIANCES

Abstract

Drawing upon the knowledge-based view of the firm and transaction cost theory, this paper combines experience accumulation and governance design arguments to examine the performance of high-tech alliances. We differentiate three alliance experience trajectories – partner-specific experience (i.e., prior alliances with the same partner), technology-specific experience (i.e., prior alliances in similar product areas), and general collaborative experience – and suggest that experience accumulation at the parent firm level and governance design at the alliance level jointly influence the odds of alliance success. Based on a sample of 144 biotechnology alliances, we examine the extent to which these alliances result in knowledge accumulation, create new opportunities, and enable parent firms to achieve their objectives. We find that only partner-specific experience has a positive impact on alliance performance, and that this effect is due to the interaction between partner-specific experience and the alliance's governance design. The development of inter-firm routines can enhance the effectiveness of partnerships, particularly non-equity alliances lacking formal coordination and control mechanisms.

INTRODUCTION

In his recent extensive survey of the literature on strategic alliances, Gulati (1998) portrays the problem of understanding the factors influencing alliance performance as "one of the most interesting and also one of the most vexing questions" on the research agenda (p. 309). Indeed, the complexity of this problem has been widely recognized in research over the last decade. The difficulties associated with studying alliance performance have been attributed to many factors, including the lack of consensus around a typology of collaborative agreements, diversity in firms' strategic intents in pursuing alliances, and the lack of objective performance data (e.g., Anderson, 1990; Geringer & Hebert, 1991; Kogut, 1988). These obstacles notwithstanding, the theoretical and practical relevance of identifying antecedents of alliance performance provides a strong motivation for research that moves beyond firms' initial governance choices or alliance survival to study collaborators' specific alliance outcomes.

This paper examines the performance of strategic alliances in the biotechnology industry and develops a set of hypotheses based on the knowledge-based view of the firm and transaction cost theory to explain differences in alliance performance. Following various learning views on alliances (e.g., Hamel, 1991; Inkpen & Beamish, 1997; Khanna, Gulati, & Nohria, 1998) and other perspectives noting that alliances provide firms with valuable stepping stones in order to commit sequentially in uncertain investment contexts (e.g., Balakrishnan & Koza, 1993; Kogut, 1991), we focus on the alliance's overall achievement of objectives as well as the degree to which the collaboration contributes to the accumulation of knowledge and to the creation of new opportunities for parent firms.

While prior studies have sought to identify sources of alliance performance, the present analysis contributes to research on alliance outcomes along several dimensions. First, the paper provides a theoretical basis for the intuitive prediction that the parent firm's

accumulation of knowledge from previous alliance experiences can influence the performance of a given alliance. Such experience can facilitate development of the capabilities necessary to effectively manage alliance activities, from understanding where to invest in alliances to choosing partners and negotiating alliances to designing the collaboration and adapting the relationship over time as needed. Using event study methods, Anand and Khanna (1998) have found initial evidence for experience effects for joint ventures but not licensing agreements. The shareholder wealth effects of joint venture formation are larger for firms with greater experience in joint ventures, particularly research joint ventures. Barkema, Shenkar, Vermeulen, and Bell (1997) report that domestic joint venture experience, but not international joint venture (IJV) experience, promotes IJV longevity.

Second, we contrast three types of experience accumulation mechanisms in order to specify what type of knowledge is most relevant in explaining the success of some alliances. More specifically, the analysis assesses how partner-specific experience (i.e., prior alliances with the given partner), technology-specific experience (i.e., prior alliances in similar product areas), and general collaborative experience potentially give rise to knowledge accumulation, create new opportunities, and enable parent firms to achieve their objectives in a given alliance. While most prior research considers organizational learning in internal contexts such as manufacturing or R&D, we wish to examine these different experience effects in the alliance setting. Firms' multiple investments in alliances potentially provide learning opportunities but, at the same time, alliances are more infrequent (e.g., March, Sproull, & Tamuz, 1991), heterogeneous, and causally ambiguous (Lippman & Rumelt, 1982) than manufacturing and R&D processes for which experience effects have been well documented. By considering alternative alliance experience trajectories, we are able to assess the transferability of experiences across different partnering contexts.

Third, the paper considers the interaction effect between partner-specific experience and alliance governance design to provide a direct test of how the fit between prior ties and alliance governance structure affects alliance performance. Previous research has shown that parent firms are selective in their alliance governance decisions in that firms tend to choose non-equity structures in the presence of prior ties and equity structures otherwise (e.g., Gulati, 1995; Gulati & Singh, 1998). Research has made efficiency arguments to motivate reduced form tests using governance choice models, but has not tested the performance outcomes of the fit between prior ties and governance design. Thus, one of our objectives is to examine whether the governance choices of firms indeed moderate the performance effects of prior alliance experience. We suggest that the tacit knowledge and inter-organizational routines developed and refined through prior alliances with a given partner will be more important in shaping the performance of non-equity alliances than equity-based collaborations.

Finally, our assessment of alliance performance based on the knowledge-based view of the firm and transaction cost theory highlights the importance of both the parent firm level and the transaction level of analysis as well as their interdependence. Identifying the most relevant level of analysis in research on interfirm collaboration is currently a matter of debate. For instance, Oxley (1997) argues that transactional attributes alone determine the efficiency of an alliance. By studying alliance performance explicitly and examining both alliance governance and the parent firm's accumulated alliance experience, we situate the alliance within the parent firm's adaptive choices and evolutionary processes. Our arguments are therefore responsive to and consistent with Koza and Lewin's (1998) recent call to view alliances from a co-evolutionary perspective.

The paper is organized as follows: the next section develops a set of theoretical arguments and testable hypotheses relating the firm's prior alliance experiences and the

alliance's governance structure to alliance performance. The following section then provides details on our research design and survey of biotechnology alliances. Results are provided in the subsequent section, and the paper concludes by discussing the nature of alliance experience effects and the study's implications for future research.

THEORY AND HYPOTHESES

The performance of strategic alliances has been researched directly, as well as indirectly through reduced form models, from a variety of perspectives such as transaction cost theory (e.g., Balakrishnan & Koza, 1993; Hennart & Reddy, 1997; Oxley, 1997), real options theory (Kogut, 1991), agency theory (Reuer & Miller, 1997; Wild, 1994), and organizational learning theory (e.g., Barkema, Shenkar, Vermeulen, & Bell, 1997). Recently, a number of scholars have also advanced explanations of alliance performance based on the parent firms' abilities to manage the post-formation dynamics of their interaction (Ariño & de la Torre, 1998; Doz, 1996; Doz & Hamel, 1998). Similarly, current research on interfirm collaboration has posed the question as to whether an alliance capability exists and how firms might cultivate it (e.g., Zajac, 1998).

In this paper, we intend to contribute to this stream of work by offering a theoretical treatment and an empirical test of the performance effects of different alliance experience trajectories. One of these trajectories has to do with the accumulation of knowledge about the alliance process in general. A second trajectory relates to the accumulation of technological expertise in the area of the focal agreement. Finally, a third trajectory involves the accumulation of alliance experience with the same partner. We discuss each of these three alliance experience trajectories in turn below.

General Collaborative Experience

The rationale for hypothesizing that the accumulation of experience in an organizational activity will translate into improved performance has been discussed at length in several streams of research. First, the learning curve literature in the operations management area has investigated the phenomenon of decreasing unit costs with the accumulation of production experience (Dutton & Thomas, 1984; Epple, Argote, & Devadas, 1991; Yelle, 1979). More recently, this stream of work has inquired into the shapes of learning curves and factors affecting the shapes of learning curves (e.g., Lapre & Van Wassenhove, 1998; Lapre, Mukherjee, & Van Wassenhove, 1998). Second, the behavioral school in organizational studies has approached the problem with a broader view of the learning process, considering the entire range of activities being performed within the boundaries of an organization (Cyert & March, 1963; Levitt & March, 1988; March & Simon, 1958). Third, the evolutionary economics school has developed theory on how organizations change in time and space based on the evolution, adaptation, and replication of routinized behavior (Cohen & Bacdayan, 1994; Nelson & Winter, 1982; Winter, 1987; Winter, 1995). Firms accumulate a collective understanding about the execution of organizational tasks, which is tacitly (i.e., without explicit articulation or codification) updated and refined to achieve continuous marginal improvements in performance.

All of these theoretical traditions suggest a positive relationship between general alliance experience and performance. They also provide the foundations for arguments pointing to the importance of mastering complex alliance processes in order to enhance the likelihood of alliance success (e.g., Doz, 1996; Doz & Hamel, 1998). This leads to the following general hypothesis:

Hypothesis 1: The greater the firm's previous experience with alliances in general, the better the performance of the focal alliance.

While the vast majority of empirical analyses study internal manufacturing or R&D activities as the types of tasks subject to organizational learning processes,[1] we are interested in the application of these theoretical insights to the strategic alliance context. Whether or not experience effects will be manifest in the alliance setting is ultimately an empirical question, however, since several factors may be in operation that mitigate the potential benefits of alliance experience. First, alliances are typically less frequent and more heterogeneous than most manufacturing and R&D processes. The lower frequency and greater heterogeneity of alliance activity increases the probability that lessons learned from previous experiences will be applied to a context which is superficially similar but inherently different, a problem cognitive psychologists refer to as negative transfer effects (Cohen & Bacdayan, 1994; Cormier & Hagman, 1987).[2] Second, as administrative processes, alliances are characterized by significant ambiguity and behavioral uncertainty, making it difficult to attach time, quality, and cost dimensions to interfirm collaboration (e.g., Anderson, 1990; Geringer & Hebert, 1991). Third, the paucity of performance metrics is a related obstacle to the firm's attempts to incrementally adapt its routines and thereby improve its performance in future collaborations.[3] Thus, the performance measurement problem not only makes alliances difficult for researchers to study, but also makes them hard for firms to learn. These issues make an empirical test of H1 interesting since these factors may partially or wholly offset the theorized benefits of experience accumulation. These issues also lead us to examine more specific types of alliance experience, as discussed below.

Technology-Specific Experience

The accumulation of expertise from previous alliances completed in similar technical domains is the second trajectory that we take into consideration in our performance model. Apart from the benefits of alliance experience in general that were discussed above, technology-specific alliance experience potentially has a positive impact on alliance

performance for two additional reasons. First, Cohen and Levinthal (1990) have theorized and empirically shown that firms engaged in creative efforts accumulate an absorptive capacity proportional to the amount of previous discovery made in similar domains. If this is true, then prior alliances in the same or highly related technological areas should build a proportionally higher degree of absorptive capacity at the firm level, which will enhance the probability of success of new exploratory ventures. Second, firms' experiences specific to a given technological area will likely be less heterogeneous than alliance experience in general. While positive technology-specific alliance experience effects can still potentially be mitigated by factors such as low frequency, ambiguity, and the lack of performance metrics, the likelihood of negative transfer effects should be lower for alliance experience derived from similar areas.

Hypothesis 2: The greater the firm's previous experience with alliances in similar product areas, the better the performance of the focal alliance.

Partner-Specific Experience

The process of alliance implementation produces a wide range of knowledge spillovers, over and above the knowledge outputs specific to an alliance's narrower technological or other objectives. For example, prior relationships between partners help them to develop a more refined understanding of each other's cultures, management systems, capabilities, weaknesses, and so forth. Thus, by engaging in multiple alliances with each other, partners can tacitly develop a set of routines which undergird the way they interact with each other. Every time partners add another collaborative agreement, they have an opportunity to reinforce and adapt these inter-organizational routines, which can progressively smoothen the interaction patterns between the two firms. The fact that firms have developed this capability tends to heighten expectations for a new alliance between the partners, which in turn triggers iterative learning and adjustment cycles (Doz, 1996), leading to refinement of the capability further. Related evidence in the supply chain management

literature suggests that the development of interfirm coordination routines partially accounts for the performance of Japanese automotive manufacturers (Dyer, 1997). Furthermore, Dyer and Singh (1998) reason that relationship-specific knowledge stemming from frequent partner interactions leads to a relational capability that can translate into improved transactional outcomes as well as firm-level competitive advantages.

It is worth noting that the above arguments rest primarily on collaborators' development of inter-organizational routines through multiple alliances. A second theoretical mechanism supporting positive partner-specific alliance experience effects is the development of personal trust among the members of the two organizations. While trust likely supports the capabilities developed from prior alliances, it might not be a necessary condition for alliance effectiveness (e.g., Koza & Lewin, 1998). For instance, Hewlett Packard has 18 alliances with Cisco and more than 30 with Microsoft, but it is hard to define their partner interactions as trust-based. The partners are aware of the potential for opportunism but rely on established routines and reciprocal understandings of what works and what doesn't to manage difficulties that arise during alliance implementation. Thus, familiarity can breed trust that supports positive alliance experience effects (Gulati, 1995), but we expect that it will systematically breed inter-organizational routines that generate positive learning effects, as the following hypothesis suggests:

Hypothesis 3: The greater the firm's previous experience with alliances with the partner, the better the performance of the focal alliance.

Partner-Specific Experience and Governance Design

The arguments set forth above suggest that alliance experience accumulation will be beneficial to collaborators in several different ways. However, these hypotheses do not explicitly identify contingencies, apart from the type of experience accumulated, influencing the conditions under which these experience trajectories will be more or less helpful to partnering firms.

One important contingency is the governance design choices made by the two partners at the time of the alliance's formation. Prior studies examining firms' alliance governance choices have argued that the fit between prior alliance experience and the firm's choice of an equity or non-equity structure for the focal alliance influences the efficiency of the relationship (Gulati, 1995; Gulati & Singh, 1998). We seek to explicitly test whether the interaction between partner-specific experience and alliance governance has an impact on alliance performance.

We expect that the alliance's governance structure will have an important moderating influence on the performance enhancements expected from partner-specific experience. The difference in experience effects result from fundamental governance differences across equity and non-equity alliances (e.g., Gulati & Singh, 1998; Oxley, 1997; Pisano, 1989). In equity joint ventures, for instance, firms have formal monitoring rights to enhance coordination. Joint control is also facilitated by the establishment of a separate business entity that permits sequential decision making as in other hierarchical forms of governance. Residual claimancy also facilitates coordination by aligning transacting parties' incentives *ex ante* (Hennart, 1988). These features of equity alliances are important for partners who have not collaborated in the past as they afford governance devices to compensate for the lack of inter-organizational routines to support the alliance's implementation and development path. Equity also ameliorates problems of behavioral uncertainty and potential opportunism over time. As a consequence, empirical research shows that partners lacking prior relationships with each other turn to equity rather than non-equity alliances (Gulati, 1995) and employ safeguards more extensively in their alliances (Parkhe, 1993).

By contrast, we expect that partners with alliance experience with each other have developed their inter-organizational routines such that the monitoring, control, and incentive alignment features of equity are to some degree redundant with the coordination skills they

have refined through prior collaboration. Such capabilities may be tacit, in contrast to the formal coordination provided by equity structures, and these skills allow firms to engage in iterative relationships using less formal governance arrangements (Williamson, 1979). These arguments lead to the following hypothesis:

Hypothesis 4: The positive performance effect of partner-specific experience will be greater for non-equity alliances than equity alliances.

METHODOLOGY

Model Specification

The basic structure of the multivariate statistical models is as follows:

(1) Alliance Performance = β_0 + β_1General Collaborative Experience + β_2Technology-Specific Experience + β_3Partner-Specific Experience + β_4Partner-Specific Experience • Equity + β_5Equity + β_6Alliance Relevance + β_7Division of Labor + β_8Coordinating Committee + β_9Contract Alterations + β_{10}Monitoring Changes + ε.

The specification incorporates three sets of explanatory variables. The first three independent variables relate to the firm's accumulated experience with alliances. We address the firm's accumulated experience with any partner on any subject (i.e., General Collaborative Experience), with any partner on similar technological subjects (i.e., Technology-Specific Experience), and with the partner in question (i.e., Partner-Specific Experience). The multiplicative term Partner-Specific Experience • Equity is included in the model to test the hypothesized moderating effect of the alliance's governance structure on the partner experience – performance relationship (i.e. H4). The next four variables represent specific design features of the alliance. In particular, we considered whether the alliance was an equity or a non-equity collaborative agreement (i.e., Equity), the relevance of the alliance to the firm's overall business (i.e., Alliance Relevance), the division of labor in the collaboration (i.e., Division of Labor), and whether the alliance had a committee in place to

coordinate the execution of tasks (i.e., Coordination Committee). Finally, the last two variables indicate possible post-formation governance changes in the alliance. We examined whether parent firms altered the collaborative agreement itself (i.e., Contract Alterations) and whether firms introduced or formalized monitoring mechanisms for the collaboration (i.e., Monitoring Changes).

Sample and Data

To obtain data to test the hypotheses developed earlier, we administered a survey to biotech and pharmaceutical firms engaged in interfirm collaboration. This empirical context is appropriate and interesting for this study as alliances figure prominently in these firms' competitive strategies, rapid though heterogeneous growth in alliances suggests that alliance capabilities acquired from accumulated experience may provide a source of advantage vis-à-vis rivals, and this industry has recently attracted the attention of strategy and management researchers. The University of North Carolina's (UNC) (1993) database on biotech alliances was first used to identify the relevant target population of alliances. The BioScan database and other library sources was then used to obtain the addresses of 262 firms involved in 445 alliances out of a total of 753 collaborative agreements in the human diagnostic and therapeutic treatments and equipment sub-fields identified by the UNC database.

The survey we designed was pre-tested using five industry experts. Following the pre-testing phase, a two-page questionnaire was faxed or mailed to the CEOs of the targeted sample of firms. An accompanying letter explained the study's aims, promised a report on the principal findings, and requested that the questionnaire be forwarded to the individual who was most knowledgeable about the agreement. After two rounds of follow-up calls, 81 firms completed questionnaires for 145 agreements, which corresponds to a 30.9 percent response rate. This response rate was considered satisfactory given the seniority of respondents as well as the heavy surveying activity in this industry. The final sample of

agreements is representative of the biotech alliance population in covering 32.6 percent of the total number of observable transactions (i.e., 145/445). No response biases could be statistically detected with respect to the experience levels of respondents versus the total sample of firms.

Measures

Alliance Performance. The relatively small number of studies on alliance performance can be partially attributed to the difficulties researchers face in measuring alliance performance.[4] Given our interest in examining the effects of experience accumulation on the effectiveness of alliances, we used three perceptual indicators of alliance performance to directly gauge the implications of alliances for parent firms. First, respondents indicated on a five-point Likert scale their satisfaction with the knowledge accumulated from participating in the collaborative agreement (i.e., Accumulation of Knowledge). Alliance research identifies knowledge accumulation as a key organizational outcome of interfirm collaboration (e.g., Hamel, 1991; Inkpen & Beamish, 1997; Khanna, Gulati, & Nohria, 1998). Second, respondents indicated the extent to which the alliance created new opportunities for the firm (i.e., Creation of Opportunities). Many alliances evolve beyond parent firms' initial expectations, and the real option view of alliances in particular emphasizes the creation of new, often unexpected, opportunities as an important source of value from collaboration (e.g., Kogut, 1991). Finally, to capture other elements of firms' strategic intents in engaging in alliances, respondents were asked to rate the degree to which the alliance satisfied the parent firm's initial objectives (i.e., Achievement of Objectives). These three indicators were standardized and summed to construct a global measure of alliance performance (i.e., Alliance Performance), which had a Cronbach alpha of 0.83 (Nunnally, 1978).

Explanatory Variables. To measure each firm's experience with alliances, we asked respondents to report the number of prior agreements with any partner on any subject (i.e., General Collaborative Experience), the number of prior agreements with any partner on similar subjects (i.e., Technology-Specific Experience), and the number of prior agreements with the partner (i.e., Partner-Specific Experience). Examination of each of these variable's distributions indicated significant positive skewness, so we redefined these three variables using the logarithmic transformation 'new variable' = log(1 + 'old variable').[5]

As discussed above, the second set of explanatory variables serves to characterize the design features of the collaborative agreement at the time of alliance formation. We included a dummy variable to indicate whether the collaborative agreement is an equity or non-equity alliance (i.e., Equity) given our interest in examining how the alliance's formal governance structure affects the partner experience – performance relationship. Inclusion of this control is also motivated by the fact that the alliance's governance structure can reflect the firm's alliance experience levels (Gulati, 1995) and may also influence the effectiveness of collaboration through the provision of residual claimancy and control rights (Chi, 1994; Hennart, 1988). To control for the relative importance of the alliance, we included a measure of alliance relevance. Alliances that demand greater resource commitments attract managerial attention (Ocasio, 1997) and encourage commitment by supplying incentives to make the best of the collaborative arrangement (Williamson, 1983). Respondents were asked to describe the relevance of the alliance for the overall business of the parent firm in terms of the relative size of available resources committed. The variable can take on values ranging from 1 to 4, which correspond to 'marginal,' 'normal,' 'important,' and 'critical.' The four categories were anchored by ranges of resource commitments relative to the firm's available resources: less than 5% for 'marginal,' between 5% and 10% for 'normal,' 10% to 25% for 'important,' and more than 25% for 'critical' agreements. Alliance research also stresses the

importance of selecting partners with complementary capabilities and clearly designating responsibilities in the alliance to reduce performance uncertainties and coordination problems (e.g., Geringer, 1988; Oxley, 1997). To construct a measure for the alliance's division of labor, we asked respondents to indicate partners' responsibilities by allocating 100 percentage points between the collaborators across the various activities encompassed by the alliance. The division of labor in the collaboration was then measured as follows:

$$(2)\ \text{Division of Labor}_i = \frac{1}{n_i}\sum_{j=1}^{n_i}\left|P_{1ij} - P_{2ij}\right|,$$

where n_i is the number of project activities undertaken by alliance i, P_{1ij} is the percentage representing parent 1's responsibility for task j, and P_{2ij} is the percentage indicating parent 2's responsibility for task j (i.e., $P_{1ij} + P_{2ij} = 100\%$ for all j). When the variable takes on a value of zero, the collaborators equally share in the responsibility for every project activity. When the variable attains its maximum of one, a partner is solely responsible for individual project activities. Thus, the larger the variable, the clearer the alliance's division of labor. As a final control for the alliance's features, we introduced a binary indicator to account for the presence or absence of a coordination committee that facilitates the execution of collaborative activities (i.e., Coordination Committee).

The final two control variables address changes in the alliance's governance structure after the collaboration has been set up. Firms can use such changes to purposefully adapt the relationship over time as the relationship evolves, learning accumulates, and partners' interests and expectations change as they co-evolve (Ariño & de la Torre, 1998; Doz, 1996; Koza & Lewin, 1998), yet these *ex post* changes to an alliance can also involve significant hold-up problems or renegotiation costs (Williamson, 1985). First, we controlled for possible *ex post* changes in the collaborative agreement using a dummy variable to account for the existence of contract alterations in the alliance (i.e., Contract Alterations). Second, we

incorporated a dummy variable to indicate whether the partners introduced or formalized monitoring mechanisms after the alliance's establishment (i.e., Monitoring Changes).

RESULTS

Table 1 presents descriptive statistics and a correlation matrix. The table indicates that firms' experiences with alliances were very heterogeneous. The firms' average number of alliances in general was 12.6 and ranged from zero to well over one hundred. Similarly, the number of prior alliances in related technological subjects averaged 1.2 and ranged from zero to twenty. Finally, the average number of prior alliances with the partner in question was 0.2 and ranged from zero to five. Partner experience is positively correlated with alliance performance, but the other more general forms of alliance experience do not have significant bivariate relationships with alliance performance. Thirty-seven percent of the alliances were equity agreements, which tended to perform better on average than non-equity collaborations. The bivariate correlations also suggest that more relevant alliances tend not only to perform better, but also are more apt to undergo contractual changes than less significant alliances. The significant correlations among the alliance experience measures and other variables suggest, however, that multivariate analysis is needed to sort out the partial effects of alternative alliance experience trajectories, alliance design features, and other influences on the performance of the focal alliance.

==========
Insert Table 1 about here
==========

The correlations among the explanatory variables, as well as the inclusion of the partner-specific experience • equity multiplicative term, raises the possibility of multicollinearity problems. To investigate whether multicollinearity posed a problem for our models, we investigated the Variance Inflation Factors (VIFs) for all of the specifications we

estimated. The maximum VIF for all of these models was 4.8, which is below the rule-of-thumb cutoff value of ten for multiple regression models (Neter, Wasserman, & Kutner, 1985: 392). Regression diagnostics did reveal the presence of several outlying observations. We eliminated outliers from the analysis when their DFFITS values exceeded $2\sqrt{p/n}$ in absolute value, where p is the number of estimated parameters and n is the sample size (Belsley, Kuh, & Welsch, 1980).

Table 2 presents the results from the multiple regression analyses of alliance performance. Model (1) provides a baseline specification that restricts the set of regressors to the control variables. Model (2) augments this baseline model by incorporating the three experience variables. Model (3) presents the results of the full model incorporating the partner experience-governance interaction effect. Comparisons of the three models were made using hierarchical F-tests. Model (3) provides a significant improvement in explanatory power over Models (2) and (1) (i.e., $F_{(3),(2)} = 3.95$, $p<0.05$; $F_{(3),(1)} = 3.52$, $p<0.01$). Model (2) does not explain the variance in alliance performance better that Model (1) (i.e., $F_{(2),(1)} = 1.91$), which can be explained based on the insignificance of general collaborative experience and prior alliance experience in a given technological area as well as the importance of the interaction term.

==========
Insert Table 2 about here
==========

Hypotheses 1 and 2 posited that general collaborative experience and technology-specific experience would positively influence alliance performance. The results presented in Table 2 provide no support for these two hypotheses. These findings indicate that broad alliance experiences in heterogeneous domains, or alliance experiences that are not specific to the partner in question, do not have a positive impact on alliance performance.

The results do indicate, however, that partner-specific experience fosters better alliance performance. Model (2) indicates that the greater the firm's prior alliance experience with the partner, the better the performance of the focal alliance ($p<0.05$). The beneficial effects of partner-specific alliance experience are qualified in Model (3), which indicates that the performance implications of partner-specific experience differ across equity and non-equity alliances. Consistent with the predictions of H4, the performance effects of partner-specific experience are magnified for non-equity collaborations.

The large negative parameter estimate for the partner-specific experience • equity interaction term raises the question of whether partner experience significantly enhances alliance performance for both equity and non-equity collaborations. A hierarchical F-test comparing Models (2) and (3) confirmed that partner-specific experience does have a significant overall effect on alliance performance (i.e., $F = 8.02$, $p<0.001$). Taking the derivative of Model (3) with respect to partner-specific experience yields the following:

$$(3) \qquad \frac{\partial \text{Alliance Performance}}{\partial \text{Partner Experience}} = 3.40 - 3.49 \cdot \text{Equity}$$

This equation indicates that the partner-specific experience parameter estimate for non-equity alliances is 3.40 and is –0.09 (i.e., 3.40 – 3.49) for equity alliances. Using t-tests that control for the level of the moderator and the correlation between the standard errors of the parameters for the experience direct effect and the interaction term (Jaccard, Turrisi, & Wan, 1990), we find that partner-specific experience has a significant positive effect on alliance performance for non-equity alliances (i.e., $t = 3.58$, $p<0.001$) but not for equity alliances (i.e., $t = -0.11$). Thus, the positive effects observed in the main-effects equation, Model (2), can be attributed to the greater proportion of non-equity alliances in our sample (i.e., 64 %).

Regarding the control variables, the results show that equity collaborations on average outperform non-equity alliances, particularly when collaborators lack prior alliances with each other. Alliance performance is higher for collaborative agreements involving a

significant resource commitment from the parent firm vis-à-vis less significant alliances. Finally, the performance of strategic alliances is positively related to the parent firms' division of labor. Alliances with a clear division of labor outperform alliances involving tasks that are more evenly shared between collaborators.

Table 3 presents the multiple regression results for each of the three alliance performance indicators. The parameter estimates are largely consistent across the specifications for the accumulation of knowledge, creation of opportunities, and achievement of objectives. General collaborative experience and technology-specific experiences have no effect on alliance performance. As before, for non-equity alliances, partner-specific experience has a positive effect on knowledge accumulation (i.e., $t = 3.50$, $p<0.001$), the creation of new opportunities (i.e., $t = 2.41$, $p<0.05$), and the achievement of objectives (i.e., $t = 2.49$, $p<0.05$), but these effects were not significant for equity-based relationships (i.e., $t = -0.30$, $t = -1.14$, and $t = 0.69$, respectively).

==========
Insert Table 3 about here
==========

We note that the interaction effect between partner-specific alliance experience and equity/non-equity is negative as before for accumulation of knowledge and creation of opportunities. While the parameter estimate is directionally consistent for achievement of objectives, it does not reach significance at the 0.10 level. As before, the benefits of prior alliances are confined to partner-specific experience rather than general collaborative experience or technology-specific experience. In the results presented in Table 3, we also see that contract alterations become significant in the model for knowledge accumulation, which suggests that these adaptations to the alliance can be beneficial to knowledge building.

DISCUSSION

Implications for Research

This study set out to explore the implications of firms' accumulation of experience from previous cooperative agreements as well as governance design choices for the performance of strategic alliances. Building on several different research traditions, the general assumption that experience accumulation is expected to enhance performance was tested and found to be only partially supported. Whereas learning curve phenomena have been commonplace in manufacturing contexts, the relationship between the stock of past experience in handling the task and the performance of the task itself appears to be more complex when the objective is to effectively manage inter-organizational cooperative processes.

In an effort to start unpacking this complexity, it was necessary to identify more precisely what kind of knowledge is accumulated through alliance experience and to consider from a theoretical and an empirical standpoint different types of experience trajectories, each related to a different knowledge domain. Firms therefore have been hypothesized to be capable of developing inter-organizational routines from their repeated interaction with the same partnering firm, of developing absorptive capacity by accumulating expertise in related technological areas, and of improving the way they manage the alliance process itself through the development and fine-tuning of general collaborative routines. However, only the experience trajectory built on prior alliances with the same partner shows a significant impact on the performance of the focal alliance. Our findings reveal that technology-specific alliance experience does not appear to create absorptive capacity, and neither does the firm's prior exposure to large numbers of alliances in general translate into improved effectiveness for future alliances.

A number of factors may explain these results. First, alliances are typically characterized by significantly lower frequency in comparison, for example, with manufacturing processes. This implies, among other things, that organizations will be likely to experience decay of their abilities to recall past events, either because of personnel turnover or because of natural limitations to human memory. Second, alliances are also more heterogeneous in nature compared to production processes or other standard administrative tasks. This imposes an additional challenge to the cognitive capacity of the individuals exposed to alliance processes, in that it will be harder for them to find commonalties among diverse experiences and transfer generalizations to enhance the success of future collaborative endeavors. The probability of transferring lessons learned in a certain context to other domains that appear similar but are inherently different, a problem referred to as negative transfer effects, increases with task heterogeneity (Cormier & Hagman, 1985). Third, alliances are often causally ambiguous in that the links between managerial actions taken and performance outcomes lack sufficient clarity (Lippman & Rumelt, 1982). Behavioral uncertainty and task interdependence in alliances make it difficult to sort out which actions lead to which outcomes and what are the best ways to improve the future management of alliances.

While there is not support for positive experience effects for prior alliances in general or alliances within a technological area, the data analysis reveals the importance of partner-specific alliance experience. The larger the number of agreements previously completed with the counterpart in the focal alliance, the higher the chances of success for that alliance. We suggest that the repetition of ties results in quasi-spontaneous development of inter-organizational routines among the two firms. In turn, these routines may contribute to smoother interactions and adaptation, speedier conflict resolution, and consequently improved performance outcomes. By definition, routinization processes are tacit in nature

and therefore do not require explicit efforts to articulate and codify the procedures to be followed in the execution of the tasks (Nelson & Winter, 1982; Winter, 1987). The development of these routines can certainly be facilitated by the emergence of interpersonal trust, but their beneficial effects are not necessarily dependent upon trust building (Koza & Lewin, 1998).

Combining our evidence on the performance implications of general alliance experience and partner-specific experience, these results contribute to the debate, central to network theory, on the relative importance of the breadth of ties versus their depth in determining firm performance (Burt, 1992; Coleman, 1990; Gulati, 1998). Similar to Walker, Kogut and Shan's (1997) results from their analysis of network formation, this study's findings indicate that depth in the network tie seems to overcome breadth of ties as a determinant of alliance effectiveness. While our modeling does not explicitly characterize the structure of the interfirm network, the results suggest that the benefits of relational embeddedness (Coleman, Katz & Menzel, 1966) are stronger than those derived from structural embeddedness (Burt, 1992).

The effects of partner-specific experience on alliance performance ought to be qualified, however. According to the analysis, the positive impact of partner-specific experience on performance is confined to non-equity alliances. Equity alliances seem to be relatively insensitive to the reciprocal accumulation of knowledge about the counterpart and to the development of inter-organizational routines among the two collaborators. This finding indicates the potential for viewing inter-organizational routines developed through prior interaction and the more formal coordination mechanisms provided by equity governance as substitute coordination mechanisms. More specifically, firms that have developed an alliance history with a partner and a corresponding set of routines have less need to turn to equity structures to align incentives, provide monitoring rights, and institute

formal controls over the collaborative relationship. By contrast, firms lacking prior experiences with a partner will find equity structures helpful to protect against opportunism and facilitate coordination of the collaborative undertaking.

The interaction effects we report between partner-specific experiences and alliances' governance structures also inform the recent debate on what level of analysis is most relevant for alliance performance and for ongoing research on interfirm collaboration (e.g., Oxley, 1997; Shelanski & Klein, 1995). Oxley (1997), for instance, has recently argued that attributes of the transaction alone determine the efficiency of an alliance and hence firms' governance choices. We find that both experience accumulation at the parent firm level and governance design at the alliance level are important and that the effects of experience accumulation on a focal alliance's performance are contingent upon the governance design of that alliance. Hence, we show that both levels of analysis matter and suggest that future research needs to consider their joint and interactive effects on alliance performance. Finally, our results indicate the importance of conceptually situating an alliance within parent firms' prior adaptation decisions, as reflected in their accumulated alliance experiences, a finding that is in accord with Koza and Lewin's (1998) call for researchers to view alliances from a firm level, co-evolutionary perspective.

Managerial Implications

From the theoretical arguments and the empirical evidence discussed above, one can identify several important implications for firms engaged in alliances or planning collaborations. The first one has to do with the firm's assessment of its level of relational experience as a guide for its governance design choices. If we set all variables in our full model appearing in Table 2 to their means except partner-specific experience and equity, it can be shown that firms with no prior ties should select an equity alliance, and a non-equity alliance becomes preferable as soon as the firms have one prior relationship. We have

discussed how prior partner-specific alliance experience and equity governance can be viewed as substitute coordination mechanisms.

The second implication of the findings underscores the importance of partner selection. If relational experience plays an important role in determining the odds of success, then a careful observation of the quality of the firm's existing inter-organizational routines developed from past alliance experiences should be given special consideration at the alliance formation stage. For inexperienced firms, then, the selection of the first alliance partners takes on a special relevance in that the benefits from future alliances will derive from deepening the relationship with those partners. This appears to caution against adopting a broad-based "portfolio" approach that emphasizes the spreading of the network of partnerships.

If the development and refinement of relational capabilities is of central concern to firms engaged in alliances (Dyer & Singh, 1998), then an important managerial issue becomes how firms can invest in such capabilities. The complexities of this endeavor lie in the inherent tacitness of inter-organizational cooperative routines. Thus, specific investments of managerial time and effort to track-down, discuss, and codify key lessons learned from past cooperative experiences appear to be important to nourish relational capabilities. For example, Hewlett Packard routinely writes extensive post-mortem analyses of alliance partnerships, including an explicit assessment of the quality of the post-formation interaction. The development of these documents might be useful for future alliance processes, not only because they might improve the selection of future partners, but because the firm's completion of the documents and the associated knowledge articulation process can result in an improved understanding of the firm's, as well as the partner's, cooperative routines.

Future Research Directions

The contributions as well as the limitations of the present study indicate several avenues for future research. First, work is needed to explore the generalizability of our findings in different industry contexts, for alternative types of alliances, and in different geographic markets. Second, a related research need is to address further the boundary conditions of experience accumulation in strategic alliances. The paper's introduction also noted the mixed findings that currently exist on alliance experience effects. In light of this mixed empirical evidence as well as inherent theoretical interest in exploring whether and how firms can develop alliance capabilities, more research on alliance experience effects in different contexts and for different forms of collaboration is warranted. Future work may also find other ways to differentiate alliance experience trajectories to identify the types of knowledge and capabilities firms can acquire through alliances.

Finally, alliance experience might not be the only mechanism responsible for the creation and evolution of organizational capabilities in the alliance domain. Further research is needed in order to understand how firms accumulate knowledge about managing alliances other than via learning-by-doing processes. Activities involving parent firms' deliberate efforts to extract valuable lessons from their own past alliance experience appear to be worthy of explicit investigation. For instance, future research might consider how firms articulate, codify and diffuse their understanding of alliance dynamics through brainstorming sessions, implementation manuals, knowledge management tools (i.e., databases, intranets, etc.), internal training programs, and so on. Such activities have been highlighted in writings for practitioners (Harbison & Pekar, 1997), but have only recently begun to receive academic attention (Kale, 1999). Research in directions such as these are likely to take on more importance as scholars attempt to better understand the antecedents of alliance performance, including the roles played by firm capabilities in conjunction with alliance design choices.

ENDNOTES

[1] For example, see the Harvard studies on the continuous improvement of the new product development process for empirical evidence of the arguments applied to the R&D context (e.g., Clark & Fujimoto, 1991)

[2] See Haleblian & Finkelstein, 1998 for an application to organizational contexts.

[3] For a more detailed discussion of these arguments applied to the context of acquisitions, see Zollo (1998).

[4] Researchers attempting to examine either the organizational effects of alliances or the performance of the alliance itself have used different approaches. For instance, many studies have used alliance longevity or survival as an indicator of collaborative effectiveness (e.g., Barkema, Shenkar, Vermeulen, & Bell, 1997; Li, 1995; Park & Russo, 1996). An alternative technique employed by several studies is to examine the corporate valuation effects of firms' alliance investment decisions using event study methods (e.g., Koh & Venkatraman, 1991). Other research has turned to patenting data or subjective indicators of parent firm or alliance managers' satisfaction to examine specific dimensions of alliance performance (see Geringer & Hebert, 1991 and Gulati, 1998 for reviews).

[5] Skewness can inflate the risk of Type I and Type II errors in multivariate models (Tabachnick & Fidell, 1996), and the logarithmic transformation has been shown to remedy this problem. The transformation 'new variable' = log(1 + 'old variable') was used since the untransformed measures can equal zero and the log of zero is undefined. Inspection of the transformed variables' distributions revealed that this transformation corrected for skewness.

REFERENCES

Anand, B., & Khanna, T. 1998. Do firms learn to create value? The case of alliances. Harvard Business School working paper.

Anderson, E. 1990. Two firms, one frontier: On assessing joint venture performance. Sloan Management Review, 31: 19-30.

Ariño, A., & de la Torre, J. 1998. Learning from failure: Towards an evolutionary model of collaborative ventures. Organization Science, 9: 306-325.

Balakrishnan, S., & Koza, M. P. 1993. Information asymmetry, adverse selection, and joint ventures. Journal of Economic Behavior and Organization, 20: 99-117.

Barkema, H. G., Shenkar, O., Vermeulen, F., & Bell, J. H. J. 1997. Working abroad, working with others: How firms learn to operate international joint ventures. Academy of Management Journal, 40: 426-442.

Belsley, D. A., Kuh, E., & Welsch, R. E. 1980. Regression diagnostics. New York, NY: Wiley.

Burt, R. L. 1992. Structural holes. Cambridge, MA: Harvard University Press.

Chi, T. 1994. Trading in strategic resources: Necessary conditions, transaction cost problems, and choice of exchange structure. Strategic Management Journal, 15: 271-290.

Cohen, W. M., & Bacdayan, P. 1994. Organizational routines are stored as procedural memory: Evidence from a laboratory study. Organization Science, 5: 554-568.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: a new perspective on learning and innovation. Administrative Science Quarterly, 35: 128-153.

Coleman, J. S. 1990. Social capital in the creation of human capital. American Journal of Sociology, 94: S95-S120.

Coleman, J. S., Katz, E., & Menzel, H. 1966. Medical innovation: A diffusion study. New York: Bobbs-Merrill.

Cormier, S., & Hagman, J. 1987. Transfer of learning: Contemporary research and applications. San Diego, CA: Academic Press Inc.

Cyert, R. M. & March, J. G. 1963. A behavioral theory of the firm. Englewood Cliffs, NJ: Prentice-Hall.

Doz, Y. L. 1996. The evolution of cooperation in strategic alliances: Initial conditions or learning processes? Strategic Management Journal, 17 (Summer Special Issue): 55-84.

Doz, Y. L., & Hamel, G. 1998. Alliance advantage: The art of creating value through partnering. Boston, MA: Harvard Business School Press.

Dutton, J. M., & Thomas, A. 1984. Treating progress functions as a managerial opportunity. Academy of Management Review, 9: 235-247.

Dyer, J. H. 1997. Effective interfirm collaboration: How firms minimize transaction costs and maximize firm value. Strategic Management Journal, 18: 535-556.

Dyer, J. H., & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review, 23: 660-679.

Epple, D., Argote, L., & Devadas, R. 1991. Organizational learning curves: A method for investigating intra-plant transfer of knowledge acquired through learning by doing. Organization Science, 2: 58-70.

Geringer, J. M. 1988. Joint venture partner selection: Strategies for developed countries. New York, NY: Quorum Books.

Geringer, J. M., & Hebert, L. 1991. Measuring performance of international joint ventures. Journal of International Business Studies, 22: 249-263.

Gulati, R. 1995. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. Academy of Management Journal, 38: 85-112.

Gulati, R. 1998. Alliances and networks. Strategic Management Journal, 19: 293-317.

Gulati, R., & Singh, H. 1998. The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. Administrative Science Quarterly, 43: 781-814.

Haleblian, J., & Finkelstein, S. 1998. Understanding acquisition performance: The role of transfer effects. Unpublished manuscript.

Hamel, G. 1991. Competition for competence and interpartner learning within international strategic alliances. Strategic Management Journal, 12: 83-103.

Harbison, J., & Pekar, P. 1997. Smart alliances. San Francisco, CA: Jossey-Bass.

Hennart, J.-F. 1988. A transaction cost theory of equity joint ventures. Strategic Management Journal, 9: 361-374.

Hennart, J.-F., & Reddy, S. 1997. The choice between mergers/acquisitions and joint ventures: The case of Japanese investors in the United States. Strategic Management Journal, 18: 1-12.

Inkpen, A. C., & Beamish, P. W. 1997. Knowledge, bargaining power, and the instability of international joint ventures. Academy of Management Review, 22: 177-202.

Jaccard, J., Turrisi, & Wan, C. K. 1990. Interaction effects in multiple regression. Newbury Park, CA: Sage Publications.

Kale, P. 1999. Alliance capability and success: A knowledge-based approach. Unpublished manuscript.

Khanna, T., Gulati, R., & Nohria, N. 1998. The dynamics of learning alliances: Competition, cooperation, and relative scope. Strategic Management Journal, 19: 193-210.

Kogut, B. 1988. Joint ventures: Theoretical and empirical perspectives. Strategic Management Journal, 9: 319-332.

Kogut, B. 1991. Joint ventures and the option to acquire and expand. Management Science, 37: 19-33.

Koh, J., & Venkatraman, N. 1991. Joint venture formations and stock market reactions: An assessment of the information technology sector. Academy of Management Journal, 34: 869-892.

Koza, M., & Lewin, A. 1998. The co-evolution of strategic alliances. Organization Science, 9: 255-264.

Lapre, M., & Van Wassenhove, L. 1998. Productivity improvement in a network of learning factories: A learning curve analysis. Unpublished manuscript.

Lapre, M., Mukherjee, A. S., & Van Wassenhove, L. 1998. Behind the learning curve: Linking learning activities to waste reduction. Unpublished manuscript.

Levitt, B., & March, J. G. 1988. Organizational learning. Annual Review of Sociology, 14: 319-340.

Li, J. 1995. Foreign entry and survival: Effects of strategic choices on performance in international markets. Strategic Management Journal, 16: 333-351.

Lippman, S,. & Rumelt, R. 1982. Uncertain imitability: An analysis of inter-firm differences in efficiency under competition. Bell Journal of Economics, 13: 418-438.

March, J. G., & Simon, H. A. 1958. Organizations. New York: John Wiley.

March J.G., Sproull, L. S., & Tamuz, M., 1991. Learning from samples of one or fewer. Organization Science, 2: 1-13.

Nelson, R. & Winter, S. 1982. An evolutionary theory of economic change. Cambridge, MA: Harvard University Press.

Neter, J., Wasserman, W., & Kutner, M. H. 1985. Applied linear statistical models (Second Edition). Homewood, IL: Irwin.

North Carolina Biotechnology Center Actions Database. 1993. North Carolina Biotechnology Center, Research Triangle Park, NC.

Nunnally, J. C. 1978. Psychometric theory. (Second Edition). New York, NY: MacGraw-Hill.

Ocasio, W. 1997. Towards an attention-based view of the firm. Strategic Management Journal, 18: 187-206.

Oxley, J. E., 1997. Appropriability hazards and governance in strategic alliances: A transaction cost approach. Journal of Law, Economics, and Organization, 13: 387-409.

Park, S. H., & Russo, M. V. 1996. When competition eclipses cooperation: An event history analysis of joint venture failure. Management Science, 42: 875-890.

Parkhe, A. 1993. Strategic alliance structuring: A game theoretic and transaction costs examination of interfirm cooperation. Academy of Management Journal, 36: 794-829.

Pisano, G. P. 1989. Using equity participation to support exchange: Evidence from the biotechnology industry. Journal of Law, Economics, and Organization, 5: 109-126.

Reuer, J. J., & Miller, K. D. 1997. Agency costs and the performance implications of international joint venture internalization. Strategic Management Journal, 18: 425-438.

Shelanski, H. A., & Klein, P. G. 1995. Empirical research in transaction cost economics: A review and assessment. Journal of Law, Economics, and Organization, 11: 335-361.

Tabachnick, B. G., & Fidell, L. S. 1996. Using multivariate statistics (Third Edition). New York, NY: Harper Collins.

Walker, G., Kogut, B., & Shan, W. 1997. Social capital, structural holds, and the formation of an industry network. Organization Science, 8: 109-125.

Wild, K. L. 1994. Management incentives and the valuation of international joint venture formation. Paper presented at the annual meetings of the Academy of International Business, Boston, MA.

Williamson, O. E. 1979. Transaction-cost economics: The governance of contractual relations. Journal of Law and Economics, 22: 233-261.

Williamson, O. E. 1983. Credible commitments: Using hostages to support exchange. American Economic Review, 73: 519-540.

Williamson, O. E. 1985. The economic institutions of capitalism. New York, NY: Free Press.

Winter, S. 1987. Knowledge and competence as strategic assets. In Teece, D. J. (Ed.), The competitive challenge: Strategies for industrial innovation and renewal: 159-184. Cambridge, MA: Ballinger.

Winter, S. 1995. Four Rs for profitability: rents, resources, routines, and replication. In Montgomery, C. A. (Ed.), Resource-based and evolutionary theories of the firm: Towards a synthesis: 147-178. Norwell, MA: Kluwer.

Yelle, L. E. 1979. The learning curve: Historical review and comprehensive survey. Decision Sciences, 10: 302-328.

Zajac, E. J. 1998. Commentary on 'alliances and networks' by R. Gulati. Strategic Management Journal, 19: 319-321.

Zollo M. 1998. Knowledge codification, process routinization, and the creation of organizational capabilities: Post-acquisition management in the US banking industry. Unpublished dissertation, University of Pennsylvania.

TABLE 1

Descriptive Statistics and Correlation Matrix[a]

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Alliance Performance	-.32	2.44	---											
2. Accumulation of Knowledge	3.34	1.11	.85***	---										
3. Creation of Opportunities	2.54	1.22	.79***	.50***	---									
4. Achievement of Objectives	2.94	1.41	.84***	.62***	.48***	---								
5. Collaborative Experience	1.76	1.27	.08	.06	.05	.09	---							
6. Technological Experience	.49	.68	-.10	-.11	-.12	-.02	.28**	---						
7. Partner Experience	.14	.34	.26**	.25**	.15	.25**	.36***	.04	---					
8. Equity	.37	.49	.19*	.14	.20*	.14	-.02	-.01	.11	---				
9. Alliance Relevance	2.13	1.07	.37***	.34***	.30**	.28**	-.15	-.16	.11	.01	---			
10. Division of Labor	.72	.30	.15	.08	.11	.19†	-.06	.03	-.11	-.06	-.01	---		
11. Coordination Committee	.44	.50	.08	.09	.00	.09	-.02	-.14	-.11	.12	-.04	-.11	---	
12. Contract Alterations	.21	.41	.21*	.21*	.18†	.14	.06	-.07	.05	.07	.32***	-.14	.17†	---
13. Monitoring Changes	.14	.35	.17†	.14	.15	.13	.10	-.17†	.28**	.02	.13	-.15	.07	-.01

[a] N = 108. † p<0.10; * p<0.05; ** p<0.01; *** p<0.001.

TABLE 2
Multiple Regression Estimation Results for Alliance Performance[b]

Independent Variable	(1)	(2)	(3)
Intercept	-4.55***	-4.20***	-3.75***
	(.74)	(.81)	(.80)
Equity	1.07**	1.03*	1.48***
	(.40)	(.40)	(.41)
Alliance Relevance	.71***	.68**	.65**
	(.20)	(.21)	(.20)
Division of Labor	2.58***	2.56***	1.80*
	(.71)	(.70)	(.73)
Coordination Committee	.41	.46	.50
	(.39)	(.39)	(.38)
Contract Alterations	.77	.68	.80
	(.52)	(.52)	(.51)
Monitoring Changes	1.81**	1.26†	.62
	(.61)	(.66)	(.68)
General Collaborative Experience	---	-.12	-.11
		(.18)	(.17)
Technology-Specific Experience	---	-.26	-.32
		(.29)	(.28)
Partner-Specific Experience	---	1.44*	3.40***
		(.67)	(.95)
Partner Specific Experience • Equity	---	---	-3.49**
			(1.24)
Model F value	8.45***	6.44***	7.04***
R-square	.36	.39	.44
N	99	99	99

[b] Standard errors appear in parentheses. † p<0.10; * p<0.05; ** p<0.01; *** p<0.001.

TABLE 3
Multiple Regression Estimation Results for Alliance Performance Indicators[c]

Independent Variable	Accumulation of Knowledge	Creation of Opportunities	Achievement of Objectives
Intercept	1.89***	.91*	.73
	(.38)	(.43)	(.52)
Equity	.48*	.80***	.52†
	(.21)	(.23)	(.28)
Alliance Relevance	.22*	.31**	.32*
	(.10)	(.11)	(.13)
Division of Labor	.81*	.66†	1.19*
	(.36)	(.39)	(.46)
Coordination Committee	.37†	.07	.43†
	(.19)	(.22)	(.26)
Contract Alterations	.56*	.06	.11
	(.25)	(.29)	(.35)
Monitoring Changes	.11	.06	-.02
	(.32)	(.34)	(.42)
General Collaborative Experience	-.05	.07	.07
	(.08)	(.09)	(.11)
Technology-Specific Experience	-.15	-.21	-.01
	(.14)	(.16)	(.20)
Partner-Specific Experience	1.75***	1.18*	1.52*
	(.50)	(.49)	(.61)
Partner-Specific Experience • Equity	-1.91*	-1.71*	-1.11
	(.76)	(.66)	(.83)
Model F value	4.92***	3.53***	3.09**
R-square	.36	.28	.25
N	100	102	105

[c] Standard errors appear in parentheses. † $p<0.10$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$.