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The Effect of Team Leader Characteristics on Learning, Knowledge Application, and Performance of Cross-Functional New Product Development Teams

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ABSTRACT

This study examines how leadership characteristics in new product development teams affect the learning, knowledge application, and subsequently the performance of these teams. Using data from a study of 229 members from 52 high-tech new product projects, we empirically demonstrate that team learning has a strong positive effect on the innovativeness and speed to market of the new products. Moreover, a democratic leadership style, initiation of goal structure by the team leader, and his or her position within the organization were positively related to team learning. Managerial implications of these results are discussed.

Subject Areas: Cross-Functional Product Development Teams, knowledge Management, Learning, New Product Development, and Team Leadership.

INTRODUCTION

Innovative new products and speed to market are often regarded as keys to survival and success in today's highly competitive market environment. Increasingly organizations are using cross-functional teams to improve their new product development (NPD) performance (Zirger & Hartley, 1996; Griffin, 1997; Wind & Mahajan, 1997). Cross-functional product development teams (CFPDTs) are groups of individuals drawn from different functional specialties or departments who are brought together for the common purpose of creating and refining new products (Ulrich & Eppinger, 1995). The use of such teams has been associated with lower development cost, faster speed to market, greater innovation, and better product design and quality (Sarin & Mahajan, 2001).

Despite their growing use and obvious potential benefits, results of NPD teams' endeavors have been mixed (Barczak & Wilemon, 1989; Katzenback

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& Smith, 1993). Below par performance of several cross-functional product development teams can be attributed to the misapplication and mismanagement of such teams (Henke, Krachenberg, & Lyons, 1993). Additionally, failure rate in new product development remains high because organizations fail to conduct postmortems of projects, missing out on an opportunity to learn from their past successes and mistakes. Many researchers view new product development as a process of learning (Takeuchi & Nonaka, 1986; Leonard-Barton, 1992; Moorman, 1995; Madhavan & Grover, 1998; Nonaka, 1991; Doughtery, 1992).

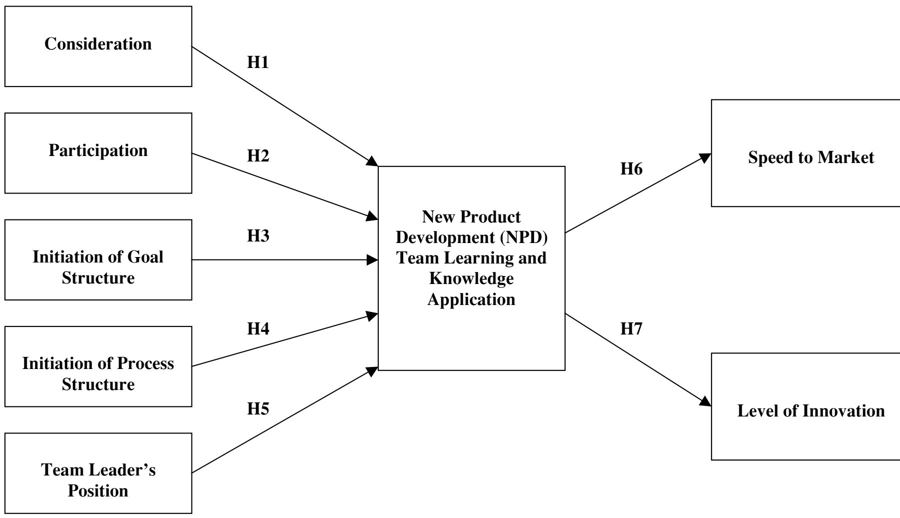
Although some studies (e.g., Lynn, 1997; Meyers & Wilemon, 1989; McKee, 1992) have explored the issue of learning in NPD teams, none have empirically examined the relationship between learning and performance of NPD teams. Moreover, recent studies suggest that the characteristics of the team leader can exert considerable influence over the work climate and learning within teams (Madhavan & Grover, 1998; Edmondson, 1999; Norrgren & Schaller, 1999; Hult, Hurley, Guinipero, & Nichols, 2000).

As the key interface between NPD team members, leaders are in a critical position to encourage the application of newly learned information to current and future NPD efforts. Consistent with this line of thinking, the knowledge management literature (e.g., Kogut & Zander, 1992; Grant, 1996; Madhavan & Grover, 1998) argues for the importance of the organization as a mechanism to enable and coordinate the application of the knowledge of the *individual* toward a common desired goal. In the individual-oriented view of knowledge management, the role of the firm becomes one of fostering (through incentives and direction) the knowledge application of the individuals it employs, as opposed to nurturing the creation of an organization-wide pool of knowledge. Thus, in this individual knowledge-based model, one would expect effective NPD team leaders to be those who possess behaviors and characteristics that encourage both the learning and knowledge application of team members such that they can maximize the desired outcomes (i.e., performance) of the team (Madhavan & Grover, 1998).

However, there is still much to be learned about the relationship between the team leader's behavior and team learning and knowledge application. The knowledge-based view of the firm argues that an organization's goal is to encourage the effective application of individual knowledge, yet it is unclear what team leadership characteristics are useful in achieving this in an NPD environment. In short, while the above arguments may lead one to intuitively believe that leadership behavior can affect learning, knowledge, and performance in NPD teams, this critical relationship has not been empirically tested.

In an effort to bridge these gaps in the literature, the objective of this paper is to empirically examine how the team leader's characteristics affect the learning, knowledge application, and performance of NPD teams. The model proposed and tested in this study is presented in Figure 1. We suggest that the NPD team leader's management style and position exert a significant influence on the learning within the team, which subsequently affects the performance of the NPD team in terms of the level of innovation introduced in the product, and the speed with which the team brings the product to market.

Figure 1: Model of the effect of team leader characteristics on the learning, knowledge application, and performance of new product development teams.



CONCEPTUAL FRAMEWORK AND HYPOTHESES

Learning, Knowledge Application, and Team Leader Characteristics

Learning has been described in various literatures as a change in behavior resulting from experience (Fiol & Lyles, 1985; Levitt & March, 1988; Huber, 1991; Barabba & Zaltman, 1991; Slater & Narver, 1995; Moenaert & Caeldries, 1996). This experience could be based either in actions/events or information/knowledge. Consistent with this conceptualization, within our study, we define learning as occurring when the processing of experience changes the range of potential behaviors/actions (Huber, 1991).

Learning involves making use of information. By relying on experience, firms use information they have acquired, disseminated, and integrated. Learning acts to reduce transaction costs, support decisions, and shape behavior. It provides a link between the different functions, helps frame problems or opportunities, and guides decision formulation and implementation (Walsh & Ungson, 1990; Fiol & Lyles, 1995). Not surprisingly then, learning has been described as a fundamental capability/competence of the organization, because it facilitates the various business processes (Day, 1994), such as new product development (Madhavan & Grover, 1998). Information use associated with learning leads to the detection and correction of errors (Arygris & Schön, 1978), and improves the likelihood of effective new product development in a firm.

While prior studies have empirically linked organization-level information processes and memory to firm creativity and NPD effectiveness (i.e., Moorman, 1995; Moorman & Miner, 1997), or project-level information processes to project outcomes (i.e., Moenaert & Souder, 1990), empirical research examining the antecedents and consequences of learning at the level of NPD projects remains woefully inadequate. Although some initial attempts have been made in this direction (i.e., Meyers & Wilemon, 1989), significant work remains to be done. This paper presents one of the few examples of empirical research linking learning to NPD outcomes at the project level. To our knowledge, we are among the first to empirically examine the relationship between the team leader's characteristics and learning in NPD teams.

The definition of learning described above (Fiol & Lyles, 1985; Levitt & March, 1988; Huber, 1991; Slater & Narver, 1995) and operationalized in this research is consistent with a focus on an individual (as opposed to organizational) knowledge-based view of the firm (Kogut & Zander, 1992; Grant, 1996; Madhavan & Grover, 1998). According to Grant (1996, p. 112), "knowledge creation is an individual activity . . . the primary role of firms is in the application of existing knowledge to the production of goods and services." If, as Alavi and Leidner (1999) argue, knowledge is information that has been processed in the mind of the *individual*, then this has direct implications to NPD teams and their leadership. By definition, cross-functional NPD teams bring together individuals with different background and expertise with the common goal of bringing a product to market. With knowledge embedded in the mind of the individual, as opposed to the organization, it would follow that the interaction between the NPD team leader and these individuals on the team would stand to have a direct impact on the successful application of their knowledge. This is consistent with Madhavan and Grover's (1998) theoretical arguments regarding distributed knowledge and cognition in NPD team management.

Edmondson (2003) suggests that by virtue of working closely, individuals tend to develop shared assumptions and beliefs through a process of "sensemaking." Such cognitive frames can often impede learning by affecting the manner in which individuals interpret and apply new knowledge and experience. Edmondson adds that team leaders play a critical role in helping their team members frame and reframe knowledge and experience. Individuals on the team directly observe leadership characteristics, and the extent to which these characteristics either help or hinder knowledge application by individuals on the team plays an influential role in the success of the project (Edmondson, 2003). Building on these central arguments proposed by Alavi and Leidner (1999), Madhavan and Grover (1998), and Edmondson (2003), the following discussion articulates the theoretical framework and hypotheses developed in this study.

Knowledge is commonly split into two groups reflecting that which can be easily codified and transferred (often referred to as *explicit* knowledge) and that which is internal and not easily codified and transferred (*tacit* knowledge). The creation and application of *tacit* knowledge can lead to greater benefits to the firm. Although embedded tacit knowledge is useful in defending a firm against imitation by competitors (McEvily & Chakravarthy, 2002), transferring and sharing tacit knowledge between individuals within an organization becomes a difficult task (Madhavan & Grover, 1998). Organizations commonly use four mechanisms to foster the integration of an individual's knowledge (Grant, 1996):

- Rules and Directives—policies and standards that aim to "convert" tacit to explicit knowledge that can be understood by others (Demsetz, 1991).
- Sequencing—directing the integration of knowledge through controlling the order in which individuals interact.
- Routines—creating and implementing a series of repeatable activities and pattern of responses to specific situations or tasks.
- Group problem-solving—coordination of activities through joint, simultaneous interaction (Galbraith, 1973).

In spite of these activities, the transfer of tacit knowledge remains a significant challenge within organizations (Kogut & Zander, 1992; Argote & Ingram, 2000). This is especially true in cross-functional activities such as new product development where knowledge is often codified and structured differently in the various functional areas of the firm (Carlile, 2002; Madhavan & Grover, 1998). As noted above, the application of knowledge is a critical challenge for managers of NPD teams. If done effectively, it could lead to significant success (Massey, Montoya-Weiss, & O'Driscoll, 2002). It is within this framework that our present study explores how characteristics of project leaders affect learning and knowledge application, and thus, performance in NPD teams.

Effective project leadership has been identified as one of the most important ways of directing and steering projects successfully and efficiently through the NPD process (McDonough & Griffin, 1997). Project team leaders play an influential role by championing the new product, coaching and developing team members, and managing the CFPDT dynamics (Barczak & Wilemon, 1992; McDonough & Griffin, 1997; McDonough & Barczak, 1991). It is widely acknowledged that a team leader can significantly impact the internal dynamics and outcomes of the team (Yukl, 1994). Recent studies (e.g., Edmondson, 1999; Lovelace, Shapiro, & Weingart, 2001) suggest that the characteristics of team leaders significantly affect the work climate and learning in teams. Team leaders do so by not only influencing the behavior of individual team members, but also the desire and ability of the team members to reach organizational goals through the application of acquired knowledge.

Yukl (1994) suggests that the effectiveness of a leader is based on four sources: personal characteristics, situational/contingency factors, leader behavior, and power/influence. In this study we focus on the last two sources of the team leader's effectiveness: behavior and power/influence. These sources were chosen because they are managerially controllable or can easily be inculcated in the team leaders through training. We examine the effect of the team leader's behavior (in terms of his or her management style) and power/influence (in terms of his or her position) on team learning.

Team leader's management style

Management styles of leaders can differ along several dimensions (Fleishman, 1957; Stogdill, 1963; Muczyk & Reimann, 1987). Within this paper, we focus on leadership characteristics that can be broadly defined as facilitative behavior and initiation of structure (House & Dressler, 1974).

Facilitative behavior: Consideration and participation

Facilitative behavior is defined as the degree to which the team leader is considered friendly, approachable, and democratic (Stogdill, 1963; House & Dressler, 1974). A supportive and coaching-oriented team leader makes the members safe in the team environment. Edmondson (1999) further suggests that the creation of such psychological safety encourages the team members to openly admit, analyze, and learn from their errors. Facilitative team leaders constantly challenge the team members to new heights, encourage them to think freely, and to openly discuss their opinions and ideas (Norrgren & Schaller, 1999). Facilitative team leaders create a nurturing environment within the team where team members feel safe to take risks and explore nonroutine alternatives (Edmondson, 1999; Norrgren & Schaller, 1999). This encourages members to voice dissenting opinions without fears of reprisal or backlash, and allows individuals to disagree on issue-based conflict.

A democratic and participatory style of leadership makes the communication among team members more effective (Kidd & Christy, 1961; Wilemon & Thamhain, 1983). A facilitative style of leadership encourages the establishment of trust and collaboration within teams (Norrgren & Schaller, 1999), which in turn promotes an integrative approach to problem-solving (Aram, Morgan, & Esbeck, 1971; Muczyk & Reimann, 1997).

This facilitative behavior has two underlying elements: *consideration* and *participation*. *Consideration* is the degree to which the team leader demonstrates concern and interest for the well-being of team members. It creates a sense of belonging and provides team members with a sense of support, concern, and appreciation that what they are doing is valued and important. *Participation* is the degree to which the team leader invites members' active involvement in the decision-making process. It encourages the flow of new ideas and collaboration within the team. Thus, consideration and participation are likely to promote group problem-solving, one of the four mechanisms for integrating individual tacit knowledge (Galbraith, 1973; Grant, 1996). Therefore, we hypothesize:

H1: Consideration by team leaders will be positively related to NPD team learning and the application of knowledge.

H2: Participation by team leaders will be positively related to NPD team learning and the application of knowledge.

Initiation of goal and process structure

Initiation of structure is defined as the degree to which the team leader assigns tasks and prescribes behaviors to the team members in order to achieve the desired results (House & Dressler, 1974; Muczyk & Reimann, 1997). Research shows that a lack of task structure and failure of the team members to understand roles and responsibilities is a major barrier to the success of cross-functional product development teams (Wilemon &Thamhain, 1983). In successful teams, leaders are able to effectively communicate the collective mission to the team and outline the process by which it should be accomplished (Hardaker & Ward, 1987). Structure also helps to create recurring communication patterns and enhances communication by clearly and explicitly stating goals and task descriptions (Bolman & Deal, 1993), and the means of achieving them. Thus, initiation of structure becomes important and critical in product development projects, especially where the tasks are ambiguous or complex.

Existence of task-focused structure has been found to reduce instances of dysfunctional communication and enhance conflict resolution in teams (Antonioni, 1996). By clarifying the responsibility of each individual team member, team leaders communicate the individual and collective accountability. Structure allows the leader to impart mental models and shared vision to members of the development team (Madhavan & Grover, 1998). Expressing mental models decreases the insularity of functional members, who have their own mental models and frames of reference (Dougherty, 1992). Shared mental models decrease the communication breakdowns among members from different functional areas (Quinn, Andersen, & Finkelstein, 1996).

The team leader can not only clearly and explicitly define the goals and objectives of the team and team members (*goal* structure), they can also outline the procedures, activities, and tasks to accomplish these goals (*process* structure). Both elements of initiation of structure are concerned with indirectly influencing team member behavior via structuring the environment surrounding the task (Porter & Lilly, 1996; Antonioni, 1996). Within this paper, we assess two dimensions of this construct, *goal* and *process*, separately. We contend that initiation of structure fosters the use of rules, directives, and routines, mechanisms identified earlier as being critical in integrating tacit knowledge embedded in individuals (Demsetz, 1996; Grant, 1996). Initiation of structure improves communication and understanding among team members, and results in enhanced learning due to better transference and use of information among team members. Lack of structure in a team with respect to its objectives, plans, and daily activities result in increasing the potential for dysfunctional conflict and communication breakdowns (Porter & Lilly, 1996). Given this view we hypothesize:

H3: Initiation of goal structure by team leader will be positively related to NPD team learning and the application of knowledge.

H4: Initiation of process structure by team leader will be positively related to NPD team learning and the application of knowledge.

Team leader's position

Team leader's position is an indication of the formal and informal status enjoyed by the team leader. Team leader's position leads to influence within the organization (Katz & Kahn, 1978) and helps reduce the uncertainty surrounding the leader's decisions and ability to achieve objectives (Baveles, 1960). High-ranking leaders can improve a project's chance for success by ensuring that the NPD efforts are not limited by resource constraints (Brown & Eisenhardt, 1995). The abundance of resources provides slack, which is often considered to be critical to learning and creative processes (Zirger & Maidique, 1985; Damanpour, 1991).

Leaders with a higher rank provide an umbrella of legitimacy and credibility to the NPD project. New product development projects lacking a senior leader frequently encounter significant hurdles (Van de Ven & Poole, 1995). The pressure to meet aggressive deadlines prevents learning largely due to the vertical communications problems with the top management (Elmes & Kassouf, 1995). Senior team leaders are in a better position to arbitrate and negotiate the conflict between the frequently incompatible goals of the individual, the project, and the various functional groups/departments involved in the NPD process (Ancona & Caldwell, 1990). Managers promoting collaborative conflict resolution are better able to achieve cross-functional integration (Song, Xie, & Dyer, 2000). Team leaders who are able to manage conflicting trade-offs and integrate multiple perspectives are better at knowledge management. Such team leaders are more effective in converting tacit NPD knowledge residing embedded in individuals to explicit knowledge shared by other members of the team and the rest of the organization (Brown & Eisenhardt, 1995; Leonard-Barton, 1995; Madhavan & Grover, 1998). Effective knowledge management and conversion of tacit knowledge to shared knowledge contributes significantly to the learning and knowledge application processes within the NPD team (Madhavan & Grover, 1998).

High-ranking team leaders by definition are well networked both inside and outside the organization. Owing to their extensive contacts, these leaders can often access hard-to-get information and expertise both within and outside the organization. Senior leaders often have a broader perspective on the situation, and can educate the other team members by sharing such a bird's-eye view with them. This leads us to hypothesize:

H5: Team leader's position will be positively related to learning and the application of knowledge in NPD teams.

Learning and New Product Development Outcomes

To fully understand its importance, it is critical to explore links between learning and gains in organizational effectiveness and performance. Within this paper, we examine two performance measures commonly associated with NPD: speed to market and level of innovation.

Speed to market

Speed to market is a measure of the time taken by the team to develop the product (Olson, Walker, & Ruekert, 1995; Sarin & Mahajan, 2001). Time has become a critical element in competing in today's environment. Faster development has been associated with better initial market performance (e.g., Ali, Krapfel, & LeBahn, 1995).

Organizations learn either by acquiring preexisting information, or by developing new knowledge through trial and error (Huber, 1991; Cohen & Levinthal, 1990; Argyis & Schön, 1978). Recent studies have shown that learning influences effectiveness of teams in organizations (Edmondson, 1999). Learning helps create more effective routines (Cohen & Levinthal, 1990; Fiol & Lyles, 1985; Nelson & Winter, 1982). As one learns through experiences, it allows one to perform future activities more efficiently (Arrow, 1962; Zirger & Maidque, 1985). With experience, teams and team members become more proficient at acquiring, disseminating, processing, and assimilating information. Learning accumulated from experience encourages teams to become more efficient (Edmondson, 1999) in that they are applying their acquired knowledge into new, yet somewhat familiar situations (Grant, 1996). As individuals apply their knowledge, they make fewer mistakes and quicker decisions leading to a faster time to market. The application of knowledge related to specific tactics, routines, or activities that team members have learned (through experience) are likely to speed their NPD efforts.

Level of innovation

Product innovation is critical for the growth of organizations in order to adapt to changing markets, technologies, and competitors (Hage, 1980; Morone, 1993). The level of innovation is defined as the degree of newness of the product under development (Ancona & Caldwell, 1990; 1992a; Olson et al., 1995; Sarin & Mahajan, 2001).

Innovation is viewed as a consequence of the learning process. The innovation process requires the creation and application of new knowledge (Schoonhoven, Eisenhardt, & Lyman, 1990). Greater innovation requires greater knowledge development (Dewar & Dutton, 1986), beyond the current knowledge base and zone of comfort of the organizational entity (Itami & Namagami, 1992; Cohen & Levinthal, 1990). Major innovations require new skills, levels of market understanding, and better information processing abilities and systems throughout the organization (Moorman & Miner, 1997). Learning increases the organization's abilities to respond to markets and consequently to enhance its performance through the development of new insights (Slater & Narver, 1995). Further, Moorman (1995) finds that a deeper integration of information into the current knowledge base of the organization leads to the development of more creative new products. By effectively applying this knowledge, individuals and teams might then ultimately be able to create more innovative products.

Taken together, we hypothesize:

H6: NPD team learning and the application of knowledge will be positively associated with the speed to market of the new product.

H7: NPD team learning and the application of knowledge will be positively associated with the level of innovation introduced in the new product.

Control variables

Although not the focus of our study, several variables need to be controlled for because they have been shown to affect key variables in the model. Previous research suggests that the breadth of functional involvement (functional diversity), project complexity, and the size of an NPD team can have significant influence on a team's communication, information processing, and performance (Ancona & Caldwell, 1992a, b). Similarly, others (i.e., Narver & Slater, 1990; McKee, 1992; Moorman, 1995) have suggested that risk-taking is related to creativity and learning in organizations. Therefore, to ensure that the effects uncovered in our analysis are due to the relationships of interest alone, we control for the extraneous variance attributable to these NPD team composition and project characteristic variables.

Specifically, we control for the complexity and risk of the product being developed, and the size and functional diversity of the NPD team in our analysis.

METHODOLOGY

Study Context, Sample Selection, and Data Collection

This study was conducted as a part of a larger one on new product development. The high-tech industries were chosen as a context because of their high level of product development activity using cross-functional NPD teams (Ancona & Caldwell, 1992a, b; Henderson & Lee, 1992; Sarin & Mahajan, 2001). Moreover, the high environmental and technical uncertainty surrounding these industries along with compressed lifecycles create a need to develop knowledge-based, learning-intensive teams. Thus, given the learning and knowledge emphasis of this study, the high-tech industries were considered to provide a suitable context.

To be included in the study, NPD projects were required to meet three criteria. First, only intra-organizational NPD projects were to be included in order to reduce noise caused by interorganizational factors. Second, all new product introductions were to be bound for the external market; products being developed for intra-organizational use were excluded. Third, due to a high turnover in the high-tech industries, and problems associated with respondent recall, only NPD projects at advanced stages of development or those introduced within the previous 12 months were included in the study.

Moreover, to ensure variance in the sample, organizations were asked to provide projects that varied along product-market dimensions such as: project risk, project duration, the level of success achieved, the level of industry dynamism, and competitive intensity. Through personal contacts and referrals, several Fortune 1000 high-tech organizations were invited to participate in this study. A key liaison was identified in each participating firm and was presented with the screening criteria for inclusion in the study. With the help of this liaison, projects were identified in each organization.

The data were collected in two phases. Nine organizations agreed to participate in phase one of the study, which consisted of qualitative data collection using in-depth interviews. During this phase, 26 interviews were conducted with team leaders, team members, and NPD managers. Each interview lasted from forty-five minutes to an hour. These qualitative data were used not only to cultivate a deeper understanding of the issues, but also to develop and validate the theoretical framework proposed.

In the second phase of data collection, a survey instrument was administered to 246 individuals from 64 different new product development teams. Project teams ranged in size from 3 to 22 members, with the average team containing a little over 7 members. The average duration of the sampled NPD projects was 24 months, and these teams were drawn from 13 divisions of 6 Fortune 1000 organizations. Four of these organizations had earlier participated in phase one of the study. Five organizations dropped out of the study after phase one citing confidentiality constraints or a lack of time. The annual revenues of the participating divisions ranged from $100 million to $1 billion.

Every member of the teams selected in the sample was invited to participate in the study, regardless of functional affiliation or position (team leader versus team member). Completed surveys were received from members representing various functional backgrounds and hierarchical levels within the organizations and teams. Completed surveys consisted of the following functional affiliations: research and development (R&D) and lab (27%), engineering (24%), software (7%), manufacturing (7%), marketing (11%), management and administration (9%), and 14% nonresponses along this item.

Out of the 64 teams returning a completed survey, only teams with three or more respondents were included in the final analysis. This was to allow for accurate estimation of within- and between-group variances for the methodology used to test the hypotheses. Therefore, out of the 246 completed surveys received, 229 surveys from 52 teams were found to be usable. The size of our sample is consistent with other studies (Hoffman & Stetzer, 1996; Kidwell, Mossholder, & Bennett, 1997) that have used a hierarchical linear modeling (HLM) approach to test their hypotheses. This HLM methodology is described in detail in the model estimation section.

Measures

A new scale was developed to measure learning. Recall that consistent with past research we defined learning as the degree to which processing of experience changes the nature and range of potential team actions (Argyris & Schön, 1978; Barabba & Zaltman, 1991; Huber, 1991; Fiol & Lyles, 1985; and Moenaert & Caeldries, 1996). Since it is possible that the NPD performance of the team may bias the respondent's evaluation of the team's learning, it was important to minimize retrospective biases in which team members equated learning to effective action. Therefore, instead of asking the team members to evaluate how much they had learned *while* conducting the project, we asked them to evaluate how their current team experiences would influence future NPD actions, NPD actions in similar situations, or NPD actions taken in other areas of the organization.

This approach to measuring team learning provided the respondents with a neutral vantage point for reflecting upon and evaluating team learning in the current project, while decoupling it from inflation due to project success or failure. We believe such an approach has a greater likelihood of obtaining a more accurate assessment of team learning and knowledge application during the project, minimizing any bias from the success or failure of the current NPD project. Since learning is a dynamic process, the change in behavior as a result of the current experience is likely to be an ongoing and incremental real-time process. As a result, despite being measured in projective terms, our operationalization of learning should be related to the performance of the current project.

Established multi-item scales were used to measure all other perceptual constructs. Standard procedures were used to establish the unidimensionality and reliability of each scale. All scales, except one, exceeded the minimal internal consistency threshold (coefficient alpha) proposed by Nunnally (1978). The coefficient alpha for the scale measuring goal structure was .67. However, it was considered acceptable because it was close to the proposed threshold of .70. Procedures outlined by Venkatraman (1989) were used to establish the convergent and discriminant validity of the constructs using confirmatory factor analysis. Scales measuring all the constructs displayed excellent convergent and discriminant validity. The operational definition, scale items, and reliability coefficients of each construct are provided in the Appendix.

Model Estimation

The data in this study were analyzed, and the hypotheses tested, using hierarchical linear models (HLM). A brief description of this methodology and its underlying assumptions is provided below.

Hierarchical linear models

There is an increasing recognition that many organizational phenomena, such as behavior of individuals within teams, occur as hierarchically ordered systems, with variables of interest residing at different levels of analysis (Hoffman, Griffin, & Gavin, 2000; Klein & Kozlowski, 2000b). The study of such phenomena necessitates the use of multilevel theoretical and analytical models. Hierarchical linear models provide a conceptual and statistical mechanism for investigating relationships that cross levels of analysis (Hoffman et al., 2000).

Hierarchical linear model methodology is particularly well suited for analyzing hierarchically nested data structures where micro-level observations (i.e., individuals) are nested within macro-level observations (i.e., group/team) (Bryk & Raudenbush, 1992; Kreft & Leeuw, 1998). Hierarchical linear modeling explicitly recognizes that individuals within a group may be more similar to each other than to individuals in other groups, and therefore may not provide independent observations (Hoffman et al., 2000). Recognizing the partial interdependence of individuals within a group, HLM allows one to investigate both lower-level (individual) and higher-level (team) variance in the outcome variable while maintaining the appropriate level of analysis for the independent variables (Klein, Hoffman, & Gavin, 2000, p. 471). For nested data, an HLM analysis is not only more accurate, but is preferred to other approaches (i.e., OLS estimation), which do not estimate individual- and group-level variances separately.

In HLM analysis, the lower level of analysis is also referred to as Level 1, while the higher level of analysis is referred to as Level 2. Although more than two levels of analysis are possible with HLM, for the purpose of this discussion we will limit ourselves to just two levels. In our study the lower level of analysis (i.e., Level 1) refers to the individual level, while the higher level of analysis (i.e., Level 2) refers to the team/group level.

Hoffman et al. (2000) describe HLM as a two-stage approach, where in the first stage relationships among Level 1 (individual-level) variables are estimated for each higher-level unit (i.e., team) separately. The outcome of this level of analysis is a slope and intercept term, estimated for each Level 2 unit (i.e., team). These intercept and slope estimates can vary across groups/teams. The intercept term reflects the average level of the dependent variable, and the slope term reflects the relationship between the independent and dependent variable(s) for that team. These Level 1 slope and intercept estimates are then used as outcome variables in the Level 2 analysis. Thus, the HLM approach can be summarized as a regression of regressions, where Level 1 regression parameters (i.e., slope and intercept) are regressed onto higher-level variables in the Level 2 analysis (Hoffman et al., 2000).

Because data are analyzed at the lower level *before* aggregation across the higher level, HLM allows the retention of within-subjects variation in the data that would otherwise be lost if data were analyzed *after* aggregation (Bryk & Raudenbush, 1992; Kreft & Leeuw, 1998), if the data were to be summed and aggregated across individual members of a team. Thus HLM allows us to develop a clearer understanding of team-based phenomena without any loss of individual variance in team member behavior. As such, a hierarchical linear model approach is preferable to either analyzing the data at the individual level, or averaging responses across multiple members of a team to come up with a team-level response. Although described separately above, the two stages of analyses are conducted almost simultaneously (Hoffman et al., 2000).

Assumptions

Hierarchical linear models analysis is based on certain key assumptions, which are summarized by Hoffman, Griffin, and Gavin (2000) as follows.

Methodological assumptions.

1. Lower-level units are nested within identifiable higher-level units.
2. Lower-level units are exposed to and influenced by characteristics and/or processes of the higher-level units.
3. Outcome variable is measured at the lowest level of interest to the researcher.
4. Outcome variable varies both within the lower-level units and between the higher-level units.

Statistical assumptions.

1. Level 1 residuals are independent and normally distributed with a mean of 0 and a variance of σ^2 for every Level 1 unit within each Level 2 unit.
2. Level 1 predictors are independent of Level 1 residuals.
3. Random errors at Level 2 are multivariate normal, each with a mean of 0, variance of Γ_{qq}, and a covariance of Γ'_{qq}, and are independent of Level 2 units.
4. The set of Level 2 predictors is independent of every Level 2 residual.
5. Residuals at Level 1 and Level 2 are also independent.

Excellent discussions of hierarchical linear models can be found in Bryk and Raudenbush (1992), Hoffman (1997), Hoffman, Griffin, and Gavin (2000), and Klein and Kozlowski (2000a).

Decomposition of variance and level of aggregation

For nested data or data containing hierarchical levels, the total variance in any construct can be decomposed into its within- and between-group components (Bryk &

Raudenbush, 1992; Hoffman et al., 2000). Intraclass correlation coefficient (ICC) provides an indication of this decomposition of the total variance. Intraclass correlation coefficient is described as the ratio of between-group variance in constructs to its total variance, which can be computed using the following formula (Bryk & Raudenbush, 1992; Kreft & Leeuw, 1998):

$$ICC = \frac{\Gamma_{00}}{\left(\Gamma_{00} + \sigma^2\right)}$$

where,

$$\Gamma_{00} = \text{between group variance component of the construct}$$

$$\sigma^2 = \text{within group variance component of the construct.}$$

In HLM, ICC can be calculated by running an intercept-only (no predictors) Level 1 and Level 2 HLM model with the construct as a Level 1 dependent variable. This analysis is the conceptual equivalent of a one-way ANOVA (Bryk & Raudenbush, 1992; Hoffman et al., 2000), and allows one to partition the within-group and between-group variances. The ICC for each construct was then estimated using the above formula. Table 1 presents the ICC for the constructs used in this study. An examination of the table shows that for most of the constructs the within-group variance component was much larger compared to between-group variance. Klein and Kozlowski (2000b) note that this is common in samples composed of groups containing fewer than 25 individuals per group. Overall, the between-group variance (Γ_{00}) was statistically significant beyond the .05 level for all constructs except process structure.

The ICC also has important implications for the level at which a particular construct can be included (or aggregated) in the Level 1 HLM analysis. Klein et al. (2000, p. 518) note that the literature provides few hard and fast (and several varying) standards to use to in determining when a variable has an acceptable level of homogeneity to justify aggregation to a higher level. They further note that in

Table 1: Intraclass correlation coefficients of the constructs.

Construct	ICC
Consideration	0.190
Participation	0.100
Goal Structure	0.070
Process Structure	0.003*
Team Leader Position	0.238
Team Learning	0.113
Speed to Market	0.293
Level of Innovation	0.325
Project Complexity	0.275
Project Risk	0.321
Team Size	0.175
Functional Diversity	0.636

*Between-group variance not significant.

many cases the differing criteria and procedures used to justify aggregation may yield similar conclusions. Klein and Kozlowski (2000b) suggest that aggregation to the higher level can be justified if the between-group variance for the construct (as reflected by ICC) is statistically significant. We used this heuristic to determine the level of analysis of the constructs in our Level 1 HLM models. Only constructs where 90% or more of the total variance was within-groups were estimated at the individual level. Constructs with at least 10% of the total variance between-groups (and statistically significant) were estimated at the group level.

Model estimation

To test Hypotheses 1–5 proposed in this study, we regressed team learning on the characteristics of the team leader, while controlling for the size and functional diversity of the team, and the risk and complexity of the NPD project. Controlling for these team and project characteristics offers a more stringent test of our hypotheses. Equation (1) outlines the Level 1 regression model that was estimated using HLM to test for H1–H5. The coefficients of the independent variables and their significance levels provide a test of the hypotheses.

$$\begin{aligned}\text{Team Learning} = {} & \text{Constant} + b_1 * \text{Consideration} + b_2 * \text{Participation}\\ & + b_3 * \text{Goal Structure} + b_4 * \text{Process Structure}\\ & + b_5 * \text{Team Leader Position} + b_6 * \text{Project Complexity}\\ & + b_7 * \text{Project Risk} + b_8 * \text{Team Size}\\ & + b_9 * \text{Functional Diversity} \qquad (1)\end{aligned}$$

Hypotheses 6–7 explore the effect of team learning on the performance of a cross-functional NPD team. Since NPD performance is also likely to be influenced by the characteristics of the team and the project undertaken, we control for these characteristics in regressing performance on learning. As before, this offers a more stringent test of H6–H8, which are tested using the following two Level 1 equations:

$$\begin{aligned}\text{Speed to Market} = {} & \text{Constant} + b_{10} * \text{Team Learning}\\ & + b_{11} * \text{Project Complexity}\\ & + b_{12} * \text{Project Risk} + b_{13} * \text{Team Size}\\ & + b_{14} * \text{Functional Diversity} \qquad (2)\end{aligned}$$

$$\begin{aligned}\text{Level of Innovation} = {} & \text{Constant} + b_{15} * \text{Team Learning}\\ & + b_{16} * \text{Project Complexity} + b_{17} * \text{Project Risk}\\ & + b_{18} * \text{Team Size} + b_{19} * \text{Functional Diversity} \qquad (3)\end{aligned}$$

The coefficients of the independent variables in Equations (1) through (3) were estimated using Level 2 data in an intercept-only model. The coefficients of these intercepts and their significance levels provide a test of the hypotheses proposed in this paper (Hoffman et al., 2000). For the sake of simplicity, the coefficients of these Level 2 intercept terms will be referred to as the regression coefficients in the discussion of the results below. The reduction in the deviance score (relative to the null model) is used to determine the variance explained by each HLM model (Bryk & Raudenbush, 1992; Kreft & Leeuw, 1998).

RESULTS

Relationships between Team Leader Characterstics and NPD Team Learning

Table 2 presents the correlations between Level 1 (individual level) variables used in this study. The unstandardized regression coefficients results from the HLM analyses specified in Equations (1)–(3) are presented in Table 3. Hypotheses 1–4 examine the relationships between team leader behavior and learning/knowledge in NPD teams. Our results show that as hypothesized, learning and knowledge application in NPD teams had a significant positive relationship with team leader behaviors such as participation ($b_2 = .23$; $p < .000$) and initiation of goal structure ($b_3 = .15$; $p = .004$). Therefore, we find strong support for H2 and H3. To our surprise considerate behavior by the team leader ($b_1 = -.02$; $p = .40$) and initiation of process structure ($b_4 = .01$; $p = .35$) were not significantly related to team learning. Hence H1 and H4 were not supported.

Hypothesis 5 suggests that the team leader's position in the organization is likely to be positively related to NPD team learning and knowledge application. Results presented in Table 3 show that this hypothesis was strongly supported ($b_5 = .24$; $p = .004$). Among the four control variables, project risk was positively related ($b_7 = .21$; $p < .000$), and team size ($b_8 = -.01$; $p = .03$) was negatively related to team learning. The complexity of the project being undertaken and the functional diversity of the team did not show a statistically significant relationship with team learning.

Relationships between Team Learning and NPD Performance

Hypotheses 6 and 7 explore the relationships between learning/knowledge application and performance of the NPD team. We hypothesize that team learning is positively related to speed to market and level of innovation of the product being developed by the team. Table 3 shows that, as expected, team learning has a significant positive relationship with both speed to market ($b_{10} = .21$; $p = .008$) and the level of innovation ($b_{15} = .35$; $p < .000$). Therefore H6 and H7 are strongly supported.

Out of the four project and team characteristics that we controlled for, project complexity exerted a significant effect on each dependent variable, while project risk was significant for only speed to market. Team size and functional diversity did not seem to be significantly related to either of the NPD performance variables. Our results show that given their significant effect on team learning and performance, it is important to control for project and team characteristics in any analysis of NPD teams. Doing so provides us with a much more stringent and accurate test of our hypotheses. Next we discuss the implications of these results.

Table 2: Correlation table for level 1 (individual level) variables.

	(X1)	(X2)	(X3)	(X4)	(X5)	(Z1)	(Y1)	(Y2)	(C1)	(C2)	(C3)	(C4)
Consideration (X1)	1.0											
Participation (X2)	.54	1.0										
Goal Structure (X3)	.52	.32	1.0									
Process Structure (X4)	.19	.02	.44	1.0								
Team Leader Position (X5)	.44	.19	.35	.31	1.0							
Team Learning (Z1)	.42	.46	.41	.27	.43	1.0						
Speed to Market (Y1)	.24	.19	.23	.26	.14	.17	1.0					
Level of Innovation (Y2)	.10	.07	.21	.18	.21	.34	.14	1.0				
Project Complexity (C1)	.15	.02	.18	.08	.16	.21	.17	.64	1.0			
Project Risk (C2)	.11	.07	.15	.17	.17	.33	.21	.37	.40	1.0		
Team Size (C3)	.03	.07	.07	−.08	.07	−.04	.11	.02	.28	.20	1.0	
Functional Diversity (C4)	.08	.12	.00	−.07	−.03	.04	−.10	−.01	−.12	.00	−.08	1.0

n (L1) = 229.
All values of .11 or higher are significant beyond the .05 level.

Table 3: Results of the HLM regression analyses (unstandardized regression coefficients).

Independent Variables	Team Learning	*df*	Speed to Market	*df*	Level of Innovation	*df*
	Dependent Variables					
Constant	3.84***	*51*	2.95***	*51*	3.72***	*51*
Consideration	−.02	*51*				
Participation	.23***	*219*				
Goal Structure	.15**	*219*				
Process Structure	.01	*219*				
Team Leader Position	.24**	*51*				
Team Learning			.21**	*51*	.35***	*51*
Control Variables						
Project Complexity	.01	*51*	.15**	*51*	.50***	*51*
Project Risk	.21***	*51*	.24**	*51*	.05	*51*
Team Size	−.01*	*51*	.002	*51*	−.003	*51*
Functional Diversity	.07	*51*	.26	*51*	−.01	*51*
Explained Variance	0.28		.06		.18	

*$p < .05$; **$p < .01$; ***$p < .001$.
n (L1) = 229; n (L2) = 52.

DISCUSSION AND CONCLUSIONS

Recent research on organizational learning (e.g., Garvin, 1993; McKee, 1992; Pisano, Bohmer, & Edmondson, 2001) suggests that learning is neither automatic nor always beneficial, but rather results from action, reflection, and exploitation of opportunities within the organization. Pisano and colleagues note that unless organizations can develop mechanisms for capturing knowledge and implementing learning, experience may not always translate into competence. That is, learning needs to be managed (Garvin, 1993; McKee, 1992).

Our study extends this stream of research by exploring how organizations can manage learning (and thus performance) within cross-functional new product development teams through their choice of individuals assigned to lead such teams. As discussed, this analysis is consistent with the knowledge-based view of the firm that focuses on the application of knowledge from an individual (as opposed to an organizational) perspective (Grant, 1996; Madhavan & Grover, 1998). Specifically, we examine how the team leader's characteristics (i.e., management style and position) affect the learning and application of knowledge in NPD teams and consequently its performance. All the team leader characteristics considered in this study are controllable either by the team leaders themselves or by senior management. Many of these skills such as initiation of goal and process structure can be inculcated in the team leaders with appropriate training, and can be used to manage learning within NPD teams.

Edmondson (1999) notes that there is a great paucity of empirically validated research on organizational learning in general, and on team-based learning in particular. Our study further contributes to the organizational learning and knowledge management literature by presenting one of the few empirical examinations of learning and knowledge management in NPD teams. Additionally, ours is one of the first studies to methodologically address the hierarchically nested data structure of new product development teams by using hierarchical linear models to test the proposed hypotheses.

Our results show that team leaders exert considerable influence over NPD team learning and knowledge application, and are able to explain a significant proportion of the variance therein. Specifically we find that the more team leaders involve the members in the decision-making process of the team, the greater is the learning within teams. Such participatory behavior by the team leaders encourages team members to take a broader view of their jobs and consider a wider variety of information, inputs, and constraints in their decision-making process. Such a democratic climate leads not only to a free exchange of ideas but also to more opportunities for cross-functional knowledge fertilization, preventing localized and isolated problem solving. Moreover, such behavior helps convert tacit knowledge within individuals to explicit knowledge shared by many team members (Madhavan & Grover, 1998).

We expected considerate behavior by the team leader to have similar effects on team learning, however, much to our surprise, we found that they were not significantly related. While it is possible that considerate behavior encourages open communication and information sharing within the teams, it could also lead to complacency within the teams. Highly considerate team leaders are likely to create a conflict-averse team climate that prioritizes maintenance of peace and harmony above everything. Under such conditions, team members are less likely to challenge each other's opinions and ideas, which lowers the overall level of team learning. Thus the benefits of considerate leader behavior may be neutralized by the learning-averse climate that is created as an unintended consequence of such a management style.

We find that the degree to which the team leader provides structure to the team by clearly outlining the goals and expectations of the team members, the higher the learning within the NPD team. Contrary to expectations, similar results are not seen when the team leaders try to initiate process structure within the teams. That is, clearly outlined overarching goals motivate the team members by focusing their attention and energy on the outcomes expected of the team (Locke & Latham, 1990). Focusing on the end results allows the team members to come up with innovative and creative means for achieving those objectives. These findings are consistent with the research on goal-setting theory (i.e., Locke & Latham, 1990).

However, when the team leaders try to provide structure to the team in terms of organizing and defining activities of the team members, there is no consistent relationship between structure and team learning. One possible explanation could be that initiation of process structure could be construed as micromanagement by the team members, since it has the potential to constrain their behaviors and activities in a highly uncertain and dynamic NPD environment. This finding is consistent with Earley, Connolly, and Ekegren (1989) who suggest that setting too specific a structure for complicated, uncertain, and hard tasks is counterproductive, because the rigidity is likely to stifle creativity and innovativeness.

While it is possible that initiation of process structure helps team members learn through procedural knowledge (Grant, 1996), it is also likely to shift the focus away from goal achievement to procedural fulfillment, suppressing creativity and nonroutine problem-solving in the process. Our results suggest that team leaders have to walk a fine line in cultivating and enhancing learning within NPD teams. They have to initiate enough structure to reduce uncertainty and motivate team members, but not enough to extinguish creative problem-solving.

In examining the effect of team leader position on NPD team learning and the application of knowledge, we hypothesized that a positive relationship is likely to exist. This proposition was based on the argument that leaders in high positions have extensive internal and external knowledge networks, and the ability to make these resources available to the NPD team. Our results support this argument and show the existence of a strong and positive relationship between team leader position and learning in NPD teams. This finding implies that in order to improve learning and the application of knowledge within NPD teams, organizations need to pay close attention to the seniority/position of the leaders appointed to these teams. The ability of these team leaders to access and integrate diverse/extensive knowledge bases, latent and overt, within and outside the organization is critical to learning within the teams. Further, within the knowledge-based framework, these findings point to NPD leadership characteristics that appear to foster the abilities of individuals within teams to apply their knowledge.

Last but not least, we empirically show that learning has a significant positive relationship with speed to market and innovation within NPD teams. Learning in NPD teams increases as members engage in nonroutine and creative problem-solving and experiment through a process of trial and error. This further increases the capacity of the team to improve the level of innovation being introduced in the product. Again, within the knowledge-based framework, this could be interpreted as demonstrating the link between experience and knowledge application within NPD teams and performance in terms of speed to market and innovation.

Interestingly, our results also show that the control variables such as project characteristics have a strong influence on the learning and performance of the NPD teams. For example, project risk is positively related to NPD team learning, because risky projects often require team members to come up with creative and nonroutine solutions. Team size on the other hand is negatively related to learning. A possible reason for this negative relationship might be that as the size of the team grows, more time and effort is spent on process and coordinating activities rather than addressing the problem. In general we find that project risk and complexity have a significant effect on NPD performance. Therefore, it is imperative that studies examining NPD teams control for the effect of project and team characteristics in order to minimize the possibility of spurious results. Controlling for these variables in our study provides a much more stringent test of our hypotheses than otherwise.

The results empirically demonstrate that learning significantly enhances the NPD team's ability to innovate and bring products to market faster. They also show that learning and knowledge application can be nurtured in teams by effective leadership. Organizations can either select team leaders with appropriate skills or train leaders to inculcate these management skills to enhance team learning and consequently achieve superior new product development performance.

Taken together, these findings suggest that a firm's NPD efforts are ultimately best served when management selects and encourages high-ranking team leaders who clearly articulate goals, yet do not interfere with or micromanage the day-to-day activities of the team. Goals should be set, but team leaders should not get involved in putting together micro-level plans of activities and their implementation. Further, to maximize team learning and the application of knowledge, our findings suggest that team leaders should actively involve the individual members in team decision making, but not let their concern about the feelings of team members overshadow their focus on project objectives.

While our study examines the effect of team leaders on team learning using a rigorous, cross-sectional approach, there is clearly much more that can be learned from further exploration of these relationships. For example, future studies could examine this issue longitudinally to see if the effect of team leadership differs at various stages of the NPD process. It may be that management styles that are most conducive to team learning in the early stages of the NPD process (i.e., idea generation), are likely to be much different from those in the later stages of the process (i.e., prelaunch). The need for consideration, participation, and goal and process structure is likely to evolve over the course of the development process. While we considered five managerially controllable team leader characteristics in this study, future work could extend this line of research to other team leader characteristics. Finally, it would be desirable to have a larger sample size in future extensions of this research for greater empirical power, and to examine some of the interaction effects suggested by the extant literature. [Received: March 2002. Accepted: January 2003.]

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APPENDIX

Construct Definitions and Measures

Construct	Definition	Items	References
Participative Behavior (4 items, Alpha = .81)	The degree to which the team leader is perceived to be democratic in his/her interactions with the team members.	Team members can exert influence regarding how the team should function. Team members can influence decisions of the team leader regarding things concerning the team. Our team leader frequently asks the team members for their opinion when a problem comes up that involves the project. Our team leader frequently makes decisions concerning the team, without consulting the team members. [R]	Teas (1981, 1983)
Consideration (5 items, Alpha = .83)	The degree to which the team leader is perceived to demonstrate concern for the well being of team members.	Our team leader is friendly and approachable. Our team leader gives advance notice of changes. Our team leader makes my job pleasant. Our team leader does little things to make it pleasant to be a member of this team. Our team leader treats all members of the team as his/her equal.	Teas (1981, 1983)
Process Structure (5 items, Alpha = .72)	The degree to which the team leader organizes and defines the activities of team members.	Our team leader encourages the use of uniform procedures. Our team leader decides what shall be done and how it will be done. Our team leader schedules the work to be done. Our team leader maintains definite standards of performance.	Teas (1981, 1983)

		Our team leader asks the team members to follow standard rules and regulations.	
Goal Structure (3 items, Alpha = .67)	The degree to which the team leader lets team members know what is expected of them and makes his/her desires known to the group.	Our team leader lets the team know what is expected of them. Our team leader makes his/her attitudes clear to the team members. Our team leader makes sure that his/her part in the team is understood by the team members.	Teas (1981; 1983)
Team Leader Position (6 items, Alpha = .76)	The degree to which the team leader enjoys formal and informal status within the organization.	Our team leader is well respected in the organization for his/her management skills. Our team leader is well respected in the organization for his/her technical skills. Our team leader is widely "networked" in the organization. Our team leader occupies a high position in the organization. Our team leader enjoys authority in the organization. Our team leader has significant decision-making responsibility in our organization.	New Scale Some items derived from Fleishman (1957), House & Dressler (1974), and Stogdill (1963)
Team Learning (6 items, Alpha = .83)	The degree to which processing of team experience changes the nature and range of potential team actions.	Being a part of this team has been a great learning experience for the team members. Member's experience with the team is likely to help them perform better in cross-functional teams in the future. Member's experience with the project is likely to help them perform better on product development projects in the future. Team members are likely to repeat the mistakes made here on other projects [R].	New Scale Items derived from Argyris & Schön (1978), Barabba, Zaltman (1991), Huber (1991), Fiol & Lyles (1985), and Moenaert & Caeldries (1996)

(Continued)

(Continued) Construct Definitions and Measures

Construct	Definition	Items	References
		Due to their experience on this project, team members will be better prepared to handle similar situations. Members are likely to apply the lessons learned on this project to other areas in the organization.	
Speed to Market (5 items; $\alpha = .86$)	A time measure of the pace at which the product was developed by the team.	This product was developed much faster than other comparable products developed by our organization. This product was developed much faster than similar products developed by our nearest competitors. This product could have been developed in a shorter time [R]. The product concept formation (i.e., opportunity identification and product design) took longer than expected [R]. The product commercialization (i.e., product/market testing, production, distribution, promotion, sales) took longer than expected [R].	Sarin & Majajan (2001); Olson, Walker, & Ruekert (1995)
Degree of Innovation (6 items; $\alpha = .85$)	The degree of "newness" of the product under development.	Several product-related innovations were introduced during the development of this product. High quality technical innovations were introduced during the development of this product.	Sarin & Majajan (2001); Olson, Walker, & Ruekert (1995)

		Compared to similar products developed by our competitors, our product will offer unique features/attributes/benefits to the customers.	
		Our product introduces many completely new features to this class of products.	
		Compared to similar products developed by our organization, our product will offer unique features.	
		Check one of the following statements that best (or most closely) describes the product developed by your team [R]:	
		The product is new to both our firm as well as the customers.	
		The product is new to the customer but not very new to our firm.	
		The product is new to our firm but not very new to the customers.	
		The product is neither new to our firm nor new to the customers.	
		Our product is an imitation of an existing product.	
Project Complexity (5 item; $\alpha = .86$)	The degree to which the development process was complicated and difficult.	The product developed by our team was technically complex to develop.	Hill (1972); McCabe (1987); Kahn & Mentzer (1992)
		Our team had to use non-routine technology to develop the product.	
		The development process associated with the product was relatively simple. [R]	
		Development of this product required pioneering innovation.	
		The product developed by our team is/was complex.	

(*Continued*)

(Continued) Construct Definitions and Measures

Construct	Definition	Items	References
Team Size (1 item; $\alpha = NA$)	The number of members who form the core/primary part of your product development team.	Please indicate the number of members who form the core/primary part of your product development team: ___	
Project Risk (4 item; $\alpha = .88$)	The magnitude of failure associated with the project.	Our organization has a lot riding on this project. Poor market performance by this product will have serious consequences for our business. Our organization has made a significant investment in the development of this product. The outcome of this project has high strategic value for our organization.	Sarin and Mahajan (2001); March & Shapira (1987)
Functional Diversity (1 item; $\alpha = NA$)	The degree of functional heterogeneity in the team.	Please indicate how many members of your product team belong to the following functional areas: Marketing : ___ Manufacturing : ___ Engineering : ___ Entropy based index was used to calculate functional diversity (H): $H = -\sum^{s} P_i * (\ln P_i)$ P = fractional share of team members assigned to marketing, manufacturing, and engineering. S = the number of functional areas that can potentially be represented.	Ancona & Caldwell (1992)

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