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ABSTRACT

Recognizing that strategic alliances represents important means for developing knowledge in critical arenas, such as new product development, the authors advance the notion of collateral learning that assess knowledge acquisition internal to a firm in the alliance. To examine its antecedents, the authors build on the behavioral theory of the firm and propose that strategic importance and performance vulnerability as the motivational components and organizational similarity and alliance experience as the awareness components advocated in the theory. Results from 133 alliance firms suggest that both of the motivational and awareness components are equally important in influencing collateral learning in new product alliances. Specifically, to develop collateral learning, firms should have extensive alliance experience and acknowledged stake in their alliance partners. The results also support the theorized U-shaped relationship between organizational similarity of the alliance partners and collateral learning. Thus, collateral learning is facilitated when organizations are either similar or dissimilar, while medium levels of organizational similarity facilitate collateral learning to a relatively lower extent. Although performance vulnerability is found to be associated negatively with collateral learning, extensive alliance experience can attenuate such a negative effect.

Key words: strategic alliances; new product development; collateral learning

1. Introduction

Since knowledge and learning comprise the fundamental building blocks of strategically crucial capabilities (Teece, Pisano, & Schuen, 1997), a rich literature surrounding learning topics has developed. In particular, this literature informs on the role of strategic alliances as learning mechanisms in competitively crucial knowledge domains such as new product development (Zollo & Winter, 2002). Because high-tech firms often operate in an incubator environment, they must develop effective new product development knowledge, processes, and capabilities (Gemunden, Ritter, & Heydebreck, 1996). To bolster their efforts, these firms increasingly team up in alliances with other firms for new product development (e.g., Kotabe & Swan, 1995; Johnson, Sohi, & Grewal, 2004) through which new product development related learning necessarily results. Typically, this learning involves the acquisition of knowledge and technologies focused on the project and surrounding the specific new product being developed (e.g., Rothaermel & Deeds, 2004). This knowledge, to a significant extent, is confined to the development episode and the specific product involved.

We argue that another type of learning occurs in parallel, which, while a bit subtler, is perhaps even more important. This parallel learning, or collateral learning, coincides with the project focused learning in the alliance, but importantly, it involves knowledge acquisition internal to the firm. Specifically, we suggest that collateral learning is the extent to which the firm upgrades its existing new product development skills and routines as a result of the specific new product development episode associated with the alliance (e.g., Khanna, Gulati, & Nohria, 1998; Rothaermel & Deeds, 2004). This augmented new product knowledge is not confined to any one new product project or any particular alliance, but instead can be leveraged repeatedly across numerous other new product development projects (Inkpen, 2000). It is this acquisition of

generalizable new product development knowledge derived from the alliance, i.e., the collateral learning that is the focus of our research.

Because absorptive capacity theory depicts the process of learning from past experience and activities, and thus accommodates the study of capabilities development (Cohen & Levinthal, 1990), we draw on it to conceptualize collateral learning derived from activities and experiences in new product alliances (Moorman & Miner, 1998). We elaborate our conceptualization of this important learning avenue and draw on the behavioral theory of the firm (Cyert & March, 1963) and its relevant extensions (e.g., Chen & Miller, 1994; Huber, 1991; Zhou, Tse, & Li, 2006) to investigate the antecedents. Specifically, recent treatments of the behavioral theory of the firm suggest that motivation and awareness are critical determinants of positive firm outcomes (e.g., Jayachandran & Varadarajan, 2006; Zhou *et al.*, 2006). Thus, we consider collateral learning associated with a firm's motivation to learn and the awareness of action requirements. Motivation refers to a firm's incentive to act and is critical in the facilitation of learning, among other strategic activities (e.g., Jayachandran & Varadarajan, 2006; Zhou *et al.*, 2006). In this study we propose that performance vulnerability and strategic importance are factors underpinning motivation. Performance vulnerability refers to the subjective assessment of negative consequences associated with an alliance partners performance (Das and Teng, 1996); whereas, strategic importance reflects the intensification of the strategic dependency and involvement between partners (Johnson, 1999). The awareness component involves recognition and attention to potential actions and options (e.g., Chen & Miller, 1994; Jayachandran & Varadarajan, 2006). In new product alliances, we suggest that previous alliance experience and organizational similarity are factors underpinning awareness. Alliance experience depicts the firm's prior exposure to alliances and its familiarity with alliance making and management (Kale, Dyer, & Singh, 2002). Organizational similarity represents the

extent of similarity between two alliance firms pertaining to their opinions, behaviors, and their culture such as strategic orientations and organizational innovativeness, among others (Achrol, Scheer, & Stern, 1990). These factors individually and together determine the extent of collateral learning.

Our research contributes to the literature by extending the motivation-awareness framework suggested in the behavioral theory of firm to a new product alliance setting. Since capabilities and their development in a firm continue to be critical in sustaining competitive advantage and enhancing performance, our study advances the understanding of learning that underpins capabilities development from the previously unexplored perspective of collateral learning. We argue that valuable learning can derive from sources where such learning is not necessarily the primary objective. We urge managers and researchers to attend to the collateral learning that occurs in conjunction with the alliance as it can significantly buttress new product capabilities development. Importantly, while this study involves the specific context of new product alliances, we believe that collateral learning occurs from a whole range of activities throughout the firm, strengthening capabilities in an array of domains. Thus it is imperative to understand its drivers, i.e., motivations and awareness, behind collateral learning.

2. Conceptual Background

In new product alliances, learning traditionally involves the joint creation of new knowledge in the alliance that focuses on augmenting particular knowledge stocks such as technologies dedicated to the specific product being developed (Kotabe & Swan, 1995; Rothaermel & Deeds, 2004). Alliance scholars have described this learning as a “common benefit” because, at least initially, it serves the firms jointly in accomplishing specific alliance objectives (Khanna *et al.*, 1998). Above and beyond this, we believe that “private benefits” can accrue to the firm

through collateral learning (Khanna *et al.*, 1998). By this, we mean that in addition to the accrual of alliance specific knowledge that is focused exclusively on alliance objectives, as a result of alliance activities and efforts, knowledge also accrues collaterally within an alliance firm.

Collateral learning is the extent to which a firm, through its alliance activities and interactions, enhances its own new product development routines and upgrades its own internal knowledge bases in the general domain of new product development apart from any particular alliance objective. It involves learning that occurs in parallel with the alliance inside the individual firm where deeper and richer new product related knowledge stocks accrue (Inkpen, 1998; Miner, Bassoff, & Moorman, 2001). In essence, collateral learning is coincidental and a highly desirable but unintended consequence of the new product alliance.

While it may be tempting to equate collateral learning with spillover, the concepts are quite distinct. Spillover involves flows of information throughout a firm's external environment or extended network (e.g., Cassiman & Veugelers, 2002; Owen-Smith & Powell, 2004). For example, Bharadwaj, Clark, and Kulviwat (2005) suggest that spillover can result from trade between firms, which may involve not only the exchange of products, but also technology licensing. It can occur between firms when patents are filed, research is published or presented at professional meetings, with personnel turnover or interaction, and even from published news articles. Thus, like collateral learning, spillover is generally not directly intentional. However, spillover is more arms' length and tends to involve in the public domain in contrast to collateral learning which is proximal to the alliance and happens within it. Although collateral learning occurs apart from the specific alliance objectives, it results specifically and exclusively from interactions with a particular alliance partner and activities within the domain of the alliance. Thus, spillover involves a firm's use of public knowledge available from the environment (e.g.,

Bharadwaj *et al.*, 2005; Cassiman & Veugelers, 2002), while collateral learning involves the knowledge that derives from the interactions and activities between the new product alliance partners, not extending to factors outside the relationship.

Collateral learning is conceptually related to the notion of absorptive capacity (ACAP: Cohen & Levinthal, 1990). ACAP perspectives depict a firm's learning as the upgrading and augmentation of existing knowledge stocks through the absorption of new knowledge from external experiences and activities (Lane, Koka, & Pathak, 2006; Zahra & George, 2002). Extending ACAP notions, where cues and new information to be integrated and assimilated derive from external sources (Kim, 1998), in collateral learning, the new cues and information to be assimilated by the firm and incorporated into its own individual capabilities are rooted in the shared experience of an alliance focused on a specific new product project (Inkpen, 2000). The firm's new product development capability, which is leveraged repeatedly and separately from the alliance, is augmented, in this case, by experiences and cues from an interfirm relationship, i.e., the alliance (Grant & Baden-Fuller, 2004). Although ACAP has been cast as involving incremental learning that may not necessarily penetrate the firm's core (e.g., single loop learning) (Lane *et al.*, 2006), we see collateral learning as a deeper process involving more complex and less programmable learning (e.g., double loop) by which the firm retains and incorporates valuable and complementary knowledge to enhance core new product development capabilities (e.g., Argyris, 1994). More importantly, collateral learning involves parallel learning – focal firms learn from and with their partners to upgrade their own skills. The focal firm incorporates what is complementary and valuable from alliance activities and partner interactions to augment its knowledge bases.

To provide some understanding of the factors that influence collateral learning, we draw on the motivation and awareness of action components in the behavioral theory of the firm (Cyert &

March, 1963) and its extensions (e.g., Miller & Chen, 1994; Jayachandran & Varadarajan, 2006; Zhou *et al.*, 2006). Specifically, we propose strategic importance and performance vulnerability as factors underpinning motivation, and previous alliance experience and organizational similarity as factors underpinning awareness. Further, because ultimately we believe that collateral learning is a critically important means for enhancing a firm's new product outcomes, we investigate how it relates to new product alliance success and overall new product success (Khanna *et al.*, 1998). Below we detail our hypotheses.

3. Hypotheses

3.1. Antecedents of collateral learning

Strategic importance involves the firm's motivational investment in the alliance and suggests an intensification of strategic dependence and involvement between partners (Johnson, 1999). In new product alliances strategic importance facilitates learning from and with partners and the development of mechanisms for internalizing and deploying knowledge beyond specific alliance domains and activities, i.e., collateral learning, for two reasons. First, strategic importance indicates that the firm has substantial stakes in the alliance and purposefully assumes substantial dependence on the alliance and the partner. The willingness to assume dependence implies transparency and openness, and a generally a healthy relationship where, along with alliance specific learning, the firm can acquire and internalize knowledge, accruing private benefits.

The second reason strategic importance facilitates collateral learning is that it implies a strategic mindset with respect to the new product alliance relationship. The firm has a strong vested interest in the relationship and with that comes the expectation of an array of positive outcomes. These expectations encourage the firm's proactive integration of its knowledge with the partner's to expand knowledge stocks in general and simultaneously accrue private benefits (Borys

& Jemison, 1989). In essence, because of the vested interest in it, strategic importance indicates that the firm will likely attempt to optimize on an array of potential benefits from the alliance including any opportunities for augmenting knowledge stores apart from and beyond immediate new product development episode. Thus, in such a strategically important relationship, because of the volitional control in assuming dependence and because of the vested interest, the firm is motivated to cultivate and increase its propensity of collateral learning. Thus, we posit:

H1. Strategic importance relates positively to collateral learning.

Performance vulnerability is defined as the appraisal of negative consequences associated with the possible functional failure of products/services or activities provided by a partner firm (Pablo, Sitkin, & Jemison, 1996). While various governance mechanisms, such as contractual agreements, performance guarantees, or credible commitments can offer some protection regarding performance vulnerability, bounded rationality suggests that such risk cannot be eliminated (Simon, 1957).

In contrast to strategic importance, we suggest that performance vulnerability discourages the firm from collateral learning. Particularly in high tech industries, the relentless pressure for new products compels a firm to constantly assess and reassess its partner's performance. Such performance assessments and the accompanying negative consequences are influenced largely by information from the external environment that is relevant to the partner firm and alliance activities (Huber, 1991). For example, when an alliance partner is incapable of keeping pace in the face of rapidly changing product technologies, increasingly negative performance appraisals result (Das & Teng, 1996), which subsequently reduces the firm's motivation to learn from and with the partner (Grant & Baden-Fuller, 2004).

Often alliances formed are for the purpose of learning and enhancing core competencies through a partner's complementary knowledge (e.g., Anand & Khanna, 2000; Grant & Baden-Fuller, 2004). Alliance firms focus on establishing best practices, for example those that increase new product development capabilities (Hamel, Doz, & Prahalad, 1989), through exposure to the partner's processes and practices. Perceptions of negative consequences or insecurities associated with a partner's performance, however, affects the firm's expectations of the quality of knowledge potentially obtained in alliance activities. Insecurity regarding a partner's ability to meet required technological standards or perform as expected results in serious doubts and questions regarding the value and worth of knowledge associated with the partner. Conversely, in general, confidence in partner performance will enhance learning and knowledge development. This confidence will encourage the firm's integration of knowledge accumulated in alliance interactions and activities and private benefits will accrue to the firm as it augments its knowledge reservoirs and enhances new product development practices. Thus, when the partner's performance is questionable, i.e., performance vulnerability is high, it discourages learning in the alliance, and also inhibits collateral learning.

H2. Assessment of partner performance vulnerability relates negatively to collateral learning.

Alliance experience involves the extent of a firm's prior exposure to alliances and its familiarity with alliance making and management (Kale *et al.*, 2002). Research suggests that firms with more alliance experiences are likely to develop effective learning mechanisms that allow them to make sense and be aware of their partners' knowledge and skills and to institutionalize knowledge gained in the alliance (e.g., Anand & Khanna, 2000; Hamel, 1991). In new product alliances specifically, firms may have diverse knowledge stocks relevant to different and unrelated domains. Thus, past experience in alliances becomes critical because it cultivates effective

processes by which a firm becomes aware of learning opportunities and recognizes the pros and cons of knowledge acquisition.

We suggest that a firm's alliance experience not only directly influences collateral learning but it also reduces the negative effect of performance vulnerability on collateral learning. Experience facilitates the identification and recognition of what knowledge is valuable and should be retained and also the recognition of which knowledge is faulty or hazardous and should be dismissed (e.g., Dyer & Singh, 1998; Kale *et al.*, 2002). In other words, pre-existing learning mechanisms and interfirm management capabilities built in from past alliance experience facilitates the accrual of private benefits from the alliance identification and recognition of concerns over partner performance vulnerability, thus reducing its negative impact on collateral learning.

More specifically, prior alliance experience can be regarded as a mechanism that allows the firm to retrieve information about current and past alliance relationships and their consequences. It enables processing of information available for evaluating and predicting specific alliance relationships. Knowledge from previous alliances helps the firm cope with and manage existing relationships. Thus, when there is ambiguity concerning an alliance partner's performance with significant downside effects possibly ensuing, accumulated alliance experience can lessen the concern regarding the vulnerability arising from possible partner performance default, allowing the firm to focus more on learning and combining knowledge unique in the partner. We hypothesize:

H3. The extent of the firm's alliance experience positively relates to collateral learning.

H4. The extent of the firm's alliance experience moderates the effect of performance vulnerability assessment on collateral learning; as alliance experience increases, the negative effect of partner performance vulnerability assessment on collateral learning diminishes.

Organizational similarity, another awareness component, represents the extent of similarity between two alliance firms pertaining to their opinions, behaviors (or operations), and their firm culture such as strategic orientations and organizational innovativeness, among others (Achrol, Scheer, & Stern, 1990). Alliance firms may be different (dissimilar) or alike (similar) in terms of their operational approaches and philosophies regarding new product development and introduction. While interfirm similarities has been identified as critical (e.g., Simonin, 1999), its effects are not well understood. For example, some research suggests similarity between relationship partners enhances performance (e.g., Dyer *et al.*, 2001; Homburg, Schneider, & Fassnacht, 2003). Other evidence suggests similarity may actually inhibit performance (e.g., March, 1991). Still other research finds no clear pattern of the influence of similarity on desirable outcomes (e.g., Johnson, Cullen, Sakano, & Takenouchi, 1996; Lane & Lubatkin, 1998). We believe that these discrepancies result because organizational similarity affects alliances outcomes in more complex ways than the extant literature indicates.

When alliance firms see themselves as similar, i.e., as having common understanding of customers, competitors, and products, sharing similar strategic goals, and deploying the same routines, they develop common ground, a sense of normative fit, which facilitates coordination and uniformity of perception and action, and communication (e.g., Johnson *et al.*, 1996; Li & Berta, 2002). These commonalities will result in positive outcomes such as collateral learning (Homburg *et al.*, 2003). Highly similar alliance firms are likely to be aware of new opportunities arising from their interactions with each other, resulting in increased knowledge building and internalization.

However high dissimilarity, we argue, for different reasons may also enhance outcomes. High dissimilarity means that the alliance is characterized by complementarity and diversity in perspectives, processes, and approaches (e.g., Johnson *et al.*, 1996). Given these differences, new

cues and information in alliance interactions and activities are rampant and abundant and the possibility for learning in general is great (e.g., Chung, Singh, & Lee, 2000; Khanna *et al.*, 1998). Thus, dissimilarity can in fact invigorate learning processes. With exposure to diverse perspectives, approaches, and processes in alliance interactions and activities, the potential for intra-firm knowledge augmentation, i.e., collateral learning is great.

At the ends of the spectrum, high similarity or high dissimilarity, collateral learning is enhanced as different mechanisms trigger the recognition and identification of valuable knowledge and possible learning opportunities. However, the mid levels of organizational similarity are problematic because the extent of similarity between firms is not sufficient to establish common ground, suggesting that the firms may not recognize knowledge acquisition and integration opportunities; whereas the extent of dissimilarity is not great enough that knowledge acquisition and integration opportunities will materialize and surface from the diversity. Thus, we hypothesize a nonlinear effect to reflect the complex influence of similarity on collateral learning.

H5. The relationship between organizational similarity and collateral learning is U-shaped; high levels of similarity and low levels of similarity (high dissimilarity) relate to high levels of collateral learning while medium levels of similarity relate to low collateral learning.

4. Methodology

4.1. Preliminary fieldwork

Our preliminary fieldwork involved two stages, 1) interviews focused on conceptualization and model development, and 2) interviews focused on instrument development. Using a snowballing approach to gain access, we conducted telephone interviews with ten senior executives who represented different industries such as electronics and software development and were knowledgeable about inter-organizational relationships. In the unstructured interviews, managers

were asked to describe situations they had encountered in dealing with their strategic partners which provided critical information in model development.

Once we developed the model and construct measures, another wave of preliminary fieldwork was conducted to pretest our research instrument. Because of its close business connections with high tech firms, the engineering college affiliated with the researchers' university assisted in setting up interviews with six senior executives with titles such as Vice President or CEO. Four interviews were successfully conducted. The executives filled out the instrument and provided detailed feedback. This feedback resulted in the following instrument restructuring and modification: 1) the instruction to identify a new product alliance partner as a reference was moved from the cover page to the beginning of the questions, 2) four demographic-type questions were moved to the beginning of the questionnaire to insure respondents' connection and reference to the specific alliance they had identified, 3) the statement, "Please be sure to keep focusing on the partner firm you have identified," was used wherever appropriate to ensure that the managers responses remained anchored on the alliance partner firm they had selected at the beginning, 4) some items were removed or modified based on the feedback and extensive discussions with three academic experts.

4.2. Sample and study procedures

Testing our conceptual model required 1) firms that have engaged in alliances, and 2) a context that involves considerable learning from and with alliance partners. New product alliances in high tech sectors, specifically electronics industries, provide such a setting (Kotabe & Swan, 1995). Because firms in electronics industries such as semi-conductors and software are driven by innovation, forming alliances to create novel products is quite common. For example, Microsoft and Sony collaborated to develop broadband networks, and Siemens cooperated with IBM and

Toshiba to advance in more customized memories and application-specific integrated circuits.

Alliances with a particular focus on new product development involve a high level of proprietary knowledge sharing and learning in the relationship. As such, they are deemed appropriate for our study.

Because we are primarily interested in new product alliances in high-tech sectors, as we detail subsequently, we followed a complex and rigorous process in identifying firms in alliances, selecting our sample, qualifying key informants, and collecting data.

Step 1: Identifying firms with alliance activities. This step involved an extensive review of secondary sources listed on ProQuest database, which covers most major national newspapers, magazines, and other publications. We identified 1,252 firms with reported alliance activities in electronics industries.

Step 2: Identifying company contact information. We went to the website of each individual firm identified in Step 1 and obtained the firm's initial contact information including firm address, telephone numbers, and names and titles of senior executives who were likely responsible for new product development. Firms located outside the US were not included. This step also served to verify that the firm was in the high-tech sector. Verification of contact information via the Internet resulted in 801 firms.

Step 3: Prescreening and qualifying key informants. Telephone screening was used to (1) verify that the high-tech firm was in fact currently engaged in at least one new product alliance, (2) identify and locate key informants, and obtain their specific contact information, and (3) verify that the key informant was qualified to report on the new product alliance and obtain his/her cooperation with regard to participating in the study. We located 404 firms that had new product alliances and where the appropriate manager was willing to participate in this research.

Step 4: Collecting data.

First Survey. We conducted a survey with senior managers identified in Step 3. In particular, we collected data on the antecedents of collateral learning and its immediate outcome, i.e., new product alliance success. In the initial mailing, we mailed 404 survey packets including a cover letter to state the purpose of this study and promise to provide a summary of findings to respondents, a postage envelope, and a questionnaire. All survey packets were serialized for tracking purposes. Informants who did not reply within two weeks were mailed a second set of survey materials (Dillman, 1978). In the follow-up mailing, we attached a one-dollar bill to each of the original packet to encourage participation. We received 140 responses, a 35% response rate. Of these, 133 firms provided complete information.

Second Survey. While we did not formally posit a relationship, we were interested in the effects of collateral learning on the overall new product outcomes and sought to collect the relevant information. Given the 133 responses received from the first survey had a tracking number; we were able to identify each and re-establish contact. We first mailed our survey packets, including a cover letter stating the survey purpose of the study and asking the perspective respondents to participate by filling out the survey, a postage prepaid envelop, and the one-page second survey, to 133 firms. Given that the questions on this arm of the survey were more general in nature, we could rely on other senior executives other than the one initially identified. We received 83 completed responses.

4.3. Response bias and validity checks

We verified the validity of our data in three ways. First, we assessed potential nonresponse bias by comparing nonrespondent firms with respondent firms in terms of firm age, sales, and the number of employees. We used various websites to acquire the necessary secondary data. Our t-

test results suggest no significant difference between respondent and non-respondent firms, providing evidence that our sample is representative and that our study is generalizable across firms in the high-tech industries. Second, we compared early responses with late responses on all key constructs. Results reveal no significant difference (Armstrong & Overton, 1977). Third, we performed a validity check on our key informants' qualification. Respondents were asked in the survey to report on their positions, years employed with their company, and their level of involvement and influence in the alliance of concern. Ninety percent (90%) of our respondents were presidents, vice presidents, or senior executives in the areas of marketing, new product development, or engineering and had worked for their firm for an average of eight years. Respondents reported high involvement (5.86 of 7.00) and strong influence (5.73 of 7.00) on the alliance relationship specified.

4.4. Measures

We used multi-item measures to assess the latent constructs (Bagozzi, Yi, & Philips, 1991). In particular, we used reflective scales to measure collateral learning, its antecedents, and new product alliance success in the first survey. To avoid common methods variance, we adopted approaches suggested in recent research (Crampton & Wagner III, 1994; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, we carefully designed our questionnaire by separating our key constructs into several subsections and using different formats (e.g., circle responses vs. write down responses) to reduce simply "straight line" responses by managers.

Second, we used the Hamon's single factor test to assess the common method bias for our dependent and independent variables (Podasakoff *et al.*, 2003). Using exploratory factor analysis, we estimated a model that had all items for the five latent constructs (i.e., collateral learning, strategic importance, performance vulnerability, alliance experience, and organizational similarity).

The first four eigenvalues exceeded 1 (the lowest being 1.58), and the fifth equaled .77. The rotated component matrix indicated that all items loaded on the corresponding factors. When we forced the extraction of a five-factor model, results remained the same.

4.4.1. Collateral learning

Collateral learning involves the ability of the firm to advance its internal knowledge through learning from and with its partners in an interfirm relationship (Cohen & Levinthal, 1990). We relied on the organizational learning literature to develop a multiple-item scale (e.g., Miner *et al.*, 2001). Sample items include “in the process of this joint product development, we have absorbed significant amounts of knowledge from our partner” and “we are able to deploy the skills and knowledge that we learn from this partner firm in developing new products.” Respondents indicated their agreement or disagreement on a one (strongly disagree) to seven (strongly agree) scale.

4.4.2. Antecedents of collateral learning

Strategic importance refers to the extent to which the firm’s stake relies on its specific alliance partner. We adopt Johnson’s (1999) instrument to assess strategic importance. A sample item includes “our firm’s long term product development strategy depends on maintaining a good and healthy relationship with this partner.” Managers responded on a one for strongly disagree to seven for strongly agree scale.

Performance vulnerability relates to the uncertainty associated with a partner’s performance and the negative consequences associated with such an unexpected performance expectation gap (Das & Teng, 1996). Four items anchored on a one (strongly disagree) to seven (strongly agree) scale were adapted from past research (Kohli, 1989). One item was dropped after measure

purification. A sample item includes “the chance that our new products will fail in the market is high if the partner firm does not deliver required technology.”

Alliance experience relates to the past experience of history of the firm involving in other alliance activities. Extant research suggests that past experience has strong effects on learning (e.g., Dyer & Singh, 1998; Kale *et al.*, 2002). To assess alliance experience, five items generated from field interviews and literature reviews were included and were anchored on a seven-point scale where one indicated strongly disagree and seven indicated strongly agree. One item was dropped after measure purification. A sample item includes “we are familiar with the practice of forming alliances.”

Organizational similarity is defined as the extent of similarity between the firm and its specific partner (Johnson *et al.*, 1996). The scale includes four new items with an emphasis on new product development strategies and processes and is anchored on a seven-point semantic differential scale, with one end indicating “very similar to the partner firm” and another end indicating “very different from the partner firm.” Specifically, a respondent was asked to indicate to what extent his/her company was different from or similar to an identified partner in terms of “new product strategies,” “innovativeness,” “risk taking,” and “new product development processes.” We use a linear term to depict its direct effect and a square term to represent its nonlinear effect on collateral learning. All items are reverse coded.

4.4.3. Consequences of collateral learning

As noted, though we did not posit formal relationships we were interested in the performance outcomes of collateral learning thus we assessed it with two different measures. Although the two performance measures both involve subjective enquiries, data were collected at two different points in time. First in the initial survey, we assessed *new product alliance success*,

the overall performance and profitability of the particular new product alliance relationship identified by respondents with three items, using a seven-point scale where one indicated “strongly agree” and seven indicated “strongly disagree.” A sample item includes “the overall performance of this new product alliance program has met our objectives.” Then in the second survey we measured *overall new product success*, the performance of a firm’s total new product development program. Each of the four items comprising the formative scale (Diamantopoulos & Winklhofer, 2001) was anchored on a seven-point low to high response range.

4.4.4. Control variables

We include cross-national distance, industry type, relationship age, firm age, and firm size as control variables. Cross national distance denotes the differences between two firms that are based in two different countries. Past studies have shown that the gap between two firms in terms of their political and socio-economic environments can influence various business practices and firm culture (e.g. Song, Xie, & Dyer, 2000). One example is that when managers of different companies come from different countries, languages and other business practices can be different, hindering information and knowledge sharing (Kotabe, Dunlap-Hinkler, Parente, and Mishra, 2007). We create a dummy variable to depict whether participant firms are located in the same country. We use zero to represent domestic partner firms and one to represent international partner firms. Similarly, industry type was included as a control by a dummy variable reflecting whether the firm and its partner are in the same industry. Since participant firms in different industries may affect their knowledge exploitation and exploration, we control for this effect (Nonaka & Takeuchi, 1995). We use zero to indicate when two alliance firms are in different industries and one when they are in the same industry.

In addition, we include relationship age (Jap & Ganesan, 2000), which represents the length of business relationships between two participant firms and is expected to affect perception of performance vulnerability, strategic importance, and the level of their similarity. To assess the relationship age, each respondent was asked to provide the number of years his or her firm had been in the relationship with the specified partner firm. Finally, we included firm size and firm age to control other firm specific factors not hypothesized in our study. We controlled for firm size to rule out the possible alternative explanation that larger firms may have the potential to be more diverse and that firm size may therefore be driving any organizational (dis)similarity effects. Larger firms may also suggest that they have more resources to invest in learning and knowledge acquisition (Jansen, Van Den Bosch, & Volberda, 2005). Hence we included firm size. We also controlled for firm age since previous research has documented that age affects learning (Autio, Sapienza, Almeida, 2000). We operationalized firm size as logarithm of sales of previous year and firm age as the logarithm of number of years in business.

5. Results

5.1. Measure validation

Confirmatory factor analyses assessed the convergent and discriminant validity of all variables measured on reflective scales (Gerbing & Anderson, 1988). Results indicate a reasonable fit for the model ($\chi^2 = 295.15$, d.f. = 194, $p < .001$; NNFI = .940; CFI = .949; RMSEA = .063). All the indicators loaded substantively (.63 or above) and significantly on their hypothesized factors ($p < .001$). Average variance extracted ranges from .53 to .77 and construct reliabilities, from .82 to .93 (Nunnally & Bernstein, 1994). With regard to evidence of discriminant validity, in all cases the average variance extracted by each factor exceeded the squared correlation between the factor pair (Fornell & Larcker, 1981). Establishing discriminant validity using the average variance extracted

measure also protects against the deleterious effects of multicollinearity in the presence of measurement error (e.g., Grewal, Cote, & Baumgartner, 2004). We provide confirmatory factor analysis results in Appendix A and descriptive statistics in Table 1.

[Insert Table 1 about here]

5.2. Results

We used OLS regression to test our hypotheses. To improve the interpretability of the main effects in the presence of interaction terms we mean centered our constructs before creating interaction terms. We report the results of H1 to H5 in Table 2. Our findings support H1, which expects that strategic importance has positive effects on collateral learning ($b = .344, p < .01$). H2 suggests that the firm's assessment of partner performance vulnerability is negatively related to collateral learning and is supported by our findings ($b = -.113, p < .05$). H3 posits a positive relationship between alliance experience and collateral learning. The coefficient associated with alliance experience is positive and significant ($b = .088, p < .10$), providing support for the hypothesis. With respect to H4, the interaction effect of alliance experience and performance vulnerability on collateral learning, we find support for this hypothesis ($b = .060, p < .10$). In H5 we had argued for a U-shaped relationship between organizational similarity and collateral learning. The results show a negative linear term ($b = -.203, p < .10$) and a positive squared term ($b = .089, p < .10$). To better understand the relationship between organizational similarity and collateral learning we plotted the linear and squared jointly. Indeed, as shown in Figure 1, the relationship appears to be U-shaped, thereby providing support for our theoretical conjectures.

[Insert Table 2 and Figure 1 about here]

Though investigating the determinants of collateral learning is the major focus of our research, we were also interested in the performance consequences of this important learning

avenue. To explore this we provide some descriptive results to demonstrate the association of collateral learning with our two performance outcomes. Table 1 shows the correlation between collateral learning and new product alliance success is .285 ($p < .01$), suggesting that a firm's enhanced general new product knowledge is associated with more successful new product alliance. In addition, the correlation between new product alliance success and overall new product success is .19 ($p < .10$), suggesting a small yet statistically significant association between these two performance measures.

Further, although our results show that relationship age, a control variable, does not significantly relate to collateral learning, examining the correlation matrix (see Table 1) offers some interesting insights as to how it relates to other key constructs. Specifically, consistent with other results, the correlation table shows that relationship age does not associate with collateral learning ($r = .005$, $p > .10$), yet it relates negatively to performance vulnerability ($r = -.172$, $p < .10$). This might suggest that newer relationships experience more performance vulnerability which then in turn, inhibits collateral learning. Performance vulnerability, strategic importance, and collateral learning significantly correlate with new product alliance success at -.155, .194, and .285 respectively, indicating that these factors may be crucial to performance outcomes associated with specific alliance relationships. In contrast, alliance experience is correlated with overall new product alliance success at .313 ($p < .01$), showing that alliance experience perhaps is a prerequisite to success.

6. Discussion

With the prominence of knowledge and learning in modern corporations, strategic alliances are seen as viable vehicles to develop knowledge in crucial domains such as new product development. Aside from knowledge creation concerning the specific objectives of a new product

development alliance, we argue for the importance of collateral learning that concerns knowledge acquisition internal to a firm in the strategic alliance. To theorize collateral learning, we build on extant literature concerning absorptive capacity to suggest that through its alliance activities and actions, firms assimilate into its capability portfolio knowledge gained from the alliance (Johnson *et al.*, 2004; Lane *et al.*, 2006). Specifically, in the co-development of new products, firms learn the best practices and upgrade knowledge stores that can be leveraged into other new product development projects. Hewlett Packard (HP) is a case in point. HP allied with Canon to produce laser printers in the early nineties and has become the biggest printer producer since then. Through such a successful alliance, HP leveraged its knowledge stores to other interfirm relationships and has been able to garner superior outcomes from all other alliance relationships (Draulans, deMan, & Volberda, 2003; Kanter 2002).

6.1. Implications

Before discussing the theoretical and managerial implications from our research, it's critical to recognize its limitations. We used a survey based approach and all limitations of such an approach are applicable for our research. For example, a cross-sectional design precludes ability to extract causal relationships and is limited to correlational analyses. Further, as we used single survey to test a number of our hypothesized relationships issues relating to common method bias might arise. While we took steps advocated in the extant literature to mitigate common method problems and ensure the validity of our data, with single source data the concerns persist.

Despite these limitations, the findings from our research convey important implications for academics and managers alike. Foremost, we find that collateral learning is associated positively with new product alliance success, which in turn affects positively overall new product success. Although the correlation results cannot establish any direction of causation, they still convey an

important message to managers that the firm's generally upgraded knowledge in its own new product development processes would likely be leveraged in the alliance and be of benefit to it. In turn, while happening in conjunction with the acquisition of alliance specific learning focused on the new product being jointly developed, collateral learning serves to augment and reinforce the specific project-focused knowledge and skills.

To realize the important benefits from collateral learning, it becomes critical to understand the key drivers. We investigate this arena using the behavioral theory of the firm as a framework and study two important components: the motivation to learn and the awareness of learning opportunities. From a motivational perspective, when firms strategically integrate with their alliance partners they establish long term commitment and trust with the partners and, as a result, the firms are more motivated to learn from and together with the partners to upgrade their knowledge stores. Given that alliance partners sometimes may also become competitors, strategically integrating with these alliance partners can demonstrate a firm's long-term commitment toward its partners, and provide an incentive for interfirm learning (Johnson & Sohi, 2003). On the other hand, performance vulnerability perception is found to negatively affect collateral learning. Because of the uncertainties and the negative outcomes associated with the partner's performance, it indeed discourages the focal firm from collateral learning.

With respect to the awareness components, prior alliance experience positively relates to collateral learning, suggesting that firms that have extensive alliance experience are more likely to uncover their partners' strengths and weaknesses, which in turn facilitates the development of collateral learning. Experience is dynamic, as is collateral learning (Teece *et al.*, 1997; Winter, 2000). The knowledge stored from a firm's past interactions with its partners provides a platform for the firm to sense, create, and materialize new knowledge with current or future partners

(Johnson *et al.*, 2004). Alliance experience also helps to alleviate the negative consequences that arise from performance vulnerability. Although from a transaction cost perspective, risk is as crucial as trust and opportunism, it has not received equal attention from researchers (Rindfleisch & Heide, 1997). Thus, from a theory perspective our findings on performance vulnerability become critical.

Consistent with our theorizing we find that collateral learning is facilitated in alliances in which organizational similarity among the alliance partners is either high or low. Collateral learning seems to be at its nadir at medium levels of organizational similarity among the alliance partners. Thus, it is clear that firms should seek strategic alliance partners with whom they have (1) a common understanding concerning organizational objectives, critical routines and capabilities, and the marketplace, or (2) complementarity and diversity in perspectives, processes, and mental models.

6.2. Conclusion

We extend strategic alliances theory by explicitly examining an important link between strategic alliances and a firm's core strategic activity, i.e., new product development. Our research looks at learning that derives from strategic alliances but is held and resides within the individual firm. Our conceptualization of collateral learning that suggests firms' knowledge store upgrades through activities with an alliance partner firm can be critical in augmenting strategically central capabilities. The importance of collateral learning is established by our findings that it is associated with new product alliance success. As shown by our research, it would behoove researchers to establish the direction of causation between collateral learning and new product alliance success and identify moderators and mediators for its influence on alliance success.

Similarly, whether success breeds success; future research may establish a causal link between new product alliance success and overall new product success.

In addition, given the importance of collateral learning, further research that studies other antecedents of collateral learning such as trust, commitment, and levels of competition among partner firms should also be fruitful. Although we found support for our assertion that there exists a U-shape relationship between organizational similarity and collateral learning, its relationship may change when considering the kinds of knowledge (e.g., marketing knowledge vs. product knowledge) alliance firms may pursue. We encourage future attempts to uncover the role of knowledge types. Further, like all learning at a collective level, attribution of personnel may affect collateral learning. Future research may look into how this issue or to what extent it affects collateral learning at a firm level. For example, managers who are more risk averse may avoid learning from their alliance partners. Similarly, managers who are more seasoned are more aware of possible opportunities and benefits their alliance partners may bring to their firm.

Finally, our research focuses on firms in high tech industries, yet firms may behave differently in other industries. Future research is encouraged to explore whether collateral learning and its antecedents are more salient in high tech vs. low tech industries.

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Appendix A

Measures

Survey 1: Constructs / Measures	Range of Standardized Factor Loadings	Construct Reliabilities	Average Variance Extracted
<p>Collateral Learning (new scale, anchored on a 7-point Likert scale, with “1” represents “strongly disagree” and “7” represents “strongly agree”)</p> <ol style="list-style-type: none"> Working with this partner firm enhances our capacity to learn. In the process of this joint product development, we have absorbed significant amounts of knowledge from our partner. We are able to deploy the skills and knowledge that we learn from this partner firm in developing new products. Through the association with this partner/ally, we learn better ways to develop new products. Together, our partner firm and we have made huge strides in our understanding of the technologies involved in this new product. 	.65 - .87	.82	.53
<p>Organizational Similarity (new scale, anchored on a 7-point semantic differential scale with “1” means “very similar to partner firm” and “7” represents “very different from partner firm”)</p> <ol style="list-style-type: none"> New product strategies (reverse coded) Innovativeness (reverse coded) Risk taking (reverse coded) New product development processes (reverse coded) 	.63 - .72	.82	.53
<p>Strategic Importance (adapted from Johnson 1999, anchored on a 7-point Likert scale, with “1” represents “strongly disagree” and “7” represents “strongly agree”)</p> <ol style="list-style-type: none"> Our firm’s long-term product development strategy depends on maintaining a good, healthy relationship with this partner. 	.77 - .84	.85	.65

2. A strong cooperative relationship must be maintained between our company and the ally for us to remain competitive in our industry.			
3. When developing our firm's new product development strategy, we depend on the participation of our partner/ally.			
Performance Vulnerability (adapted from Kohli 1989, anchored on a 7-point Likert scale, with "1" represents "strongly disagree" and "7" represents "strongly agree")	.82 - .84	.87	.68
1. We are at risk if our partner firm does not perform according to requirements.			
2. We would take a big loss if our partner firm were not reliable in delivering required technology.			
3. The chance that our new products will fail in the market is high if the partner firm does not deliver required technology.			
Alliance Experience (new scale, anchored on a 7-point Likert scale, with "1" represents "strongly disagree" and "7" represents "strongly agree")	.79 - .84	.87	.70
1. We are experienced in managing alliance partners.			
2. We are familiar with the practice of forming alliances.			
3. This is our first time working with other firms to develop new products (reverse coded).			
4. We are very new at figuring out how alliances work (reverse coded).			
New Product Alliance Success (new scale, anchored on a 7-point Likert scale, with "1" represents "strongly disagree" and "7" represents "strongly agree")	.80 - .84	.87	.70
1. The overall performance of this new product alliance program has met our objectives.			
2. The overall assessment of this alliance is satisfactory.			
3. We have achieved our primary objectives in forming this alliance.			
Chi-square = 295.153 (p < .01, d.f. = 194); RMSEA = .063; NNFI = .940; CFI = .949			

Survey 2: Construct and Measure

Overall New Product Success (new scale, anchored on a seven point semantic differential scale, 1=low and 7=high)

For your firm's principal served market segment over the past 3 years,

1. new product introduction rate relative to a largest competitor was ____.
2. new product success rate relative to largest competitor was ____.
3. first to market with new applications was ____.
4. new product cycle time (i.e., inception to rollout) relative to competition was ____.

Table 1
Descriptive Statistics: Mean, Standard Deviation, and Correlation Coefficients

	1	2	3	4	5	6	7	8
1. Overall new product success ^a	1.000							
2. New product alliance success	.190*	1.000						
3. Collateral learning	.100	.285***	1.000					
4. Organizational similarity	.013	.124	.071	1.000				
5. Strategic importance	-.030	.194**	.429***	.079	1.000			
6. Performance vulnerability	-.083	-.155*	.020	.062	.367***	1.000		
7. Alliance experience	.313***	.127	.193**	.125	.075	-.022	1.000	
8. Relationship age	.089	.096	.005	-.093	.007	-.172*	.139	1.00
Mean	4.579	5.068	5.142	3.917	4.429	4.631	5.372	1.126
Standard Deviation	1.302	1.076	1.040	1.23	1.459	1.611	1.641	.960

***p = < .01; **p = < .05; *p = < .10

^a n=83 for overall new product success and with other variables and n=133 for all other variables.

Table 2
Effects of Motivational and Awareness Components on Collateral Learning^a

Hypotheses	Independent Variables	Dependent Variable Collateral Learning (n = 133)
	Constant	3.351*** (.470)
H1 (+)	Strategic importance	.344*** (.062)
H2 (-)	Performance vulnerability	-.113** (.056)
H3 (+)	Alliance experience	.088* (.053)
H4 (+)	Alliance experience*Performance vulnerability	.060* (.031)
H5 (-)	Organizational similarity	-.203* (.101)
H5 (+)	Organizational similarity*organizational similarity	.089* (.044)
	Cross national distance	-.065 (.184)
	Industry type	-.081 (.167)
	Relationship age	-.057 (.073)
	Focal firm age	.029 (.128)
	Focal firm size	.025 (.035)
	R ²	.276***
	Adjusted R ²	.223***

***p<.01; **p<.05; *p<.10 (two-tailed tests)
Standard errors are presented in parentheses

Figure 1

Effects of Organizational Similarity on Collateral learning

