Developing Alliance Formation Process Capabilities: Replication, Adaptation and Flexibility in Creating Research and Development Consortia

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Abstract

Our study draws from learning theory and path dependence research to hypothesize how companies build the capability for managing strategic alliance formation processes. Specifically, we focus on firms' patterns of R&D consortia formation processes in the United States. Prior research identified two different consortium formation processes: emergent and engineered processes. This study explores the sequences of these processes for 1063 companies entering into alliances with 737 US-based consortia between 1984-2005, resulting in 3767 independent consortium joining events. Our results suggest that companies build alliance formation capabilities through a combination of replication, adaptability and flexibility. In showing these results, our study contributes to the alliance capability literature, the alliance formation process literature and research into organizational learning and path dependence.

Keywords: alliance capability; formation process; R&D consortia; organizational learning; path dependence

Contents

1. Introduction

As the prevalence and importance of strategic alliances to companies has evolved over the last two decades, so has the research into strategic alliances. While initial research primarily examined the motives for and best practices for managing a single strategic alliance (e.g., Killing, 1982; Kogut, 1988), and recent studies have added new insights into this body of knowledge (e.g., Hagedoorn and Wang, 2012; Jiang and Li, 2009; Lee, Park, Ryu and Baik, 2010), in the last decade researchers have increasingly expanded the scope to investigate the challenges of managing multiple alliances. Of particular interest have been the related issues of alliance portfolio and alliance capability development. The former addresses a focal firm's current array of strategic alliances with different partners. The central topics in alliance portfolio research has been the composition of the portfolio (e.g., Yamakawa, Yang and Lin, 2010), because it indicates the range of resources the firm has access to through its alliances, and in the synergies or conflicts that may exist among these alliances. Alliance capability, meanwhile, focuses on the alliance formation and management skills of the focal firm, and its success in effectively managing its alliance portfolio. Building from Dyer and Singh's (1998) seminal paper arguing for the importance of a relational view of organizations, researchers have demonstrated that alliance capability is positively related to alliance portfolio performance (Heimeriks and Duysters, 2007) and to overall firm performance (Kale, Dyer and Singh, 2002), and that alliance capability increases in importance as an alliance portfolio grows in diversity (Duysters et al., 2012).

The source of alliance capability impact has generally been attributed to the ability of firms to learn from alliance experiences. This has led alliance capability researchers to focus on the relative effectiveness of different learning mechanisms for developing and sharing knowledge generated from the alliance (e.g., DeMan, 2005; Heimeriks, Klein and Reuer, 2009; Kale and Singh, 2007). There is growing recognition, however, for the need for more research into the *processes* that firms develop to manage their alliances (Sarkar et al, 2009; Schilke and Goerzen, 2010). Understanding how firms develop processes for coordinating alliances, for learning and sharing knowledge from the alliances, or for transforming alliances provides an important complement to the focus on learning mechanisms.

The purpose of our study is to address the gap in our understanding of alliance capability management by investigating an important process in managing alliances: the formation process. To date, several alliance capability studies have noted the benefits of effectively managing discrete activities of the formation process, such as partner selection and negotiations (Sarkar et al., 2009), but research has not examined the skills associated with the entire formation process. Further, it has not acknowledged that formation processes are heterogeneous. There are multiple processes and managers skilled at one formation process may not be good at another. In our study we build from research on different formation processes -- with the correspondingly distinctive skill required to manage them -- and investigate when a company replicates an existing approach, building upon an existing capability, when it adapts to changing conditions and develops a new set of organizing skills, and when it attempts to maintain a breadth of organizing skills and alternates between different formation processes. We do so by studying the formation processes of Research and Development (R&D) Consortia over a 22-year period.

There are several unique features about our paper. First, it extends alliance capability research to examine formation processes. We believe a focus on the formation process offers insights beyond those found in studies of alliance learning mechanisms. Many consortium formation activities – e.g., seeking domain consensus, open solicitation, expectations of continuity -- may not easily transfer to another consortium formation. How a company approaches a formation process may be affected by these challenges. Heterogeneity in formation process experience of firms implies both learning and performance consequences and raises questions of when routines form, and under what circumstances they are modified. Therefore, a contribution of our study is that it identifies conditions that affect process capability development. Paralleling recent calls for a deeper understanding of the evolution of alliance portfolios (e.g., Lavie and Singh, 2011; Wassmer, 2010), our study reveals how the alliance formation process capability may reflect replication, adaptability and learning.

In addition, researchers have noted that a common limitation of alliance capability research is that it has typically relied upon cross-sectional data (e.g., Draulens, De Man and Volberda, 2003; Heimeriks, 2010). In our study, we focus on the patterns of R&D consortia formation processes for 1063 companies. These firms entered into alliances with 737 U.S.-based consortia in the period 1984-2005, constituting 3767 independent consortium joining events. Thus we answer a call from Sarkar et al. (2009: 598) to increase the “formal understanding of a process-based framework of alliance capability”.

Finally, our research extends alliance formation process research by considering multiple formations. Prior research on alliance formation (Doz, Olk and Ring, 2000; Ring, Doz and Olk, 2005), as well as on alliances in general (e.g., Arino and de la Torre, 1998; Ring and Van de Ven, 1994) has examined the dynamics of a single alliance but not those for multiple alliances. Expanding the analysis to more than one formation reveals that a focal formation process is affected by the types of earlier formation processes, but that the relationship is also influenced by internal and external factors.

Our paper is structured as follows. We begin by reviewing the alliance capability literature, noting that it has overlooked formation process skills. We then describe two formation processes for R&D consortia identified in the literature. Following this, we develop three hypotheses about when a company will repeat a particular formation process, switch to a different formation process, or alternate between the two formation processes. Our data and measures are then presented, along with the results that confirm there are multiple approaches to how firms develop a formation process capability. We conclude our paper with a discussion of the significance of these findings for our understanding of alliance capabilities, including the conditions affecting capability development, and research into alliance formation processes.

2. Background

2.1 Alliance Capability

Research interest into alliance capability stems from the consistent finding that firms vary in their approaches toward managing multiple alliances and that these variations are related to alliance and firm performance. Firms differ in their collaborative know-how (Simonin, 1997) and firms with greater experience are able to create more value from alliances (e.g., Anand and Khanna, 2000). Research has shown that, in addition to prior experience, the firm's ability to capture, share and disseminate the alliance management know-how, and maintaining dedicated resources for managing alliances are also important for developing alliance capabilities. For example, studies have noted the importance of a strategic alliance unit (Kale, Dyer and Singh, 2002) and formal mechanisms put in place to encourage learning (Heimeriks and Duyster, 2007). Thus, alliance capability has generally been defined as the mechanisms and routines that are purposefully designed to accumulate, store, integrate, and diffuse relevant organizational knowledge about alliance management (e.g., Kale et al., 2002). Alliance capability has been operationalized as the extent to which a firm internally applies learning mechanisms that facilitate the transfer and adaptation of the knowledge attained through participation in alliances (e.g., Duysters et al., 2012).

Recently, Schilke and Goerzen (2010) reviewed this research and sought to extend the concept beyond formal learning mechanisms. Drawing upon dynamic capabilities research (e.g., Teece, Pisano, and Shuen, 1997; Zahra, Sapienza and Davidson, 2007), they conceptualized alliance capability as a specific type of dynamic capability. They argued for – and empirically tested – alliance capability consisting of five dimensions: interorganizational coordination (i.e., routines to synchronize activities with alliance partners), alliance portfolio coordination (i.e., routines to synchronize activities across alliances), interorganizational learning (i.e., routines for learning from and using partner's knowledge), alliance proactiveness (i.e., routines for identifying potentially valuable partnering opportunities), and alliance transformation (i.e., routines for modifying an alliance throughout the alliance development process). While this revision brings additional dimensions to the concept of alliance capability, and strengthens the connection to the broader construct of dynamic capabilities, it still overlooks an important element of effective alliance management: the skills and abilities firms need to form a new alliance. As we will describe below, the formation process of an alliance involves more activities than just early identification of alliance opportunities. Further, this conceptualization does not address the need for an alliance process-based framework of alliance capability (Sarker et al., 2009), nor the concern that strategic alliance process research represents an underdeveloped research area (Salk, 2005; Contractor, 2005). To explore how firms may create a capability for managing the formation process of an alliance, we next discuss the different types of formation processes for one alliance type: the Research and Development (R&D) consortium.

2.2 R&D Consortia Formation

R&D consortia may be defined as contractual alliances between two or more partners, formed to share the costs and benefits of research and development activities (Hagedoorn, 2002). Prior research has studied the motivations for forming and the governance of R&D consortia (e.g., Aldrich and Sasaki, 1995; Evan and Olk, 1991; Mathews, 2002; Roelofsen et al., 2011; Sakakibara, 1997), generally revealing that consortia offer a firm a lower-cost and flexible approach to the acquisition of technological capabilities compared to internal development. R&D consortia facilitate risk sharing, encourage collaboration, and lead to the development of knowledge that can foster new capabilities (Gomes-Casseres, et al., 2006).

To exploit the knowledge from these external sources, firms must first identify suitable partners, form alliances, develop trusting, cooperative associations, and transfer and assimilate knowledge (Das and Teng, 1998; Zahra and George, 2002).

Doz et al. (2000) identified two distinct formation processes for R&D consortia (see Table 1 for details). Emergent consortia are those that are arise among firms in an existing network of common suppliers, customers, and alliance partners. Emergent consortia formation processes reflect several interdependent factors. Notably, potential partners will often operate in the same or a related industry, be served by the same suppliers, or serve the same customers. These conditions increase the likelihood that the future partners are already aware of one another, even though they may not have directly worked together. Further, the presence of common resource needs and strategic goals increases the likelihood that firms will know about their future partners, and share environmental threats and technological opportunities. Moreover, technological relatedness between firms increases their ability to understand a potential partner's knowledge base.

The second consortium formation process that Doz et al. (2000) identified is an engineered formation. In this process, firms are typically initially unaware of their potential partners, or at least of the relevant capabilities that may be available through collaborative relationships. Because these organizations operate in different strategic arenas, they likely have fewer common threats, shared interests or network ties (Gulati, 1999). Firms that do not face the same environment, do not come from similar industries, and do not have high levels of technological relatedness are expected to have difficulty finding one another (Das and Teng, 1998). These factors reduce the likelihood of emergent alliance formation processes but lead to opportunities for individual or organizational 'champions' or even third parties -- such as universities or government agencies -- to link potential partners (Doz et al., 2000).

Table 1. R&D Consortia Formation Process Activities

Formation Stage	Description of Factors	Emergent	Engineered
Triggering Entity	The existence of a triggering entity is likely to be critical to the emergence of some R&D networks. In cases in which technologies are not as well specified, or where tacit know-how is to be employed triggering entities may be required. A triggering entity may be required to lesson the concerns of participants that the costs and benefits of collaboration will be shared "fairly". Triggering entities may be individuals, firms, agencies of governments, or environmental events.	No direct effect May not be required	Necessary for formation
Seeking Domain Consensus	Efforts to produce consensus by sense making and understanding processes undertaken during negotiation processes. As these processes develop they will reflect agreement regarding expectations about performance, who is in and out, the scope of the alliance, definitions of equity and efficiency. Intellectual, strategic, cultural and ethical issues are included. When there have been prior relationships between participants, some shared expectations are likely to be present from the onset of the collaboration.	Open to interested parties, likely to be similar organization – snowball effect	Triggering entity targets diverse members – hub and spoke effect
Open Solicitation	Additional partners may be sought for strategic reasons. The more closely allied those reasons are to the firm's existing product/market objectives, the more likely it seems that the search for partners will focus on firms which will be reasonably familiar to the managers of the focal firm. Most areas of science or technology, whether in a country or a region of a country, involve a few firms and public research institutes and/or universities who between them carry out the bulk of the research in that area	Defining boundaries	Aligning interests
Expectations of Continuity	Participants who have had no experience with each other can only construct a shadow of the future as they gain experience. Many R&D networks are of limited duration, linked with specific projects with given time horizons. Networks embedded in larger social structures, however, may cause their members to have greater expectations of continuity.	Strong, until opportunity or threat is dealt with	Very low at onset
Formal Structure	The participants in an R&D network must be able to deliver expectations over a sustained period of time. The way in which they design the structure of the collaboration will be helpful. External events will affect relationships over time. Given a changing external environment, success is likely to be a function of a number of other design factors. For example, the ways in which the different firms communicate with each other, and build common understandings of the task at hand, is likely to be affected by the network's structure.	Tight coupling to constrain opportunism	Filling structural holes, loose coupling

As Table 1 reveals, these two formation processes involve qualitatively different organizational skills, routines, and abilities with respect to alliance formation and management. Specifically, partner identification, the initiation of contact, bargaining, developing contracts, and finally the structuring of relationship governance mechanisms vary systematically across emergent and engineered formations. Faced with these different approaches, the question arises about how companies go about developing their alliance formation process capability.

We draw from similar arguments put forth about the development of alliance portfolios (e.g., Lavie and Singh, 2011; Wassmer, 2010) and argue that there are multiple ways by which firms might go about developing their alliance formation process capability. Organizational learning and path dependence literatures, as well as more general process research (e.g., Van de Ven, 1992), both indicate that organizations tend to develop processes that are replicated and eventually may become a routine. Additionally, these literatures both propose that a firm may adapt its routines and replace a once dominate routine with another, or that the firm may show flexibility by having two routines that co-exist and are co-dominant. Organizational learning research labels these three activities as learning-by-doing, adaptive learning, and improvisational learning, while path dependence research refers to these processes as history or path dependence, path breaking routines and path independence. Overall, these three processes are also indicative of the learning dynamics underlying exploitation, exploration, and ambidexterity in the context of organizational innovation. While exploitation involves the incremental refinement of existing routines (replication), exploration involves an active search for new routines (adaptation), and ambidexterity involves a careful balancing of the two opposing processes in a form of improvisation (flexibility).

We use the insights from these overlapping research streams to form three sets of hypotheses about how companies may develop an alliance formation capability. We propose that companies may form an R&D consortium by replicating a prior formation process, by adapting to a changing environment and use a new formation process, and by showing flexibility by alternating between two different formation processes.

3. Hypotheses

3.1 Replication

Organizational learning and path dependence research both argue that capabilities develop from replicating prior experiences. For example, the concept of learning-by-doing describes situations in which experience leads to an increasing understanding of a process, which tends to result in increased efficiency (Argote, 1999). Learning-by-doing leads to the development of strategic capabilities through a routine building process. That is, organizational routines are acquired, developed and refined as a consequence of successful responses to operational challenges and opportunities. When successful responses are identified, they are repeated and thus become encoded into an organization's knowledge base in the form of standard operating procedures. This also likely increases a firm's absorptive capacity, which in turn increases the propensity to form additional alliances (Zhang, Baden-Fuller and Mangematin, 2007). Ultimately, learning-by-doing implies that effective past behavior will be reinforced, and that established routines become a significant influence on subsequent behaviors (March, 1991; March and Simon, 1958; Nelson and Winter, 1982). Similarly, path dependence research (e.g., Montealegre, 2002; Teece et al., 2007) shows that companies tend to repeat patterns that were previously successful.

Applying this logic to R&D consortia, as organizations engage in forming R&D consortia they acquire important tacit information that they can use in selecting partners, sharing proprietary information and structuring appropriate contracts. As a result, organizations move along a learning curve, reducing the time and resources spent on subsequent consortia formation processes. Through repetition, prior experience is refined leading to greater efficiency, which may be reflected in reduced cost, greater frequency or speed of formation, or increased effectiveness of new relationships. The behaviors in this case represent the processes of partner identification, relationship structuring, partnership management, etc.

Experience with these elements of consortium formation help to build organizational routines for handling them, so that subsequent decisions to join a consortium will likely leverage these routines and lead to reduced costs, errors, and time for each subsequent formation exercise.

If firms do learn to organize as a result of experience, then much of their learning about R&D consortia formation will be specific to the type of formation process with which they have experience. The two consortia formation processes (emergent vs. engineered) will generate different experiences regarding partner identification, information sharing and structuring contracts. Emergent consortia require only that a firm be open to partnering with firms that they most likely already know. The definition and valuation of proprietary knowledge is easiest when partner firms face similar markets and competitive threats, and contracting is relatively straightforward when the purpose of a consortium is narrowly focused. In contrast, engineered R&D consortia bring together organizations that are more likely to face different competitive challenges. These organizations do not operate in the same environment and are expected to be less aware of their shared interests. The value of the knowledge to be exchanged is also more likely to vary across consortium members, depending on the uses to which the knowledge may be put. Therefore, the value of this knowledge will be difficult to define and agree upon, possibly leading to greater complexity in contracting. The generally more open-ended nature and broadly defined purpose of engineered R&D consortia can also create greater challenges in structuring the contracts. In sum, the knowledge necessary to identify, negotiate and manage partner relationships is expected to be quite distinct across emergent vs. engineered R&D consortia formation processes.

The replication argument suggests that firms become increasingly skilled at forming R&D consortia as they gain experience in a particular type of consortium formation process. We expect that because the two consortium formation processes (emergent vs. engineered) involve quite different activities, they will lead to different sets of replications. Firms' experience with joining emergent consortia will positively influence the likelihood that the same process is used for forming future consortia. Similarly, experience with engineered consortia will increase the likelihood that new consortia will be formed through an engineered process. Furthermore, if the skills and experience involved in formation are different for emergent and engineered R&D consortia, then firm experience with one type of formation process will be of limited applicability to the other type of formation process. This offers the possibility of a strong test of the replication logic. That is, we expect that prior experience with one formation type will have *no positive influence* upon the formation of consortia of the other type. This suggests the following pair of hypotheses:

> Hypothesis 1a: Accumulated experience with emergent R&D consortium formation processes is positively related to the probability that organizations form future R&D consortia through emergent processes, but not through engineered processes.

> Hypothesis 1b: Accumulated experience with engineered R&D consortium formation processes is positively related to the probability that organizations form future R&D consortia through engineered processes, but not through emergent processes.

3.2 Adaptation

The above argument offers a clear explanation for why a firm might replicate a single process. However, it ignores the ability some organizations have for engaging in exploratory learning or path breaking routines (Levinthal and March, 1993; March, 1991). Factors beyond prior experience may influence the processes used to form new R&D consortia (McEvily and Marcus, 2005). From a theoretical perspective, the question is how do firms develop these new capabilities and overcome the potentially myopic effect of prior experience (March, 1991)?

Additional learning mechanisms such as adaptation, experimentation and improvisation can influence capability development in dynamic environments (e.g., Eisenhardt and Tabrizi, 1995; Miner, et al. 2001). Adaptive organizational learning is defined as changes to behavior in response to some stimulus (March, 1991). However, to distinguish clearly between learning based on prior experience and learning as a result of other processes, here we adopt a narrow definition of adaptive organizational learning that restricts it to those behavioral changes that occur in response to external stimuli.

Adaptive organizational learning and path breaking behavior research (e.g., Garud, Kumaraswamy and Kanoe, 2010; Lewin, Massini and Peeters, 2011) each show that routines can change when external circumstances demand a novel response. Examples include radical technological or competitive shifts. Such a situation demands the search for new combinations of assets, processes and capabilities. Thus, when external stimuli are sufficiently strong, firms will develop new routines that form the basis of their capabilities. With respect to R&D consortia formation, adaptive learning involves switching from an established consortium formation process to a new process. In other words, a firm with an established routine for forming R&D consortia through emergent processes may respond to some external stimulus that causes it to adapt its formation preferences to the alternative, engineered, formation process (or vice versa).

Though many forces encourage companies to adapt, the dynamism of the competitive environment and the actions of other firms in the industry are likely to have great impact (e.g., Kim and Pennings, 2009). High technology industries are dynamic settings that offer great opportunities for the acquisition of new technological knowledge from external sources such as universities and government labs. These industries provide multiple external stimuli to which organizations must respond by altering their decision rules and routines (Brown and Eisenhardt, 1995). We may conclude therefore that firms operating in high technology industries have a higher probability of switching their routines than firms in low technology industries.

A second important external stimulus for adaptive learning is the behavior of other firms within the same industry (Angst, Agarwal, Sambamurthy and Kelley, 2010). A high rate of consortium formation within an industry environment has the potential to demonstrate the efficacy of alternative routines that should be explored. Bolton (1993) for example found that R&D consortium joining became an institutionalized decision. After early adopters had formed a consortium, the use of a consortium became a commonly accepted practice. Therefore, industry level experience with the formation processes is expected to increase the probability that individual organizations are exposed to new formation routines with different processes and benefits (and costs). The presence of other formations should increase the likelihood of a firm switching routines and adapting a different formation process. These observations suggest the following hypothesis:

> Hypothesis 2: The probability of a change of the dominant routine with respect to consortium formation process will be positively related to (a) the dynamism of the environment, and (b) to the rate of learning that is occurring in the industry.

3.3. Flexibility

A third possible approach for developing alliance formation capability comes from situations in which neither external stimuli nor prior histories are the most significant cause of behavioral changes. In some organizational contexts, proactive processes of experimentation and improvisation can support capability development (Miner et al., 2001). Improvisation or path independence reflects deliberate acts facilitated by past routines (e.g., Brown and Eisenhardt, 1995; Eisenhardt and Tabrizi, 1995; Moorman and Miner, 1998; Weick, 1998). Further, as opposed to reactive adaptation to some external shocks or opportunity, flexibility signals processes of enactment in which new knowledge is actively sought either for its own sake, or to resolve a specific organizational problem (Miner et al., 2001). The tension between continuing with the known past and trying something completely new leads an organization to “work with the unexpected” (Weick, 1998: p.544). The organization must be simultaneously capable of exploiting existing knowledge and capabilities while exploring new opportunities (Birkinshaw and Gibson, 2004). While prior experience must inform subsequent action, it should not constrain it by developing into core rigidities (Leonard-Barton, 1992) or competency traps (Levitt and March, 1988).

With respect to R&D consortia formation, we expect that firms that are more flexible will exhibit higher rates of switching between formation processes. These firms are likely to have cultures, systems and procedures that are conducive to experimentation and encourage change and path independence. While a number of organizational and environmental characteristics may influence the propensity to try new things, research has repeatedly linked firm size and slack resources associated with the propensity of a firm to engage in organizational change (e.g., Chattopadhyay, Glick and Huber, 2001; Lant and Mezias, 1992). The relationships for both slack resources (e.g., Nohria and Gulati, 1996; George, 2005) and for firm size (e.g., Almeida, Dokko and Rosenkopf, 2003) to organizational actions and outcomes, such as search patterns or learning, are not simple ones but often interact with age or experience. We therefore argue that flexibility will come from the interaction of firm size or slack resources with experience.

Smaller firms are expected to be more flexible, innovative and able to take more risks. Smaller firms are less constrained by the demands of customers and expectations of suppliers. Firms with fewer employees are also subject to less organizational inertia because the routines are embedded within fewer individuals, and change efforts take less time to impact the entire organization. Therefore, we expect that organizational size in terms of number of employees will be inversely related to flexibility in consortium formation processes.

Change and experimentation imply uncertainty and risk. Firms that have greater slack resources available to them usually have a greater discretion in managerial decision-making (e.g., George, 2005). This discretion facilitates organizational adjustments to environmental turbulence and supports creating new capabilities (Nohria and Gulati, 1996). Since it is easier for managers to take risks when resources are plentiful, we can expect that firms with more financial freedom in the form of slack resources will be more likely to experiment with alternative consortium formation processes.

The literature suggests that although flexibility allows firms to break away from established routines, paradoxically experience is an important resource upon which individuals, groups, and entire organizations can draw when improvising new solutions (Miner et al., 2001; Weick, 1998). Prior practices serve as referents by providing both inspiration and constraint for subsequent actions (Miner et al., 2001). Therefore, while experimentation and improvisation may be characterized as exploratory 'probes into the future' (Brown and Eisenhardt, 1995), we can expect that these efforts are influenced by prior experience. However, the influence of the past differs from replication. In flexibility, prior experiences provide only a jumping off point for further exploration and innovation through reinterpretation, embellishment or variation (Weick, 1998).

Thus, prior experiences provide a basis for developing new responses or routines (Brown and Esienhardt, 1995; Miner et al., 1998; Weick, 1998). Flexibility will be a joint function of organizational properties that lead to path independence or improvisation and of the organization's prior experience with R&D consortium formation processes. We can expect that smaller firms with more experience will be more flexible than larger firms. Furthermore, experienced firms with more slack resources will be more flexible than those with fewer slack resources. This suggests the following pair of hypotheses:

Hypothesis 3a: There will be a negative interaction between prior experience with R&D consortia formation and organizational size that will decrease the probability of flexibility in formation processes.

Hypothesis 3b: There will be a positive interaction between prior experience with R&D consortia formation and slack resources that will increase the probability of flexibility in formation processes.

4. Data and Methods

In order to test the study's hypotheses, we use a three-stage research design that includes data collection from multiple primary and secondary sources. Preliminary analysis involved identifying the formation processes of a sample of 53 R&D consortia from primary data used in Doz et al. (2000). This was followed by developing a set of proxy variables to indicate the formation process for 737 R&D consortia formed between 1984 and 2005. In the final stage we test this study's hypotheses using the sample of 737 R&D consortia and 1063 firms.

The preliminary analysis used data reported in Doz et al. (2000). That dataset consisted of detailed information on the formation process of 53 R&D consortia. Doz et al. (2000) used partial least squares (PLS) analysis to identify the key characteristics of the consortium formation process. Through PLS, five stages were identified: (1) the presence of a triggering entity; (2) seeking domain consensus; (3) the open solicitation of members; (4) member expectations for continuity; and (5) formal alliance structure. As reported by Doz et al. (2000) each stage consisted of several different constructs, which were in turn each derived from a number of different variables. Although the authors used these data to identify the two paths of emergent and engineered formation processes, they did not evaluate whether a particular formation process was emergent or engineered. For our study, we first wanted to know if a particular consortium formation was emergent or engineered. To develop a single score reflecting the formation process, we used the Doz et al. (2000) data. We calculated a consortium's weighted value for each of the five formation stages and then rescaled the scores from 1=emergent and 2=engineered. After doing this for each stage, we then averaged each consortium's scores for the five stages to derive a single score, which was between 1 and 2. In order to conduct the next stage of our analysis, we then rounded the single score to either a 1 or a 2. Thus, each of the 53 consortia was categorized as either emergent (scored as 1) or engineered (scored as 2), according to the average of its factor scores. Of the 53 consortia, 32 were classified as "engineered" and 21 as "emergent."

Next, we used discriminant analysis to identify proxy variables for consortium formation process. We examined a wide range of potential discriminating variables from the industry, consortium and firm level of analysis. All of these variables were tested in a discriminant model with the consortium formation process as the dependent variable. The analysis correctly classified 79 percent of the consortia, an improvement of almost 30 percent over chance. Press's Q statistic, an indicator of classification accuracy, is also significant ($\chi^2 = 12.736$, 1 d.f., $p<.01$).

This discriminant function was then used to infer the formation processes for our sample of 946 R&D consortia formed between 1984 and 2005. In order to reduce the likelihood of misclassification we eliminated the 22 percent of consortia for which the joining process was most ambiguous, reducing the number of consortia in the sample from 946 to 737. Thus, 295 emergent and 442 engineered consortia were identified, representing a total of 1775 (47.1%) individual joining events for emergent consortia and 1992 (52.9%) individual joining events for engineered consortia. We used these data to analyze the study's hypotheses. The sample for this stage of our analysis was the 3767 individual joining decisions of 1063 companies that joined one or more of the 737 R&D consortia.

4.1 Dependent variables

For hypotheses 1a and 1b, which address replication, the dependent variable is joining of each type of consortium. The joining event is coded 1 for joining an emergent formation process and 2 for joining an engineered formation process. The data for this variable are obtained from the preliminary stages of the analysis.

Hypothesis 2a and 2b are concerned with adaptation, where decisions to join reflect a change in an existing dominant routine. The question arises, what is the number of episodes of a particular activity that must occur before a routine can be said to be established? Clearly, one event is not a routine. Two occurrences of the same event must be an absolute minimum requirement to be called a routine. However, to be consistent with the theory that consortium formation capabilities are heterogeneous in a population of firms, we would expect that only a minority of firms in the sample could have built such a capability. As the average number of joining events in this sample is 2.8, three events represent an above average number of consortium joining decisions by a firm. Therefore, we operationalize a dominant consortium formation routine as occurring when a firm has a history of at least three consortium joining episodes involving a single process *and* no experience with the alternative process. Switching can occur from emergent to engineered, or from engineered to emergent. In both cases, the switching variable is coded as 1 for switch, or 0 for no switch. Data limitations, resulting partly from our conservative definition of a routine, mean empirically separating the direction of routine switching results in a sample that is too small. However, as we have no specific hypotheses regarding the direction of the routine switch, the more conservative definition of routine is desirable.

Hypotheses 3a and 3b are concerned with the antecedents of flexibility. We operationalize this as frequent switching of consortium joining process. Firms that are flexible are not constrained by existing routines and can make frequent switches between formation types. Flexibility is measured by the cumulative number of switches between routines made by each firm in the period.

4.2 Independent variables

Prior formation experience. This variable measures an organization's accumulated past experience with the formation processes. For every firm, this involved a frequency count of joining experiences in emergent and engineered consortia for each year in the study. These frequencies were summed in a cumulative total for each year from 1984 to 2005 so that for each year, a running total of the frequency of experiences with each formation process was created. For hypotheses 3a and 3b the firm cumulative experience with both formation processes was combined into a single measure of firm joining experience.

Industry cumulative experience. This variable indicates the extent to which other firms in the industry are also joining R&D consortia through either emergent or engineered processes. Because the *U.S. Federal Register* provides a comprehensive source for records of legitimate R&D consortia in the U.S., our sample from 1984 to 2005 also should be comprehensive regarding the number of firms from each industry that join these consortia. Therefore, our measure involves a frequency count of the consortium joining activities of all firms from each industry. We measured industry using the four digit SIC. As a result, 212 industries were represented in this study. A separate measure was created for each type of experience (i.e., industry experience with emergent consortia and with engineered consortia).

Environmental Dynamism. We operationalize the dynamism of the industry using a classification of high technology versus non high technology. High technology is defined in terms of whether an industry on average makes R&D investments that exceed five percent of sales. We also crosschecked this definition with lists published by the American Electronics Association, Bureau of the Census, Bureau of Labor Statistics, and the Organization for Economic Cooperation and Development. We coded an industry as high technology when it was identified as such by at least four out of these five sources.

In recognition that high technology firms are considerably heterogeneous in their technology, knowledge base, time frames for innovation and product development, and regimes for knowledge appropriation and spillover (e.g., Kodama, 1992; Kotabe and Swan, 1995), we further divided the high technology classification into three groups: high technology services including software manufacturers, technology consultants, and contract research organizations (technology service firms); high technology manufacturers of products assembled primarily from electronic and mechanical components (mechanical technology firms), and high technology manufacturers of products created at a molecular level, including biotechnology, pharmaceutical and chemical products (biochemical technology firms). While mechanical technology firms exhibit shorter product development cycles, they also suffer from weaker patent protection and have to deal with higher risks and opportunities from knowledge spillovers. In contrast biochemical technology firms tend to have longer development cycles, with far stronger patent protections and consequently more limited risks of knowledge spillover. By distinguishing among these various forms of high technology firms we are explicitly acknowledging that there are qualitatively different competitive dynamics and technological trajectories, which may influence adaptation. A dummy variable coded 1 for mechanical technology firms, 2 for biochemical technology firms, and 3 for technology service firms. The comparison variable for all three groups is non-high technology firms.

Company Size. For hypotheses 1a, 1b, 2a and 2b, company size is a control variable, and is operationalized as the number of employees for each year of the study. We obtained our data from Standard & Poor's *Research Insight* database. For hypotheses 3a and 3b we use hierarchical regression analysis. Therefore, for this last analysis we take an average of the log of the number of employees across the period 1984 to 2005.

Slack Resources. This variable is measured as the current ratio, for each year of the study. We obtained data on each firm's current assets and current liabilities from the Standard & Poor's *Research Insight* database.

For hypotheses 1a, 1b, 2a and 2b, slack resources are treated as a control variable. For hypotheses 3a and 3b, in which we use hierarchical regression, slack resources are a variable of interest and we create an average value for the period under study.

Interaction term: cumulative experience by organizational size; cumulative experience by slack resources. For the hypothesized interaction terms we multiply each firm's cumulative experience with all forms of consortia by its size, and its average slack resources. These variables therefore combine data from the Standard & Poors *Research Insight* database with that obtained from the *U.S. Federal Register.*

Control variables. In order to examine more carefully the determinants of each of the three patterns, we include the other independent variables in each model. Therefore, in hypothesis 1a, and 1b where we examine the effects of company prior experience, we also include controls for company size, slack resources, industry type and industry cumulative experience with the two formation processes. In hypothesis 2a and 2b, we focus on the effect of industry and environment on adaptation. We therefore control for company size, slack resources, and the cumulative experience of the firm with each formation process. Finally, in hypotheses 3a and 3b we focus on how firm characteristics individually and combined with prior experience influence flexibility. We therefore control for the effect of cumulative industry experience on learning behaviors. In addition, for hypotheses 3a and 3b we control for total assets. This was measured as the log of total assets, averaged for the period of the study. These data were obtained from Standard & Poor's *Research Insight* database.

4.3 Analysis

We evaluated the hypotheses using event history analysis and hierarchical regression analysis. The event history model used is a Cox proportional hazards regression model with time dependent covariates (Allison, 1984). In this model, the dependent variable is each firm's decision to join a consortium. This event can be described in one of three alternative states:

an emergent vs. engineered vs. no consortium formation process. Each decision to join is treated as an independent observation in this analysis, allowing a firm to be observed more than once if it joins multiple consortia during the period of the study. As we have hypothesized that prior experience has an important influence on subsequent decisions, the assumption of independence of dependent variables is violated. However, by directly including prior experiences as an independent variable in the model, this problem is mitigated (Allison, 1984).

The Cox model with time dependent covariates allows the inclusion of independent variables that change in value in each time period. An important concern when using event history analysis is left and right censoring, in which one or more occurrence of the event of interest is not included within the sample either because they occurred before data gathering began, or after it was concluded. Our sample includes the first joiners for every consortium, thereby eliminating the problem of left censoring. Furthermore, there is no firm in the sample that does not join either an emergent or an engineered consortium at some point during the study period, thus eliminating the problem of right censoring. For hypotheses 1a and 1b, two separate Cox regression models are examined, one assessing the proportional hazard rate for the decision to join an emergent consortium, and the second to assess the proportional hazard rate for the decision to join an engineered consortium. For hypotheses 2a and 2b, a single model is constructed examining the decision to switch from a dominant routine for consortium formation.

A limitation of the Cox model is its inability to accept missing data. This can become problematic when dealing with a dataset including so many firms over a 22-year period with variables drawn from multiple secondary sources. In particular, limitations arise because firms were either not in existence at the beginning of the period, or no longer in existence at the end of this period. To mitigate this problem, we have split the dataset into two equal time periods, 1986-1995 and 1996-2005. This approach has the added benefit of ascertaining the stability of results across the two periods.

To ensure that dividing the dataset did not substantively change the results, we have also analyzed the complete dataset. Because of space constraints we report the results for the divided dataset here. The unreported results are available from the authors upon request.

5. Results

Our first pair of hypotheses (1a and 1b) suggest that firms' accumulated prior experiences with a particular consortium formation process are associated with an increased probability of subsequent consortium formation though the same process. The results of the analyses are presented in Tables 2a to 2b.

Table 2a: Results for 1986-1995 (for joining an emergent consortium)

Determinants	Model 1 Exp(B)	Model 2 Exp(B)	Model 3 Exp(B)
Size	1.000	1.000	1.000
Slack	1.000***	1.000***	1.000***
Industry			
Type m	0.946	0.934	0.756
Type b	0.998	0.986	0.853
Type s	1.177	1.141	1.231
Industry experience engineered	0.969***	0.980	1.001
Industry experience emergent	1.008	1.004	0.982
History of Joining Engineered Consortia		0.909*	0.828***
History of Joining Emergent Consortia			1.080***
Chi-square	24.218***	29.158***	50.639***
Change in Chi-Square		4.581*	23.818***

Note: *** p<.001; ** p<.01; *p<.05

Table 2b: Results for 1996-2005 (for joining an emergent consortium)

Determinants	Model 1 Exp(B)	Model 2 Exp(B)	Model 3 Exp(B)
Size	1.000	1.000	1.000
Slack	1.000	1.000	1.000
Industry			
Type m	1.054	1.092	1.142
Type b	0.747	0.750	0.756
Type s	0.000	0.000	0.000
Industry experience engineered	1.058***	1.046***	1.021
Industry experience emergent	0.942***	0.962***	0.985
History of Joining Emergent Consortia		0.915***	0.872***
History of Joining Engineered Consortia			1.271***
Chi-square	65.777***	76.589***	96.287***
Change in Chi-Square		12.435***	22.875***

Table 2a presents the results for the Cox regression of joining an emergent consortium in the period 1986 to 1995. In model 1, we enter the control variables for firm size, slack resources, and industry type. We note that the coefficients for slack resources and industry accumulated experience with engineered consortia formation processes are significant. In model 2 we introduce the individual firms' accumulated experience with joining engineered consortia. The effect of prior experience, at the firm level, with engineered consortium formation reduces the probability of forming a consortium through emergent processes by close to 10 percent for every additional unit of firm experience (one unit for each joining event). In model 3 we introduce firm accumulated experience with forming emergent consortia. The coefficient for this variable indicates that for every additional prior experience with this type of consortium increases the probability that a firm will form a new consortium through this process by 8 percent. Table 2b repeats the analysis for the period 1996-2005. The results parallel those in the earlier time period. Most importantly, while accumulated experience at the firm level with the formation of engineered consortia is unrelated, the results indicate that each prior experience with emergent consortium formation increases the probability of joining another consortium using this method by nearly 5 percent.

Table 3a summarizes the results for our analysis of engineered consortium formation activities during the period 1986 to 1995. These results mirror those for emergent consortia. Specifically, firm level experience with emergent consortia reduces the probability of joining consortia through engineered processes by 8.5 percent. In model 3, firm experience with joining engineered consortia accounts for a significant 27 percent increase in the probability that a firm will join another consortium through an engineered process. We repeat the same analysis for the period 1996-2005 (Table 3b). The results are consistent with the previous period. Each additional unit of experience with joining emergent consortia reduces the probability of forming an engineered consortium by 3 percent. In contrast, the effect of each unit of prior joining experience for engineered consortia is to increase the probability of forming future consortia through this process by close to 20 percent.

Table 3a: Results for 1986-1995 (for joining an engineered consortium)

Determinants	Model 1 Exp(B)	Model 2 Exp(B)	Model 3 Exp(B)
Size	1.000	1.000	1.000
Slack	1.000***	1.000***	1.000***
Industry			
Type m	1.232	1.233	1.159
Type b	1.068	1.070	1.018
Type s	2.034***	2.132***	2.307***
Industry experience engineered	0.992	0.989*	1.000
Industry experience emergent	1.005	1.006	0.992
History of Joining Engineered Consortia		1.030	0.954
History of Joining Emergent Consortia			1.048***
Chi-square	50.158***	51.562***	67.846***
Change in Chi-Square		3.042	14.900***

Note: *** p<.001; ** p<.01; *p<.05

Table 3b: Results for 1996-2005 (for joining an engineered consortium)

Determinants	Model 1 Exp(B)	Model 2 Exp(B)	Model 3 Exp(B)
Size	1.000	1.000	1.000
Slack	1.000	1.000	1.000
Industry			
Type m	1.045	1.043	1.065
Type b	1.018	1.009	1.005
Type s	0.000	0.000	0.000
Industry experience engineered	1.024***	1.019***	1.004
Industry experience emergent	0.973***	0.981*	0.996
History of Joining Emergent Consortia		0.970**	0.903***
History of Joining Engineered Consortia			1.199***
Chi-square	20.335***	27.755***	46.578***
Change in Chi-Square		6.368**	20.291***

Note: *** p<.001; ** p<.01; *p<.05

Taken together, these results strongly support the replication hypotheses -- 1a and 1b – which argue that prior experience significantly predicts the development of capabilities for forming new R&D consortia. Furthermore, the evidence is quite clear that experience with each formation type does not generalize to the alternative formation type. This suggests that these two formation processes are distinct in terms of the knowledge and capabilities that are developed.

Hypotheses 2a and 2b suggest that adaptation will occur when external stimuli cause firms to override existing dominant routines. Table 4 summarizes the results of the Cox regression analysis of external stimuli on the decision to switch from one formation process routine to another. The first two columns present the results for the period 1986-1995 and the second pair of columns presents the results for 1996-2005. In model 1a, we introduce the control variables of firm characteristics and firm level accumulated experience. We note that several of the individual coefficients are significant, including firm accumulated history in both engineered and emergent consortia, which both substantially increase the probability of switching. This result may be caused by our definition of the dependent variable - switching formation process – as occurring after more than three prior joining events in either of the processes. Only firms with an above average number of joining experiences in a single formation process will be able to switch routine by definition.

Table 4: The effect of environmental stimuli on the development of capabilities

Determinants	1986-1995 Model 1a Exp(B)	1986-1995 Model 1b Exp(B)	1996-2005 Model 2a Exp(B)	1996-2005 Model 2b Exp(B)
Size	1.000***	1.000***	1.000***	1.000***
Slack	1.000	1.000	1.000	1.000
History of Joining Engineered Consortia	1.879***	2.122***	1.172***	1.431***
History of Joining Emergent Consortia	1.128***	1.126***	1.017*	0.957***
Industry				
Type m		0.888		2.674***
Type b		1.909***		1.579@
Type s		0.199***		
Industry experience engineered		0.969***		0.950***
Industry experience emergent		1.031***		1.049***
Chi-square	139.209***	162.014***	263.315***	294.759***
Change in Chi-Square		41.364***		61.901***

Note: *** p<.001; ** p<.01; *p<.05; @ p<.10

In model 1b, we add the influence of industry type, and industry level accumulated experience with emergent and engineered consortium formation process. The inclusion of the external stimulus variables adds significantly to the power of the model. In comparison to the low-technology firms, firms in a high technology manufacturing environment are not significantly more likely to switch consortia joining routines. However, bio-chemical technology firms were significantly more likely to switch routines than low technology firms. The coefficient indicates that firms in bio-chemical industries are 90 percent more likely to switch routines than firms in low-technology industry environments. For firms in high technology service industries we find that it is 80 percent less likely that these firms will switch routines in comparison to low technology firms.

Models 2a and 2b repeat this analysis for the period 1996-2005. In this second period, the addition of the environmental stimulus variables again contribute significantly to the explanation of routine switching even after controlling for firm experience and other characteristics. In this second period, we find that firms in high technology manufacturing industries are 167 percent more likely to switch their dominant routines than are low technology firms. Although only marginally statistically significant, it is 58 percent more likely that firms in biochemical technology industries will switch than will low technology firms. With respect to the extent to which other firms in the industry are joining each type of consortium, we observe that each time a firm in the same industry joins an engineered consortium, it reduces the chance of switching by five percent. Each time a firm in the same industry joins an emergent consortium, it increases the probability of switching routines by five percent.

To summarize, results support hypotheses - 2a and 2b - that external environmental stimuli lead to adaptation in the consortium formation process. Interestingly, the extent to which other firms in the same industry are joining engineered versus emergent consortia appears to have opposite effects. Industry rates of engineered consortium formation appear to reduce the likelihood of switching, while industry rates for emergent consortium formation increase switching activities.

Hypotheses 3a and 3b suggest that firm size and slack resources interact with accumulated experience to increase the probability of flexibility, defined as frequent switching of formation processes. Table 5 presents the results of the hierarchical regression analysis.

Model 1, which includes the control variables only, is significant. However, only assets are significantly related to routine switching. In model 2, the main effect variables are added and explain a significant amount of additional variance in routine switching. There are non-significant main effects for company size and slack resources and a significant main effect for slack resources.

Table 5: Regression analysis of firm characteristics on improvisational routine switching

Variables	Model 1	Model 2	Model 3	Model 4
Log Assets	0.158***	0.094	0.063	0.063
Industry cumulative experience with emergent consortia	0.16	-0.33	-.080	-.055
Industry cumulative experience with engineered consortia	0.228	0.167	0.205	0.191
Industry type – mechanical	-0.066	-0.056	-0.051	-0.063
Industry type – biological	-0.015	-0.011	0.005	-0.015
Industry type - service	-0.095	-0.046	-0.038	-0.047
Company size – log employees		-0.029	0.369***	0.027
Slack resources - Current Ratio		0.008	-0.008	-0.424***
Company cumulative experience with all forms of consortia		0.415***	1.324***	-0.081
Company size x total company experience			-1.115***	
Slack resources x total company experience				0.679***
Adjusted R^2	.046	.199	.308	.245
F-value	4.943***	14.533***	22.777***	16.902***
ΔR^2		0.156	0.108	0.047
F-Value for ΔR^2		31.821***	76.418***	30.254***

Note: *** p<.001; ** p<.01; *p<.05

In model 3, we assess the effect of an interaction between company size and total company experience with consortium formation processes on routine switching. The inclusion of the interaction term explains a significant amount of additional variance in routine switching. Consistent with hypothesis 3a, the interaction between organizational size and company experience of consortium formation is negative and significantly related to routine switching. Finally, in model 4, we assess the interaction between slack resources and total company experience with consortium formation processes on routine switching. The inclusion of the interaction term explains a significant amount of additional variance in routine switching. Consistent with hypothesis 3b, we observe a positive and significant interaction effect between organizational slack resources and company experience on routine switching. These results together provide support for hypotheses 3a and 3b concerning the influence of organizational characteristics on flexibility. Furthermore, the hypothesized interaction between experience and organizational factors that support (or inhibit) flexibility are both present in the expected directions. In the next section, we will discuss the implications of our results.

6. Discussion

In this study we have sought to extend the understanding of how firms build the capability for forming strategic alliances. Using data on R&D consortia formation processes, we explored the conditions when a firm is likely to replicate an existing formation process, adapt to a new formation process, or demonstrate flexibility between different formation processes. Our study reveals support for all three approaches to alliance capability development and the conditions under which theory predicts each can be expected to occur.

It has been widely argued that with experience over time, organizations tend to develop and refine their standard operating procedures and routines, align their strategies and capabilities. This is a central and perhaps inevitable feature of organizational life that results from the natural characteristics of bounded human rationality and the resulting local search for satisfactory solutions. The empirical evidence developed in this study confirms the significance of replication for the development of a capability for R&D consortium formation. The results unambiguously demonstrate that for every additional year of experience with a particular formation process, there is a significant increase (between 5 and 27 percent) in the probability of joining another consortium formed through the same process. This effect is achieved after controlling for the other firm, industry and environmental factors hypothesized to impact the development of consortia ties.

Further strong evidence in support of this hypothesis is the fact that the effect of prior experience is specific to the type of formation process being used. Experience with the alternative formation process is significantly negatively related to subsequent formation processes. That is, there is a significant 1 and 6 percent *decrease* in the probability of formation of a consortium through a given process, for every additional year of experience with membership in a consortium formed through the alternative process. These results provide unique and powerful evidence for the importance of prior experience on capability development.

If replication is consistent with exploitation and path dependence in organizational innovation, the case of exploration and path breaking can be represented by adaptation. Adaptation, defined as a change in behavior occurring in response to some external stimulus, represents an important aspect of exploration in organizational innovation. As firms are exposed to increasing levels of external stimuli that suggest (or necessitate) new organizational responses, the probability of a routine breaking organizational innovation will increase. Our study provides evidence of a significant increase in routine breaking organizational innovation in response to the industry level of experience with R&D consortia formed through emergent processes. This reflects the notion of embeddedness with respect to an industry (Hagedoorn, 2006). In particular, where other firms in the industry are building experience with R&D consortium formation, this increases the exposure of the focal firm to these organizational innovations and increases the probability that adaptive processes will occur. In addition, firms that are operating in more dynamic environments, such as high technology industries, are also likely to be exposed to more frequent stimuli for adaptation. Our results are generally supportive of the presence of this change. We find evidence that for firms in each of the high technology sectors relative to low-technology industries there is typically an increase in the probability of adaptation. It appears that adaptive processes, which lead to the development of new organizational capabilities, find significant stimuli in industry and environmental conditions.

Finally, we have suggested that flexibility will be indicated by a pattern of consortium formation that does not reflect the presence of a single dominant approach. Some firms can engage in forms of improvisational learning or path independence that take advantage of prior experience, without being bound by it. These firms are able to develop new capabilities as well as continuing to refine existing ones, and thus avoid the problem of the competency trap. We have argued that organizations that are smaller in terms of the number of employees, and those which have greater slack resources are among those more likely to not be constrained by routines and to switch frequently between formation types. However, consistent with the view that even improvisation is enhanced by experience (Weick, 1998), we find that prior history of consortium formation is necessary to limit the negative influence of organizational size and enhance the positive influence of slack resources on improvisational learning.

Our paper makes several significant contributions to our understanding of strategic alliances. First, our study extends alliance capability research to examine formation processes. Prior research has not considered the development of the skills related to managing the formation process of an alliance. The differential impact of the two formation process experiences on subsequent formation processes supports our contention that emergent and engineered formation processes require different skill sets. Further, by analyzing data representing the formation of R&D consortia over a 22-year period, we find that not only are these separate processes but the presence of each in the industry has a unique affect on subsequent formation processes and the development of alliance capabilities. Future research should explore in a finer grain analysis the specific capabilities associated with each formation process and the specific learning mechanisms that are used to transfer the lessons learned in one formation process to another. Related to this, our study reveals that that the development of alliance formation process capability is influenced by replication, adaptability and learning. These findings extend recent efforts towards understanding the evolution of alliance portfolios as the result of a complex interaction of multiple influences (e.g., Lavie and Singh, 2011) to the formation capability. Future research into alliance capability should begin to explore the dynamic relationship among these three influences. Our research also extends alliance formation process research by considering multiple formations. Expanding the analysis to more than one formation confirms that a subsequent formation process is affected by earlier formations, but the relationship is also influenced directly and indirectly by internal and external factors.

This research is not without limitations. Our reliance on secondary sources for firm level data has required that we focus only on publicly traded firms. Therefore, our results should be generalized to other organizations only with caution. Related, using secondary data does not permit us to investigate the internal organizational actions associated with alliance formation process learning and differentiate those from actions related to path dependence. Future research should attempt to tease apart differences among these explanations for alliance formation process capability. Second, we focused only on the formation processes of those firms that joined consortia in the first year of operation. This deliberate choice enabled us to exclude organizations that may have joined for reasons other than those that we have explored here. It is possible, in fact likely, that there are other processes such as imitation, which would be strongly indicated by an examination of the patterns of consortium joining behavior over time. This will make an interesting topic for future research. Limitations of the Cox regression model with respect to missing data also led us to exclude a large number of observations. Missing data is an inevitable problem in a study conducted over a 22-year period and involving multiple secondary data sources. The large remaining sample size, and the robust support from conducting two separate analyses leads us to believe that this problem should not be overstated however.

A number of additional future research directions are worth examining. Not least of these is the issue of how patterns of capability development may unfold over time and how the three approaches interact. Further research, and conceptualization, is required on the issue of whether flexibility is something that involves simultaneous exploration and exploitation, or a process of punctuated equilibrium in which long periods of exploitation are followed by brief periods of exploration (Gupta et al., 2006). Perhaps flexibility can take either form, and the result depends on contingencies such as the type of organizational change that is being considered. A further avenue for research is the question, unanswered in the present study, of whether these three patterns of capability development are as important to an organization as the content of the alliance portfolio. Future research should consider the impact of the formation process capability upon relevant performance outcomes.

This study examined three approaches towards building a capability for alliance formation processes – replication, adaptation, and flexibility. Our empirical study has provided initial support for each of these ideas. We hope that this also provides insights into the multiple levels of factors influencing organizational learning and path dependence. Organizations are embedded not only in their environments, but also in their own past. Firms that are able to build from their experience, their industry knowledge and their environment are rare, but these organizations may have a distinct advantage for developing alliance capability and use this ability to find and build successful cooperative relationships.

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