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An empirical multi-level analysis for achieving balance between incremental and radical innovations

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ABSTRACT

An examination of 202 innovation projects in 42 firms revealed two approaches in how firms manage employees to explore new knowledge for radical innovations and to exploit existing knowledge for incremental innovations. The first is the system of organization-level management practices, whereby employees are recruited based primarily on prior work experience in other companies and developed interdepartmentally, and compensation is based primarily on joint performance without a specific innovation project in mind. The second is the system of team-level management practices, whereby employees are selected based mainly on overlapping knowledge with team members, and are trained and rewarded for a specific innovation project. Although both systems offer employees the necessary psychological safety for attaining radical innovations and the perspective-taking capability helpful for incremental innovations, each system is better for achieving one type of innovation than the other. The system of organization-level management practices better achieves radical innovations because it provides greater psychological safety, while the system of team-level management practices better achieves incremental innovations because it develops superior perspective-taking capability. Using both systems assists in incremental innovations but not radical innovations, because contradictory expectations are placed on the employees, diminishing psychological safety. The main implication of these findings is that companies should manage their employees differently depending on the type of innovation they wish to achieve.

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1. Introduction

How companies can simultaneously achieve both exploration of new knowledge for radical innovations and exploitation of existing knowledge for incremental innovations is still one of the key dilemmas in the organizational learning research (for recent reviews and examples, see Salomo et al., 2007; Smith et al., 2006). The literature typically suggests that firms must achieve both radical and incremental innovations in order to succeed in the future, but they must focus on one or the other because of limited resources or else one can crowd out the other (e.g., Benner and Tushman, 2003; March, 2006). Therefore, despite this issue's importance, it remains unclear how companies can achieve both simultaneously (Salomo et al., 2007).

Prior studies suggest four possible solutions to the problem of achieving radical and incremental innovations: ambidexterity, punctuated equilibrium, specialization, and employee management. First, ambidexterity refers to the simultaneous achievement of both radical and incremental innovations through separation of the units of the firm that undertake radical innovations from those units that undertake incremental innovations (e.g., Tushman and O'Reilly, 1996; Benner and Tushman, 2003). Second, punctuated equilibrium deals with temporal instead of organizational separation and recommends alternating periods of incremental and radical innovations as a more feasible method than the synchronous quest of both (e.g., Burgelman, 2002; Holmqvist, 2004). Third, the specialization strategy proposes that firms focus on either radical or incremental innovations in their interaction with other firms (Siggelkow and Rivkin, 2006). Finally, the employee management approach proposes a system of innovative human resource management policies to achieve balance (Un, 2007).

The present study builds on and extends this latest thinking (Un, 2007), and conducts a more fine-grained analysis of solutions to achieve balance. It extends the core argument of the employee management approach to empirically test the impact of two systems of employee management practices: one system that operates at the level of the company without specific innovation projects in mind and another that functions at the level of the project teams that have been formed to specifically generate innovations. Although firms potentially use practices at both levels to encourage innovation, this is the first study to analyze them together. Therefore, in the present paper, the system of organization-level practices and the system of team-level practices are applied to the study of the different degrees of innovativeness of innovations generated by teams that have been formed specifically to create them. As such, the current study differs from other studies that have analyzed employee management to attain innovation and efficiency (Un, 2007) and product and process innovations as outcomes of organizational learning (Benner and Tushman, 2002).

I propose that companies can manage individuals to accomplish both radical and incremental innovations simultaneously using differential recruitment, development, and compensation depending on the type of innovation desired. I argue that a firm can use a system of organization-level management practices, whereby employees are recruited based primarily on prior work experience in other companies, developed interdepartmentally, and compensated based primarily on joint performance without a specific innovation project in mind. In addition, a system of team-level management practices can be adopted, whereby employees are selected based mainly on overlapping knowledge with team members, and are trained and rewarded for working in a project team on a specific innovation project. Although both systems of practices provide employees with the psychological safety needed to achieve radical innovations and the perspective-taking capability helpful for incremental innovations, each system is better for achieving one type of innovation than the other. The system of organization-level management practices is better suited to achieving radical innovations because it offers greater psychological safety, while the system of team-level management practices is better suited to incremental innovations because it better develops perspective-taking capability. Using the two systems simultaneously helps in incremental but not radical innovations, because they can produce conflicting expectations on employees, reducing psychological safety.

The paper adds to the organizational learning research by looking deeper inside the firm to find a solution to achieve this balance. Rather than discussing actions at the level of the company, as done in previous studies (Benner and Tushman, 2003; Burgelman, 2002; Siggelkow and Rivkin, 2006), I propose actions inside the firm at both the firm and team levels, analyzing in particular teams that

have been formed to explore and combine knowledge for innovation. Such multi-level analysis is important because organizational learning tends to occur at the level of individuals and teams, and empirical studies at these levels are limited (Taylor and Greve, 2006). The paper also contributes to the innovation literature by integrating two research streams that have been analyzed in parallel, one examining how individuals must be managed at the organization level independently of when they are organized to innovate (e.g., Lawrence and Lorsch, 1967; Lee and Allen, 1981; Schein, 1992) and one examining how individuals must be managed at the team level when they are selected to work on innovation projects (e.g., Ancona and Caldwell, 1992; Hoegl and Parboteeah, 2007).

Finally, this paper also adds to the literature on the so-called "innovative" human resource management practices (Ichniowski et al., 1997; Osterman, 2006) by showing that when these policies are applied to all employees at either the firm level independently of when employees are organized for innovations or when they are organized into teams to generate them can enable firms to achieve both radical and incremental innovations, although one set of practices is more suitable than the other set for one type of innovations than the other.

The rest of the paper is structured as follows. In Section 2, I discuss the requirements of radical and incremental innovations and explain how firms can manage individuals to achieve both types of innovation simultaneously. I then describe two systems of management practices, both of which function to facilitate innovation, and discuss the type of innovation to which each system is better suited. In Section 3, I describe my research methods, and present the results and statistical analyses in Section 4. Discussion and directions for future research are provided in Section 5.

2. Literature review, theory, and research hypotheses

Both radical and incremental innovations in organizational learning are activities that create knowledge. Radical innovations entail creating knowledge in order to make fundamental changes that represent revolutionary alterations in a product's technology (Dewar and Dutton, 1986; Henderson and Clark, 1990; Herrmann et al., 2007). In contrast, incremental innovations deal with creating knowledge for minor improvements or simple adjustments in a product's current technology (Banbury and Mitchell, 1995; Henderson and Clark, 1990; Un, 2008). The major difference captured by the labels "radical" and "incremental" is the degree of novel technological content, and hence the degree of new knowledge, embedded in the innovation.

Product innovations consist of two parts (Roberts, 2007): (1) the creation of an idea or invention, which a single individual can do, and (2) the conversion of that idea into a business or other useful application that has commercial value. Product innovation is achieved by integrating the knowledge of multiple individuals (Schumpeter, 1934; Un and Cuervo-Cazurra, 2004, 2005; Van de Ven et al., 1999). Although a single individual in the firm can innovate, for example by initiating an idea for improving an existing product or creating a new one, the scale and complexity of the task of product innovation needs diverse types of knowledge from different individuals if the company is to create value from this new idea (Leonard-Barton, 1995; Nonaka and Takeuchi, 1995). Other employees who possess knowledge in different departments are needed so that the innovation generates value by linking the firm's abilities with market needs. Thus, all members of the company are potential innovators that need to be managed to generate innovations (Teece, 2006).

The innovation process is complex because individuals must feel psychologically safe to search and experiment with novel ideas and must possess the perspective-taking capability to be able to integrate existing knowledge, which is a difficult process. Although both psychological safety and perspective-taking capability are important for innovation (Un, 2007), radical innovations require more new knowledge than do incremental innovations (Dewar and Dutton, 1986; Henderson and Clark, 1990) and thus require more psychological safety for exploring new ideas. Incremental innovations primarily require the integration of existing firm-internal knowledge (Lee and Allen, 1981), and perspective-taking capability is thus more critical than psychological safety.

Psychological safety deals with a common understanding that employees are safe to take chances and try out new ideas. The concept implies a sense of trust that they will not be harmed by someone else for expressing their thoughts and ideas (Schein, 1992; for a recent review see Un, 2007). It explains an organizational context that builds on positive feelings between individuals, where these

individuals feel free and safe to express their opinions and ideas. Such positive affect is critical for creative exploration of new knowledge and generation of innovations (Amabile et al., 2005) because it promotes the production of novel insights or solutions to problems (p. 368). Amabile et al. (1996) argues that organizational characteristics conducive to generation of creative ideas include reduced organizational impediments, particularly organizational politics and workload pressures, and increased freedom and encouragement from management (p. 1159). Work pressures decrease employees' creative search for new insights and thus should be reduced to achieve innovations (Amabile, 2002).

Perspective-taking capability deals with the ability of employees to take the view of employees from other departments in the firm with whom they must combine knowledge to create innovations. Such knowledge integration is difficult (Carlile, 2004; Un, 2008). Building on prior studies (e.g., Carlile, 2002; Dougherty, 1992), Un (2008) found that departments differ in their viewpoints and ways of doing things, requiring departmental intelligence for successful interdepartmental knowledge integration. A department may consider an issue important and recommend that it be incorporated in making new products, but another views it as unimportant and rejects it. Therefore, the lack of departmental intelligence or the inability of individuals from different departments to adopt each other's perspectives can influence combination of knowledge for innovations.

2.1. Managing innovators for radical and incremental innovations

How companies manage employees is critical for generating innovations. Innovation scholars (e.g., Amabile et al., 2002; Badawy, 2010; O'Connor and McDermott, 2004) propose that the way in which a company manages employees will create an organizational context that either encourages or discourages innovations. For a firm to achieve innovations, employees must be managed in a way that they feel safe to search and experiment with new knowledge (Amabile et al., 1996; Badawy, 2008). To create such a culture of innovations, the way of determining reward within the organization is especially critical (Badawy, 2008; O'Connor and McDermott, 2004; Schein, 1992). Schein (1996) also argues that there are distinct viewpoints of people in the production, engineering, and management parts of the organization that contribute to the difficulty in achieving innovations. Un (2008) found that such variation extends to other parts of the firm, particularly sales/marketing and customer service, making combination of their knowledge for product innovation arduous and requiring management of individuals in a way that they can take each others' viewpoints.

I follow this line of thinking and explain two systems of employee management practices: the system of organization-level management practices and the system of team-level management practices. I discuss systems of practices rather than individual practices because some policies complement each other to create similar influences on employees and thus should be analyzed together (Ichniowski et al., 1997; Osterman, 2006).

2.1.1. The system of organization-level management practices and radical and incremental innovations

The system of organization-level management practices includes experience-based recruitment, career development, and joint performance-based compensation implemented without a specific innovation project in mind. These practices differ from Un's (2007) innovative practices, which are based on the human resource management literature (e.g., Ichniowski et al., 1997; Osterman, 2006) that recommends team-based job design, team-based reward, and team-based cross-functional job rotation implemented without any innovation projects in mind. Policies in the present paper integrate arguments set forth in prior innovation studies, which have suggested four main practices relating to employee management for innovations: job design (Lawrence and Lorsch, 1967; Hoegl et al., 2003), experience-based recruitment (Song et al., 2003), career development (Leonard-Barton, 1995; Nonaka and Takeuchi, 1995), and joint performance-based compensation (Katz and Allen, 1985). I control for job design and analyze the other three practices. This is the first study to analyze and empirically test these practices together and to separate out the impact of team-level practices from organization-level practices on radical and incremental innovations.

Experience-based recruitment refers to hiring new employees into the company on the basis of their diverse work experiences in other companies. Hiring individuals who have worked for other

companies helps the firms achieve innovations, because the employees have access to more sources of knowledge that are useful for exploration and experimentation (Song et al., 2003; Leonard-Barton, 1995). Song et al. (2003) argue that newly hired employees from other companies tend to have technological expertise that is distinct from that of the hiring firm. Newly recruited engineers, for example, tend to work in noncore technological areas in their new firm. As such, the hiring firm can enhance learning and innovations when new recruits are used for experimenting with knowledge and ideas that are radically different from what the firm already knows.

Career development refers to a practice whereby employees work in different departments throughout their careers with the company. Leonard-Barton (1995) proposes that newly hired employees should be given career development whereby they are sent to acquire skills in other departments so that they have not only deep knowledge in a particular department based on their formal training, but also some knowledge about other areas with regard to how they think and do things. Such career development tends to be found in highly innovative firms. For example, Nonaka and Takeuchi (1995) show that in innovative Japanese firms employees are given career development that involves working in different departments throughout their careers. A typical career path of an employee includes spending several years working in sales/marketing, another few years in manufacturing, and then moving on to research and development (R&D). This practice is different from cross-functional team job rotation whereby individuals are limited to being rotated to functional areas of the team specifically for working on the innovation projects.

Joint performance-based compensation refers to rewarding individuals in terms of their salary and bonus payments and increases based primarily on the performance of a company, business unit, or plant, rather than exclusively on individual performance (Ichniowski et al., 1997). This practice has been demonstrated to be effective because employees are encouraged to take a broader view of the company and help achieve performance at other levels beyond the level of the individual or group. Kerr (1975) explains that if individuals are rewarded based on firm performance they will focus their attention and efforts on working towards achieving it. Aoki (1988) argues that when employees are rewarded based on firm performance they will share knowledge and information with each other to work more effectively and efficiently to achieve firm performance. Essentially, how individuals are rewarded will influence their behaviors and thus firm performance (Coombs and Gilley, 2005).

The system of organization-level management practices assists in promoting the organizational context that provides the psychological safety necessary for innovations by reducing pressures on the individuals and building trust between them. First, experience-based recruitment aids in the search for new ideas, not only by lowering pressures in the exploration of new knowledge, but also by granting employees access to a variety of knowledge sources. Having worked in other companies, individuals have established relationships with other individuals in those companies (Almeida and Kogut, 1999; Song et al., 2003). Personal contacts external to the focal firm can be sources of novel ideas for the hiring company. Moreover, it is viewed as safer to experiment with ideas with external contacts than with colleagues within the firm. External relationships do not put pressures on employees.

Second, career development helps employees feel safer to search and try out different ideas, because it aids in building a positive work environment by promoting trust between more employees. It enables employees to develop social relationships with individuals throughout the organization, and since people tend to trust those individuals they know more than those they do not know, and trust is critical for developing an organizational context that provides psychological safety, this practice reinforces the other practices in encouraging employees to explore novel ideas needed for radical innovations. Third, the organization-level joint performance-based incentive scheme reduces the pressures on individuals by spreading them to other organizational members. The reduced pressures allow individuals to become more positive about their work environment, which facilitates the exploration and experimentation with new ideas that is supportive of radical innovations (O'Connor and McDermott, 2004). Based on the preceding arguments, I hypothesize that:

H1a. The system of organization-level management practices is positively related to radical innovations.

The system of organization-level management practices also supports incremental innovations by managing employees to have interdepartmental perspective-taking capability, or the ability to adopt the views of individuals from other departments. This ability requires understanding what others'

standpoints involve and an acceptance of their differences. Without perspective-taking capability, diversity of knowledge contributed from different departments necessary for innovations is not successfully combined.

The system of organization-level practices helps employees develop perspective-taking capability both by having them experience different perspectives through career development and by encouraging acceptance of different viewpoints through joint performance-based compensation and experience-based recruitment. First, employees' ability to take and accept others' perspectives can be acquired by directly experiencing those viewpoints in career development. Parker and Axtell (2001) argue that when employees have done the work of other employees they are more able to take the perspectives of those employees whose work they have performed. As a result of this common experience, employees have a better appreciation of how others think and do things, and thus are more willing to accept their ideas rather than rejecting them simply because they are different. Un (2008) also shows that in the process of combining knowledge of individuals based in different departments for product improvement, acquiring experiences in each others' departments helps employees take each others' viewpoints and combine knowledge. The explanation is that the overlapping experiences enable individuals to have empathy and thus become more willing to accept others' viewpoints in combining knowledge.

Second, although joint performance-based compensation has a smaller effect on the development of perspective-taking capability than career development, it nonetheless has some effect because it encourages acceptance of different viewpoints. Rewarding individuals based on firm or business unit performance motivates them to take a broader view of their role in the organization, and to combine their knowledge with different viewpoints because they see its importance. Third, experience-based recruitment has a smaller effect on perspective-taking capability than career development. However, it encourages employees to accept diverse viewpoints because they are more accustomed to working with individuals possessing different perspectives. Following these ideas, I hypothesize that:

H1b. The system of organization-level management practices is positively related to incremental innovations.

2.1.2. The system of team-level management practices and radical and incremental innovations

The system of team-level management practices consists of team members' selection, training, and reward with a specific innovation project in mind. This approach integrates previous studies that propose three main practices that firms should adopt in managing employees who are in teams organized for product innovations. The first is project-team selection, or selection of team members based on the appropriate skills (Hoegl and Parboteeah, 2007), particularly overlapping knowledge (Madhavan and Grover, 1998). The second is project-team training, or the training of team members specifically to work on the project in question (Roth and Kleiner, 2000; Thamhain and Wilemon, 1997). The third is project-team reward, namely rewarding team members for working on the project (Ancona and Caldwell, 1999; Pinto et al., 1993; Sarin and Mahajan, 2001). Until now, none of these practices have been examined or empirically tested together. This is also the first study to differentiate the effects of organization-level practices from team-level practices on the innovativeness of innovations created by teams assembled specifically to generate these innovations.

The team-level management practices can also produce psychological safety and thus help achieve radical innovations. The three practices complement one another, providing the psychological safety that encourages exploration of new ideas, helping to achieve radical innovations. First, project-team selection can help provide the sense of safety that individuals need to explore new ideas critical for achieving innovations that are radically different. It also enables individuals to have some common knowledge with others on the team, which helps establish confidence in each other's competence, and thus trust, promoting psychological safety. Second, project-team training on how to work together as a team, such as how and where different members can look for new ideas, can also promote radical innovations. Individuals behave as directed, exploring new knowledge and completing the project in order to receive the reward. Third, project-team reward helps reduce pressures on the individual, because such pressures are shared across the team members rather than being focused on a single individual (Un, 2007). When individuals are operating under reduced pressures, they will take chances

to search for and try out new ideas for radical innovations. Based on these arguments, I hypothesize that:

H2a. The system of team-level management practices is positively related to radical innovations.

The system of team-level management practices also has a positive effect on incremental innovations. First, project-team selection can be used to assemble a team of people with the perspective-taking capability necessary to integrate knowledge for incremental innovations. Managers can select individuals with characteristics that better facilitate the achievement of a specific task (de Korvin et al., 2002), such as people who possess overlapping knowledge with other team members, which supports incremental innovations by promoting individuals' ability to adopt each other's perspectives (Nonaka, 1994). People that possess this overlapping knowledge must be selected because employees tend to possess highly specialized knowledge with little overlap (Madhavan and Grover, 1998). Second, project-team training can reinforce perspective-taking capability and achieve incremental innovations. Project-team training is provided so that work processes, such as setting the agenda for meetings to share knowledge, task allocation, and suggestions about the resources that are needed and where they may be acquired, run more smoothly (Roth and Kleiner, 2000; Thamhain and Wilemon, 1997). Individuals that receive project-team training understand who will contribute which knowledge to the project, and have a clear objective and a schedule for meetings to work on the project. Consequently, they meet more frequently than those that do not have these measures in place, facilitating integration of existing knowledge for incremental innovations.

Third, project-team reward focuses individuals on integrating existing knowledge in order to complete it (Pinto et al., 1993; Sarin and Mahajan, 2001). When the desired objective is project completion, the reward can be fine-tuned to the desired outcome. Ancona and Caldwell (1999) argue that firms should reward teams for their project team performance. Ichniowski et al. (1997) studied single-function teams and demonstrated that reward for team performance impacts team interaction and performance. Pinto et al. (1993) and Maltz and Kohli (2000) also indicate that rewards based on team outcomes place the emphasis on a common goal and facilitate integration of knowledge to accomplish the task. Similarly, cooperation is developed by providing a common goal and informing people that their role is to combine knowledge, rewarding them to the extent that the group successfully accomplishes its goal. Hence, I hypothesize that:

H2b. The system of team-level management practices is positively related to incremental innovations.

2.1.3. Comparing the effects of the systems of organization-level and team-level management practices on radical and incremental innovations

When comparing the effects of the two systems of innovation practices, the system of team-level practices is less supportive of radical innovations than the system of organization-level practices. It provides less psychological safety than organization-level system because it diffuses the pressures to fewer people. Moreover, team practices can complement each other to create "groupthink" (Janis, 1972). Project-team selection can reinforce groupthink because team members have similar experience and knowledge. However, experience-based recruitment provides greater opportunity to explore new ideas with external contacts. Project-team training can reinforce groupthink as team members are trained to think and do things a certain way in order to complete the project. In contrast, career development provides employees greater psychological safety through the development of social relationships and skills in multiple departments that enhance exploration of new ideas. Project-team reward can also create groupthink, whereby team members are motivated to think and behave in a particular way as expected by other team members in order to receive the reward. Whereas project-team reward diffuses the pressures among team members, joint performance-based compensation diffuses the pressures to a larger group of employees, such as the firm or the business unit of the firm. Therefore, I hypothesize that:

H3a. The system of organization-level management practices has a larger positive effect on radical innovations than the system of team-level management practices.

However, I argue that the system of team-level management practices is better suited to incremental innovations than the system of organization-level management practices, because it provides more of the perspective-taking capability that is helpful for integrating the existing knowledge needed for incremental innovation. The general perspective-taking capability offered by the system of organization-level management practices must be adjusted to the specific needs of the project in order to be as effective as the system of team practices, because different products may have varying requirements. First, selection of team members based on firm-internal overlapping experience suitable for the needs of the project will enable more efficient integration of existing knowledge for incremental innovation. Although recruitment of individuals with prior work experience in other companies can enhance perspective-taking capability, its effect on incremental innovation will be more limited than that of project-team selection. This is because the perspective-taking capability developed by the system of organization-level management practices is less targeted to the needs of the specific innovation projects.

Second, project-team training focuses individuals' attention on integrating existing knowledge efficiently. Although career development helps improve perspective-taking capability, it must be adjusted to the specific needs of the innovation projects to be as effective as project-specific team training. Third, project-team reward is more focused than reward based on the performance of the firm or the business unit because individuals can see the impact of their individual contributions more explicitly. Project-team reward focuses team members' attention on combining existing firm-internal knowledge. The emphasis is on finishing the project within the schedule and budget (Ancona and Caldwell, 1992) in order to receive the reward. Therefore, I hypothesize that:

H3b. The system of team-level management practices has a larger positive effect than the system of organization-level management practices on incremental innovation.

2.1.4. The effects of combining both systems of practices on radical and incremental innovations

The intriguing question is what happens when a firm combines practices from both systems. Building on the idea that practices can be incompatible with one another, such as individual-based and team-based practices (Kerr, 1975; Un, 2007), I argue that the use of policies from both organization-level and team-level systems of practices simultaneously can create conflict and will lead to lower radical innovation than using each system individually. Contradictory expectations can diminish psychological safety and discourage risk taking and experimentation (Schein, 1992; Un, 2007: 14). Conflicting policies make the rules arbitrary and unpredictable and such uncertainty makes action and inaction equally difficult (Schein, 1992). Such negative affect can result in reduced creative search and reduced experimentation with new ideas (Amabile et al., 2005), harming radical innovation.

Joint performance-based compensation, which helps build psychological safety, can be incompatible with project-team reward. This is because this compensation depends on individuals' acting for the company or the business unit in a way that is incompatible with primarily focusing on project-team performance. These contradictory expectations, working for the firm or for the team, create tension for employees and discourage risk taking and experimentation with novel ideas since they are not mutually reinforcing. Even when reward is based on both organization and team performance, contradiction occurs when the latter is considered more important than the former (Un, 2007: 15). Instead of working towards firm performance, the employees will focus on team performance, thereby making incentive schemes from the organization system less desirable from the employees' perspective. However, because the firm implements such a practice, employees will feel obligated to pay attention to it, putting them in a predicament where they are forced to make a decision about whether to allocate some of their time and effort towards it.

When the compensation for team performance is greater than the reward from the organization system, employees will work harder toward achieving team performance and experience higher pressures than if they had to primarily focus on firm performance. The greater pressures result in employees being less willing to explore new ideas to make radically different products. Prior studies (Lee et al., 2004; Un, 2007: 15) also suggest that even if the firm provides similar compensation from both systems, individuals will need to decide which one to focus on and take the necessary actions, because they have scarce resources, especially time and effort. These conflicting practices reduce

psychological safety, while career development and experience-based recruitment promote it. Summarizing these arguments, I hypothesize that:

H4a. Using both systems of practices has a lower impact on radical innovation than using each system separately.

However, using policies from both systems can lead to higher incremental innovation, because they complement each other in building the perspective-taking capability of employees. First, selection based on overlapping experiences in the company will help reinforce experience-based recruitment to develop perspective-taking capability. Since experimentation with new ideas is not required in incremental innovation, employees will focus on combining existing knowledge effectively to achieve the reward for working on the team. Second, project-team training can include coaching on each other's viewpoints, reinforcing learning through experiencing others' viewpoints in career development. While career development provides context-specific or tacit knowledge about others' perspectives, project-team training can help explain how these differences can be reconciled in integrating knowledge for the specific innovation project. Third, the additional reward for working on the project will motivate people to take others' perspectives to integrate knowledge in order to finish the project and receive the reward. Therefore, I hypothesize that:

H4b. Using both systems of practices has a larger positive impact on incremental innovations than using each system separately.

3. Methods

I tested my hypotheses using survey data from 202 projects in 42 firms located in the USA. Using a four-digit SIC code, I focus on firms that manufacture personal PC, photo imaging, and automotive products. These are large established firms with an average of more than 10,000 employees, revenue of more than $1 billion, and an average market share of at least 5%. I controlled for firm size by analyzing only large firms. Dewar and Dutton (1986), for example, show that large firms tend to be better at radical innovations than smaller firms. I selected firms that belong to the aforementioned industries in order to establish generalizeability across these industries. Previous studies suggest that firms in different industries face different pressures for innovation that affect how they manage people (Lawrence and Lorsch, 1967).

I selected a set of product innovation projects whose main objective was to provide new functional benefits to consumers as a result of their concerns with the products. Top management decided on the products in need of innovation; therefore, all projects received their support. The current study focuses on product innovations driven by users' experiences. For each firm, five projects were randomly selected from the list provided by top management. Top managers were asked to provide a list of all projects that had been completed, with the product having been on the market for at least 6 months, so that performance could be rated. For each company, I selected projects that top management decided needed "significant" innovation if they were to improve financial performance.

One example of a project in the PC industry was a drastic change to the technology of the notebook computer that would enable customers to replace parts themselves. In the photo imaging industry, one example is the introduction of a new technology to increase user-friendliness and functional benefits to users. In the automotive industry the projects include significant changes in the technology of the sport utility vehicle to minimize roll over problems. Due to confidentiality agreements with the participating companies, I cannot describe these projects in detail.

Data were gathered through surveys. I collected data from three different sources using three separate surveys to avoid single-respondent bias (Klein et al., 1999). Data on practices in the system of team-level management practices were collected from the project leaders. Data on practices in the system of organization-level management practices were obtained from the personnel manager of each firm. Data on the radical and incremental innovations of the projects were collected from a vice-president of engineering of each firm.

3.1. Variables and measures

Table 1 summarizes the constructs, variables and measures used in the study. The two dependent variables are radical innovations and incremental innovations, and the two predictors are the organization and the team systems of practices. The dependent and independent variables are measured using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Following Dewar and Dutton (1986), I measured radical and incremental innovations by the degree to which top managers (vice presidents of engineering) agree that the innovated products depart from their prior technologies. I measured radical innovations by asking: "How much do you agree with the following statement as the description of the outcomes of the following projects? [names of projects listed]: significant new knowledge contained in the innovated product." Using the same scale, incremental innovations were assessed by asking the top managers of engineering the following question: "How much do you agree with the following statements as the description of the outcomes of the following projects? [names of projects listed]: Limited new knowledge contained in the innovated product."

I used separate questions to ensure that the respondents were clear about the degree of newness of knowledge contained in the innovated products. From my field interviews, pre-testing of the survey instruments, and presentations of my preliminary results to selected participating companies, it was

Table 1
Constructs, variables and measures.

Constructs	Variables	Measures Response on a five-point scale (1 = strongly disagree, to 5 = strongly agree)
Innovation	Radical innovation	How much do you agree with the following statement as the description of the outcomes of the following projects? [names of projects listed]: significant new knowledge contained in the innovated product.
	Incremental innovation	How much do you agree with the following statements as the description of the outcomes of the following projects? [names of projects listed]: limited new knowledge contained in the innovated product.
System of organization-level management practices	Experience-based recruitment	How much do you agree with the statement that the company recruits employees based partly on their prior work experiences in other firms, such as suppliers, competitors, and external customers?
	Joint performance-based compensation	How much do you agree with the statement that individuals are rewarded based partly on the performance of the company or a business unit?
	Career development	How much do you agree with the statement that new employees are given cross-functional career development?
System of team-level management practices	Project-team selection	How much do you agree with the statement that project members were selected based partly on their overlapping work experiences?
	Project-team reward	How much do you agree with the statement that project outcomes impacted members' compensation (such as promotion, salary increase, bonus payment)?
	Project-team training	How much do you agree with the statement that project members receive training on how to work on the project?
Controls	Job design	How much do you agree with the statement that individuals' formal daily responsibilities involve working on cross-functional teams?
	Communication routine	How much do you agree with the statement that cross-functional communication happens regularly and frequently in this company?
	Industry 1	1 if industry is computer, 0 otherwise
	Industry 2	1 if industry is photo imaging, 0 otherwise
	Country of origin	1 if country of origin is the United States, 0 otherwise

confirmed that project managers viewed innovated products that lacked new knowledge as "less successful" projects. This is partly because they were personally involved with these projects and therefore viewed it as a reflection of their personal performance on these projects. For this reason I did not use the data provided by the project managers. Top managers did not view innovated products that lacked new knowledge as project failures. To them project success is dependent upon how well the innovated product performs in the marketplace in terms of profits generated for the firm.

This is consistent with studies indicating that, because top managers' performance evaluation is based in part on how well products are doing in the marketplace, they tend to pay close attention to this, although they are normally not involved in the specific details of the innovation process (e.g., Un and Cuervo-Cazurra, 2005). Therefore, they are objective and willing to speak openly about the degree of newness of knowledge contained in the innovated products. I aggregated their responses to the firm level by taking an average across the five projects for each firm. Since there was only one rater for the five projects in each firm, it was unnecessary to conduct an inter-rater reliability test.

The predictors are the system of organization-level management practices and the system of team-level management practices. There are three practices that represent the system of organization-level management practices: experience-based recruitment, career development, and joint performance-based compensation. I used the same scale that was used for the dependent variables. I measured experience-based recruitment by asking the following question: "How much do you agree with the statement that the company recruits employees based partly on their prior work experiences in other firms, such as suppliers, competitors, and external customers?" I measured career development using the following question: "How much do you agree with the statement that new employees are given cross-functional career development?" I then measured the joint performance-based compensation system by asking: "How much do you agree with the statement that individuals are rewarded based partly on the performance of the company or a business unit?"

There are also three practices that represent the system of team-level management practices: project-team selection, project-team training, and project-team reward. Using the same scale, I measured project-team selection by asking the following question: "How much do you agree with the statement that project members were selected based partly on their overlapping work experiences?" I measured project-team training by asking the following question: "How much do you agree with the statement that project members receive training on how to work on the project?" Lastly, project-team reward was measured using the following question: "How much do you agree with the statement that project outcomes impacted members' reward (such as promotion, salary increase, bonus payment)?" I aggregated the team leaders' responses on team practices for each firm to the level of the firm by taking an average. Because there were five respondents per firm, I conducted inter-rater reliability tests to ensure agreement between respondents about the use of these practices. The agreement level that these practices were used in these project teams was 81%.

I also controlled for relevant variables in this study. Previous research suggests that job design, in which individuals are organized into cross-functional teams or taskforces to accomplish daily tasks, facilitates innovations (Hoegl et al., 2003; Lawrence and Lorsch, 1967). Therefore, I control for its effect. I measured job design by asking the following question: "How much do you agree with the statement that individual's formal daily responsibilities involve working on cross-functional teams?" Another control is routine communication. It has been argued that routine communication facilitates product innovations (e.g. Allen, 1977; Patrashkova and McComb, 2004; Un and Cuervo-Cazurra, 2004). I measured this by asking the following question: "How much do you agree with the statement that cross-functional communication happens regularly and frequently in this company?" I also controlled for industry effect because previous studies suggest that different industries face different pressure for innovations and therefore manage employees differently (Lawrence and Lorsch, 1967). Some companies in my sample are of Japanese and others of U.S. origin. Several studies have indicated that U.S. and Japanese companies manage people differently, which might explain their differing innovative capabilities (Nonaka and Takeuchi, 1995; Un, 2002). I therefore control for the effect of country of origin of companies in the sample.

Despite the strengths of this research design, there are several limitations. First, the variables were analyzed using one-item measures. It is possible that these variables are multidimensional and thus require multiple-item measures. Second, firms in this study are large, and results may not be

generalizable to smaller firms. Third, they are manufacturing firms, and results may not be generalizable to firms in the service sector.

3.2. Methods of analysis

I used ordinary least square (OLS) regression to test the hypotheses, using the following model:

$$\begin{aligned} Innovation\ (radical,\ incremental) = {} & b0 + b1 \times experience - based\ \ recruitment + b2 \\ & \times career\ \ development + b3 \times joint\ \ \ performance \\ & - based\ \ compensation + b4 \times project - team\ \ selection \\ & + b5 \times project - team\ training + b6 \times project \\ & - team\ \ reward + b7 \times job\ \ design + b8 \\ & \times communication\ \ routine + b9 \times industry\ 1 + b10 \\ & \times industry + b11 \times country\ \ of\ \ origin + e \end{aligned}$$

The size and significance of the coefficients of the practices, and the results from the Chi-square tests of significant differences of coefficients across models (not presented here), determine whether the hypotheses are supported. Specifically, H1a is supported when the coefficients of the organization-level practices are positive and significant with radical innovations. H1b is supported when the coefficients of these practices are positive and significant with incremental innovations. H2a is supported when the coefficients of the team-level practices are positive and significant with radical innovations. H2b is supported if they are positive and significant with incremental innovations. H3a is supported when the coefficients of organization-level practices are significantly larger than the coefficients of team-level practices when tested on radical innovations. H3b is supported when the coefficients of the team-level practices are significantly larger than those of the organization-level practices when tested on incremental innovations. H4a is supported when the coefficients of practices are significantly smaller than when each set of practices are tested separately on radical innovations. H4b is supported when the coefficients of both sets of practices are significantly larger than when they are tested separately on incremental innovations.

4. Results

Table 2 presents the descriptive statistics and correlation matrix. The predictors from both the organization and the team system of practices correlate significantly with radical and incremental innovations. Because of significant correlation between some of the practices, I checked for multicollinearity problems; the variance inflation factor (VIF) values and tolerances (1/VIF) ruled out these problems.

Table 3 presents results from testing the relationship between the two sets of practices with the radical and incremental innovations of firms. Hypotheses H1a and H1b indicate that the system of organization-level management practices has a positive relationship with radical and incremental innovations. Results presented in Models 2 and 6 support these hypotheses. The coefficients of the practices are positive and significant for both radical and incremental innovations. Among the practices, career development appears to have the largest positive effect on radical innovations, while joint performance-based compensation appears to have a larger influence on incremental innovations than the other two practices.

Hypotheses H2a and H2b state that the system of team-level practices is positively related to incremental and radical innovations respectively. Results presented in Models 3 and 7 support these hypotheses. As indicated, the coefficients of all three practices are positive and significant with radical and incremental innovations. Among them, project-team training appears to be most promising for radical innovations, while project-team selection seems to have a larger influence on incremental innovations.

Hypotheses H3a and H3b compare the impact of the two systems on radical and incremental innovations. H3a predicts that the system of organization-level management practices has a larger

Table 2
Descriptive statistics and correlation matrix.

		Max	Min	Mean	Std dev.	1	2	3	4	5	6	7	8	9	10	11	12
Innovation	1. Radical innovation	5	1	3.96	3.22												
	2. Incremental innovation	5	1	3.20	2.41	0.26											
System of organization-level management practices	3. Experience-based recruitment	5	1	4.51	2.13	0.47	0.33										
	4. Career development	5	1	3.82	2.18	0.53	0.37	0.26									
	5. Joint performance-based compensation	5	1	3.93	2.41	0.48	0.35	0.17	0.16								
System of team-level management practices	6. Project-team selection	5	1	2.68	1.25	0.35	0.44	0.23	0.11	0.18							
	7. Project-team training	5	1	3.68	1.98	0.31	0.49	0.18	0.22	−0.14	0.18						
	8. Project-team reward	5	1	2.59	1.76	0.30	0.48	0.15	0.26	−0.12	0.12	0.12					
Controls	9. Job design	5	1	1.42	1.43	0.48	0.29	0.29	0.28	−0.14	0.22	0.17	0.22				
	10. Communication routine	5	1	2.68	2.15	0.43	0.41	0.39	0.41	0.34	0.25	0.23	−0.34	0.49			
	11. Industry 1	1	0	0.66	0.17	0.19	0.0	0.10	0.23	0.09	0.19	−0.22	−0.12	0.15	0.14		
	12. Industry 2	1	0	0.17	0.39	0.15	−0.19	−0.10	−0.20	0.16	0.13	0.19	0.18	0.16	−0.08	−0.48	
	13. Country of origin	1	0	0.66	0.49	−0.28	0.27	0.16	0.19	0.22	0.18	−0.14	−0.09	0.15	0.10	0.42	−0.26

$N=42$. Correlation coefficients ≥ 0.28 are significant at 0.05 level (two-tailed tests).

Table 3
Results of the regression analysis of the organization-level and team-level practices on radical and incremental innovations.

	Radical innovation				Incremental innovation			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Experience-based recruitment	–	0.79** (0.32)	–	0.67*** (0.25)	–	0.35* (0.16)	–	0.34* (0.13)
Career development	–	0.86*** (0.30)	–	0.55*** (0.21)	–	0.32*** (0.11)	–	0.42*** (0.15)
Joint performance-based compensation	–	0.65*** (0.21)	–	0.49** (0.22)	–	0.40*** (0.16)	–	0.36** (0.14)
Project-team selection	–	–	0.32* (0.15)	0.26* (0.12)	–	–	0.75*** (0.29)	0.53* (0.24)
Project-team training	–	–	0.39*** (0.11)	0.33* (0.15)	–	–	0.64** (0.28)	0.73* (0.31)
Project-team reward	–	–	0.34*** (0.09)	0.31* (0.14)	–	–	0.67*** (0.26)	0.59** (0.23)
Job design	0.39** (0.16)	0.95* (0.42)	0.74* (0.30)	0.62* (0.29)	0.40 (0.49)	0.58 (0.37)	0.49 (0.57)	0.42 (0.34)
Communication routine	0.64*** (0.24)	0.57* (0.26)	0.70*** (0.28)	0.44* (0.20)	0.72*** (0.26)	0.51*** (0.23)	0.58*** (0.22)	0.45* (0.21)
Industry 1	0.16 (0.22)	0.31 (0.20)	0.53 (0.48)	0.45 (0.29)	0.45 (0.61)	0.34 (0.26)	0.45 (0.48)	0.28 (0.25)
Industry 2	0.19 (0.41)	0.62 (0.56)	0.65 (0.41)	0.28 (0.22)	0.44 (0.25)	0.42 (0.40)	0.74 (0.59)	0.59 (0.30)
Country of origin	5.74*** (2.01)	4.67*** (1.42)	5.85** (2.40)	4.42*** (1.23)	5.28*** (2.14)	6.11*** (2.44)	5.62*** (2.13)	4.58** (1.42)
R^2	0.23	0.38	0.31	0.40	0.24	0.28	0.37	0.43
Adj. R^2	0.16	0.36	0.27	0.31	0.22	0.27	0.32	0.38
F	4.25**	7.36***	6.55***	7.52***	6.86***	4.65**	5.42**	3.25*
Change in R^2		0.15	–0.07	0.04		0.05	0.05	0.060
F for change in R^2		4.52***	6.25***	7.48***		4.91***	5.12***	3.47*

$N = 42$.
Significance level:
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

positive effect on radical innovations than the system of team-level management practices. Results presented in Models 2 and 3 support this hypothesis: the coefficients of organization-level practices are significant and larger than the coefficients of team-level practices. H3b posits that the system of team-level practices has a larger positive effect on incremental innovations than the system of organization-level management practices. Results presented in Models 6 and 7 support this hypothesis: the coefficients of the team-level practices are significant and larger than the coefficients of organization-level practices.

Hypotheses H4a and H4b examine whether combining the policies from the two systems will lead to higher radical and incremental innovations than using each system separately. H4a predicts that using both systems will lead to lower radical innovations than using them separately. Results presented in Model 4 support this hypothesis. As indicated in Model 4, the coefficients of policies from both systems are significant and smaller than those from the models that contain only one system of practices. Hypothesis H4b, which hypothesizes that using both systems will have a larger positive effect on incremental innovations than using either system separately, is also supported. The size of the coefficients of career development and project-team training increases when they were tested together on incremental innovations compared to when they were tested separately.

5. Discussion and future research directions

In this article, I analyze how firms manage individuals to explore new knowledge for radical innovations and to exploit existing knowledge for incremental innovations. Whether firms should attempt to achieve both simultaneously is still one of the key dilemmas in the organizational learning research (e.g., Smith et al., 2006). Prior studies typically agree that companies need to undertake both activities in order to succeed in the future, but it is still unclear how this can be achieved (Salomo et al., 2007). Prior studies also suggest that this may be achieved using ambidextrous organizational structure (e.g., Benner and Tushman, 2003), punctuated equilibrium (e.g., Burgelman, 2002), specialization (e.g., Siggelkow and Rivkin, 2006), and employee management (Un, 2007). However, organizational learning is a multi-level phenomenon where individuals and teams also play critical roles. To date, empirical studies at these levels are limited (Taylor and Greve, 2006).

I approach these issues by examining the firm at the level of individuals and teams. Rather than discussing actions at the level of the company or part of the company, as in previous approaches, I propose actions within the firm, at the level of employee management at the team and firm levels. I demonstrate that companies can manage employees to accomplish both radical and incremental innovations simultaneously, using either organization-level or team-level management practices. The system of organization-level management practices consists of experience-based recruitment, career development, and joint performance-based compensation implemented without a specific innovation project in mind. The system of team-level management practices consists of employee selection based primarily on overlapping knowledge with other team members; training and reward is given for working in a project team on a specific innovation project.

Although both systems of practices provide employees with the psychological safety needed to achieve radical innovations and the perspective-taking capability helpful for incremental innovations, each system is better suited to achieving one type of innovations than the other. The system of organization-level management practices is better suited to achieving radical innovations because it provides greater psychological safety, while the system of team-level management practices is better suited to achieving incremental innovations because it develops better perspective-taking capability. Using the two systems simultaneously improves incremental but not radical innovations, because the systems can produce conflicting expectations on individuals, reducing psychological safety.

5.1. Scholarly implications

This paper makes three novel theoretical contributions. First, this is among the first papers in the organizational learning research to theoretically and empirically demonstrate that companies can manage employees to achieve a balance between the search for new knowledge for radical innovations and the exploitation of existing knowledge for incremental innovations (Badawy, 2009).

This complements previous approaches that have focused primarily on the level of firm or its various units. The approach taken in this study is important, not only because individuals and teams are important for organizational learning (March, 2006; Taylor and Greve, 2006), but also because analyses at this level in the firm are limited (e.g., Smith et al., 2006).

In addition, this paper is among the first to also explain how and why psychological safety and perspective-taking capability are critical in the exploration of new knowledge for radical innovations and the exploitation of existing knowledge for incremental innovations. It demonstrates and explains the manner in which practices within the two team- and organization-level systems complement each other in the creation of psychological safety for the exploration of new knowledge for radical innovations, and in the improvement of perspective-taking capability for the exploitation of existing knowledge for incremental innovations. It further explains the conditions under which systems of practices should be used separately or together in achieving the different types of innovation.

Second, the paper adds to the innovation literature by integrating two streams of research, one analyzing how employees should be managed at the organization level independently of when they are organized to innovate (e.g., Lawrence and Lorsch, 1967; Nohria and Ghoshal, 1997) and one analyzing how employees should be managed at the team level when they are selected to work on innovation projects (e.g., Ancona and Caldwell, 1992; Hoegl and Parboteeah, 2007). Until now, not only have the specific management practices not been analyzed and tested together at either level, but no study has analyzed the impact of simultaneously using practices at both the organization and team levels. The present study demonstrates the importance of using both approaches to allow firm learning and innovation, and provides a theoretical account for this phenomenon. Furthermore, it explains why, while both sets of practices facilitate both types of innovations, organization-level practices are more suitable for radical innovations and team-level practices are more suitable for incremental innovations. It also accounts for the fact that using both sets of practices is helpful for incremental innovations but potentially detrimental to radical innovations.

Third, this study contributes to research on the effects of complementarity of practices on employees (e.g., Ichniowski et al., 1997; Osterman, 2006). Until now, analyses have focused on the effects on employees' productivity in the production function and just recently extended theoretically to employees across functions (Un, 2007). I demonstrate that systems of practices at the organization and team levels can be applied throughout the firm to reach a balance between exploration of new knowledge for radical innovations and exploitation of existing knowledge for incremental innovations, two activities critical to firms' success.

5.2. Managerial implications

This article also has practical implications. Managers of large established firms competing on radical and incremental innovations must manage employees in a way that builds the psychological safety necessary for them to explore new ideas for radical innovations. At the same time, they must also manage employees to develop perspective-taking capability. I provide two different approaches to managing employees to achieve radical and incremental innovations. Specifically, for firms that wish to emphasize radical innovation, the system of organization-level management practices may be more appropriate than the system of team-level management practices. In contrast, team-level management practices appear to be more suitable than organization-level management practices for firms that wish to emphasize incremental innovations over radical innovations. When both are used, they will complement each other to generate more incremental innovations. However, managers should examine the costs of implementing both systems. If firms wish to emphasize radical innovations, I do not recommend the use of both systems, because they can create inconsistent demands on the employees, reducing psychological safety and therefore reducing radical innovations.

5.3. Future research directions

This study opens up several avenues for future research. First, all firms in this study are large and the results may not be generalizeable to smaller firms. Previous studies (e.g., Dewar and Dutton, 1986) have demonstrated that large firms tend to be better at radical innovations than smaller firms. One

explanation given is that they tend to have slack resources that enable them to explore and achieve radical innovations. Future studies can analyze the impact of the organization and team systems of practices on innovations in small firms. It seems likely that in small firms, where interaction and social ties might be easier to establish, individuals may feel psychologically safer to explore and try out new ideas. However, people in different departments may lack perspective-taking capability. This capability must be acquired if individuals from different departments are to understand each other's viewpoints.

Second, I focused on product innovations, whose determinants differ from those of innovations in services; therefore, results from this study may not generalize to service firms. Future studies can analyze how the systems of organization-level and team-level management practices relate to innovations in service-oriented firms. It seems probable that, even in service innovations, the system of organization-level management practices will enhance firms' ability to achieve radical innovations, while the team-level management practices will be more effective for incremental innovations. Third, in this study I used one-item measures for innovations and management practices. These are complex variables that may best be captured using multiple-item measures. Future studies can analyze the multidimensionality of these variables. Finally, future studies can measure and test the mediating effects of psychological safety and perspective-taking capability on radical and incremental innovations.

In conclusion, firms need to achieve both exploration of knowledge for radical innovations and exploitation of knowledge for incremental innovations if they are to succeed in the long term. One way this may be accomplished is through management of employees to develop psychological safety in order to search for new knowledge and improve perspective-taking capability in order to exploit existing knowledge. This article offers two ways of managing people to achieve this balance. However, for firms that wish to achieve more radical innovations, the system of organization-level practices appears to be more suitable. For firms that prefer incremental innovations, the system of team practices appears to be more suitable. Using both systems leads to higher incremental innovations, but this could be at the expense of radical innovations.

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