Seoul Journal of Business
Volume 18, Number 2 (December 2012)

The Hazards of Leapfrog: Search Routines for Alliance Partner and Evolution of Organizational Capabilities*

JONGHOON BAE**
Seoul National University
Seoul, Korea

Abstract

This study presents an evolutionary model of capability development and examines the role of strategic alliance in the evolution of organizational capabilities. In particular, this study begins with the observation that each alliance partner's capability development co-evolves. This study contributes to the literature on capability development by showing the following: (1) a firm's strategic alliance is 'fitness-enhancing' when its partners' learning is 'ineffective'; (2) without making additional efforts (i.e., in-house development), a firm is able to employ strategic alliances and to balance between exploitation and exploration to the extent that its (potential) partners are not effective learners; and (3) a firm is unlikely to balance between exploitation and exploration to the extent that its (potential) partners are effective learners.

Keywords: Exploration, Search, Capability Development, and Co-evolution

INTRODUCTION

The ways of developing organizational capabilities are diverse, including in-house development, technology licensing, mergers and acquisitions. With a concern for cooperative interfirm rela-

* This study was supported by the Institute of Management Research at Seoul National University. The author deeply appreciates valuable comments and suggestions from two anonymous reviewers.

** Seoul National University, Graduate School of Business (58-509), Seoul 151-916, South Korea, Tel: + 82 – 2 – 880 2553, e-mail: jbae01@ snu.ac.kr

tions as a source of competitive advantage (Uzzi 1997; Kogut 2000), organization researchers have long recognized strategic alliances, such as joint ventures and R&D agreements, as an important way to develop organizational capabilities (Dussauge et al. 2000; Dyer and Singh 1998; Hamel et al. 1989). While the literature has vindicated the role of strategic alliances in the development of organizational capabilities (Bae and Gargiulo 2004; Hagedoorn, Lin and Vonortas 2000; Lavie 2007; Mowery, Oxley and Silverman 1996; Rothaermel and Deeds 2004; Sampson 2005; Stuart 2000), one important limitation exists in interpreting these findings: the developmental outcome for one partner in an alliance cannot be fully understood in isolation from that of the others.

As is well illustrated in Red Queen process (Barnett and Hansen 1996), each partner's capability development co-evolves. For example, the room for learning from partners depends on what these partners know and will know. Hence, the evolutionary change of organizational capabilities is reciprocal between interacting partners in alliances. However, little research draws on models or theories that capture strategic interdependence between alliance partners in the course of capability development.

To address this limitation, this paper employs an evolutionary model of capability development and examines the role of strategic alliances in the evolution of organizational capabilities. In particular, this study construes the fitness of a firm's capabilities as the probability that the capabilities of a given type in a given period are favored and thus selected by the market in the subsequent period. It also views strategic alliances as a form of routines to search for external capabilities, namely, search routines. With the concepts of fitness and search routine, this study contributes to the literature on capability development by showing the following: (1) a firm's strategic alliance is 'fitness-enhancing' when its partners' learning is 'ineffective'. In particular, a firm's own balance in capability development between exploitation and exploration is subject to the outcome of search engaged by its partners in the market, measured by the extent of capability heterogeneity among partners; (2) without making additional efforts (i.e., in-house development), a firm is able to employ strategic alliances and to balance between exploitation and exploration to the extent that its (potential) partners are not effective learners, i.e., engage heavily in local search, commonly observed in an emerging market; and (3) a firm is unlikely to balance

between exploitation and exploration to the extent that its (potential) partners are effective learners, i.e., engage heavily in distant search, commonly observed in a perfectly competitive market. Accordingly, without making additional efforts, the firm may fail to balance between exploitation and exploration because the current market may not select such balancing of exploitation and exploration. The firm may exploit only the best practice available, thus becoming similar to its (potential) partners.

AN EVOLUTIONARY MODEL FOR SEARCH ROUTINES

Search Routine as a Behavioral Rule

As Cyert and March (1963) pointed out, the firm is a political coalition of boundedly rational individuals, including managers who run directly the firm and customers who fund indirectly the firm. The coalition membership is neither clear nor stable because some members are more important than the others in defining the membership. That's why much attention is given to the role of leadership or authority in stabilizing the coalition membership (e.g. Simon 1957). Given that the coalition members change over time through turnover or recruitment, however, the attributes of individuals may not reflect a stable aspect of the firm. What is stable with the firm is then a flow of decisions made by the major coalition members – a firm's routines.

Routines are behavioral rules, which refer to a repetitive pattern of activity inside the firm (Cohen and Bacdayan 1994; Cyert and March 1963; March and Simon 1958; Nelson and Winter 1982; Levitt and March 1988; Rumelt 1984). While definitions concerning routines are diverse, a simple definition is a work procedure. In any organization, the interaction among individuals is guided by work procedures or manuals. The phrase, 'go by the book', refers to such interactions guided by manuals or work procedures. While researchers often fail to separate a firm's routines from its activities, it is important to distinguish between them. An activity is the actual flow of decisions that are stochastically drawn from a routine (Nelson and Winter 1982). The actual flow of decisions inside the firm is then a trace of routines activated. Such routines are also known as performance programs (March and Simon 1958), stan-

dard operating procedure (Cyert and March 1963) and the blueprint for the firm (Hannan and Freeman 1977). The types of routines are diverse, ranging from well-specified technical manual for production to company-wide policies regarding R&D. Among these routines, a search routine is a behavioral rule for changing the current routines by sampling alternative solutions from a firm's task environments.

Search Routine for Partner Selection

Firms compete for the profitable niches in the market while maintaining various exchange networks, including strategic alliances (Gulati et al. 2000; McConnell & Nantell, 1985; Pfeffer & Nowak, 1976; Porter, 1996). In a bid to remain competitive, firms carefully search for possible exchange partners; that is, they select new alliance partners and drop old ones to adapt to shifting demands (Hennart 1988; Kogut 1988). Owing to high uncertainty over the quality of potential partners, i.e., resources held by partners, firms employ bundles of search routines to select one party over the others. The literature on strategic alliances has identified a variety of such rules in the following three ways.

First, experience guides the selection of partners: two parties agree to exchange when they have previous experience of exchanges (Eisenhardt and Schoonhoven 1996; Gulati 1995); or when they know common third parties with whom they transacted before (Larson 1992). Direct experience with potential partners and third party referrals provide rich information on the resource of the partners while monitoring their opportunistic behavior. Hence, once economic relations develop, future transactions tend to be embedded in these relations and, in some cases, these cooperative relations grow into acquisitions or vertical integrations.

Second, power symmetry between partners guides partner selection (Chung et al. 2000). Market status and associated market power are critical to the inception of exchanges between two parties. Cooperation ensues when each party expects a fair division of cooperative outcomes, which is likely to occur when the market power of parties to an exchange is balanced (Bae 2011; Bae and Gargiulo 2004). In addition to market power, firms occupying similar market status are likely to depend on the same resources for survival (e.g., Freeman and Hannan 1983). This direct competition occasionally develops an incentive for cooperation.

Third, the exploration of new business opportunities directs the selection of partners (Baum et al. 2005; Beckman, Haunschild, and Phillips 2004; Lavie and Rosenkopf 2006; Rothaermel and Deeds 2004). Innovation often requires organizations to obtain resources that are not readily available from their existing partners. Cooperation between well established incumbents and unknown startups is a case in point.

From a social network perspective, the above mentioned search routines correspond to the following three types of search: relational, positional, and global search (Burt, 1982; Gulati and Gargiulo 1999; Watts, 2000). Relational search directs a firm's attention to a pool of organizations with which it has direct or indirect interactions (Gulati 1995), whereas positional search induces a firm to examine potential partners with which a focal organization shares the similar market status or power (Everett and Borgatti 1988; Leenders 1996; Marsden and Friedkin 1997). With respect to capabilities to obtain, relational and positional search routines have the same function: they both serve as the further exploitation of similar capabilities to the extent that firms of similar market positions exhibit similar capabilities. For example, POSCO in Korea and Nippon Steel Corporation in Japan, the most successful integrated steel makers, agreed to make a strategic alliance in 2000, covering from joint R&D investments to joint marketing efforts. Since they developed favorable relations over 30 years, the strategic alliance was apparently facilitated by relational search. In contrast, global search leads a focal organization to search beyond the current exchange partners (e.g., Bae et al. 2011). This type of search concerns the exploration of new capabilities. The strategic alliance between MCI and Yahoo is one example. Global search is also understood as cognitive search (Gavetti and Levinthal 2000), with which the firm evaluates alternatives on the basis of social/resource dissimilarity. For the simplicity of discussion, both relational and positional searches are denoted by c-search, and global search is denoted by d-search.

Capability Development and Partner Selection

Organizations learn and thus develop new capabilities in the course of cooperation. Organizational capabilities are not resources but a set of work processes that help the firm to solve its business problems (Bae and Kang 2010; Decarolis and Deeds 1999; Demsetz

1988; Foss 1996; Kogut and Zander 1992; Winter 1987). The direct consequence of strategic alliance is that parties to this cooperation combine their complementary resources, developing new capabilities either in the input market or in the output market (e.g., Sakakibara 1997). For example, R&D alliances may serve as expediting new product development, a capability in the input market, whereas marketing ones may help access new demand in an effective manner, a capability in the output market.

Moreover, parties to cooperation learn in order to cooperate better. Alliance participants are often encouraged to make specialized investments in a bid to coordinate effectively their decisions and investments. For example, one party opts for its partner's procedure for performance evaluation when it monitors the operation of their alliance. These partner-specific investments underlie the spillover of knowledge in strategic alliances, namely, learning from partners. Accordingly, firms develop new capabilities indirectly (Hamel et al. 1989; Kogut 1988; Watts 2001).

Directly or indirectly, alliance partners learn from each other. Hence, the decision rules for partner selection, i.e., search routine for partners, may determine the outcome of capability development. However, capability development or organizational learning via strategic alliance is not without limitation. First, by definition, organizational learning through alliances is directly related to the quality of resources held by alliance partners. Yet, the resources of partners are not fixed. Rather, each partner's capability development co-evolves (e.g., Kogut 2000). Hence, the evolutionary change of a firm's capabilities is limited by the changes in capabilities by its partners. Second, learning may not be perfect when partners lack in absorptive capacity to learn from each other (Cohen & Levinthal, 1990; Karim and Mitchell 2000). A firm's absorptive capacity includes a set of specialized skills and procedures for accelerating knowledge transfer between partners, i.e., routines for learning.

In short, strategic alliances are an important channel for capability development or organizational learning. Yet, their proposed effects are subject to two constraints, co-evolution of partners' capabilities and a focal firm's routines for learning. With this set-up, this paper examines the role of alliances in the evolution of organizational capabilities. In particular, this paper proposes an evolutionary model of capability development, which has the following characteristics. First, each firm opts for a specific search routine. Second, partners

learn from each other yet in a way that their respective search routine allows for. Lastly, organizational learning co-evolves to the extent that each partner develops new capabilities.

THE HAZRD OF LEADFROG

Evolution and Networks

Research on the evolution of exchange networks, as Zeggelink (1994) indicated, has heavily relied on the variants of Markov process. While being methodologically deterministic, i.e., no agency involved in the process, the transition matrix presumed by Markov process is a structure-generating rule, in which only the immediate history of interacting actors determines the subsequent state of these actors; and yet there is no room for individual actors to control the transition from one state to another. Alternatively, Markov process is path-dependent in that the future of interacting actors is subject to the history of their interaction, and, at the same time, it is path-independent in that a transition matrix is not affected by different states of interacting actors. As a result, a system of interacting actors, i.e., exchange network, reproduces itself over time without the explicit interruption of independent actors embedded within the network, an explanation that abstracts away the micro mechanism to guide individual behaviors.

However, this paper concerns the way that partners' unorganized efforts to develop individual capabilities lead to the co-evolution of their capabilities. Accordingly, it is necessary to endogenize agency – individual volitions – to model the evolution of organizational capabilities. This is why this study brings in the concept of search routine to the discussion of capability development. To this end, this study builds on Zeggelink (1994) and Boyd & Richerson (1985), especially, their evolution model with a predetermined transmission rule, and proposes an evolutionary model of capability development with a good emphasis of search routine. In particular, the firms in this model are assumed to behave with unique organizational capabilities, and they use different search routines for replicating or modifying their capabilities.

1. The set-up

As mentioned above, the developmental outcome for one partner in an alliance cannot be fully understood in isolation from that of the others. To capture this interdependency in capability development, this study seeks to model the recursive process of organizational learning where what one party learns from its partner depends on what its partner learns from others. The elements of the model are as follows.

(1) Organizational capabilities. Suppose there are two distinct types of organizational capabilities, α and β available in the market. Suppose that each organization in the market takes either of these two types of capabilities in any point in time. Rivals that compete for incompatible production systems would be a case in point. Of course, it is possible that an organization recombines the two types of capabilities and develops a novel one. For the interests of illustration, I make a rather restrictive assumption that an organization sustains either type of capabilities mentioned above. However, the structure of this set-up remains intact when one construes this novel type as another distinct type of capabilities, which emerge with a different probability, rather than a recombination of existing types, α and β.

(2) The fitness of capabilities. Fitness in this model is a relative concept and is characterized as the use-frequency of capabilities in the market, i.e., parameter 'v', which captures how many organizations opt for alpha capabilities. When alpha capabilities have a higher level of fitness than beta capabilities, a firm with alpha capabilities will outperform its rivals with beta capabilities. In other words, a firm with alpha capabilities will have a higher chance of surviving the market competition, thus remaining active in the subsequent periods. Hence, as competition unfolds over time, capabilities with a high fitness level are likely to be more frequent in the market than those with a low fitness level. In particular, a parameter, D, captures the relative advantage of alpha capabilities over beta capabilities, which varies between -1 and 1. When D is positive, alpha capabilities have a higher fitness level.

(3) Learning via strategic alliances. Organizations are supposed to develop their capabilities through strategic alliances such that they either exploit their existing capabilities or explore new capabilities by learning from their alliance partners. For each period, organizations are assumed to select (and thus search) only one

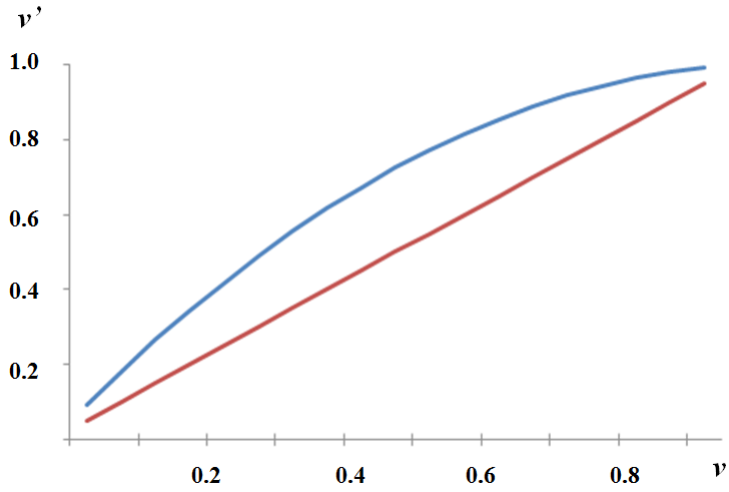
alliance partner. Note that in-house development, or self-learning, is construed also as an alliance where an organization selects itself as a partner. Given that each organization is allowed to take on either of the two types, the frequency of each type is equivalent to that of organizations that opt for a given type of capabilities. To keep tract of the evolution of capabilities, attention is given to the changes in the frequency of each type of capabilities in the market. The rule for organizational learning via strategic alliance is further detailed in Appendix.

(4) Search routine. A firm's search routine is characterized by a single parameter, i.e., the intensity of local search, D^*, which varies between zero and one. When this parameter gets closer to one, it means that a firm engages intensively in local search, which means that it selects a partner with similar capabilities and thus exploits its existing capabilities. When D^* is zero, a firm's search routine yields outcomes that are equivalent to ones when alliances are made at random. This means that each firm blindly enters alliances, whose competitive outcomes should reflect the variations in the fitness of capabilities available in the market. Moreover, organizations are assumed not to know ex ante which capability is more superior, but to know only after they learn from their partners. Lastly, the fitness (i.e., competitive advantage) of each type of capabilities is independent across time, which means that what is fittest today is not necessarily the fittest tomorrow. Accordingly, the formation of alliances is also independent across time.

2. A simple evolution of capabilities

This section begins with a baseline case of capability development, where alliances between two organizations occur at random and the two types of capabilities have identical fitness values. Note that the frequency of alpha capabilities at time $t + 1$ is (the probability of selecting a partner of certain capabilities at time t), multiplied by (the probability of learning certain capabilities from the partner at time t).

For example, when an organization that develops alpha capabilities selects its partner with beta capabilities, the frequency of alpha capabilities after organizational learning via alliances, v', is given by $v(1 - v)(1/2)$, where v is the frequency of alpha capabilities before organizational learning. In a similar vein, when an organization with alpha capabilities allies with one of the same alpha capabilities (or itself), the frequency is given by v^2. Taken together,



X axis is the frequency of type-alpha capabilities at time *t*. Y axis refers to the frequency of type-alpha capabilities at time $t + 1$. The 45 degree line refers to the temporal evolution in the frequency of type-alpha capabilities when alliances are made at random and each type capabilities have the identical fitness values, whereas the upper, curve refers to cases when the fitness of type alpha is larger than that of type beta. That is, $D = 0.8$.

Figure 1. Random Search and the Evolution of Capabilities with different Fitness Value

the frequency after organizational learning satisfies the following: $v' = v$ (it is because = $v' = v^2 + 2v(1 - v)(1/2)$). This means that the distribution of organizational capabilities in the market remain constant over time when organizational search for alliance partner is random and when the two types of capabilities are identical in fitness.

What if capabilities differ in fitness? A natural conjecture is that organizations compete for capabilities that have a better fitness value. Hence, every organization in the market would eventually end up with the same type of capabilities that are fittest. Suppose that the two types of capabilities differ such that capability α has a larger value of fitness (i.e., competitive advantage) than β by D, which varies from zero to one. Figure 1 illustrates the evolution of capabilities when D is positive.

X axis is the frequency of type-alpha capabilities at time t. Y axis

refers to the frequency of type-alpha capabilities at time t+1. As is noted in Appendix, the temporal variation in the frequency of alpha capabilities is expressed in the following way.

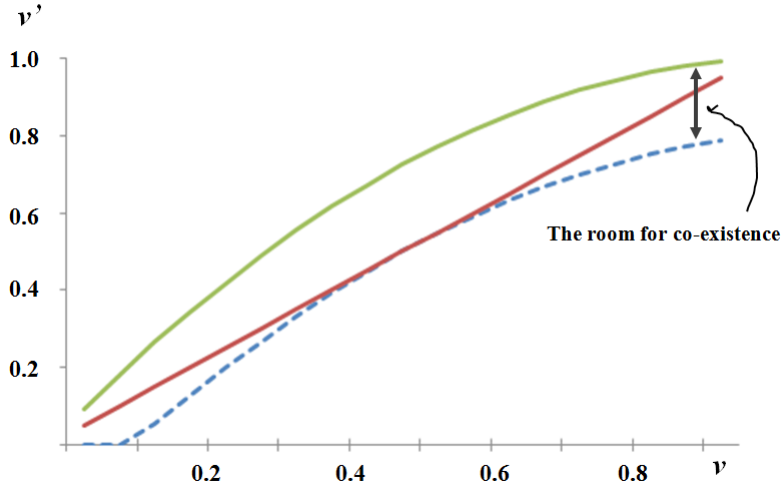
$$v' = v + Dv(1-v) - \frac{DD^*}{2}$$

Hence, the 45 degree line refers to the temporal evolution in the frequency of type-alpha capabilities when alliances are made at random and each type capabilities have the identical fitness values. In comparison, the upper, curve refers to cases when the fitness of type alpha is larger than that of type beta.

The evolution of capability development will be in equilibrium only when the frequency of alpha capabilities is either zero or one (**Claim 1**). That is, once one type of capabilities is fitter than the other, a single type of capabilities prevails in the market. The best practices whose fitness is known are readily adopted by organizations, an action that leads to organizational homogeneity with respect to their capabilities. In contrast, the frequency of α will remain constant if there is no additional fitness associated with α, i.e., $D = 0$.

In the preceding discussion, organizations do not have specific preferences over their alliance partners and draw their partners randomly from a pool of organizations in the market. Organization scholars have however noted that decision-making at the organization is guided by routines or standard operating procedures (Cyert & March, 1963; March & Simon, 1958; Nelson & Winter, 1982). Along this line, the selection of alliance partner is subject to these routines, c-search (namely local search) and d-search (also known as distant search).

In particular, organization scholars draw attention to local search, which states that organizations are likely to select others of comparable resources and capabilities (Baum, Calabrese, & Silverman, 2000; Beckman, Hanuschild, & Phillips, 2004; Chung, Singh, & Lee, 2000). As Cyert and March (1963) pointed out, risks associated with *d*-search require organizations to mobilize more resources than in *c*-search. As a result, organizations are more likely to employ *c*-routine than *d*-routine when seeking to solve their business problems. Figure 2 illustrates the evolution of capabilities when organizations search locally, i.e., select partners whose capabilities are identical in type. The intensity of local search is denoted by D^*, which varies between zero and one. A high value of



The lower, dashed line refers to cases when type alpha has a more fitness value and the intensity of local search (D^*) is 0.5. Note that D = 0.8

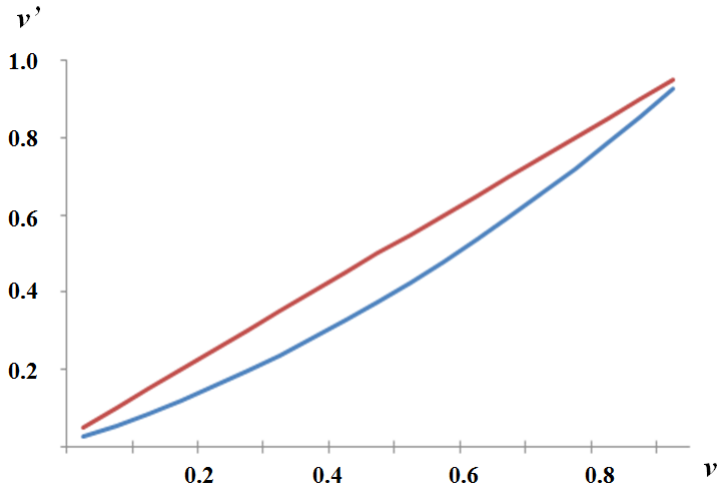
Figure 2. Exploitation that leads to the Co-existence of Capabilities

D^* indicates that the tendency for organization to engage in local search is increasing.

The lower, dashed line refers to cases when alpha capabilities have a more fitness value and the intensity of local search is 0.5. Three patterns deserve attention.

Fist, despite the relative advantage of alpha capabilities, the frequency of alpha capabilities is much lower than expected. After organizational learning, the frequency should follow the upper curve, which is derived from organizations randomly selecting their partners. This means that as the intensity of local search increases, organizations may fail to learn what they have to learn, i.e., the fittest capabilities. Accordingly, organizations may run their operations in a less optimal manner, thus being inefficient (**Claim 2**).

Second, as the intensity of local search increases, organizations remain heterogeneous with respect to capabilities (**Claim 3**). The fact that the fittest capabilities, i.e., alpha ones, fail to prevail indicates that organizations fail to operate efficiently. This in turn suggests that the two types of capabilities, alpha and beta, co-exist in the market even though the former has a relative advantage over the latter. Accordingly, some organizations continue to develop



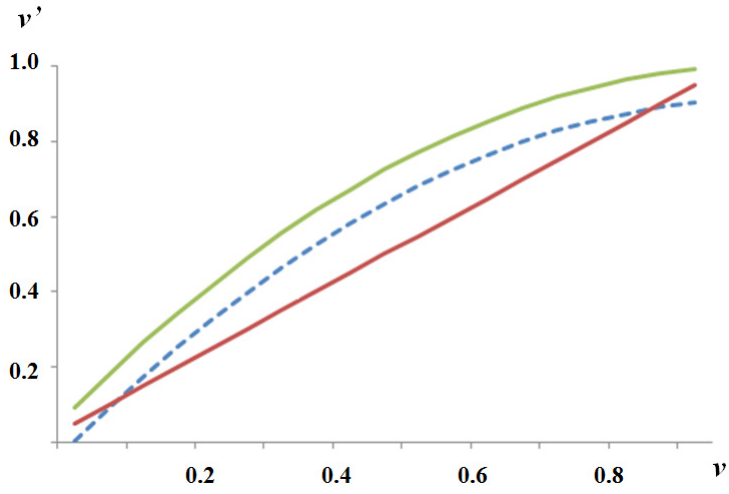
The lower, curve refers to cases when type alpha has a fewer fitness value, i.e., D = -0.5, and search occurs at random.

Figure 3. The Exogenous Changes in the Fitness of Capabilities

beta capabilities while others enjoy alpha capabilities. Such organizational heterogeneity arises from the intensity of local search.

In contrast, this discussion implies that organizational capabilities become rapidly homogeneous over time when the number of organizations to engage in *d*-search increases. That is, organizations with *d*-search may interact with others of different capabilities in a way that depletes any differentiation advantages available. That is, organizational learning leads evolutionarily to the reduction in differentiation advantages (**Claim 4**).

One may question whether inefficient search routines will survive the selection pressure of the market? Doesn't market competition drive organizations with inefficient search routines out of the market? If local search hinders the diffusion of alpha capabilities, organizations opting for distant search may prevail in the market. This reasoning will be valid however only when the relative advantage of different capabilities remains constant over time. Rather, the fitness of different capabilities tends to change across times. For example, prudent leaders with clumsy communication skills were thought highly in the past, yet they are nowadays replaced by aggressive managers with strong communication skills. A rigid

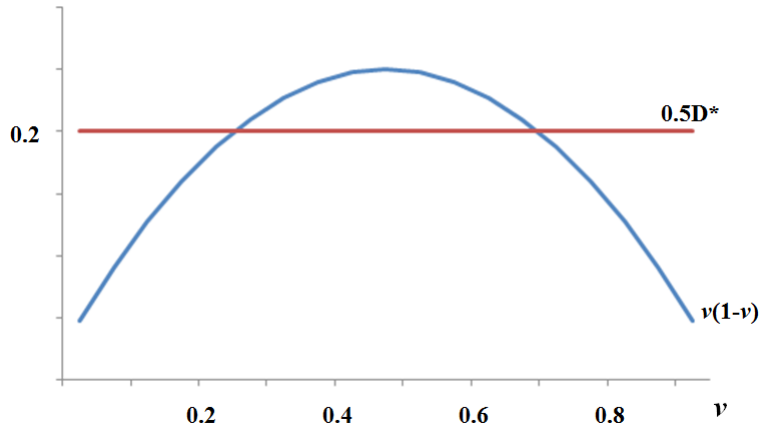


X axis is the frequency of type-alpha capabilities at time *t*. Y axis refers to the frequency of type-alpha capabilities at time $t + 1$. The lower, dashed line refers to cases when type alpha has a more fitness value and the intensity of local search (i.e., D^*) is 0.2. Note that $D = 0.8$.

Figure 4. Effective Balance between Exploitation and Exploration

bureaucratic control was welcomed as a forerunner of the modern world, yet it is now attributed to the source of the red tape. The fast follower strategy was a powerhouse for Samsung in the past, yet it is no longer relevant for the same company now. Figure 3 illustrates this situation clearly. Once the relative advantage of alpha capabilities, D, becomes negative, i.e., alpha starts to lose its fitness value, what prevails in the market now is not alpha capabilities but beta capabilities.

The above illustration has one important implication. Insofar as organizations do not know in advance exogenous shocks to the relative advantage of different capabilities, the best strategy for organizations to survive is to avoid over-adapting to the fittest capabilities in the current period. Rather it is to spend some resources in sustaining capabilities that have less fitness. In doing so, organizations maintain a diversity of capabilities whose fitness are supposed to change across time (**Claim 5**). This is exactly what March (1991) emphasizes in his study on organizational learning: avoid over-adapt to the current market and sustain the balance of



X axis is the frequency of type-alpha capabilities at time *t*. Y axis refers to the intensity of local search as well as the variance of organizational capabilities. As long as $0 < D^* < 0.5$, there are values of v that balances between exploration and exploitation.

Figure 5. Effective Balance and the Frequency of Alpha Capabilities

exploiting current capabilities and exploring new ones. Research on dynamic capabilities (Teece, Pisano, & Shuen, 1997) also gives verdict on the balance of diversity in a similar manner.

Figure 4 summarizes this implication. The effective balance of two types of capabilities is defined as the range of v that is above the level of diversity that sustains at random search. This definition is based on an assumption that when you sustain diverse capabilities and when you have the fittest capabilities more than what you expect out of random search, your search activities are better than at least random search. While March (1991) was silent on the exact balance level of exploitation and exploration, Figure 4 implies that diversity that sustains above that of random search would be one guide. As is also shown in Figure 5, the effective balance varies with the intensity of local search, D^*. As long as $0 < D^* < 0.5$, there are values of v that balances effectively between exploration and exploitation.[1)]

1) Note that the values of v that allow for the effective balance destabilize the market because the market is in equilibrium where the curve cuts through the 45 degree line. That is, in the end, everybody stands equally despite its efforts to sustain the effective balance.

Efficient Market with Inefficient Organizations

If economists are to address the evolution of capabilities, how would they go around with the routine-based development of capabilities? Three alternative explanations are possible. Let me examine one by one. In most market transactions, organizations usually seek continued trading relationships with current customers partly because the acquisition of new customers is costly. Accordingly, these organizations develop capabilities to serve current customers and thus look for capabilities that enhance the current operations. This leads them to search for partners of similar capabilities. That is, local search or c-search emerges as a rational response to the 'cost' of acquiring new customers and new capabilities. The co-existence of different types of capabilities depicted by Figure 4 reflects rather the cost of acquiring new customers, which means that the efficient market of profit-maximizing organizations allows for the co-existence of capabilities that differ in fitness value.

Alternatively, consider market transactions that involve a great deal of ambiguity in customers' product preference. The forecasting of demand in the near future is always a daunting task for managers because customers often exhibit preferences that are unstable and volatile. The demand for fashion apparel is one example in this regard. In such situations, even rational managers may find it difficult to satisfy what their customers want properly. Being puzzled by unstable consumer tastes, managers may balance their efforts between different types of capabilities. In other words, the case of Figure 4 is a reflection of the managers' rational response to the 'fuzzy' selection environments, i.e., the unstable tastes of consumers, rather than the use of local search that guides their capital investments.

Lastly, not the consumers but the capital market may underlie the co-existence of different capabilities. Apparently efficient yet institutionally constructed, the capital market tends to discount heavily the value of new investments that fail to fit into their models of profitable business, one that are shared collectively by investors. This provides the firm the incentive to search locally, i.e., avoid acquiring capabilities that are apparently remote from their current operation. The predictable response of managers is then a lot of

easily comprehensible practices, i.e., 'legitimate' business plans and investments that were approved positively by investors. In other words, local search emerges not because organizations are not optimizers but because investors require these organizations to stick to what they have operated.

The three alternatives mentioned above presume that organizations make informed and thus optimal decisions, whereas the markets, whether consumers or investors, behave in a sub-optimal way. However, the routine-based approach depicted in this study assumes that the markets are efficient, yet organizations are inefficient and further suggests that the efficient market of inefficient organizations will be sustainable across times. The reasons are as follows.

First, whether consumers' tastes or investors' shared mental models, the basis of the markets is the sum of desires or preferences over alternative behavioral options. A specific taste or mental model enters exogenously an individual's utility function. That is, desires are present as such and refute their diagnosis, which means that it is meaningless to check whether a given preference is rational or not. Unless you unveil the history of utility formation, which is a long-debated topic of ethics, any desires that enter individual utility functions are rational. In this regard, what is the best practice is clear in the short run, yet inefficient firms may fail to foresee the unforeseen future. Second, the first alternative is compatible with the analysis of this paper when you view D^* as a reflection of the cost of customer acquisition. A high value of the acquisition cost would give a high value of D^* accordingly. Moreover, organizations may not optimize when the benefit of serving new, lucrative demands outweighs the cost of customer acquisition. They make sub-optimal decisions at least in the short run.

Besides sub-optimal decisions by organizations, what implications does the above analysis have? The evolutionary model above characterizes the evolution of organizational capabilities through strategic alliances and has the following implications for the evolution of organizational capabilities:

First, effective organizational learning may not be fitness-enhancing in the long run when the fitness of capabilities available is not equal (see Claim 4). Rather the market optimizes across times, i.e., always selects the fittest ones in every period. Organizational learning is said to be effective when the firm are better than its rivals at discovering and obtaining capabilities that are fitness-enhancing.

In the short run, effective learning helps individual organizations to outperform their rivals. Yet, in the long run, the dynamic effects of effective learning are rather paradoxical. Red queen process among rivals eventually leads every organization to develop similar capabilities, leaving little room for differentiation advantage. Indeed, intense competition in mature markets often reaches rapidly an equilibrium state where rivals are endowed with identical resources: the tendency of firm homogeneity.

This tendency is likely to be strong when new capabilities are available only outside the network. This in turn suggests that a market with rivals of effective organizational learning is vulnerable to new entrants insofar as new entrants carry new capabilities. Competence-destroying innovations illustrate this likelihood (Tushman and Anderson 1986). It then follows that organizations actively involved in organizational learning are likely to undermine their differentiation advantages because the evolution of capabilities in the market will be competence-enhancing and thus increases the homogeneity of rivals. Another interesting conjecture is that 'inward-looking' organizations or those with sufficient in-house developments are likely to be innovators in a market of active learners.

Second, effective organizational learning however may not underlie the homogeneity of rivals when organizational capabilities are identical with respect to (evolutionary) fitness or competitive advantages (see Claim 1). This suggests that rivals' capabilities may not evolve in any direction over time when the fitness of capabilities available is distinguishable. Competition prior to the emergence of dominant design would illustrate this possibility (Anderson and Tushman 1990; Tushman and Romanelli 1985). In a market characterized by high uncertainty over demand, capital investments are largely independent because high demand uncertainty induces rivals' understanding of the market to be weakly correlated with one another. A high degree of variation in the content of capital investments is likely to occur.

Third, effective learning may expedite the homogeneity of rivals when organizations have sufficient alliance capacities. This implies that the evolution of capabilities will slow down when few organizations afford costly alliances. The speed in the evolution of capabilities is further affected by the type of routines chosen by rivals in a network (see Claim 3). The relative frequency between local and distant search determines such evolutionary speed. In-

deed, recent developments in complex networks corroborate the implications of the evolutionary model of capability development. According to Watts (2000), routine-based organizational search helps reduces the average distance of any pair of two organizations in a network insofar as a few organizations opt for *d*-search, such as short-cuts or bridging ties. To the extent that two organizations in the market share similar capabilities, the network distance between organizations reflect the degree of similarity in capabilities between them. This means that c-routine contributes to firm homogeneity when it is coupled with just a few *d*-searches.[2)]

Inefficient Diversity as a Design Concept: Implications at the Firm Level

While the evolutionary model draws attention to the context of competition among organizations, the model itself is applied to the internal resource allocation of the firm. In this case, the market is construed as the firm, whereas the organizations are considered the employees of the firm. One important implication is that the firm needs to sustain a diversity of capabilities or resources not that they help maximize the firm's revenue but that they help the firm to buffer exogenous shocks from the market. While practitioners increasingly emphasize the diversity of workforce as the driver of innovative activities, this study rather suggests that diversity per se is a cost to the firm, yet paying such a cost is important for the firm to survive the shifting demands in the product market and values in the equity market. In this regard, structural ambidexterity (Tushman and O'Reilly, 1996) is a complement to James March's balancing act of exploration and exploitation, which sacrifices the short term gains in return for the long term survival.

Along this line, diversity management is no longer a tool for economizing on the current innovation process at the workplace. Rather, it is a tool to avoid over-adaptation to the current innovation process (Leonard-Barton, 1992). It is a mere act of questioning the

2) An algorithm of Bae and Koo (2008) allows for the simulation of the evolution of capabilities at the network level, i.e., the aggregate increase in organizational learning. When relational strength is set to be 0.2, and learning difficulty 0.2, the frequency of *d*-search is positively associated with the network-level learning at 0.4649 in ten experiments. One nuanced effect of *d*-search however is that as it increases, the change to ally with dissimilar others declines, i.e., the decreasing returns to the use of *d*-search.

validity of the current practice. Such diversity adds values to the survival of the firm across time unless too much of it undermines the efficiency of the current operation substantially.

CONCLUSIONS

This paper examines the role of search routines in the evolution of organizational capabilities. It relates decisions made by individual organizations, i.e., search routines, to the evolution of capabilities at the network level. Specifically, the two types of search routines, *c*-search and *d*-search, are identified and presented to unravel interdependency in capability development among organizations that are embedded into an exchange network. The evolutionary model of this paper stands in sharp contrast to previous studies on organizational learning in the following way.

First, except for Red Queen process (Barnett and Hansen 1996), research on learning has paid little attention to the endogeneity issue in the theorizing of organizational learning. Researchers of organizational learning often presume that the variables of interest are exogenously determined and thus rush for comparative-static analysis, namely, the other-things-being-equal approach. That is, their readily available recommendation is that there is the best practice for boosting up a firm's performance. The joint pursuit of explorative and exploitative R&D is a case in point (Gibson and Birkinshaw, 2004; He and Wong, 2004; Katila and Ahuja, 2002). In doing so, they seek to identify the partial effects of a given variable while keeping constant the effects of the others. The limitation of this approach is that few variables are exogenously given. That's why an emphasis is placed on the understanding of the process that leads individual choices to economic outcomes. Yet, few models are available to unveil the process that generates observational data on a variety of behavioral outcomes, including commercial success, product adoption, and sales growth.

One way to go around this limitation is to model such economic outcomes as 'emergent' ones such that the contents of these outcomes are 'independent' of individual choices. Although the analysis of equilibrium behavior reflects the emergent consequences of individual choices, it is not a proper description of the process. Every equilibrium analysis presumes that choices get immediately

to outcomes, a case that is remote from the reality that we live in. In contrast, this study characterizes the transitional process per se by using the concept of search routines, which are building blocks for the evolution of capabilities at the network level. What matters in this approach is not the nature of equilibrium attainable but the speed of evolution that leads to attainable equilibrium and that depends on the outcome of rivals' search. It takes time to do anything; because adaptation is not made immediately, what happens in the middle is what matters. Along this line, this study shows that a firm's own balance in capability development between exploitation and exploration is subject to the outcome of search engaged by its rivals in the market. Without knowing what rivals do, it is impossible to assess the effect of organizational learning.

Second, as is consistent with Lavie, Stettner, and Tushman (2010), this study shows that the balance of exploration and exploitation is not cost-free and that the successful balance requires a firm to make additional investments, which may not always be favored by the current, competitive market. Competition naturally selects a specialist organization over a generalist counterpart, which holds also for the case of organizational learning. Indeed, the study of Ebben and Johnson (2005) clearly shows that a focused learning, i.e., either exploitative or explorative learning, is conducive to firm performance. That is, being stuck in the middle is harmful for organizations operating in the competitive market. Any move beyond the selection pressure of the market demands further efforts, i.e., costs imposed on the focal organization (e.g., Bae and Gargiulo, 2004). This in turn suggests that an organization needs to make further investments to shield itself from the selection pressure of the market. The re-design of organizational structure such as structural ambidexterity, would be one possible option to consider.

The evolutionary model of this study presents possible avenues for future research. First, search-based evolution may shed light onto the evolution of industry, which is again cannot be better understood in isolation of decision rules each firm uses, i.e., their operation routines. When industry evolves with the intensity of competition, the impact of technological innovations would be better captured by the analysis of their impacts on competition. The concepts of competence enhancing or destroying technologies are examples along this line (Tushman and Anderson 1986). The model of search-based evolution may help identify conditions under which

the evolution of capabilities by incumbents is vulnerable to new entrants.

For example, one may test whether the growth of the industry is related to that of organizations opting for *d*-search. Since the frequent use of *d*-search speeds up the evolution of capabilities at the network level, a business model that builds on a given set of capabilities is likely to prevail as a majority of organizations in the network obtain relevant capabilities in a timely fashion, which is in turn dependent upon the availability of organizations using *d*-search. One may also consider a natural experiment where a treatment effect is exogenously given to an exchange network (e.g., Haavelmo, 1994). For example, alliance formation in the US telecommunications industry in the 90s may present a good setting for the natural experiment because of the Telecommunications Act of 1996. This act served to remove the regulatory separation between telecoms operators and the media providers, including cable TV. This deregulation accelerated the creation of a new market, including personal communications services (PCSs), attracted new entrants into the industry, facilitating strategic alliances in the industry. This institutional change was virtually an exogenous shock to incumbents in the industry. One may compare the evolution of capabilities before and after year 1996 and test whether the effects of search routines were contingent upon a new stream of entrants.

Second, one important debate in the innovation literature is whether competition promotes innovation or not. This study offers an alternative that explicates the relationship between competition and innovation. As discussed above, the key finding of this study is that the frequent use of *d*-search expedites the evolution of capabilities at the network level yet in a direction that increases the homogeneity of rivals with respect to capabilities. Given that *d*-search serves as the exploration of new capabilities, it should be instrumental to innovation activities. Yet, the unintended consequence of *d*-search is that differentiation advantages obtained by *d*-search are temporary and that in the long run, such advantages dissipate rapidly. This tendency gets stronger when organizational learning via *d*-search is effective or when the selection pressure becomes stronger (see Claim 4). It is because the frequent *d*-search coupled with selection pressure leads to incremental discovery of capabilities. Note that the selection pressure in the evolutionary framework is equivalent to competition in the economic literature (Hannan and Freeman

1977). In this regard, the finding of this study strongly suggests that competition among effective learners may inhibit incumbents' innovation and that these incumbents at best introduce incremental innovations with a temporary advantage.

Alternatively, one may say that independent *d*-searches may help organizations to avoid path-dependent learning, unleashing radical innovations. Yet, insofar as organizational capabilities that are fitness-enhancing are limited in supply, the chance that *d*-searches are independent will be declining. As rivals compete for the same best practices, organizations in a network may rush for similar capabilities that are known to be fitness-enhancing. The tendency gets even worse as *d*-searches are guided by the selection environment that favors clearly and strongly a certain way of running a business, i.e., dominant design (Anderson and Tushman 1990). Hence, the selection environment with clear and strong feedbacks fosters intense competition among rivals, namely the red ocean, even when rivals invoke *d*-search. In short, those who intend to *leapfrog* by using d-search may face the hazards of it in the long run – the depletion of differentiation advantages as well as the vulnerability to new entrants with novel capabilities.

What managerial implications does this study make? First, one of important tasks facing managers is to select and bet on a profitable business by making capital investment faster than rivals do. To this end, managers monitor shifting demands and ask what the next hot thing is. This study suggests that attention should be given to capabilities that are obtained from *d*-search. Unlike organizations with c-search, those making *d*-search may have more impact on the evolution of capabilities, which will determine the way of competition and possible models of business in the network. One caution to make is that the capabilities obtained from *d*-search are likely to be obsolete easily as *d*-search becomes frequent: the fad and fashion will be short-lived.

Second, given the hazards of leapfrog, it is necessary for managers to avoid over-adaptation to a given set of capabilities and thus a dominant business. Otherwise, their capital investments are vulnerable to the advent of new capabilities and the changes in consumer preferences, both of which are exogenously given to an exchange network. Three alternatives are available to pace off the evolution of a given firm's capabilities. One is to avoid using strong incentive schemes, which align tightly the managers' pay to the market

performance of the firm. It is because strong incentive makes managers pay too much attention to the feedback from the selection environment, leading them to over-adapt to this environment that is by nature volatile and prone to change over time. Another is to increase novice hires, who are inexperienced in a current selection environment yet has expertise in other domains. These employees would serve as a new source of capabilities which may yield valuable outcomes when the market demand shifts into new businesses. The other is to have a diversified stream of revenues or businesses so as not to lock in a few capabilities that are readily obsolete.

When selection favors competition, effective learning expedites the evolution of capabilities at the expense of firm heterogeneity. By that margin, slow evolution makes an exchange network stable and effective. Go slow and live long.

APPENDIX
Organizational Learning via Alliances

For the market that consists of the two distinct types of capabilities, alpha and beta, the frequency of alpha capabilities after organizational learning, v', is given by:

$$v^2 \times 1 + (1-v)^2 \times 0 + v(1-v)\frac{(1+D)}{2} + (1-v)v\frac{(1+D)}{2}$$
$$= v + Dv(1-v)$$

where, D measures the relative advantage of alpha capabilities over beta, and varies between minus one and one.

For the same market, yet with organizations whose intensity of local search is D^*, the frequency of alpha capabilities after organizational learning is given by:

$$(v^2 + \frac{D^*}{2}) + 2[v(1-v) - \frac{D^*}{2}]\frac{(1+D)}{2}$$
$$= v + Dv(1-v) - \frac{DD^*}{2}$$

where D^* varies between zero and one.

REFERENCES

Anderson, P., and M. Tushman (1990), "Technological discontinuities and dominant designs: A cyclical model of technological change," *Administrative Science Quarterly*, 35, 604-633.

Bae, J (2011), "Cooperative exchange with substitutable ties and its competitive outcomes," *Seoul Journal of Business*, 17, 61-95.

Bae, J. and M. Gargiulo (2004), "Partner substitutability, alliance network structure, and firm profitability in the telecommunications industry," *Academy of Management Journal*, 47, 843-859.

Bae, J., and S. Kang (2010), "The elements of learning: Coordination capacity and search scale," *Korean Journal of Management*, 18, 1-30.

Bae, J. and J. Koo (2008), "Information loss, knowledge transfer cost and the value of social relations," *Strategic Organization*, 6, 227-258.

Bae, J., F.C. Wezel, and J. Koo (2011), "Cross-cutting ties, organizational density, and new firm formation in the U.S. biotech industry, 1994-98," *Academy of Management Journal*, 54, 295-311.

Barnett, W., and M. Hansen (1996), "The red queen in organizational evolution," *Strategic Management Journal*, 17, 139-157.

Baum, J, T. Calabrese, and B. Silverman (2000), "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology", *Strategic Management Journal*, 21, 267-294.

Beckman, C., P. Haunschild, and D. Phillips (2004), "Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection," *Organization Science*, 15 (3), 259-275.

Boyd, R., and P. Richerson (1985), *Culture and Evolutionary Process*. IL: University of Chicago Press.

Burt, R. (1982), *Toward a structural theory of action: Network models of social structure, perception, and action*. NY: Academic Press.

Chung, S., H. Singh, and K. Lee (2000), "Complementarity, status similarity and social capital as drivers of alliance formation," *Strategic Management Journal*, 21, 1-22.

Cohen, M., and P. Bacdayan (1994), "Organizational routines are store as procedural memory: Evidence from a laboratory study," *Organization Science*, 5, 554-568.

Cohen, M., and D. Levinthal (1990), "Absorptive capacity: A new perspective on learning and innovation," *Administrative Science Quarterly*, 35, 128-152.

Cyert, R.M., and J.G. March (1963), *A Behavioral Theory of the Firm*. Prentice-Hall, Inc.

Decarolis, D.M., and D.L. Deeds (1999), "The impact of stocks and flows of organizational knowledge on firm performance: An empirical investiga-

tion of the biotechnology industry," *Strategic Management Journal*, 20, 953-968.

Demsetz, H. (1988), "The theory of the firm revisited," *Journal of Law, Economics, and Organization*, 4, 141-161.

Dussauge, P., B. Garrette, and W. Mitchell (2000), "Learning from competing partners: Outcomes and durations of scale and link alliances in Europe, North America and Asia," *Strategic Management Journal*, 21, 99-126.

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

Ebben, J., and A. Johnson (2005), "Efficiency, flexibility, or both? Evidence linking strategy to performance in small firms," *Strategic Management Journal*, 26, 1249-1259.

Eisenhardt. K., and C. Schoonhoven (1996), "Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms," *Organization Science*, 7, 136-150.

Everett, M.G., and S.P. Borgatti (1988), "Calculating role similarities: An algorithm that helps determine the orbits of a graph," *Social Networks*, 10, 71-91.

Foss, N. (1996), "Knowledge-based approaches to the theory of the firm: Some critical comments," *Organization Science*, 7, 470-476.

Freeman, J., and M.T. Hannan (1983), "Niche width and the dynamics of organizational populations," *American Journal of Sociology*, 88, 1116-1145.

Gavetti, G., and D. Levinthal (2000), "Looking forward and looking backward: Cognitive and experiential search," *Administrative Science Quarterly*, 45, 113-137.

Gibson, C., and J. Birkinshaw (2004), "The antecedents, consequences, and mediating role of organizational ambidexterity," *Academy of Management Journal*, 47, 209-226.

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

Gulati, R., and M. Gargiulo (1999), "Where do interorganizational networks come from?," *American Journal of Sociology*, 104, 1439-1493.

Gulati, R., N. Nohria and A. Zaheer (2000), "Strategic Networks," *Strategic Management Journal*, 21, 203-215.

Hagedoorn, J., A.N., Link, and N.S. Vonortas (2000), "Research partnerships", Research Policy, 29, 567-586.

Hannan, M.T., and J. Freeman (1977), "The population ecology of organizations," *American Journal of Sociology*, 82, 929-964.

Hamel, G., Y. Doz, and C.K. Prahalad (1989), "Collaborate with your com-

petitors and win," *Harvard Business Review*, 67, 133-139.

Haavelmo, T. (1994), "The probability approach in econometrics," *Econometrica*, 12 (Supplement), iii-115.

He, Z.L., and P.K. Wong (2004), "Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis," *Organization Science*, 15, 481-494.

Hennart, J. (1988), "A transaction cost theory of equity joint ventures," *Strategic Management Journal*, 9, 361-374.

Karim, S., and W. Mitchell (2000), "Path-dependent and path-breaking change: Reconfiguring business resources following acquisitions in the U.S. medical sector, 1978-1995," *Strategic Management Journal*, 21, 1061-1081.

Katila, R., and G. Ahuja (2002), "Something old, something new: A longitudinal study of search behavior and new product introduction," *Academy of Management Journal*, 45, 1183-1194.

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

Kogut, B. (2000). "The network as knowledge: Generative rules and the emergence of structure," *Strategic Management Journal*, 21, 405-425.

Kogut, B., and U. Zander (1992), "Knowledge of the firm, combinative capabilities, and the replication of technology," *Organization Science*, 3, 383-397.

Larson, A. (1992), "Network dyads in entrepreneurial settings: A study of the governance of exchange relationships," *Administrative Science Quarterly*, 37, 76-104.

Lavie, D. (2007), "Alliance portfolios and firm performance: A study of value creation and appropriation in the U.S. software industry", *Strategic Management Journal*, 28, 1187-1212.

Lavie, D., and L. Rosenkopf (2006), "Balancing exploration and exploitation in alliance formation," *Academy of Management Journal*, 49 (4), 797-818.

Lavie, D., U. Stettner, and M.L. Tushman (2010), "Exploration and exploitation within and across organizations," *Academy of Management Annals*, 4, 109-155.

Leonard_Barton, D. (1992), "Core capabilities and core rigidities: A paradox in managing new product development," *Strategic Management Journal*, 13, 111-125

Leenders, R.A.J. (1996), "Evolution of friendship and best friendship choices," *Journal of Mathematical Sociology*, 21, 133-148.

Levitt, B., and J. March (1988), "Organizational learning," *Annual Review of Sociology*, 14, 319-340.

March, J.G. (1991), "Exploration and exploitation in organizational learning," *Organization Science*, 2, 71-87

March, J., and H. Simon (1958), *Organizations*. NY: John Wiley and Sons.

Marsden, P., and N. Friedkin (1997), "Network studies of social influence," *Sociological Methods & Research*, 22, 127-151.

McConnell, J., and T. Nantell (1985), "Corporate combinations and common stock returns: The case of joint ventures," *The Journal of Finance*, XL, 519-536.

Mowery, D., J.E. Oxley, and B. Silverman (1996), "Strategic alliances and interfirm knowledge transfer," *Strategic Management Journal*, 17, 77-91.

Nelson, R., and S. Winter (1982), *An Evolutionary Theory of Economic Change*. MA: Harvard University Press.

Pfeffer, J., and P. Nowak (1976), "Joint ventures and interorganizational interdependence," *Administrative Science Quarterly*, 21, 398-418.

Porter, M. (1996). "What is strategy?," *Harvard Business Review*, 74, 61-78.

Rothaermel, F., and D.L. Deeds (2004), "Exploration and exploitation alliances in biotechnology: A system of new product development," *Strategic Management Journal*, 25, 201-221.

Rumelt, R. (1984), "Towards a strategic theory of the firm," In R. B. Lamb (ed.). *Competitive Strategic Management*. NJ: Prentice-Hall.

Sakakibara, M. (1997), "Heterogeniety of firm capabilities and cooperative research and development: An empirical examination of motives," *Strategic Management Journal*, 18 (summer special), 143-164.

Sampson, R. (2005), "Experience effects and collaborative returns in R&D alliances," *Strategic Management Journal,* 26, 1009-1031.

Simon, H. (1957), *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization (2nd ed.)*. NY: The Free Press.

Stuart, T. (2000), "Interorganizational alliances and the performance of firms: A study of growth and innovation rates in a high-technology industry," *Strategic Management Journal*, 21, 791-811.

Uzzi, B. (1997), "Social structure and competition in interfirm networks: The paradox of embeddedness," *Administrative Science Quarterly*, 42, 35-67.

Teece, D.J., G. Pisano, and A. Shuen. (1997), "Dynamic Capabilities and Strategic Management," *Strategic Management Journal*, 18, 509-533.

Tushman, M., and P. Anderson (1986), "Technological discontinuities and organizational environments," *Administrative Science Quarterly*, 31, 439-465.

Tushman, M.L., and C.A. O'Reilly. (1996), "Ambidextrous organization: Managing evolutionary and revolutionary change," *California Management Review*, 38, 8-30.

Tushman, M., and E. Romanelli (1985), "Organizational evolution: A metamorphosis model of convergence and reorientation," in L.L. Cummings and B.M. Staw (Eds.). *Research in Organizational Behavior*, 7: 171-222.

CT: JAI Press.
Watts, D.J. (2000), *Small Worlds: The Dynamics of Networks between Order and Randomness*. NJ: Princeton University Press.
Watts, A. (2001), "A dynamic model of network formation," *Games and Economic Behavior*, 34, 331-341.
Winter, S.G. (1987), "Knowledge and competence as strategic assets," in D. Teece (ed.). *The Competitive Challenge*. Cambridge, MA: Ballinger: 159-184.
Zeggelink, E. (1994), "Dynamics of structure: An individual oriented approach," *Social Networks*, 16, 295-333.

Received July 23, 2012
First Revision Received September 12, 2012
Second Revision Received December 7, 2012
Accepted December 10, 2012