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Intellectual Capital Architectures and Bilateral Learning: A Framework For Human Resource Management

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Abstract

Both researchers and managers are increasingly interested in how firms can pursue bilateral learning; that is, simultaneously exploring new knowledge domains while exploiting current ones (cf., March, 1991). To address this issue, this paper introduces a framework of intellectual capital architectures that combine unique configurations of human, social, and organizational capital. These architectures support bilateral learning by helping to create *supplementary* alignment between human and social capital as well as *complementary* alignment between people-embodied knowledge (human and social capital) and organization-embodied knowledge (organizational capital). In order to establish the context for bilateral learning, the framework also identifies unique sets of HR practices that may influence the combinations of human, social, and organizational capital.

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Introduction

In today's environment, where innovation and agility are seen as central to a firm's competitive advantage, organizational learning has become increasingly important as a mechanism for establishing dynamic capability and strategic renewal. Researchers have noted that organizational learning—or the process of acquiring and integrating new knowledge—can help the firm: (1) expand its range of strategic choices (Hedlund, 1994), (2) improve its ability to continuously build and modify unique capabilities (Teece, Pisano, & Shuen, 1997), and (3) prevent its core capabilities from becoming core rigidities (Leonard-Barton, 1995).

Based on March's (1991) original work, most research on organizational learning focuses on two distinctive approaches to learning: exploration and exploitation. Exploration involves the pursuit of learning outside a firm's current knowledge domains, whereas exploitation involves the refining and deepening of a firm's existing knowledge stocks (March, 1991). Researchers have suggested that exploration improves a firm's ability to search new market opportunities and renew its capabilities in changing environments, while exploitation helps the firm to cultivate existing market opportunities and gain the full returns on current capabilities (Levinthal & March, 1993; Danneels, 2002; Benner & Tushman, 2003).

March emphasized that "maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity" (1991: 71). But while exploration and exploitation are both seen as valuable and perhaps complementary in their effects, researchers have noted that in practice it is difficult to pursue both simultaneously (Levinthal & March, 1993). The two types of learning typically involve different processes, structures, affiliations, and cognitive orientations (McGrath, 2001; Ahuja & Lampert, 2001). And given the realities of organizations, they often compete with one another for scarce resources (March, 1991).

In this paper, we discuss these particular issues by way of establishing a framework for studying how firms might pursue exploration and exploitation simultaneously—what we refer to

as *bilateral learning*. The paper is organized as follows: First, we review alternative perspectives on exploitation and exploration to clarify the underlying tensions that inform research on bilateral learning. Second, we examine the roles that a firm's knowledge stocks—human capital, social capital, and organizational capital—play in facilitating organizational learning. In particular, we suggest that there are two alternative architectures of human, social, and organizational capital that may support bilateral learning. Finally, we identify unique configurations of HR practices that help firms to manage bilateral learning.

Exploitation And Exploration

Organizational learning occurs through a process of acquiring, sharing, and integrating new knowledge from outside the firm as well as inside the firm (Crossan, Lane, & White, 1999; Argote & Ingram, 2000). In this regard, exploration results from relatively broad and generalized search to expand the firm's knowledge domains into unfamiliar or novel areas and/or to establish new combinatory mechanisms. Exploitation, on the other hand, relies on more narrow, localized and in-depth search in order to obtain well-defined solutions pertinent to a firm's existing knowledge domains (Galunic & Rodan, 1998; McGrath, 2001; Katila & Ahuja, 2002). The unique requirements of exploration and exploitation delineate a long-standing issue regarding whether a firm can pursue exploitation and exploration together.

Potential Tradeoff between Exploitation and Exploration

The conventional view of organizational learning emphasizes that it is unlikely for firms to pursue exploration and exploitation together. Levinthal and March (1993), for example, noted that one tends to impede the other so that firms often make a choice between the two. Specifically, because exploitation improves a firm's ability to crystallize cause-effect relationships within a particular knowledge domain, prior success tends to reinforce the belief that leveraging experience and expertise will lead to future success as well. In this situation, firms are likely to continue working in areas that are familiar and proximate to existing solutions

rather than pursuing novel, emerging, and pioneering knowledge (Ahuja & Lampert, 2001). Researchers have referred to this tendency variously as “success traps”, “competency traps”, or “learning myopia” (Aygyris & Schon, 1978; March, 1991; Levinthal & March, 1993; McGrath, 2001) in that the pursuit of exploitation entrenches a firm within its existing knowledge domains, even if those domains become decayed, obsolete or at least sub-optimal in changing environments. Benner and Tushman (2003), for example, found that process improvement activities (e.g., TQM) designed to improve efficiency through exploitation tended to deter firms from exploring new knowledge alternatives by stabilizing organizational routines and processes, thereby narrowing organizational knowledge bases over time. The net effect of this was decreased learning flexibility.

In contrast, exploration may also drive out exploitation. Levinthal and March (1993), for example, described “exploration traps” as cases where firms continuously change too many parameters of organizational knowledge thereby limiting their ability to clarify cause-effect relationships (cf., Teece et al, 1997). Ancona and Caldwell (1992) suggested that when firms attempt to continuously pursue new aspirations, where current knowledge is repeatedly replaced with more radical knowledge, they tend to indulge in expanding variations without fully utilizing their preexisting knowledge. As a result, firms may pursue exploration but with decreased efficiency.

This ‘trade-off’ perspective suggests that one approach to learning is often inconsistent with the other. And from a practical standpoint, this has the effect of firms building their current business at the expense of the future, or the reverse. The evidence from a number of industries supports this notion: over-reliance on either exploitation or exploration can be extremely detrimental. For example, early leaders in the semiconductor industry such as RCA and Sylvania could not catch up with the development of the transistor business because they were overly committed to traditional (profitable) vacuum tube business (Tushman & O’Reilly, 1996). In contrast, while Ericsson developed pioneering technologies in mobile telephony through vast

R&D investment, it overlooked the importance of exploiting and stabilizing the profitability of its current business and technology domains. As a consequence, it suffered from high-cost and operating inefficiencies (Gibson & Birkinshaw, 2004).

From a strategic standpoint, the tension between exploration and exploitation is often rooted in the tradeoffs between the efficiency of specialized resources versus the flexibility and robustness of resources across alternative futures (Amit & Schoemaker, 1993; Ghemawat & Costa, 1993; Sanchez, 1995). To really understand these tensions, we need to look more directly at the knowledge stocks—or intellectual capital—of the firm.

The Role of Intellectual Capital in Organizational Learning

Researchers from a variety of disciplines have noted the close tie between a firm's orientation toward organizational learning and its stock of intellectual capital. In this paper, we focus on three elements of intellectual capital: human, social, and organizational. *Human capital*, or the knowledge, skills, and abilities of individuals, is the primary foundation for organizational learning. As Argyris and Schon (1978) put it, "there is no organizational learning without individual learning, and individual learning is a necessary but insufficient condition for organizational learning." *Social capital*, or the knowledge embedded in and available through relational networks, provides a conduit for knowledge exchange. As Stata (1989) put it, "organizational learning occurs through shared insights, knowledge, and mental models." In this light, organizational learning is not a simplistic extension of individual learning. Instead, firms gain greater benefits from sharing and combining varied knowledge among individuals (Kogut & Zander, 1992; Nahapiet & Ghoshal, 1998). *Organizational capital* extends beyond people-embodied learning to describe the knowledge captured in processes, systems, and databases (Subramaniam & Youndt, in press). As Daft and Weick (1984: 285) observed, "individuals come and go, but organizations preserve knowledge, behavior, mental maps, norms, and values over time." These preexisting organizational processes and systems tend to not only establish patterns of behavior and interpretation systems that guide knowledge acquisition (Kim,

1993; Crossan et al, 1999), but they also provide a pivotal mechanism for integrating and combining that knowledge within organizations (Grant, 1996).

Considering the unique contributions of human, social, and organizational capital to organizational learning, it seems reasonable to posit that the tradeoff between exploration and exploitation may hinge on the particular combinations—or architectures—of intellectual capital. We discuss this idea further below (see summary in Table 1).

Human capital: Specialist versus generalist. In the context of organizational learning, a central issue that firms face is the value of specialist versus generalist human capital. Specialists typically have knowledge that is deeper, localized, embedded, and invested within particular knowledge boundaries. Generalists, on the other hand, tend to be multi-skilled with a more versatile repertoire of capabilities that can be used across alternative situations. As much as this distinction is acknowledged at the individual level, it is recognized at the organizational level as well (cf., Hitt, Bierman, Shiimizu & Kochahar, 2001). Some firms can be characterized as collectives (or aggregates) of specialist human capital while others tend toward the development of generalists.

The implications of human capital on learning are fairly straightforward. Because specialist human capital embodies domain-specific knowledge or ‘thought-worlds’ (i.e., information-processing, interpretation systems, expectation of events or phenomena), it tends to be more effective for acquiring and assimilating new, in-depth knowledge within a narrow range of parameters (Brown & Dungid, 1991; Tsoukas, 1996). The connection to exploitive learning is perhaps most clear in this case. However, Dougherty (1992) noted that specialized human capital often incurs with it a ‘functional bias’ that may reduce the willingness and ability of individuals to exchange and combine new knowledge beyond their specialized area. Based on this, we might conclude that firms oriented toward specialist human capital are *ceteris paribus*, less likely to focus on exploration, and more likely to focus on exploitative learning.

In contrast to specialists, researchers have noted that generalist human capital tends to be less entrenched in a particular perspective (i.e., less susceptible to functional bias) and, by definition, more broadly positioned in multiple knowledge domains. In the context of decision making, more diverse mental models and less cognitive conflict tend to accord generalists the capacity for varied interpretations of problems and situations (Walsh., 1988; Iansiti, 1993; Burke & Steensma, 1998; Clark, Amundson, & Cardy., 2002; Bunderson & Sutcliff, 2002). Because of this, generalist human capital not only provides the variety of knowledge immediately available for alternative tasks, but also the potential adaptability to discover, comprehend, interpret, and apply new knowledge in the future (Shane, 2000; Wright & Snell, 1998). In this regard, generalist human capital tends to be more predisposed to exploratory learning in firms.

Table 1
Intellectual Capital and Organizational Learning

Organizational Learning Intellectual Capital		Exploitation		Exploration	
		<i>Acquisition</i>	<i>Integration</i>	<i>Acquisition</i>	<i>Integration</i>
Human Capital	<i>Specialist</i>	Focused/refined search & narrow domains			
	<i>Generalist</i>			Broad search & multiple domains	
Social Capital	<i>Cooperative</i>	In-depth/limited range of knowledge exchange	Redundant & architectural knowledge		
	<i>Entrepreneurial</i>			Flexible/broad range of knowledge exchange	Brokering & synthesizing scattered knowledge
Organizational Capital	<i>Mechanistic</i>	Narrow definition & search	Detailed routines & standardized processes		
	<i>Organic</i>			Alternative interpretations	Principle-based guidelines

Social capital: Cooperative versus entrepreneurial relational archetypes. While human capital establishes a foundation for organizational learning, social capital serves as an

important mechanism for knowledge exchange and combination. Social capital has been conceptualized in various ways (e.g., Nahapiet & Ghoshal, 1998; Adler & Kwon, 2002, Kang, Morris, & Snell, in press) and researchers have recently focused on three key dimensions: cognition, affect, and structure. The *cognitive* dimension of social capital highlights the importance of shared systems of meaning, representation, and understanding among individuals. The *affective* dimension addresses the relational aspects of interpersonal exchange (i.e., trust, motives, expectations, and norms) among individuals. And the *structural* dimension of social capital refers to the overall network configuration or pattern of connections among individuals. Researchers further argue that because the three dimensions complement one another in providing the opportunity, motivation, and ability for knowledge exchange, they can and should be seen as elements of overall social system. In particular, Kang et al. (in press) identified two unique configurations (called cooperative and entrepreneurial relational archetypes) of social capital that are respectively aligned with exploitation and exploration.

The cooperative archetype is described as a tightly coupled social system that includes strong and dense network connections, generalized or institutional trust based on membership in the social unit, and shared understanding of how knowledge can be combined (referred to as architectural knowledge). Kang et al. (in press) argue that cooperative archetypes support efficient acquisition and integration of fine-grained and in-depth knowledge, thereby facilitating exploitative learning. But the authors also point out that the cooperative archetype may hinder exploration because it has the effect of suppressing the development of new and diverse social relations.

In contrast, the entrepreneurial archetype is described as a more loosely connected social system. It is characterized by weak and non-redundant relational networks, resilient dyadic trust that is developed through direct personal experiences, and common component knowledge that reflects shared technical, professional, or operational knowledge. Kang et al (in press) note that the entrepreneurial archetype facilitates the flexibility required to expand, acquire and absorb

novel knowledge thereby helping firms to pursue exploratory learning. However, as noted before, this flexibility may obviate against the efficiencies required for exploitative learning.

Organizational capital: Mechanistic versus organic. In addition to the human and social capital foundations of learning, organizational systems and processes also influence the acquisition, transfer, and integration of knowledge. Subramaniam and Youndt (in press), for example, noted that organizational capital constitutes institutional knowledge and codified experience that arises from established structures, processes, and routines (cf., Nelson and Winter, 1982). While some firms establish 'detailed' routines—or standardized rules, procedures and structures for coordination among interdependent individuals—others develop 'simple' (or limited) routines that offer only priorities, vision, and boundary conditions for possible action (Eisenhardt & Martin, 2000; Eisenhardt & Sull, 2001; Feldman & Pentland, 2003; Nelson & Winter, 1982). This distinction is also captured in the innovation literature where alternative organizational systems (e.g., mechanistic versus organic) are seen as supporting different kinds of knowledge flows for incremental versus radical innovation (Dewar & Dutton, 1986; Ghemawat & Costa, 1993; McGrath, 2001). Based on this research, organizational capital can be classified into two alternative forms: mechanistic versus organic.

Mechanistic organizational capital such as standardized structures, processes, and operating procedures tends to reinforce efficient coordination by establishing ingrained patterns of behavior and interdependence. From the standpoint of organizational learning, Crossan et al (1999) noted that standardized processes capture and institutionalize existing knowledge within organizational routines that help establish a common frame of reference among interdependent parties. Over time, these parties see things similarly and this economizes on the amount of discussion required for interpretation and understanding (De Boer, Van Den Bosch, & Volberda, 1999). Not surprisingly, researchers such as Katila and Ahuja (2002) have noted that accumulated knowledge embedded in mechanistic organizational capital is typically perceived as more reliable, robust, and legitimized. This tends to bias an organization's problem solving

activities toward decision sets that have previously proved useful (cf., Subramaniam and Youndt, in press). Organizational learning in this instance tends to proceed within the confines of refining, improving and recombining existing knowledge (i.e., exploitation).

In contrast, Eisenhardt and Sull (2001) extended the work by Daft and Weick (1984) who noted that organic work processes are, by definition, more enacted and loosely connected to precedent rules and traditional expectations about work. Rather than prescribing detailed routines or structures, these coordination mechanisms provide opportunities for individuals and groups to experiment with both the way they work and the way they organize that work. This not only helps to establish more flexible behavioral repertoires, but also engenders alternative (and perhaps creative) perspectives and interpretation systems (Daft & Weick, 1984). As a consequence, organizations are in a better position to consistently search and absorb novel information as well as integrate new knowledge associated with exploratory learning.

If we summarize the preceding discussion, the literature suggests that there are different intellectual capital architectures associated with either knowledge exploration or exploitation. In particular, exploration seems to be supported by an architecture comprised of generalist human capital, entrepreneurial social capital, and organic social capital. In contrast knowledge exploitation would be supported by an architecture comprised of specialist human capital, cooperative social capital, and mechanistic organizational capital.

Bilateral Learning

While a firm's orientation toward exploration and exploitation may be rooted in the underlying elements of its intellectual capital, the preceding discussion serves only as a foundation for further theory development. Ultimately, the issue of bilateral learning comes down to how (and if) human, social, and organizational capital can be combined in ways that support both exploration and exploitation simultaneously. We use the term *bilateral learning*;

literally “two-sided” learning or learning in two different ways. And while the implications for research and practice are clear, there has not been a good deal of work in this area.

Researchers have noted that, while the tradeoff between exploration and exploitation is typical or even probable, it is not inevitable. Bierly and Chakrabarti (1996), for example, found that several U.S. pharmaceutical firms pursued both exploitation and exploration, and interestingly, they were more profitable than their competitors who concentrated one or the other. Katila and Ahuja (2002), in a study of the global robotics industry, also found that firms successful in introducing new products were superior in leveraging their prior knowledge as well as searching new knowledge.

Further, several studies suggest that exploitation and exploration can at times be complementary. Danneels (2002), for example, found that firms could achieve successful product innovations through a reciprocal process of leveraging current competences (exploitation) and adding new competences to current knowledge stocks (exploration). This is consistent with work by Cohen and Levinthal (1990), Helfat (1997), and Uzzi and Lancaster (2003) who noted that utilizing current knowledge potentially enhances a firm’s ability to absorb new knowledge required for exploration. These findings suggest that while it may not be naturally occurring, it is in fact possible and valuable for firms to pursue exploitation and exploration together.

The Partitioning Option

One viable option, referred to as *partitioning*, enables firms to pursue exploitation and exploration by separating the two forms of learning in space and/or time (Adler, Goldoftas, Levin., 1999; Edmondson, 2002; Benner & Tushman, 2003). With spatial or structural partitioning, units engaged in exploratory learning (e.g., basic research) are physically separated from those emphasizing exploitation (e.g., product development). While structural partitioning allows for the coexistence of exploitation and exploration within a firm, it does not adequately address how a firm resolves the tensions or potential conflicts between the two units

engaged in different forms of learning. Instead, structural partitioning only shifts the issue to a different level of analysis (e.g., subunits or teams).

Alternatively, exploration and exploitation can be separated by time, referred to as temporal partitioning (Hay and Pisano, 1994; Gibson & Birkinshaw, 2004). In these cases, firms shift back and forth sequentially between the two types of learning by focusing on one type of learning then the other in an iterative fashion. While temporal partitioning conveys the potential synergies of integrating exploration and exploitation, it still raises the critical issue of how firms make a smooth transition between the two. The cognitive, relational, and procedural tensions remain, and must be reconciled in order to achieve knowledge integration and transformation. Adler et al. (1999) cautioned that switching costs associated with sequential transitioning between exploitation and exploration can lead to internal conflict, compromise, and sub-optimization where firms become “stuck in the middle” rather than achieving learning synergies.

The Bilateral Learning Option

From this it is clear that the success of partitioning strategies requires a firm’s meta-capability of coordinating and integrating separate learning processes within the firm (Collis, 1994; Winter, 2003). Some authors have begun to address this issue in particular ways. For example, Nonaka and Takeuchi (1995), Evan, et al (2002), and Gibson and Birkinshaw (2004) argue that a firm can establish a continuous process of exploitation and exploration by requiring every individual in the firm to allocate his or her time and effort to look for new knowledge and/or configure new combinatory mechanisms, and concurrently cultivate or streamline new value-creating ideas. These approaches require a behavioral orientation towards dual capacities, rather than a higher-level separation or partitioning of those capacities (Gibson and Birkinshaw, 2004).

We would argue that human capital based initiatives such as these are indeed part of the solution to bilateral learning, but they do not capture the entire architecture of intellectual capital.

In our view, a more comprehensive framework of bilateral learning would also include aspects of social and organizational capital.

Intellectual Capital Architectures

As noted earlier, the architecture of human, social and organizational capital plays unique roles in the process of acquiring and integrating new knowledge. Crossan et al (1999), for example, argued that organizational learning proceeds through a continuous cycle of (a) identifying and interpreting new knowledge at the individual level, (2) integrating and institutionalizing individual knowledge at the collective level, and (3) enforcing preexisting organizational knowledge back on individuals and groups. This explicitly denotes the mutual influence of human, social, and organizational capital on one another, and suggests that the particular combination of human, social and organizational capital can predispose a firm toward a particular type of organizational learning.

In the context of bilateral learning, we suggest that while human, social and organizational capital may each predispose a firm toward either exploitation or exploration, there may be unique combinations that obviate this tendency and in fact create a more balanced architecture. As shown in Figure 1, and discussed below, we identify two potential architectures that meet the requirements of bilateral learning. Each has the potential to maximize the knowledge variation and flexibility that characterizes exploration, while at the same time preserving efficient refinement and integration of knowledge that characterizes exploitation. We refer to the first architecture as *refined interpolation*, and the second as *disciplined extrapolation*.¹

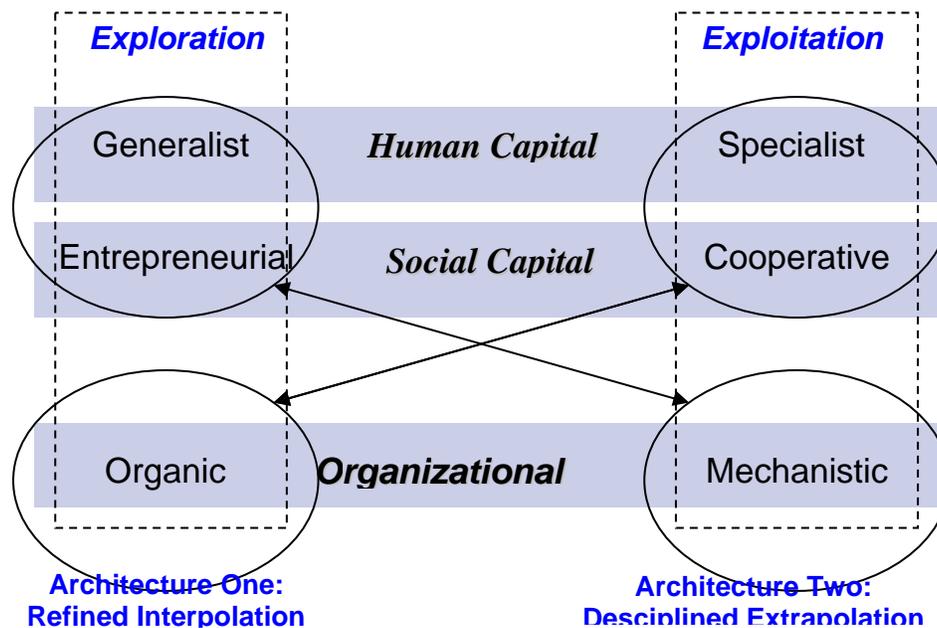
Architecture One: Refined Interpolation

¹ The terms interpolation and extrapolation are chosen specifically because of their usage in the fields of mathematics, human cognition, learning, and performance. In mathematics, for example, interpolation is defined as generalized response or performance to novel inputs lying *within* the dynamic range of data (i.e., *inter-*, from within or between). Extrapolation, in contrast, is defined as generalized response to novel inputs lying *outside* the dynamic range of the data (i.e., *extra-*, from the outside). (cf., DeLosh, Busemeyer, & McDaniel, 1997; Erickson & Kruscheke, in press).

Architecture one, *refined interpolation*, focuses on the combination of specialist human capital, cooperative social capital, and organic organizational capital.

Specialist human capital. Firms that develop specialized human capital tend to build distributed knowledge structures where individuals possess relatively little overlapped knowledge. As noted above, research suggests that specialists develop thought worlds and interpretation systems bounded to particular knowledge domains, thereby diminishing their ability and motivation to share and combine knowledge from other areas (Dougherty, 1992; Bunderson & Sutcliffe, 2001). In accordance, an important issue for firms trying to transform (or at least transfer) individual knowledge into organizational knowledge would be finding ways to facilitate knowledge sharing and combining among individuals, simultaneously expanding the range and variety of knowledge acquisition/integration that occurs. These potential caveats from specialized human capital can be complemented by cooperative social capital and organic organizational capital.

Figure 1
Intellectual Capital Architectures and Bilateral Learning



Cooperative social capital. While entrepreneurial social capital helps individuals to search and mobilize a broad range of knowledge, cooperative social capital may enhance specialists' abilities to effectively search and mobilize others' in-depth knowledge under distributed knowledge structures. There are three reasons for this; one structural, one affective, and another cognitive. First, Rulke and Glaskiewicz (2000) and Reagans and Zuckerman (2001) found that, while specialists may be less likely (than generalists) to master knowledge across different domains, close personal interactions (strong social ties) help them to share and combine knowledge from diverse sources. This is consistent with the literature on 'transactive memory' as well (e.g., Wegner, 1986; Wegner, M., Erber, & Raymond, 1991; Moreland & Myaskovsky, 2000; Lewis, 2003) where research suggests that specialized knowledge and personal interactions are preconditions for the development of transactive memory – defined as expanded awareness of others' expertise. Having an understanding of 'who knows what' (i.e., transactive memory) helps to augment specialized human capital by drawing on the varied knowledge of others. In this way, transactive memory helps specialists to recognize and access a broader range of knowledge. Second, under distributed knowledge structures it is relatively difficult to monitor individuals' effort and inputs because each individual has unique knowledge and expertise not familiar to others. In this case, specialization may incur the unintended consequence of encouraging individuals to act only in their own interests at the expense of interests of the whole (Eisenhardt, 1989). Generalized trust that enforces mutual concerns and mutual investment in the firm suppresses individuals' opportunistic behaviors to withhold knowledge and encourages them to share and combine their idiosyncratic knowledge (Leana & Van Buren, 1999). Finally, more points of mutual contact among members in a network help to facilitate joint interpretation of new information (e.g., sensemaking) as well as provide opportunities for continuous or incremental shaping of the knowledge. This is further supported by the common architectural knowledge inherent in the cooperative archetype. Common architectural knowledge provides a built-in mechanism to help a diverse human capital pool to

not only understand how the pieces fit together but also to recognize the sometimes-conflicting demands in their multidimensional jobs without prior overlapped knowledge (Nonaka, 1991; Kogut & Zander, 1992; Hill & Levenhagen, 1995).

Organic organizational capital. In the context of bilateral learning, specialist human capital provides the deep expertise needed for exploitive learning, and it is supplemented by cooperative social capital that helps share, integrate, and refine individuals' specialized knowledge for deeper exploitation. One of the dangers of organizational capital in this context is that it may establish rigid patterns of interaction that reinforce individuals' efforts to combine—and iteratively recombine—knowledge over time in order to refine it. If the systems, structures, and processes of an organization are excessively rigid and programmed (as is possibly the case with mechanistic organizational capital) the combination of cooperative social capital and specialist human capital may be perfectly suited for exploitative learning, but it may not provide the foundation for exploratory learning. Instead, the flexibility of organic organizational capital (i.e., general integrating principles, guidelines, etc.) is much more conducive for bilateral learning in this case by providing the requisite variety in knowledge integration and acquisition that are needed for exploratory learning. As Eisenhardt and Sull (2001) noted, this provides sufficient stability for coordination, but also allows some flexibility for modification and improvisation.

Organizational capital (processes, routines, etc.) provides a critical mechanism needed for coordinating and combining knowledge. In one sense, it constrains thought and behavior regarding how knowledge is to applied to work and further prescribes the context where individuals create new knowledge (described as “knowledge in action”) while applying their knowledge in work (Grant, 1996; Hargadon & Fanelli, 2002). By loosely connecting individuals to precedent, rules, and traditional expectations about work, organic organizational capital provides opportunities for individuals to more easily modify work processes. In accordance, organic organizational capital may expand not only flexible cycles of knowledge exchange,

(re)combination, interpretation, and action but also individual learning in the course of action. Much of this discussion is supported in the extant literature on organizational 'improvisation', (Cook & Brown, 1999; Hargadon & Fanelli, 2002; Orlikowski, 2002). In particular, improvisation that involves exploring and continual experimenting tends to be stimulated by: (1) distributed knowledge structures to enhance the efficiency of individual learning; (2) ongoing social accomplishments that are supported by interdependent interactions, mutual respect, social acceptance of errors, and memberships in a community of practices; and (3) minimal control structures to allow maximum flexibility in the course of action (Barrett, 1998; King & Ranft, 2001).

The configuration of specialist human capital, cooperative social capital, and organic organizational capital satisfies these requirements of improvisation. Specifically, specialists who are connected with cooperative relational archetypes build up the transactive memory that helps them develop and utilize distributive knowledge structures. Organic work processes and cooperative social capital encourage generalists to experiment with new idea and behaviors by ensuring mutual respect, trust, cooperative willingness, and strong community memberships, and, as a result, making interpersonal risk tasking safe (Edmondson, 1999). Similarly, studies of new product development have also found that inter-functional coordination stimulates infusion of heterogeneous disciplinary knowledge (i.e., products or functions) to create innovate products, especially under creative organizational cultures (Denison, Hart, & Kahn, 1996; Hargdon & Sutton, 1997; Faraj & Sproull, 2000; Clark et al, 2002).

In short, while specialist human capital and cooperative social capital are predisposed toward exploitative learning, they can be complemented toward exploratory learning by organic organizational capital that ensures continual integration and recombination of the diverse and changing knowledge base, and expands individuals' cognitive frames from "disciplined problem solving" to "creative problem solving".

Architecture Two: Disciplined Extrapolation

In contrast to discussion above regarding the logic of refined interpolation (architecture one), we would suggest that firms may be able to encourage bilateral learning in a markedly different way. In this case, referred to as disciplined extrapolation, the intellectual capital architecture blends generalist human capital, entrepreneurial social capital, and mechanistic organizational capital. As before, this profile is viewed as achieving the dual goals of maximizing knowledge variation and flexibility that characterizes exploration, as well as knowledge integration and refinement that characterizes exploitation.

Generalist human capital. Recalls, while specialists tend to be valued for their deep refined knowledge, generalists tend to be valued for the variety and versatility of their knowledge. Wright and Snell (1999) discussed the value of resource flexibility of human capital and noted that generalist skills as well as diverse human capital pools provide firms with greater adaptability required for organizational learning. In this context, generalist human capital is indeed seen as an important mechanism for discovering new opportunities that depart from existing knowledge stocks (Shane, 2000; Shane & Venkataraman, 2000). Nonaka (1991), for example, noted that individuals who work with broader cognitive maps are in a better position to exchange idiosyncratic knowledge and integrate complex issues.

An important issue for firms that develop generalist human capital would be finding ways to preserve and expand the potential advantages of knowledge exploration while building a countervailing mechanism to ensure that varied knowledge can be integrated and refined in an efficient way (i.e., exploitation). While cooperative social capital tends to reinforce the internal redundancies of the existing knowledge domains, entrepreneurial social capital is more likely to supplement generalist human capital for knowledge exploration. In turn, mechanistic organizational capital can complement the requirements of efficient knowledge integration for bilateral learning.

Entrepreneurial social capital. While cooperative social capital may be useful as an integration and coordination tool for learning among generalists as well as specialists, it tends to reinforce repeated cycles of knowledge exchange and combination through bounded relationships (often called 'relational inertia'). Over time, it may thwart the potential benefits of generalist human capital for knowledge exploration. Instead, the flexibility of entrepreneurial social capital provides more variation and 'reach' needed to acquire new or novel knowledge in diverse areas. This is supported by the recent literature on the interaction between individuals and social relationships (Kilduff & Krackhardt, 1994; Emirbayer & Goodwin, 1994, Mehra, Kilduff, & Brass, 2001). This research suggests that individuals who are adaptable to social situations are more likely to not only broker dispatched social relationships but also to effectively leverage strategically advantageous network opportunities than are those who are not. Generalists, in contrast to specialists, tend to be more adept at system-wide thinking, and are therefore often in a better position to share and combine disparate knowledge (Walsh, 1988; Iansiti, 1993). In this context, generalists who are connected with entrepreneurial social capital act as entrepreneurs who discover new knowledge and opportunities that deviate from the existing knowledge and actively reconfigure chains of knowledge in firms (Shane, 2000; Shane & Venkataraman, 2000).

Mechanistic organizational capital. In the context of bilateral learning, generalist human capital provides a source of knowledge variety and versatility needed for exploration, and is supplemented by entrepreneurial social capital that helps extend and recombine disparate knowledge for greater exploration. In this situation organic organizational capital (characterized by less precedent, rules, or expectations) may be perfectly suited for exploratory learning by enforcing consistently renewed cycles of knowledge acquisition, recombination, interpretation, and action, but it may not provide the foundation for efficient exploitive learning (Teece et al, 1997). In contrast, a stronger integrative mechanism—i.e., mechanistic organizational capital—is likely to be required for bilateral learning.

As noted above, mechanistic (or standardized) work processes typically constrain behavior and correspondingly encourage individuals to focus on searching knowledge to improve upon and quickly applicable into current tasks (Agyris & Schon, 1978; Hannan & Freeman, 1983; Gersick & Hackman, 1990; Schulz, 1998). This suggests that mechanistic work processes reinforce exploitation. However, several scholars have recently noted that mechanistic work processes do not always drive out exploration. Gilson, Mathieu, Shalley, and Ruddy (in press) show that standardized work processes are compatible with and further complement individual creativity by allowing individuals to rely on organizational routines to perform casual tasks and allocate more effort and time on complex and innovative ideas. This research suggests that mechanistic organizational capital may provide the integration, efficiency, and stability required for exploitation while still providing the latitude and discretion needed for exploration.

The reciprocal influence between generalists and mechanistic organizational capital is potentially strong here. Scholars have noted that certain individuals can give impetus to a renewal or evolution of organizational routines (i.e., mechanistic organizational capital) (Pentland & Reuter, 1994; Feldman, 2000; Feldman & Pentland, 2003; Pentland, 2003). Specifically, these individuals are disposed to interpret their actions in order to make sense of what they are doing, and react to the outcomes of previous actions under the given organizational systems and processes. They are motivated to alter preexisting organizational processes when their actions do not produce the intended and desirable outcomes or when their actions produce new opportunities to achieve better outcomes. Generalists may act as those change agents of organizational systems and process. First, generalists possess a broad range of immediate and potential knowledge to develop a great deal of behavioral repertoires that can be applied under the given organizational systems and processes (Wright & Snell, 1998). In other words, by working in a variety of knowledge domains, they experience different problems with different solutions to recognize a greater variety of contingencies and to learn a

great set of behavioral responses at their disposal (Wright & Snell, 1998). In addition, their system-focused mental models enable them to ascertain the relationships between existing organizational knowledge and organizational performance. Accordingly, generalists are positioned to evaluate the 'consensus', 'consistency', and 'distinctiveness' (i.e., effectiveness) of existing organizational systems and processes (c.f. Kelly & Michela, 1980).

In short, while generalist human capital and entrepreneurial social capital are predisposed to expand the range and variety of knowledge acquisition/sharing (i.e., exploration), mechanistic organizational capital complements those elements for bilateral learning by providing a countervailing mechanism to ensure that the variety and novelty can in turn be integrated and refined in efficient ways (i.e., exploitation). The net effect of disciplined extrapolation is to preclude individuals from jumping into continuous exploration cycles of pursuing new knowledge and new combinations with ever-increasing objectives.

Managing Intellectual Capital Architectures

While the benefits of bilateral learning may be clear, a good deal of research is needed to establish the parameters of different intellectual capital architectures. And what seems clear from the literature, and this discussion, is that these architectures do not just happen naturally. In fact, as we noted, the evidence suggests that firms tend to 'learn' toward either exploration or exploitation. This suggests that some method for overtly managing the combinations of human, social, and organizational capital is needed in order to achieve bilateral learning.

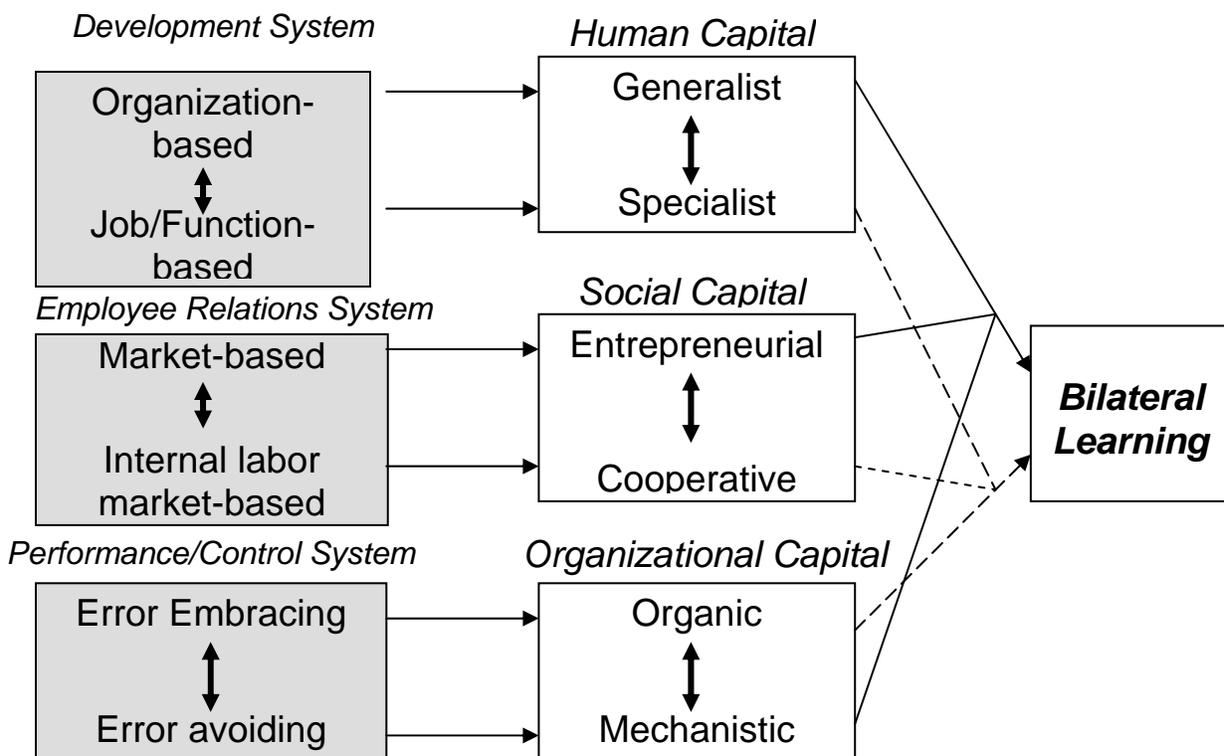
Researchers have consistently noted that human resource management (HRM) practices play an important role in developing a firm's unique human capital (Lado & Wilson, 1994; Lepak & Snell, 1999). Also, increasing evidence shows that HRM can be designed to influence social capital (Leana & Van Buren, 1999; Gittell, 2000; Gant, Inchiniowsk, & Shaw, 2002; Kang et al, in press) as well as organizational capital (cf., Wright et al, 2001; Youndt and Snell, 2004). Specifically, HR practices help to institutionalize a firm's know-how, diffuse key features of its

culture (e.g., core value and beliefs), and reinforce shared interpretations (Ferris, Arthur, Berkson, Kaplan, Harrell-Cook, & Frink, 1998; Bowen & Ostroff, 2004). It is in this context that we would offer some potential HR configurations that underlie the development of intellectual capital architectures that facilitate bilateral organizational learning.

HRM and Intellectual Capital

In devising HR configurations that would affect human, social, and organizational capital, we follow the contemporary view that HR practices are clustered into bundles or sets (e.g., Huselid, 1995; McDuffie, 1995), and present three distinctive sets of HR practices. The *development system*, including skill requirements, job specification, rotation and training, is most strongly linked to managing human capital. The *employee relations system*, including attachment, socialization, advancement, and inducement, is most strongly linked to social capital. The *performance/control system*, including job design, workflow, performance appraisal, supervision, and discretion (empowerment), is most strongly associated with organizational capital. While each set of HR practices may be more strongly aligned with a particular aspect of intellectual capital, a configurational view suggests considerable overlap among the bundles. Figure 2 shows alternative sets of HR practices that will support the development of alternative forms of human, social, and organizational capital, which, in turn, can be combined to facilitate bilateral learning.

Figure 2
HRM and Intellectual Capital Architectures



Managing human capital: The development system. Research suggests firms that focus on developing generalists are likely to use “organizationally focused, skill-based work arrangements’ including broad and multidimensional job designs, job rotations, recruiting/selection based on potential (aptitude), and so on (MacDuffie, 1995; Lepak & Snell, 1999). In contrast, firms that focus on developing specialists are likely to use “job or function-based work arrangements’ including narrow job designs, focused career development, recruiting/section based on the fit between persons and jobs, and so on.

First, regarding formal job designs, job rotations, broad or loosely-defined, and individual skill-based job designs provide the opportunities for individuals to experience a wide variety of tasks and thus, accumulate generalist knowledge (MacDuffie, 1995; Lepak & Snell, 1999). In contrast, specialists tend to develop under a much narrower job scope to capitalize on the efficiency of their deep knowledge. Career paths are similarly designed within particular

functional areas, even to the extent of establishing dual career tracks (Hammer & Stanton, 1999).

Next, regarding staffing at entry and non-entry levels, firms that focus on developing generalist human capital tend to use recruiting/staffing practices (e.g., cognitive ability and aptitude tests) that place priority on employee potential and openness to learn new skills. In contrast, firms that focus on developing specialists are more likely to consider the fit between individuals' current competence and job requirements as a primary criterion for recruiting and selection (MacDuffie, 1995; Lepak & Snell, 1999). Firms also develop generalists through extensive training to focus on future skill requirements beyond current job requirements while firms develop specialist knowledge through intensive training to focus on the improvement of current job-related skills (Bae & Lawler, 2000; Guthrie, 2001). Along with these, generalists can be developed with skill-or knowledge-based incentive systems, which encourage individuals to learn new knowledge and ideas beyond their immediate jobs (Guthrie, 2001). In contrast, specialists can be developed with those incentive systems that focus on individuals' performance and effort in current jobs for compensation.

Managing social capital: The employee relations system. In addition to the literature on HR practices for developing human capital, there is also a growing body of literature on the development of social capital (e.g., Leana & Van Buren, 1999). Alternative employee relations systems can be used to develop cooperative and entrepreneurial relational archetype in firms (cf., Kang et al., in press). One is typically referred to as the "internal labor market (ILM)-based employee relations" including; (1) internal staffing/promotion; (2) seniority-based compensation (including fixed bonus and low pay differential) and (3) socialization (including mentoring, P-O fit criteria for recruiting and promotion, extensive orientation, team structures, multi-source feedback, etc) (Doeringer & Piorer, 1971; Osterman, 1984). Its alternative can be described as the "market-based" or "network-based employee relations" including (1) extensive external staffing that utilize various external sources of human resources (2) performance-based

compensation (e.g., individual incentives, pay for reputation, profit-center, objective criteria for performance appraisal, tournament-based pay structure, etc.); and (3) general development experiences (e.g., cross-training, formal training, training for interpersonal skill improvement, social events, etc.) (Malos & Campion, 1995).

Many scholars have found that ILM-based employee relations provide several advantages for firms. First, under internal staffing or promotion individuals tend to share the same organizational membership and to be co-located over their career histories so that they are likely to develop more frequent and dense interactions (Tajfel, 1981). Internal staffing or promotion also encourages cooperative behaviors because individuals have a history that is observable prior to moving up the ladder (Osterman, 1984). Socialization and seniority-based compensation establish a set of rules and procedures that reduce the need for monitoring and agency behavior by developing collective norms and rules (Doeringer & Piore, 1971; Osterman, 1984). Finally, internal staffing and socialization induce individuals to develop and internalize common architectural knowledge on organizational processes (Nonaka & Takeuchi, 1995; Mullen & Noe, 1999). Accordingly, ILM-based employee relations are likely to facilitate the development of cooperative relational archetypes that consist of strong and dense ties, institutionalized trust based on organizational membership and norms, and common architectural knowledge in firms.

In contrast, market-based employee relations are likely to establish entrepreneurial social capital in firms. First, extensive external staffing may induce relatively sparse and weak social ties among individuals by incurring loose organizational memberships among them, their frequent in-and-out, and their networking motivation to interact only with colleagues who provide expertise to help them address problems and opportunities that arise contemporaneously (Doorewaard & Meihuizen, 2000; Fisher & White, 2000). Dyadic trust does not develop unless the results obtained through joint contributions of individuals at work are appropriately rewarded. Performance-based compensation reinforces individuals' motives to build varied relationships

while discouraging social loafing that is considered as an inherent problem in seniority-based pay (Eisenhardt, 1989; Leana & Van Buren, 1999). Such benefits of performance-based compensation are best leveraged when it is accompanied with acquisition of knowledge or new ideas (e.g., pay-for-idea or pay-for-reputation) (Hargadon & Sutton, 1997; Gant et al., 2002). Finally, common component knowledge among individuals can be expanded through general development experiences to improve foundational knowledge to absorb new knowledge (Cohen & Levinthal, 1990; Hargadon & Sutton, 1997).

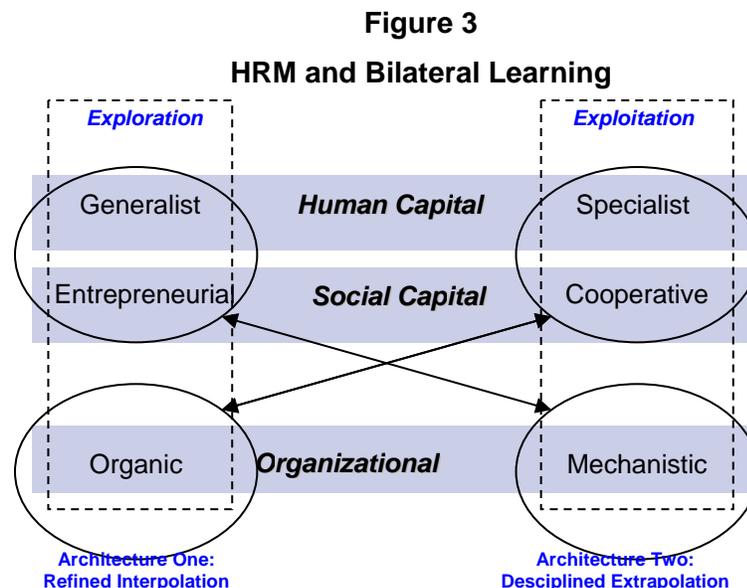
Managing organizational capital: The performance/control system. Firms are expected to rely on alternative performance/control systems to institutionalize, diffuse, and reinforce alternative forms of organizational capital. Specifically, mechanistic work processes assume that firms accumulate relatively complete information about “cause-effect relations” in organizational activities or the link between the actions individuals take and the results they achieve. In this case, an important issue is to ensure conformance of individuals to present standards, eliminate uncertainty, and increase predictability of individual behaviors at work. Accordingly, HR performance/control systems targeted toward “error avoidance” that uphold specific provisions regarding work protocols help firms to effectively implement and reinforce mechanistic work processes (Snell, 1992; Snell & Youndt, 1995). Examples of those HR practices are standard operating procedure (e.g., job descriptions), specific behavioral appraisal systems (e.g., behavioral observation scales), narrow job descriptions, close supervision, and performance program imposed top-down (Snell, 1992; Snell & Youndt, 1995).

In contrast, organic work processes encourage individuals to develop a variety of behavioral repertoires and to flexibly adjust them to perceived situations. Those processes can be supported by “error embracing” performance/control systems that acknowledge mistakes are a natural byproduct of learning. Rather than focusing on error prevention, error embracing systems allow individuals to make decisions, set their own performance goals, and make changes in the ways they perform their jobs (Lepak & Snell, 1999). In fact, those

performance/control systems intend to expand empowerment that enables individuals to effectively deal with non-routine and exceptional circumstances requiring creativity and initiative (Arthur, 1994). Examples of those HR practices include (1) reduction of status barriers between managers and employees, (2) employees' participation in problem-solving and decision-making, (3) extensive transference of task and responsibilities to employees, (4) providing chances to use personal initiatives, (5) encouraging and implementing employee suggestions, (6) developmental performance appraisal, and (7) cooperative and trustful climate (Bae & Lawler, 2000; Arthur, 1994).

HRM and Bilateral Learning: Theoretical Implications for HRM Systems

Combing the literatures on HRM, intellectual capital, and organizational learning, we can derive two alternative HR configurations to support bilateral learning. As Figure 3 shows, the configuration that supports refined interpolation (architecture one) consists of a job or function-based development system (specialist human capital), an ILM-based employee relations system, (cooperative social capital) and an error embracing performance/control system (organic organizational capital). The other configuration that supports disciplined extrapolation (architecture two) consists of an organization-based development system (generalist human capital), a market-based employee relations system (entrepreneurial social capital), and an error avoiding performance/control system (mechanistic organizational capital).



We believe that this framework provides an important theoretical implication for HRM. While HR researchers have emphasized the importance of internal fit among HR practices in order to reinforce and complement one another, there has been limited theoretical justification for this prescription, and correspondingly considerable confusion exists about specific forms of the 'internal fit' construct (Bacharach, 1989; Delery, 1998). The framework presented here provides a clear theoretical perspective for the concept of 'internal fit'. Specifically, we focus on both supplementary and complementary fit in HR (Kristof, 1996). Supplementary fit occurs when an entity shares similar fundamental characteristics with the other, and complementary fit occurs when one entity provides what the other does not.

As discussed below, each of the intellectual capital architectures involves supplementary alignment between the HR development system and the employee relations system (to support human and social capital). Beyond this, these two systems have complementary alignment with the performance/control system.

Architecture one: Refined interpolation. Job or function-based development tends to support specialized human capital while an ILM-based employee-relations system tends to support cooperative social capital. Both of these systems—and corresponding human and social capital—would tend to reinforce exploitive learning. In that regard, they represent a

supplementary alignment between the HR systems. However, in order to avoid too much emphasis on exploitation, the performance/control system would need to be aligned in a complementary fashion to support exploration. In this particular case, an error-embracing performance/control system would tend to support organic organizational capital and therefore support exploratory learning. In combination then, these three HR systems would establish a unique configuration to support the refined interpolation form of bilateral learning.

Architecture two: Disciplined extrapolation. In contrast to refined interpolation (architecture one), the model of disciplined extrapolation would involve a supplementary alignment between an organization-based development system and a market-based employee relations system. The organization-based development system would tend to support generalized human capital, while the market-based employee relations system would support entrepreneurial social capital. Both of these systems reinforce exploratory learning. As a countervailing force, to ensure bilateral learning, an error-avoiding performance/control system that reinforces mechanistic organizational capital would be needed to support knowledge exploitation. This complementary system when used in combination with the other HR systems would create an overall HR configuration that supports bilateral learning.

Discussion And Conclusion

At the outset, we noted that the purpose of this paper was to identify ways that organizations could simultaneously pursue knowledge exploration and exploitation; a concept we refer to as bilateral learning. Underlying that objective, we noted that a firm's approach to organizational learning depends on its intellectual capital architecture; that is, its unique combination of human, social, and organizational capital. These three components (human, social, and organization capital) are key resources in that they represent distinctive knowledge repositories in firms. And while their alternative forms are individually linked to either

exploration or exploitation, we suggested that their combination could be the key to bilateral learning.

Our theoretical framework presents two distinctive architectures of intellectual capital that support bilateral learning. One architecture, referred to as refined interpolation, consists of specialist human capital, cooperative social capital, and organic organizational capital. The other architecture, referred to as disciplined extrapolation, consists of generalist human capital, entrepreneurial social capital, and mechanistic organizational capital.

In one way, our framework extends previous work on organizational learning in that it provides a foundation for research on how firms might pursue exploitation and exploration together. At this point, very little research has investigated why some firms can pursue both exploration and exploitation, while others pursue only one. Our framework suggests that firms can create a virtuous relationship between exploitation and exploration that leads to bilateral learning by designing systems that support efficiency and flexibility at different levels (human, social, organizational).

To support these architectures, we have identified two alternative HR configurations that facilitate bilateral learning. One HR configuration combines job or function-based development, ILM-based employee relations, and error embracing control systems to support refined interpolation (architecture one). The other HR configuration combines organization-based development, market-based employee relations, and error avoiding performance/control systems to support disciplined extrapolation (architecture two). Each HR configuration is characterized by both a supplementary alignment between the development system and the employee relations system, as well as a complementary alignment between these systems and the performance/control system. This has the effect of balancing people-embodied knowledge (human and social capital) against organization-embodied knowledge (organizational capital).

In another way, our framework extends previous work on the competitive potential of HRM in that it provides a very detailed examination of the underlying processes that link “people

management and firm performance” (Becker & Gerhart, 1996). By clarifying the complex relationships underlying bilateral learning, we hope to expand knowledge about the potential contribution of HRM to dynamic capability of the firm, especially related to how knowledge-based assets and organizational learning lead to innovation and competitive advantage.

Future Research

Our framework offers several directions for future research. First, in this paper we have identified alternative forms of human capital in terms of diversity of individual knowledge. We have assumed individual knowledge as one-dimensional construct to simplify our conceptual framework. But individual knowledge can be seen as a multi-dimensional construct including functional, organizational, industrial, and disciplinary dimensions (Becker, 1964; Brown & Dungid, 1991). How these components of human capital interact to affect individual and organizational learning should receive further attention. An interesting issue for future research might be an investigation into how particular dimensions of human capital enhance the variety of knowledge acquisition and integration.

Second, our framework suggests that bilateral learning can be achieved through two alternative intellectual capital architectures and correspondingly, two alternative HRM systems. However, this does not mean that the two can be found in every industry and institutional context. Certain institutional and industrial environment may hinder the development of particular HRM systems and intellectual capital (see, for example, Iansiti & West, 1997).. Future research is needed to explore conditions where particular intellectual capital architectures are more common or where two alternative intellectual architectures appear across industries and countries.

Third, future research might explore the evolutionary process of intellectual capital architectures. While we have argued that human, social, and organizational capital is conceptually distinct, the three may be related in practice – one may affect the others. For example, human and social capital may affect the creation of new organizational capital.

Conversely, organizational capital may condition the development of particular types of human and social capital by molding individuals' thought and behaviors in early stages of their career. Longitudinal and qualitative research will be valuable to provide richer understanding of these complex interrelationships among human, social, and organizational capital and how particular intellectual capital architecture is formed and changed over time.

Finally, based on a normative notion, we have assumed that bilateral learning produces better performance by obtaining synergies between exploitation and exploration than exploitation or exploration only does. However, Milliman, Von Glinow, and Nathan (1991) argue that in different stages of an organizational life cycle organizations need different extent of flexibility in HRM systems. Similarly, particular forms of firms (e.g., venture capitals) and particular stages of industrial evolution may require exploitation or exploration-focused learning to improve organizational performance. Accordingly, future research is required to address the relationship between bilateral learning and firm performance.

Conclusion

The survival and prosperity of firms depend on how well they can continuously acquire and integrate knowledge. Bilateral learning is more than a concept that blends knowledge exploration and exploitation; it is a capability that needs to be developed and leveraged for competitive advantage. A firm's intellectual capital architecture represents the combination of knowledge at the individual, social, and organizational level. HRM, while not the only mechanism for managing these resources, is an important tool that helps establish the context for bilateral learning,

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