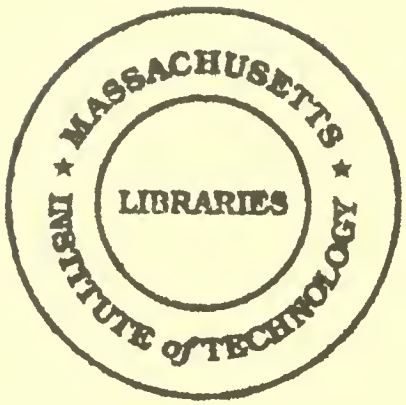
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The Mirror Image between Teams and their Organizations: Implications for Organizational Capability Development*

by
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June 2001 WP #4149

* The paper is derived from my thesis at the Sloan School of Management, Massachusetts Institute of Technology. The MIT-Japan Program Starr Foundation, the CS Holding Fellowship in International Business, and the Massachussets Institute of Technology Doctoral Fellowship provided funding for this study. I would like to thank the managers of the companies studied for sharing their experiences with me. The comments of participants at the Massachusetts Institute of Technology Proseminar helped improve the paper. I am also grateful to Eleanor Westney, Michael Beer, John Carroll, and Alvaro Cuervo-Cazurra for their comments and suggestions. All errors remain mine.

The Mirror Image between Teams and their Organizations: Implications for Organizational Capability Development

Abstract

In the organizational capability literature, though the level of analysis is the organization, its unit of analysis is the substructures of the firm, particularly the project teams that are used to mobilize and create new knowledge for generating new resources, i.e., innovation. Since the current literature lacks the explanation about how organizations might invest in developing these capabilities, I link this literature to two streams of literature on innovation, one that focuses on the organization-level factors that facilitate innovation and another that analyzes the team-level factors that also support innovation. However, these two streams of literature provide different implications about how to invest in developing these capabilities. On one hand, the organization-level innovation literature suggests that the investment should be made at the organization level independent of when employees are organized for innovation to build the supporting organization-level processes, specifically, communication routines and cooperation between different functions. On the other hand, according to the team-level innovation literature, the investment can be made as needed when organized employees into project teams for innovation. Project team management practices, i.e., project team reward and project team development facilitate communication and cooperation among team members to achieve the innovation. Based on extensive fieldwork and surveys of 182 cross-functional innovation teams belonging to 38 companies, the study shows that there is a mirror image between the project team-level processes and their organization-level processes. This finding implies that in making the investment to develop organizational capabilities, organizations that already invest at the organization level in generating the supporting organization-level processes may find it less necessary to invest at the project team level when organized for innovation. However, for organizations that lack these organization-level processes may need to invest at the project team level when organized into project teams for generating new resources, i.e., innovation.

The capability to mobilize and create knowledge for innovation has been viewed as critical for competitive advantage (Helfat, and Raubitschek, 2000). It has been referred to as "integrative capability" (Lawrence and Lorsch, 1967), "core competence" (Prahalad and Hamel, 1990), "combinative capability" (Kogut and Zander, 1992), and "dynamic capability" (Teece, Pisano, and Shuen, 1997). However, despite the extensive debate about the value of firms' capability to mobilize and create knowledge for innovation that meets the demands of the external markets (Jamison, 1999; Grant, 1998; Lukus and Ferrel, 2000; Cristiano, Liker, and White, 2000), there is still limited understanding of "how" companies accomplish this, as Foss, Knudsen, and Montgomery (1995) state: "The question of intentionality becomes particularly salient when considering how a firm sets out to build a given set of capabilities. Because resources that support a competitive advantage are by definition inimitable, and unidentifiability is a sufficient condition for inimitability, it is difficult to say how one should invest to build a competitive advantage. On the other hand, the view that one cannot make such investments purposively is not satisfactory either. Is there a way out of this conundrum?" (p. 13).

Despite the limitation in knowledge of how this capability is developed, there is some agreement about critical features of organizational capabilities. First, these capabilities require knowledge mobilization and combination (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Nelson and Winter, 1982; Winter, 2000; Helfat and Raubitschek, 2000) and new knowledge creation (Nonaka, 1994; and Leonard-Barton, 1995) that result in innovation. On one hand, researchers who analyze knowledge mobilization and assume creation follows from such mobilization (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Nelson and Winter, 1982; Winter, 2000; Helfat and Raubitscheck, 2000) suggest that organization-level processes such as

communication and cooperation among individuals in organizations are critical determinants, which are facilitated by incentives (Teece et al., 1997; Prahalad and Hamel, 1990) or social capital (Kogut and Zander, 1992). On the other hand, researchers who focus on the knowledge creation process assume that mobilization occurs, and suggest that the creation process requires slack resources in terms of overlapping knowledge among employees in the organization (Nonaka and Takeuchi, 1995).

Second, although the level of analysis of organizational capability is the organization itself, the unit of analysis is the project team, which acts as the mechanism for knowledge mobilization and creation (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Teece et al., 1997; Nonaka and Takeuchi, 1995; Leonard-Barton, 1995). Explicitly, the source of organizational capabilities is the ability of small groups of individuals, i.e., project teams, to come together to share their individual knowledge, and transform that knowledge into new knowledge that results in new products (Nonaka and Takeuchi, 1995; Leonard-Barton, 1995) or new processes (Teece et al., 1997), which generate value for the firm.

Third, innovation is a key outcome and indicator of this capability (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Teece et al., 1997; Nonaka and Takeuchi, 1995; Leonard-Barton, 1995), since the capability itself cannot be measured directly (Godfrey and Hill, 1995). Although most researchers of organizational capabilities discuss product innovation as the main outcome of this capability (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Nonaka and Takeuchi, 1995; Leonard-Barton, 1995), these innovations also meet the test of the demands of the external market. Therefore, this capability not only allows the generation of product innovation, but the quality of the innovation also matches the needs of the market (Helfat and Raubitschek, 2000).

However, the literature based on the resource-based view does not provide any empirical tests of how companies would invest in developing these capabilities. For example, Kogut and Zander (1992) suggest that organizational principles are important for building social ties in organizations that facilitate knowledge sharing, but we do not know what these organizational principles entail. Prahalad and Hamel (1990) also suggest that there should be mechanisms whereby individuals could come together to share and combine their knowledge in order to generate new resources. However, we do not know what these mechanisms are, although, similarly to other researchers, Prahalad and Hamel (1990) imply that organizations manage their employees so as to encourage knowledge mobilization through communication and cooperation. For researchers who focus on knowledge mobilization, managing employees so that they are motivated to share their individual knowledge, either by using incentives (Teece et al., 1997) or building social ties (Kogut and Zander, 1992), enables firms to gain this capability. Researchers who focus on the creation process suggest that employees should be developed to have some overlapping knowledge. Therefore, in order to have the organizational capability to mobilize and create knowledge for innovation, employees are not only managed to be motivated to share knowledge, but also so that they have the capability to absorb the knowledge being shared and converted into new organizational resources. For knowledge mobilization via communication and cooperation, some researchers suggest the use of organization-level human resource management practices related to selection (Leonard-Barton, 1995) and reward (Teece et al., 1997; Leonard-Barton, 1995; Kogut and Zander, 1992; Prahalad and Hamel, 1990); they also claim that for creation, work experience in more than one function is necessary.

Fortunately, there are two bodies of literature on innovation, one that focuses on the team level of analysis and another that emphasizes the organizational level of analysis. The team-

level innovation literature provides suggestions as to what firms could do when organizing employees into project groups for innovation, while the literature on organization-level innovation provides suggestions as to what firms could do at the organizational level independent of the specific context by which they organize for innovation.

The team-level innovation literature deals with how to manage the process of innovation when firms organize employees into project teams for the purpose of mobilizing and creating new knowledge for innovation. Although it acknowledges the importance of organizational context impinging on team processes in the process of achieving the innovation, it focuses exclusively on generating innovation. As a result, the literature suggests that these processes may be developed as needed when a firm organizes for innovation. This is achieved by using a set of project team management practices, such as team development and reward.

In contrast, the organization-level innovation literature also suggests that a set of organization-level processes, such as cross-functional communication, is critical for generating innovations. As a result, in contrast to the team-level innovation literature, this body of literature suggests that organizational design that integrates or differentiates different parts of the organization affects these organization-level processes.

Therefore, as the literature stands, we still do not know how to develop the capability to mobilize and create knowledge for innovation. On one hand, the resource-based view of the firm provides us with an understanding of why organizational capabilities are important for competition. On the other hand, the team-level innovation literature and organization-level innovation literature provide us with different explanations of how these capabilities might be developed. Therefore, the overarching research question is where do organizations invest in developing these capabilities? This study proposes that there is a mirror image between

organizations and their teams' processes, which suggests that for organizations that already invest at the organization level to develop the supporting organization-level processes may not need to make the investment at the project team level when organized employees for innovation. On the other hand, for organizations that do not have the supporting organization-level processes, they need to invest at the project team level when organized for innovation.

I conduct an empirical analysis to answer the question and test the proposition. The empirical study is based on comparative case studies and surveys of 182 cross-functional innovation teams of 38 large companies in the computer, photo imaging, and automobile industries whose task was to use market knowledge about products and services to generate innovation in response to customer demands. In order to separate out levels of analysis (Rousseau, 1985), in each company, the team leaders and personnel managers completed the surveys. Prior to the surveys, extensive qualitative data through field observation and interviews was gathered to generate in-depth understanding of how project teams relate to their organizational contexts and how they affect the development of these organizational capabilities.

The rest of the paper is organized as follows: Section 2 discusses the theory and hypotheses. Section 3 presents the research design. Section 4 provides the results, and section 5 presents the discussion and conclusions.

THEORY AND HYPOTHESES

This paper integrates two bodies of literature on innovation that focus on the organization-level and project team-level in trying to understand how organizational capabilities are developed, suggesting that project teams are embedded in the organization, and are therefore subject to the ongoing organization-level processes. Thus, in organizations where the organization-level processes, particularly organization-level cross-functional communication

frequency, organization-level shared sense of cross-functional cooperation, and organization-level overlapping knowledge, are institutionalized and embedded in their routines (Nelson and Winter, 1982), I argue that these factors occur automatically on project teams. Organizations that already have these processes in place may thus find it less necessary to develop project team-level processes to generate the processes to support knowledge mobilization and creation for innovation. However, organizations that do not have organization-level cross-functional communication frequency, organization-level shared sense of cross-functional cooperation, and organization-level overlapping knowledge institutionalized in their organizations, may find it necessary to develop the project team-level processes to achieve innovation.

The innovation capability

Organizational capability concerns an organization's ability to combine different types of resources, especially firm-specific knowledge embodied in their employees, in order to create new resources that enable firms to achieve and sustain their competitive advantage. Organizational capabilities are viewed as a type of strategic resource (Foss, 1997; Foss et al., 1995), because they are rare, valuable, inimitable, non-tradable, and non-substitutable (Barney, 1991). In this study, I focus on the organizational capabilities of mobilizing and creating knowledge for innovation. These capabilities are specified as a firm's ability to mobilize knowledge, and combine and convert individual knowledge embedded in different disciplines for creation of new knowledge that results in innovation in products and/or processes. Moreover, these capabilities are dynamic in that they involve the interaction and changes between firm's internal knowledge and the demands of the external market (Helfat and Raubitschek, 2000). In other words, it involves the continuous integration and combination of knowledge from the

external market with the internal knowledge and capabilities of the firm, such that the demands of the external market are constantly met.

Knowledge mobilization. Researchers who focus on organizational capabilities and are based in the resource-based view of the firm tend to discuss knowledge mobilization and assume creation occurs. Moreover, when discussing organizational capabilities, these researchers (e.g., Nelson and Winter, 1982; Prahalad and Hamel, 1990; Kogut and Zander, 1992; Hamel, 1994) choose to focus exclusively on firm-specific knowledge and skills of their personnel, especially their tacit knowledge (Nonaka, 1994; Spencer, 1996). The main reason is that firm-specific tacit knowledge embodied in these human resources is rare, valuable, inimitable, non-tradable, and non-substitutable, and therefore enables firms to achieve sustainable competitive advantage (Winter, 1995; Grant, 1996; Liebeskind, 1996) and rents associated with it (Peteraf, 1993). Nelson and Winter (1982), for instance, argue that the differences in firms' performance are explained by the differences in their routines, which embody individual knowledge and skills. Some organizations have routines that are conducive to knowledge mobilization and creation that enable them to expand or maintain their competitive advantage. The authors also argue that this capability is a source of competitive advantage and sustainability, because the way in which routines are developed is difficult to observe and causally ambiguous. Moreover, these routines are built over time as a result of a firm's strategies and structures, which evolve over time and are path-dependent. It is the persistence of these routines that enables firms to enjoy superior performance and at the same time makes it difficult for competitors to catch up (Teece et al., 1997).

Prahalad and Hamel's (1990) core competence is contingent on the firm's ability to mobilize and combine individual knowledge and skills across boundaries to create new

resources, i.e., innovation. This ability enables a firm to expand or sustain its competitive position. Therefore, the way in which these human resources are managed is critical in developing or possessing this capability. Similarly, Kogut and Zander (1992) argue that the firm's combinative capability is a more promising source of competitive advantage, because it depends on the social relations within small groups of individuals who share and combine their knowledge to create new resources. Leonard-Barton (1995) and Nonaka and Takeuchi (1995) also discuss knowledge sharing across individuals as critical in having this capability. What is implicit in these discussions is that the capability to mobilize knowledge includes the integrative or combinative capability of knowledge from the external markets with the internal environment of the firm, and these processes themselves safeguard a firm's sources of sustainable competitive advantage.

Although these authors take a more dynamic approach to understanding resources in competition[1], particularly the way in which individual knowledge is mobilized and combined to create new resources, the understanding of how these resources are created is limited if one does not discuss the creation processes[2] (Wernerfelt, 1997).

New knowledge creation. While researchers analyzing organizational capabilities tend to emphasize the knowledge mobilization process and assume creation occurs, a few researchers

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[1] In contrast to the static approach that views individual or groups of resources as the sources of rents either through acquisition or protection of critical resources that firms already own (e.g., Rumelt, 1982; Barney, 1986; Stigler, 1968; Bain, 1956), the dynamic approach tries to explain how new resources are generated.

[2] With the exception of Leonard-Barton (1995) and Nonaka and Takeuchi (1995).

examine the processes of knowledge creation (Leonard-Barton, 1995; and Nonaka and Takeuchi, 1995). Nonaka and Takeuchi (1995) provide a comprehensive model of the way in which new resources are created in organizations. Their model includes individual knowledge mobilization, combination, and conversion into organizational resources. The model involves two main processes, the mobilization of individual knowledge and the conversion of individual knowledge into organizational knowledge that comes in the form of innovations, which is considered to be a new resource to the firm. The basic argument behind Nonaka and Takeuchi's (1995) knowledge creation model is that knowledge mobilization and creation are difficult, not because of individuals' lack of motivation to share their knowledge, but because the nature of individual tacit knowledge constrains knowledge mobilization and conversion.

According to this model, knowledge mobilization is a necessary but insufficient condition for new resource creation. The initial step in the knowledge creation process is the "socialization" process whereby individual knowledge is mobilized or shared with other individuals. Because of the tacitness of individual knowledge, the sharing process requires the sharing of individual experiences through observation or imitation rather than documentation or articulation. The second step involves a process of "externalization" whereby individual tacit knowledge is made explicit to the receiver through the use of analogies, metaphors, hypotheses, concepts, or models (p. 64). There is then a "combination" process whereby individual explicit knowledge is shared between a group of individuals through the use of different media such as phone conversations, meetings and computer-aided media (p. 67). The final process is "internalization", whereby individuals internalize or absorb new knowledge from the socialization, externalization, and combination processes. This process is basically 'learning by doing', through interaction with other people in the process of creating new resources. All of

these processes are interactive and work together in a spiral fashion. The ability of different firms to mobilize individual knowledge and convert it into organizational knowledge varies, and it is arguable that this difference in ability explains the differences in firms' ability to generate innovations, and therefore, their overall performance. Moreover, this capability is protected from being appropriated away by competitors because the processes underlying the capability are difficult to observe and therefore difficult to imitate.

Leonard-Barton's model of knowledge creation for innovation is viewed as a shared problem-solving activity (1995: p. 61; Leonard and Sensiper, 1998). By putting the creation process under a microscope, the author suggests that the facilitators of knowledge creation are more than just incentives (Teece et al., 1997). For example, some of the barriers to shared problem-solving are the individual-level trap mind-set of organizational success, their signature or highly specialized skills, the lack of differences between individual cognitive styles or mental models, and different preferences in tools and methodologies. However, without empirically and systematically testing and analyzing what companies do and the factors and management practices that facilitate knowledge mobilization and creation, we still do not know how this capability is developed. On one hand, researchers who focus on the knowledge mobilization process suggest that communication patterns or routines and cooperation are critical for organizational capability, and rewards and/or building social ties facilitate their development. On the other hand, researchers who focus on the creation process suggest that the overlapping knowledge is crucial (Leonard-Barton, 1995; Nonaka, 1994), which has strong implications for human resources development in different parts of the organization. For example, Leonard-Barton (1995) suggests that both sets of factors are necessary; however, overlapping knowledge in organizations is limited (p.76).

Although the literature on organizational capabilities has several limitations in dealing with the treatment of knowledge mobilization vs. creation, level and unit of analysis, and measurement, the most critical limitation is the lack of explanation of how to develop them (Foss et al., 1995). Researchers analyzing knowledge mobilization suggest that incentives (Prahalad and Hamel, 1990; Teece et al., 1997) and the building of social ties (Kogut and Zander, 1992) facilitate the process. However, they do not offer explanations of types of rewards or how to build these social ties. Prahalad and Hamel (1990), for instance, suggest that firms that have core competencies manage their employees such that there is a shared sense of cooperation in achieving organizational goals and communication patterns that transcend functional and business boundaries. They view firms that have core competencies as firms that induce their employees to share or mobilize knowledge and expertise across boundaries to generate innovations. In firms that lack such core competencies, each part of the organization views other parts as rivals. Therefore, knowledge mobilization is limited since the different parts of the organization hide critical knowledge from one another rather than sharing it to create new resources. Kogut and Zander (1992) suggest that "organizing principles" facilitate the development of this capability by facilitating communication and cooperation. However, it is unclear what these organizing principles are. Moreover, Nelson and Winter (1982) and Teece et al. (1997) suggest that cross-functional communication routines are important factors in possessing this capability. Similar to the previous researchers, they do not clarify the way in which these routines are established. Leonard-Barton (1995) argues that one of the key dimensions in developing this core capability is having the values and norms that encourage knowledge sharing and cooperation. Organizations that have this core capability value cooperation, trust, and the routines of working together to share knowledge in order to create

new knowledge for innovation (p. 48). However, we do not know how these supporting routines are developed. In contrast to other researchers, Leonard-Barton (1995) suggests the use of selection and reward to induce knowledge sharing. She argues that selecting employees based partly on personality traits conducive to collaboration and rewarding them partly based on team performance encourages cooperation and knowledge sharing (p. 14).

Similarly, researchers that focus on the knowledge creation process do not establish tests of the factors that facilitate knowledge creation, although they provide some insights about the factors that might facilitate the process, particularly overlapping knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995: 77; Leonard-Barton, 1995: 76).

The organization-level processes

Similar to the literature on organizational capabilities and team-level innovation literature, the organization-level innovation literature considers communication and cooperation to be key factors in facilitating knowledge mobilization in organization. However, since the level and unit of analyses are at the organizational level, most of the literature analyzes knowledge mobilization using communication, and assumes that creation occurs.

Organization-level communication routines. As in the case of the other two bodies of literature, in this body of literature communication is considered to be key in generating innovation. Every organization has some type of communication patterns (Morrill, 1995; Katz and Kahn, 1966), routines (Nelson and Winter, 1982), or codes (Kogut and Zander, 1992), and cross-functional communication is by and large viewed as supporting knowledge mobilization for innovation. The main reason is that innovation requires the sharing and integration of different types of functional knowledge (Dougherty, 1992). Therefore, sales/marketing, design

and manufacturing are integrated in order to create cross-functional communication routine among these functions (Lawrence and Lorsch, 1967; Nohria and Ghoshal, 1997). Similarly, Kogut and Zander (1992) propose that communication codes that facilitate knowledge mobilization between design and manufacturing are necessary. Dougherty (1992) also suggests that new product development is contingent on the communication frequency among individuals in the sales/marketing, R&D, and manufacturing functions.

Organization-level shared sense of cooperation. This body of literature also suggests that knowledge mobilization is facilitated by cross-functional cooperation. Depending on the organization, individuals in different functions view other functions as coalitions of interests (Cyert and March, 1963) or as a cooperative system (Barnard, 1938). Cross-functional cooperation embodies the organization-shared vision (Prahalad and Hamel, 1990) and commitment (Lincoln and Kalleberg, 1990). Therefore, cross-functional cooperation not only embodies the collective goals and aspirations of organization members (Tsai and Ghoshal, 1998), but also their understanding of how knowledge embedded in different disciplines connects when necessary to create new resources. The common vision and commitment help organization members to see the potential value of their knowledge mobilization.

Organization-level overlapping knowledge. Organizational slack is also important for innovation (Nohria and Gulati, 1995), which in this paper takes the form of overlapping knowledge. Nohria and Gulati (1995) define slack as the pool of resources in an organization that is in excess of the minimum necessary to produce a given level of organizational output. Some examples of slack resources are redundant employees, unused capacity, and unnecessary capital expenditures. By this definition, overlapping knowledge that supports knowledge creation for

innovation is a type of slack resource. According to Nonaka (1994)[3] another name for overlapping knowledge is redundant knowledge, which, by definition, is knowledge that is unnecessarily repetitive or superfluous. To be clear, however, overlapping knowledge in this study deals with the overlapping disciplinary knowledge in the organization. Despite the lack of empirical tests, the argument for overlapping knowledge sets is that they provide individuals with the cognitive capability and absorptive capacity to combine insights synergistically, effectively and efficiently from multiple knowledge sets for innovation. Since each function or community of practice (Brown and Duguid, 1991) has its own "thought world" where knowledge is embedded, the overlapping knowledge in other functions enables individuals to take the perspective of other functions during the process of knowledge exchange with members of those functions in the process of innovation (Boland and Tenkasi, 1996). Individuals with overlapping knowledge of other functions possess absorptive capacity for receiving knowledge from other functions, since their overlapping knowledge enables them to take the perspective of those functions when combining knowledge with their own function in the process of innovation (Boland and Tenkasi, 1996).

The project team-level processes

Project team-level processes can be divided into two groups: those that facilitate knowledge mobilization and those that facilitate the creation process. While communication and cooperation facilitate knowledge mobilization, overlapping knowledge among team members

[3] Nonaka's unit of analysis is the project team, however, his idea of overlapping knowledge among team members has implication about the stock of overlapping knowledge available at the organization independent of when it is used.

facilitates the creation process. Communication and cooperation do not support the knowledge creation process, because individuals are boundedly rational, and therefore, do not have the ability to absorb different types of knowledge being communicated or mobilized and transform it into new knowledge.

Project team-level communication. The traditional approach to studying team-level innovation considers communication as the key factor in generating the innovation. At the project-team level, communication is divided into two types: internal communication, which occurs among team members, and external communication, which occurs between team members and their external links. Both types of communication are considered critical for innovation, since communication is assumed to be an exchange of knowledge among individuals involved. Since communication is viewed as an exchange of knowledge or resources, the higher the frequency, the more knowledge is being exchanged, and the better this is for innovation (Dougherty, 1987; Griffin and Hauser, 1992; Allen, 1977).

Empirically, successful innovation has been shown to require communication between R&D, engineering, and marketing to combine technological capabilities and constraints (Souder, 1987; Katz, 1982). Dougherty (1987), for instance, suggests that projects with unsuccessful outcomes typically had lower levels of communication frequency, while successful projects were those that had a higher frequency of interfunctional communication.

Project team-level shared sense of cooperation. A shared sense of cooperation among team members is also proposed to enhance teamwork performance in the process of innovation (Cannon-Bowers and Salas, 1990; Wageman and Baker, 1997). There are numerous definitions for this concept ranging from "group mind", and teamwork schemas to common cause maps (Klimoski and Mohammed, 1994: 403). In this paper, project team shared sense of cooperation

is defined as a team-shared goal and commitment to accomplishing the team task (Gladstein, 1984; Katz, 1997:138). A shared sense of cooperation enhances innovation, since it motivates knowledge exchange (Madhaven and Grover, 1998).

Project-team overlapping knowledge. While communication and cooperation facilitate knowledge mobilization, researchers who emphasize the creation process suggest that overlapping knowledge among team members supports the creation process of new knowledge for innovation. Project team overlapping knowledge is the common knowledge that team members have, which enables individuals to take the perspective of other team members in the process of exchanging knowledge for innovation (Boland and Tenkasi, 1996). Additionally, the overlapping can be understood in terms of the absorptive capacity that individuals have for other types of knowledge present within the team. Overlapping knowledge facilitates the conversion and integration of different types of knowledge to create and achieve innovation (Madhaven and Grover, 1998). The underlying logic is that overlapping knowledge provides team members with the cognitive resources to combine insights synergistically from multiple knowledge sets (Madhaven and Grover, 1998).

Linking teams to their organizations

Clark and Wheelwright (1992) suggest that, regardless of team structures used in the process of innovation, team members remain embedded in their daily context within the organization. According to these authors, there are four types of team structures used in the process of innovation: functional, lightweight, heavyweight, and autonomous. It is the first three structures that are used most frequently. In functional project team structures, all team members remain completely embedded in their daily routines, performing their routine tasks, while also performing an additional assigned task, which is related to the project. There is no clear team

leader coordinating the different parts of the project. In the lightweight project team structures, all project team members still remain completely embedded in their daily context, performing their daily tasks. However, each project team member is given another task from the project to perform and, unlike in the structure of the functional project team, members are guided by a clearly defined team leader, who coordinates and acts as a liaison with various project team members. In the heavyweight project team structures, project team members also remain embedded in their daily contexts. The role of the team leader is the most important differentiating factor between the lightweight and heavyweight structures. In the heavyweight project team structure, the team leader actively coordinates and plans the various tasks, making sure that the project is on schedule, and actively searches for and acquires resources from external sources to perform the task.

Recent studies of product development teams (e.g., Nobeoka, 1993; Aoshima, 1996) also found that project team members rarely devote all their time to working on a project team. Simply stated, most team members at any given time have "one foot" in the project team and the other in their daily context within the organization. As project teams remain embedded in the daily context of the organization, they are subject to the ongoing organization-level processes, particularly organization-level cross-functional communication routines, organization-level shared commitment and shared vision of achieving organizational goals (or lack thereof), and organization-level overlapping knowledge. Hence, project team-level processes are influenced by organization-level processes.

Organization-level cross-functional communication frequency and project team communication frequency. Because project teams are embedded in the organization, they are subject to the patterns and frequency of communication in the organization, all other factors

being equal. The frequency of communication in the organization shapes the frequency of internal communication on the team, and between team members and their external links, as demanded by the team task. In an organization where the communication pattern is both vertical within the same function and horizontal across functions, communication is seen to be more frequent. As communication frequency is a measure of resources exchanged (Ghoshal and Tsai, 1998), organizations with both horizontal and vertical communication patterns are expected to exchange more resources across different functions than organizations whose communication patterns tend to be mostly vertical (Galbraith, 1977). Morrill (1995) suggests that communication patterns and frequency are formed in the daily context of the organization. Over time, patterns and frequency are institutionalized and are taken for granted by organization members. Because they become "second nature" to organization members, they occur automatically when individuals are organized to perform other tasks outside their routines. Morrill (1995), who studied conflict management among executives, found that when conflict arises in organizations where communication tends to be vertical between superior and subordinates of the same function, communication occurs vertically to resolve that conflict, with no communication outside of that function. In organizations that have cross-functional communication, similar conflict is resolved through communication across different functions, as well as within the same function. Therefore, this study suggests that similar patterns are to be expected between organization-level cross-functional communication frequency and internal and external communication frequency on project teams, as they are composed of members from different functions.

The case studies also suggest that project team-level factors are a mirror image of organization-level factors in a given organization. Organizations that have higher cross-

functional communication frequency, shared sense of cross-functional cooperation, and overlapping knowledge, also have these same patterns in their project teams. In organizations where cross-functional communication in the daily context of organization is more frequent, team-internal and external communication also appear to be more frequent, as needed by the project team (Un, 2001). Additionally, the shared-sense of cross-functional cooperation and overlapping knowledge found at the organizational level are also found at the project team level. In organizations that lack these factors in the larger context of the organization, also lack them in their project teams. These patterns lead to the hypotheses that:

H1: The organization-level cross-functional communication frequency is positively related to project team-internal communication frequency.

H2: The organization-level cross-functional communication frequency is positively related to project team-external communication frequency.

Organization-level shared sense of cross-functional cooperation and project team-level shared sense of cooperation. As teams are embedded in the organization, organization members' views of the organization, shared vision, commitment, and the understanding of how knowledge embedded in different disciplines fits together as a system (or lack thereof), are carried over to the project teams (Staw et al., 1981). Previous studies of innovation that requires the exchange and integration of different types of functional knowledge (e.g., Dougherty, 1987; Griffin and Hauser, 1992) suggest that the main barriers to the exchange and integration process are the differences in thought worlds held by team members represented by different disciplines or communities of practice (Brown and Duguid, 1991). Schein (1996) also suggests at least

three distinct subcultures that constrain communication in the process of innovation. Roth and Kleiner (1996), in their study of cross-functional product development teams in companies analyzed by Schein (1996), which excluded examination of the organizational level processes, showed that team representatives from different functions had different visions and degrees of commitment, and could not understand who would contribute what in completing the team task. These findings are not surprising, since individuals who are brought together to work on the team bring with them the way of thinking, the knowledge and the capabilities they have acquired from the larger context of the organization in which they are embedded (Staw et al., 1981). This argument leads to the hypothesis that:

H3: The organization-level shared sense of cross-functional cooperation is positively related to the project team shared sense of cooperation.

Organization-level overlapping knowledge and project team-level overlapping knowledge. Differences exist between firms' overlapping knowledge across different functions. The study by Westney and Sakakibara (1986) suggests that the level of overlapping knowledge among organization members differs, depending on how members are trained and developed throughout their careers. The authors found that Japanese firms, in contrast to firms located in the United States, developed their engineers so that they would have overlapping knowledge in other functions. The R&D engineers were rotated to manufacturing engineering in order to develop manufacturing knowledge and an understanding of the way in which it is linked to the R&D knowledge they had already acquired in the R&D function. Henderson (1992) also argues that Japanese firms, when compared to their US and European competitors, strategically invest in

development of architectural knowledge that enhances integration of different types of knowledge in the innovation process, thereby developing the overlapping knowledge. These findings correlate with the findings of Nonaka and Takeuchi (1995:77), namely, that on cross-functional project teams working on innovation projects in Japanese firms, there is some overlapping knowledge represented on the team among its core members. This leads to the hypothesis that:

H4: Organization-level overlapping knowledge is positively related to project team overlapping knowledge.

RESEARCH DESIGN

Data were gathered through surveys of 182 cross-functional project teams of 38 large US and Japanese multinational firms in the computer, photo imaging, and automobile industries that have operations in the United States. The analysis of companies present in different industries supports the generalization of results across industries.

The companies selected were present in the computer, photo imaging, and automobile industries. The industries were selected because they face different innovation cycles –short in the computer industry, medium-sized in the photo imaging industry, and long in the automobile industry– that affect the time pressure on gathering and processing different types of knowledge for innovation (Lawrence and Lorsch, 1967).

The companies were selected based on two factors. First, they were the largest in their respective industries based on revenue. Second, they had customer service centers in the United States and Japan dealing with similar products. This requirement was necessary because this

study is part of a larger study that compares sources of this capability of US and Japanese multinational enterprises in both the United States and Japan.

For each company, the largest customer service center in terms of employees located in the United States was selected. The customer service organization was selected because it is the gatekeeper linking firm's external demands and internal design and manufacturing capability. The customer service centers selected had at least three functions represented: sales/marketing, customer service, and engineering linking to the R&D and manufacturing organizations.

In each company, a set of cross-functional project teams was randomly selected. Project teams were selected based on three criteria. First, at least three functions were represented: customer service, engineering (i.e. R&D or manufacturing) and sales/marketing or manufacturing. Second, the main objective of the team was to transform specific external customer feedback obtained from the firm's worldwide operations about their products into an innovation.

Data collection

There were three steps to the data collection process. First, in depth field interviews, observations and phone interviews were conducted to ensure a deep understanding of the phenomenon. Second, a pilot study was conducted to test the variables and measures and survey instruments. Finally, the surveys were conducted.

In order to avoid single respondent bias and separate out levels of analysis, I collected the data from two different sources using two separate surveys (Rousseau, 1985). Data on the organization-level management practices and processes were collected from a personnel manager, because a personnel function is a boundary function and therefore this manager has the

best knowledge about the interaction between and among different functions and can speak about it more objectively.

The data for the team-level variables were collected from the project team leaders. For each company the project manager was asked to provide a list of projects and the team leaders that supervised them. Based on this list, randomly selected team leaders were asked to take a survey on team management practices and their processes.

Variables and measures

The variables and measures are based on two constructs: organization-level processes and project team-level processes.

Organization-level processes. Organization-level cross-functional communication frequency (O-XCOM) is measured by cross-functional formal communication frequency (dealing with work-related issues) and informal communication frequency (not work related and on personal time, e.g., coffee breaks, after work) among management and non-management rank employees ($\alpha = 0.83$). For organization-level shared sense of cross-functional cooperation (O-MODEL), the measure is the extent to which employees in different functions share the vision of the company and the commitment toward achieving it, as opposed to an individual functional goal ($\alpha = 0.78$). For this variable, I seek to determine whether an organization has functions that operate as coalitions of interests (Cyert and March, 1963) or as a cooperative system (Barnard, 1938). For organization-level cross-functional overlapping knowledge (O-OVERLAP), the measures deal with the amount of cross-functional on-the-job and off-the-job development, and job rotation of engineers in sales/marketing, R&D, and manufacturing.

Project team-level processes. The project team-level processes that impact the capability to mobilize and create knowledge for innovation are the following: project team-internal communication frequency, project team-external communication frequency, project team shared sense of cross-functional cooperation, and project team overlapping knowledge. Project team-internal communication frequency (P-NCOM) (Griffin and Hauser, 1992) is measured by the frequency of communication among team members using face-to-face meetings, phone conversations, and e-mail, both formally and informally (α = 0.81). Project team-external communication frequency (P-XCOM) (Ancona and Caldwell, 1992a) is measured by the frequency of team member communication with people outside the team, using face-to-face meetings, phone conversations, and electronic mail (α = 0.76). Project team shared-sense of cross-functional cooperation (P-MODEL) (Cannon-Bowers et al., 1993) is measured by the level of shared commitment in accomplishing the project, and shared understanding of who will contribute which knowledge and information from various functions to accomplish the task (α = 0.85). Project team overlapping knowledge (P-OVERLAP) is measured by the total amount of overlapping knowledge among core team members, based on their past and current work experience. All the project-team level variables are averages across the organization.

Control variables. The first set of control variables consists of project team-level human resource management practices, as they are potential alternative explanations to the hypothesized relationships. Project team-level human resource management practices are: (1) project team development (P-DEVLOP) for working on the project; (2) project team reward (P-RWRD), which is the reward received based on project team performance, and which could be in the form of bonus payment, salary increase, favorable job assignment, and/or promotion (α = 0.74); (3) project team membership selection (P-SELECT), which deals with team members based on their

project-related expertise, cross-functional knowledge, and job experiences (α = 0.73). Other control variables at the project team-level are team size (C-P-SIZE) (Smith et al., 1994; Ancona and Caldwell, 1992a; Bantel and Jackson, 1989), tenure diversity of team members (C-P-TENURE), functional diversity (C-P-NUMDIS), and management support (C-P-SUPORT). Tenure diversity is measured by team tenure standard deviation, divided by its average (Bantel and Jackson, 1989). Functional diversity (Ancona and Caldwell, 1992b) is measured by the number of functions represented on the team. Prior shared experience working on team (Janis, 1972) is measured by whether the particular project team is designated to work on the type of problem posed. Management support is measured by whether the team receives enough resources from management to accomplish the project. I also control for industry and country of origin.

Methods of analysis

The Tobit method is used to analyze the data, since the dependent variables were constrained to an interval. The hypothesized relationships between the organization and project-team level processes are tested using the following specifications:

$$H1:\ P\text{-}NCOM = \alpha + \beta_1 * O\text{-}XCOM + \beta_2 * P\text{-}DEVLOP + \beta_3 * P\text{-}RWRD + \beta_4 * P\text{-}SELECT + \beta_5 * C\text{-}P\text{-}SUPORT + \beta_6 * C\text{-}INDUS1 + \beta_7 * C\text{-}INDUS2 + \beta_8 * C\text{-}JAPAN + \varepsilon$$

$$H2.\ P\text{-}XCOM = \alpha + \beta_1 * O\text{-}XCOM + \beta_2 * P\text{-}DEVLOP + \beta_3 * P\text{-}RWRD + \beta_4 * P\text{-}SELECT + \beta_5 * C\text{-}P\text{-}SUPORT + \beta_6 * C\text{-}INDUS1 + \beta_7 * C\text{-}INDUS2 + \beta_8 * C\text{-}JAPAN + \varepsilon$$

$$H3.\ P\text{-}MODEL = \alpha + \beta_1 * O\text{-}MODEL + \beta_2 * P\text{-}DEVLOP + \beta_3 * P\text{-}RWRD + \beta_4 * C\text{-}P\text{-}SIZE + \beta_5 * C\text{-}P\text{-}SUPORT + \beta_6 * C\text{-}INDUS1 + \beta_7 * C\text{-}INDUS2 + \beta_8 * C\text{-}JAPAN + \varepsilon$$

$$H4.\ P\text{-}OVERLAP = \alpha + \beta_1 * O\text{-}OVERLAP + \beta_2 * P\text{-}SELECT + \beta_3 * C\text{-}P\text{-}SIZE + \beta_4 * C\text{-}P\text{-}TENURE + \beta_5 * C\text{-}P\text{-}NUMDIS + \beta_6 * C\text{-}INDUS1 + \beta_7 * C\text{-}INDUS2 + \beta_8 * C\text{-}JAPAN + \varepsilon$$

ANALYSIS AND RESULTS

Table 1 presents the descriptive statistics and correlation analysis. The correlation coefficients among the organization-level processes and project team processes suggest that there are potential relationships between organization-level cross-functional communication frequency and project team-internal communication frequency, organization-shared sense of cross-functional cooperation and project team shared sense of cross-functional cooperation, organization-level overlapping knowledge and project team overlapping knowledge.

****
Insert Table 1 about here
****

The mirror image between teams and their organizations

Table 2 presents the results from testing hypotheses H1-H4, which relate the organization-level and project team-level processes. The results support only H1, H3 and H4.

Model 1, which tests hypothesis H1, shows that organization-level cross-functional communication frequency is positively related to project team-internal communication frequency. This result suggests that organizations that have a higher frequency of cross-functional communication built into their contexts are more likely to have a higher frequency of internal communication in project teams organized for innovation. This analysis yields another

interesting result: the control variable project team development has a stronger effect on team internal communication frequency than does cross-functional communication frequency. This result is interesting in that, despite controlling for project team development, the organization-level cross-functional communication frequency still has an effect on project team-internal communication frequency, although it is slightly weaker than the project team development effect.

Model 2 tests hypothesis H2, that organization-level cross-functional communication is positively related to project team-external communication frequency. The results show that this hypothesis is not supported. One of the reasons for this finding is that there are two types of external communication, which are not discussed in the literature but are found in this study: project team-external communication frequency within the same function and project team-external communication frequency across different functions. When these two types of communication frequency are separated, the organization-level cross-functional communication frequency has a positive effect on the project team-external communication frequency across functions, and no effect on the project team-external communication frequency within the same functions.

Model 3 tests hypothesis H3, which claims that the organization-level shared sense of cross-functional cooperation is positively related to the project team shared sense of cross-functional cooperation. The result of this analysis suggests that organizations in which different functions have shared commitment and shared vision in achieving organizational goals (as opposed to functional goals), have project teams that are also more likely to have shared commitment and objective in achieving the project goal.

Model 4 tests hypothesis H4, that organization-level overlapping knowledge is positively related to project team-level overlapping knowledge. The analysis supports H4. The results show that organizations that have overlapping knowledge at the organization level are also more likely to have overlapping knowledge at the project team level. Although some of the control variables-particularly selection of team members for cross-functional overlapping knowledge, team size, and tenure diversity also predict cross-functional overlapping knowledge on project teams, organization-level overlapping knowledge has a greater effect than these variables.

****
Insert Table 2 about here
****

The overall results support the proposition that there is a mirror image between teams and their organizations. Specifically, the results show that in organizations where cross-functional communication frequency is high, their project team-level internal communication frequency is also likely to be higher than in project teams in organizations that have low cross-functional communication frequency. The results also indicate that organizations that have a certain level of organization-level shared commitment and shared goal in achieving the organization's objectives across different functions, have project teams that are more likely to possess shared commitment and a shared goal to accomplish the project. Moreover, organizations that have a certain level of overlapping knowledge across different functions built within the larger context of their organizations, are more likely to have these resources on their project teams than organizations that do not have this overlapping knowledge. The effect of organization-level cross-functional communication frequency on project teams' external communication frequency is unclear, unless we differentiate between external communication within the same function and across different functions. When these factors are examined, we see an effect of organization-

level cross-functional communication frequency on project team-external communication frequency across different functions but no effect on project team-external communication frequency within the same functions. In conclusion, these findings suggest that organizations that have the supporting organization-level processes for knowledge mobilization and new knowledge creation for innovation may find it less necessary to develop the project team-level processes that enhance innovation.

DISCUSSION AND CONCLUSIONS

This paper provides the alternative view that as project teams are embedded in the larger context of the organization (Clark and Wheelwright, 1992), they are subject to ongoing organization-level processes, particularly organization-level cross-functional communication frequency (Nohria and Ghoshal, 1997), organization-level shared sense of cross-functional cooperation (Prahalad and Hamel, 1990), and organization-level overlapping knowledge (Leonard-Barton, 1995) that support knowledge mobilization and creation for innovation. The study finds that organization-level cross-functional communication frequency supports project team-level internal communication frequency, thereby enhancing knowledge mobilization and creation for innovation at the project team-level. It does not find support for project team-external communication frequency, in part, because project team-external communication has two components, external communication frequency within and across different functions. Cross-functional communication frequency at the organization level affects external communication across functions, but does not affect external communication frequency within the same functions. Additionally, organizations that share a sense of commitment and vision in achieving the collective goal (as opposed to the goals of functions represented on the team), are

more likely to have project teams that have a sense of shared commitment and vision in achieving the project goal. Moreover, organizations that have higher organization-level overlapping knowledge are more likely to have overlapping knowledge in their project teams (Staw et al., 1981).

In conclusion, this paper shows that if organizations have the supporting organization-level processes built into the organization, these processes are likely to occur more often on project teams, and therefore, the organizations may find it less necessary to use the additional management practices at the project team level. Organizations that lack these supporting organization-level processes may find it crucial to use the additional project team management practices, particularly project team development, in order to achieve similar performance. Therefore, organizations may either invest up front in developing the necessary processes at the organizational level (Nonaka, 1994; Aoki, 1988; Lincoln and Kalleberg, 1990), or develop them only as needed when organizing into project teams for innovation (Ancona and Caldwell, 1992a; Roth and Kleiner, 1996). However, since the capability to mobilize and create knowledge for innovation requires both knowledge mobilization and conversion, factors that facilitate both these things seem to be important. Since cross-functional overlapping knowledge takes time to develop, it is developed independent of when organizations channel their resources into project teams for mobilizing and creating new knowledge for innovation. Therefore, although team-level factors and management practices facilitate knowledge mobilization, creation of new knowledge probably requires the development of overlapping knowledge at the organizational level (Westney and Sakakibara, 1986; Henderson, 1992).

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TABLE 1

Descriptive statistics and correlation matrix

	Mean	*Stdev.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1. P-Internal communication	*2.94*	*0.44*	1.0												
2. P-External communication	*2.63*	*0.53*	0.5	1.00											
3. P-Sense of cooperation	*4.10*	*0.45*	0.2	0.04	1.00										
4. P-Overlapping knowledge	*2.87*	*1.47*	-0.1	0.37	0.24	1.00									
5. O-Cross-functional communication frequency	*3.93*	*1.22*	0.5	0.16	0.09	0.19	1.00								
6. O-Sense of cooperation	*3.74*	*0.67*	-0.1	0.14	0.36	-0.01	0.31	1.00							
7. O-Overlapping knowledge	*1.52*	*1.16*	0.1	0.15	0.26	0.72	0.16	0.12	1.00						
8. P-Development	*2.91*	*0.74*	0.3	0.46	0.35	-0.09	-0.03	0.10	0.14	1.00					
9.P-Reward	*0.53*	*0.39*	0.2	0.33	0.06	0.31	-0.09	0.14	-0.08	0.42	1.00				
10. P-Selection	*2.88*	*0.58*	0.2	0.42	0.11	0.11	-0.08	0.02	0.27	0.20	-0.15	1.00			
11. C-P-Size	*9.33*	*1.38*	-0.0	-0.18	-0.06	0.46	0.22	0.08	0.13	-0.02	0.07	-0.11	1.00		
12.C-P-Tenure	*3.40*	*1.26*	-0.4	-0.16	-0.54	0.42	0.14	-0.20	0.26	0.02	-0.09	0.16	-0.20	1.00	
13.C-P-Number of disciplines	*3.63*	*0.31*	-0.0	-0.19	-0.06	0.17	0.09	0.07	0.17	0.07	-0.27	0.06	-0.10	0.11	1.00
14.C-P-Management support	*4.58*	*0.26*	0.3	0.05	0.31	-0.17	0.14	0.14	-0.09	0.08	-0.02	0.09	0.02	0.04	-0.09

Note: Correlation coefficients above 0.32 are statistically significant at $p \leq 0.05$. P- indicates project-team level variables, O- symbolizes the organization-level variables, and C- stands for control variables.

TABLE 2

Results from testing the effect of organization-level processes on project team-level processes and controls

		P-Internal communication frequency	P-External communication frequency	P-Shared sense of cross-functional cooperation	P-Overlapping knowledge
	Model	Model 1	Model 2	Model 3	Model 4
VARIABLES	Intercept	-0.24 * (0.11)	-0.76 *** (0.11)	-1.45 *** (0.21)	0.27 (0.18)
	O-Cross-functional communication frequency	0.79 *** (0.13)	-0.02 (0.04)	-	-
	O-Shared sense of cross-functional cooperation	-	-	0.27 ** (0.04)	-
	O-Overlapping knowledge	-	-	-	0.49 *** (0.02)
CONTROLS	C-P-Development	0.81 *** (0.26)	0.43 ** (0.17)	0.38 *** (0.07)	0.32 (0.32)
	C-P-Reward	0.57 *** (0.17)	0.20 * (0.08)	0.30 *** (0.08)	0.24 (0.33)
	C-P-Selection	0.57 *** (0.19)	0.35 ** (0.11)	-0.34 (0.22)	0.06 (0.06)
	C-P-Size	-0.32 ** (0.08)	-0.00 (0.12)	0.04 (0.20)	0.27 ** (0.07)
	C-P-Tenure diversity	-0.46 *** (0.10)	-0.15 (0.15)	-0.17 (0.12)	0.43 ** (0.07)
	C-P-Number of disciplines	-0.16 † (0.08)	-0.09 (0.13)	0.01 (0.13)	0.12 (0.06)
	C-Management support for project	0.27 ** (0.09)	0.13 (0.13)	0.38 ** (0.10)	-0.24 (0.19)
	C-INDUS1	0.28 *** (0.01)	0.86 *** (0.12)	1.23 *** (0.13)	-0.61 ** (0.22)
	C-INDUS2	0.01 (0.13)	-0.03 (0.14)	0.54 ** (0.15)	-0.08 (0.11)
	C-JAPAN	0.13 (0.08)	0.94 *** (0.28)	0.40 *** (0.09)	0.46 * (0.16)
	N	41	41	41	41
	Log Likelihood	-126.63	-142.78	-139.86	-79.04
	Chi Square	112.30 ***	162.7 ***	133.54 ***	116.44 ***
	Pseudo R^2	0.40	0.30	0.43	0.54

Note: Standard errors in parentheses. Significance: ***0.001, **0.01, *.05, †0.1.