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Strategic human resource practices and innovation performance — The mediating role of knowledge management capacity

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Abstract

This study examines the role of knowledge management capacity in the relationship between strategic human resource practices and innovation performance from the knowledge-based view. This study uses regression analysis to test the hypotheses in a sample of 146 firms. The results indicate that strategic human resource practices are positively related to knowledge management capacity which, in turn, has a positive effect on innovation performance. The findings provide evidence that knowledge management capacity plays a mediating role between strategic human resource practices and innovation performance. Finally, this study discusses managerial implications and highlights future research directions.

Keywords: Strategic human resource practices; Knowledge management capacity; Innovation performance

1. Introduction

The strategic management literature recognizes innovation as a critical enabler for firms to create value and sustain competitive advantage in the increasingly complex and rapidly changing environment (Madhavan and Grover, 1998; Subramaniam and Youndt, 2005). Firms with greater innovativeness will be more successful in responding to changing environments and in developing new capabilities that allow them to achieve better performance (Montes et al., 2004). Innovation initiatives tend to depend heavily on employees' knowledge, expertise, and commitment as key inputs in the value creation process (Youndt et al., 1996). The knowledge-based view depicts firms as repositories of knowledge and competencies (Grant, 1996; Spender, 1996). According to this view, prior studies recognize the knowledge and competencies of human resource as valuable assets for firms because of their characteristics of firm-specific, socially complex, and path-dependent (Collins and Clark, 2003; Wright et al., 2001; Youndt et al., 1996; Lado and Wilson, 1994).

Human resource practices (HR practices) are the primary means by which firms can influence and shape the skills, attitudes, and behavior of individuals to do their work and thus achieve organizational goals (Collins and Clark, 2003; Martinsons, 1995). Previous literatures have paid attentions to the link of HR practices and organizational outcomes such as productivity, flexibility, and financial performance (e.g. MacDuffie, 1995; Ichniowski et al., 1997; Youndt et al., 1996; Delery and Doty, 1996; Pfeffer, 1998; Mendelson and Pillai, 1999; Collins and Clark, 2003), but the understanding needs to be extended to encompass innovation performance (Laursen and Foss, 2003). Accordingly, the present study attempts to address the link of HR practices and firm's innovation performance from the knowledge-based perspective.

For innovation to take place, firms may leverage human capital to develop organizational expertise for creating new products and services. However, expertise is much more complex and is primarily the results of deliberate practices on representative tasks in the domain (Ericsson and Charness, 1997). These deliberate practices entail individuals wanting to perform the tasks and making efforts to improve performance. Firms can identify and exert a set of strategic HR practices to elicit the willingness and motivation of employees to engage in performing these delicate practices to develop organizational

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expertise for business objectives such as innovation performance (Jacobs and Jones, 1995; Swanson, 1994). Accordingly, strategic HR practices can be conducive to innovative activities because strategic HR practices may allow firms to discover and utilize knowledge and expertise in the organization (Scarbrough, 2003). However, knowledge is within the human capital and firms cannot easily transfer the knowledge among individuals inside the firm (Hansen, 1999; Grant, 1996). Although a firm has access to the knowledge, skills and expertise of employees, it may need to possess good capacities in managing knowledge management tools in place to ensure effective utilization of the human capital in the development of organizational expertise for innovation. Knowledge management is an approach to adding or creating value by more actively leveraging the know-how and expertise resided in individual minds (Ruggles, 1998; Scarbrough, 2003). As noted above, knowledge management may influence the relationship between strategic HR practices and innovation performance.

Accordingly, the purpose of this paper is to examine the mediating effect of knowledge management capacity between strategic HR practices and innovation performance from the knowledge-based view. The remainder of the paper proceeds as follows. The next section considers the relevant literature and sets out the hypotheses of this study. Following is the methodology for the study. Then, the paper presents the results of the empirical study in achieving the goals as those set out above. In the last section, the paper discusses managerial implications and highlights future research directions.

2. Research background and hypotheses

2.1. Human resource practices

Owing to the increasing importance of HR practices to the competitive advantages of firms in the rapidly changing knowledge-based economy, some scholars have paid attentions to examine the determinants on the adoption of HR practices (e.g. Tannenbaum and Dupuree-Bruno, 1994) and their effects on organizational outcomes, such as productivity and efficiency (e.g. MacDuffie, 1995; Ichniowski et al., 1997; Youndt et al., 1996), and financial performance (e.g. Delery and Doty, 1996; Pfeffer, 1998; Mendelson and Pillai, 1999; Collins and Clark, 2003).

Tannenbaum and Dupuree-Bruno (1994) explore the relationships between organizational and environmental factors and the use of "innovative human resource practices". The items in "innovative human resource practices" include training, recruitment, selection, and employee involvement. The results demonstrate that external variables of labor availability and public scrutiny exhibit the linear relationships while favorability has a non-linear relationship with the use of HR practices. In terms of organizational factors, agency size exhibits a stronger linear effect than formalization and centralization on the use of HR practices.

In investigating the impacts of "innovative human resource practices" on manufacturing performance, MacDuffie (1995) uses four measures including hiring, compensation, status barriers, and training to represent innovative human resource practices. He indicates that integration of bundles of HR practices is positively associated with the improvements in productivity. Similarly, Ichniowski et al. (1997) examine the productivity effects of "innovative work practices". They use different measures of the innovative work practices, which include incentive pays, recruitment and selection, teamwork, flexible job assignments, employment security, communication, and training, and suggest that these innovative work practices achieve higher levels of productivity than traditional approach such as narrow job definitions, strict work rules, and hourly pay with close supervision. In addition, by using four dimensions of human resource practices, including staffing, training, performance appraisal, and compensation, Youndt et al. (1996) indicate that an HR practices system is directly related to multiple dimensions of operational performance. Also, subsequent analysis reveals that manufacturing strategies moderate this main effect.

In terms of financial performance, Delery and Doty (1996), drawing on three dominant modes of theorizing, identify seven key "strategic human resource practices", including career ladders, training, results-oriented appraisal, compensation, employment security, employee voice, and broadly defined jobs, and use them to develop theoretical arguments consistent with each of the three perspectives. The results demonstrate that each perspective can be used to structure theoretical arguments that explain significant levels of variation in financial performance. Mendelson and Pillai (1999) examine the impacts of the characteristics of "information age organization" and indicate that the relationship between these characteristics, including decentralization and incentives, information practices, and internal focus and inter-organizational networks, and business performance is stronger in industry segments that are more dynamic. In addition, Collins and Clark (2003) explore the black box between "strategic human resource practices", which include training, performance assessment, rewards, and firm performance from a field study with 73 high-tech firms. The results show that top managers' social networks mediate the relationship.

Though prior research has paid attentions to the impacts of HR practices on organizational outcomes, few studies explore the impact of HR practices on knowledge management (e.g. Currie and Kerrin, 2003) and on innovation performance (e.g. Laursen and Foss, 2003). By taking an organizational learning perspective, Currie and Kerrin (2003) use case study approach to explore the influence of "strategic human resource practices", including performance management, recruitment and selection, employee interaction, and career development, on enhancing knowledge sharing within a company. They suggest that HR practices can improve knowledge sharing in the firm with a functionally based organizational structure and culture. In investigating the effects of "new human resource management practices" on innovation performance of firms in different sectors, Laursen and Foss (2003) categorize nine HRM variables, including interdisciplinary workgroups, quality circles, collection systems of employee proposals, planned job rotation, delegation of responsibility, integration of functions, performance-related pay, firm internal training, and firm external training, into two HRM systems. Their findings indicate that the innovation performance of four manufacturing sectors correlates with the first system while that of wholesale and ICT sectors is associated with the second system.

These prior research term HR practices differently, such as strategic human resource practices (e.g. Youndt et al., 1996; Collins and Clark, 2003; Currie and Kerrin, 2003; Collins and Clark, 2003), innovative work or human resource practices (e.g. Tannenbaum and Dupuree-Bruno, 1994; MacDuffie, 1995; Ichniowski et al., 1997), new human resource practices (e.g. Laursen and Foss, 2003), and characteristics of information age organizations (e.g. Mendelson and Pillai, 1999). In addition, the measurement of HR practices is in different ways in these prior studies for coping with their research purposes. This study purposely focuses on examining the strategic impacts of HR practices on the innovation performance through the mediating effect of knowledge management capacity. This study considers those measures in the prior studies using the concepts of strategic and innovative HR practices (e.g. Youndt et al., 1996; Collins and Clark, 2003; Currie and Kerrin, 2003; Tannenbaum and Dupuree-Bruno, 1994; MacDuffie, 1995) as they are more germane to the arguments of the relationships involving HR practices, knowledge management, and innovation. Accordingly, this study adopts five dimensions, including staffing, training, participation, performance appraisal, and compensation, in the construct of strategic human resource practices.

2.2. Strategic human resource practices and innovation performance

The knowledge-based view concerns knowledge as a valuable resource of the firm (Grant, 1996; Spender, 1996). The knowledge embedded in human capital enables firms to enhance distinctive competencies and discover innovation opportunities (Hansen, 1999; Grant, 1996; Wright et al., 2001). When firms develop new products and improve management processes, they require the motivation and ability of human capital to produce creative ideas, develop innovative approaches, and exert new opportunities (Scarbrough, 2003). Human resource management function can influence and modify the attitudes, capacities, and behaviors of employees to achieve organizational goals (Collins and Clark, 2003; Martinsons, 1995) and it plays a crucial role in nurturing the necessary conditions for catalyzing and channeling individuals towards the development of innovation activities (Scarbrough, 2003; Laursen and Foss, 2003; Michie and Sheehan, 1999). Firms can use some strategic HR practices, such as staffing, training, participation, performance appraisal, and compensation, as means to motivate employees' commitment and get them involved in creative thinking and innovation (Damanpour, 1991; Laursen and Foss, 2003). Thus, this study argues that strategic HR practices would play a critical role in affecting innovation performance.

When firms develop innovation activities, they encounter relatively greater uncertainty and variability in the innovation process (Atuahene-Gima, 1996), and they need creative employees who are flexible, risk taking, and tolerant of uncertainty and ambiguity (Madsen and Ulhøi, 2005). Therefore, firms must place more emphasis on these characteristics in the staffing actions. When firms use creative capabilities and innovative characteristics as hiring and selection criteria, their employees are likely to spawn diversity of ideas and commit to more innovation behaviors (Brockbank, 1999; Atuahene-Gima, 1996). Through effective staffing, employees become important sources of new ideas in the firm's innovative process.

With regard to training, it would facilitate employees' exposure to variety of knowledge and openness to innovative ideas (Brockbank, 1999; Beatty and Schneier, 1997; Jaw and Liu, 2003). Firms may provide employees broad and various training programs to develop new knowledge, skills, and innovative capability necessary for performing their work (Brockbank, 1999; Mumford, 2000). Through training, firms can develop the organizational expertise in terms of demand and content for the innovation (Weisberg, 2006). Investments in training can develop employee expertise at all levels of the organization which is likely to provide a potentially inexhaustible source of ideas for further innovation (Torraco and Swanson, 1995). In addition, innovation requires employees a high level of involvement and participation (Damanpour, 1991; Hurley and Hult, 1998). Firms may elicit employees' involvement and participation by granting them to solve problems and to participate in decision making that affects their work (Damanpour, 1991; Glynn, 1996). A high level of participation would create the conditions to encourage employees to bring new ideas and exchange knowledge in the ongoing innovation process and, in turn, enhance innovative outcomes (Jiménez-Jiménez and Sanz-Valle, 2005; Tsai, 2002).

Because the innovation process is often lengthy, uncertain, and multidisciplinary, firms should signal the importance and value of innovation as a corporate priority, and provide formal appraisal mechanisms to measure innovation behaviors and outputs (Brockbank, 1999). Positive pressure from a performance appraisal creates challenges and feelings of achievements and serves as a critical motivator for employees (Jaw and Liu, 2003). Performance appraisal can enhance employees' motivation to engage in innovative activities, and make firms achieve favorable innovation results (Jiménez-Jiménez and Sanz-Valle, 2005). Moreover, recognizing individual and team accomplishments with compensation also encourages innovation. Both extrinsic and intrinsic rewards are essential to motivate employees to take the challenging work, and provide them incentives to generate more new ideas and develop successful new products (Brockbank, 1999; Mumford, 2000).

The preceding arguments suggest that firms can use strategic HR practices to influence the behavior and expectation of employees, and add greater value in developing innovation. Through effective strategic HR practices in terms of staffing, training, participation, performance appraisal, and compensation, firms would enhance their capability in introducing new products, services, and management system, and then achieve better innovation outcomes.

Hypothesis 1. Strategic human resource practices relate positively to innovation performance.

2.3. Strategic human resource practices and knowledge management capacity

Human capital, with their knowledge, expertise, and skills, is a valuable resource of firms (Lado and Wilson, 1994; Delery and Doty, 1996; Wright et al., 2001; Collins and Clark, 2003).

Organizations that effectively manage and leverage the knowledge and expertise embedded in individual minds will be able to create more value and achieve superior competitive advantage (Ruggles, 1998; Scarbrough, 2003). However, employees are often unwilling or unable to share their knowledge and expertise with others because of self interests and lack of trust (Currie and Kerrin, 2003; Hayes and Walsham, 2000; Mueller and Dyerson, 1999; Davenport and Prusak, 1998). Accordingly, it is important for firms to harness the involvement and participation of employees through knowledge management. HR practices are the primary approaches to elicit and reinforce employees' knowledge and expertise that a firm requires (Martinsons, 1995; Youndt et al., 1996; Collins and Clark, 2003). Since people are carriers of much of organization-specific knowledge and expertise, firms may be best to utilize HR work practices to manage knowledge and expertise (Scarbrough and Carter, 2000; Lave and Wenger, 1991). Some strategic HR practices, such as staffing, training, participation, performance evaluation, and incentive compensation, are related to enhancing commitment, lowering turnover, and increasing performance through their impact on employee development and motivation (Huselid, 1995; Becker and Gerhart, 1996; Guthrie, 2001). Firms can use these strategic HR practices to provide employees with the skills, resources, and discretion that they need to develop knowledge management. Thus, this study argues that strategic HR practices are key enabling elements for firms to increase their capacity in deploying and facilitating knowledge management tools and activities.

An effective staffing system can help firms in selecting and allocating competent and qualified workforce to do the required tasks. Acquiring employees with particular knowledge and expertise is crucial for firms to operate knowledge management tools and activities. Those newly recruited employees are likely to do the effective sharing of knowledge if they are able to take the broader perspective and appropriate attitude (Currie and Kerrin, 2003). Moreover, it is also important for firms to select the employees who can integrate effectively for development of knowledge management capacity. Selection of individuals with appropriate skills and attitudes to do the tasks enables firms to integrate knowledge from diverse sources and stimulate innovative idea generation (Martinsons, 1995; Scarbrough, 2003). In addition, employee training is also likely to affect the development of knowledge management capacity. Continuous professional development is particularly important to knowledge workers. Firms need to offer internal and external training opportunities to develop and nurture required knowledge and expertise of employees (Jaw and Liu, 2003; Brockbank, 1999; Nonaka and Takeuchi, 1995). Exposure to diverse training programs could foster employees to learn new knowledge and expertise, broaden their insight, and equip them with innovative minds and skills (Nonaka and Takeuchi, 1995). Such training programs would stimulate employees to share their expertise and experience, acquire new knowledge, and utilize what they learn subsequently in the work. Accordingly training programs are crucial for employees in the knowledge management process (Argote et al., 2003; Von Krogh, 1998).

Participation, another strategic HR practice, may attract employees to positively involve and contribute in knowledge management and learning activities. Individuals having wider skills, expertise, and work responsibilities should give greater autonomy and self-regulation to do their work (Nonaka and Takeuchi, 1995). Granting more discretion and participation in decision making can increase employees' involvement, awareness, and commitment (Damanpour, 1991; Glynn, 1996). If employees have more opportunities to provide inputs and determine the required actions, they may increase the diversity and richness of knowledge exchange and bring more new ideas (Andrews and Kacmar, 2001; Grant, 1996), thereby facilitating the discovery and utilization of dispersed knowledge and expertise in the organization.

Performance appraisals and compensation are the primary strategic HR practices that firms can use to reinforce employees' behaviors and induce them to comply with organizational goals (Collins and Clark, 2003; Scarbrough, 2003). In terms of performance appraisal, if firms want to elicit desired behaviors from employees, they must provide feedback and incentives that reinforce the desired behaviors (Collins and Clark, 2003). Employees are unlikely to do knowledge management activities, especially sharing of knowledge, as the divergent objectives set out for them in their performance agreements (Currie and Kerrin, 2003). Accordingly, if firms set up the unified appraisal criteria to link employees' performance with their involvements in sharing and applying knowledge in the work, it would motivate employees to work on knowledge management activities. Moreover, the compensation should reward creativity, risk-taking attitude, and problem-solving ability in order to promote knowledge diffusion and sharing (Argote et al., 2003; Von Krogh, 1998). Individuals may put more efforts into knowledge management activities if compensation systems reward the contribution to acquisition and exchange of knowledge (Scarbrough, 2003; Collins and Clark, 2003; Von Krogh, 1998).

According to the above reasoning, strategic HR practices are helpful to motivate employees' willingness to acquire, share, and apply knowledge within organizations. Appropriate strategic HR practices can support and promote the development of organizational environment conducive to knowledge management activities. Thus, the expectation is that strategic HR practices would influence knowledge management capacity positively.

Hypothesis 2. Strategic human resource practices relate positively to knowledge management capacity.

2.4. Knowledge management capacity and innovation performance

Organizational innovation, entailing the development of new products or services as well as new administrative systems, is emerging as an important source of sustainable competitive advantage (Damanpour, 1991; Hurley and Hult, 1998). The innovation process involves the acquisition, dissemination, and use of new and existing knowledge (Damanpour, 1991; Moorman and Miner, 1998). An organization's innovativeness is closely tied to its ability to utilize its knowledge resources (Subramaniam and Youndt, 2005). Knowledge management is an approach of more actively leveraging the knowledge and expertise

to create value and enhance organizational effectiveness (Gold et al., 2001; Ruggles, 1998; Scarbrough, 2003). Firms that exhibit a greater level of knowledge management capacity experience a learning effect that can improve their capabilities in reducing redundancy, responding rapidly to change, and developing creative ideas and innovation (Scarbrough, 2003; Gold et al., 2001). Effective knowledge management facilitates knowledge communication and exchange required in the innovation process, and further enhances innovation performance through the development of new insights and capabilities (Madhavan and Grover, 1998; Nonaka and Takeuchi, 1995; Von Krogh, 1998). Therefore, knowledge management capacity plays a pivotal role in supporting and fostering innovation. Since managing knowledge in the innovation process is complex, this study focuses on those mechanisms that the organization uses to acquire, share, and apply new or improved knowledge.

Knowledge acquisition from the outside marketplace and the inside employees provides opportunities for firms to recombine current knowledge and create new knowledge (Yli-Renko et al., 2001). The newly acquired knowledge interacting with the existing knowledge can modify organizational knowledge stock (Nonaka and Takeuchi, 1995; Gold et al., 2001) and enhance the breadth and depth of knowledge available to the firm, thereby increasing the potential for new innovative outcomes (Galunic and Rodan, 1998; Li and Calantone, 1998; Yli-Renko et al., 2001). The knowledge-based view suggests that knowledge acquisition activities will enhance a firm's ability to efficiently perform its role (Grant, 1996). Firms with good capability to acquire external and internal knowledge would reduce uncertainty and achieve a greater number of administrative and technological distinctiveness (Li and Calantone, 1998; Sarin and McDermott, 2003; Yli-Renko et al., 2001). Accordingly, this study argues that knowledge acquisition has a positive link with innovation performance.

Knowledge sharing refers to collective beliefs or behavioral routines related to the spread of learning among different individuals or units within an organization (Moorman and Miner, 1998). Prior research has discussed and demonstrated that knowledge sharing can lead to increased innovativeness of the firm (e.g. Kogut and Zander, 1992; Henderson and Cockburn, 1994; Szulanski, 1996; Tsai and Ghoshal, 1998; Dyer and Nobeoka, 2000; Tsai, 2001). In particular, scholars have argued previously that knowledge sharing implies the new combination of knowledge that has previously existed separately, which possibly would result in process improvements or novel products (Schumpeter, 1912/1934; Kogut and Zander, 1992; Tsai and Ghoshal, 1998). Since knowledge exists within different individuals and different levels of the organization, organizational members need to share it in order to establish new routines and mental models (Galunic and Rodan, 1998; Nonaka and Takeuchi, 1995). Also, when individuals are willing to share and exchange knowledge, they can generate collective learning and synergistic benefits from the processes of exchanging knowledge and resource (Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998). Innovations come about when organizational members share their expertise and convert it into explicit form of products or services (Von Krogh, 1998; Nonaka and Konno, 1998). Hence, firms that are able to effectively share knowledge among members are likely to be more innovative.

Knowledge application is a focal element in knowledge management process (Grant, 1996). From the knowledge-based view, the value of individual and organizational knowledge resides primarily on its application because of stickiness and tacitness of knowledge (Grant, 1996; Spender, 1996). New product development and innovation require the application and combination of specialized knowledge inputs from many different areas (Yli-Renko et al., 2001). A deeper application of knowledge enables firms continuously to translate their organizational expertise into embodied products (Weisberg, 2006; Sarin and McDermott, 2003). By effectively applying knowledge, individuals might make fewer mistakes or improve their efficiency and reduce redundancy (Grant, 1996; Gold et al., 2001). Organizations might then ultimately be able to speed new product development and create more innovative production processing technologies and administrative systems (Sarin and McDermott, 2003).

Accordingly, this study proposes that knowledge management capacity in terms of acquisition, sharing, and application provides a positive contribution to the firm's innovation performance. Through effective knowledge management, firms will be able to transform knowledge into innovative products, services, and processes, and thus lead to better technical and administrative innovation outcomes.

Hypothesis 3. Knowledge management capacity relates positively to innovation performance.

2.5. Mediating effect of knowledge management capacity

The preceding hypotheses link the relationships among strategic HR practices, knowledge management capacity, and innovation performance. Implicitly, the discussion suggests that strategic HR practices affect firms' innovation performance through their capacities in knowledge management. That is, firms can use a set of strategic HR practices to cultivate the level of capacity in knowledge acquisition, sharing, and application, which, in turn, promote employees' propensity to innovate and enhance their innovation performance. Thus, this study argues that knowledge management capacity plays a mediating role in the relationship between independent variables of strategic HR practices and dependent variable of innovation performance. Following this line of reasoning, this study proposes the following hypothesis.

Hypothesis 4. Knowledge management capacity mediates the relationship between strategic human resource practices and innovation performance.

3. Research methodology

3.1. Data collection and sample

The present study employs a questionnaire survey approach to collect data for testing the validity of the model and research hypotheses. Variables in the questionnaire include background

information, strategic human resource practices, knowledge management capacity, and innovation performance. All independent and dependent variables require seven-point Likert-style responses ranging from "strongly disagree" to "strongly agree". The population for the study is the top 5000 Taiwanese firms listed in the yearbook published by the China Credit Information Service Incorporation. This study uses a stratified random sampling method to select 150 firms in each of the five 1000 levels. The authors distribute 750 questionnaires and request the questionnaires to be completed by top executives (i.e. Presidents, Vice-Presidents, Directors, or General Managers) who are familiar with the topic of this study. Of the 157 returned questionnaires, 11 are incomplete. The remaining 146 valid and complete questionnaires are for the quantitative analysis. It represents a useable response rate of 19.47%. This study checks the possibility of non-response bias by comparing the characteristics of the respondents to those of the original sample. The calculated *t*-statistics for the annual revenue ($t=0.254$, $p=0.800$) and the age of the company ($t=0.051$, $p=0.960$) and the chi-square test for the industry affiliation of the company ($\chi^2=0.345$, $p=0.841$) are all statistically insignificant, suggesting that there are no significant differences between the respondent and non-respondent groups.

Due to the collection of all measures from the same source, this study uses the Harman one-factor test to examine the potential problem of common method variance. Significant common method variance would result if one general factor accounts for the majority of covariance in the variables (Podsakoff and Organ, 1986). A principal factor analysis on the questionnaire measurement items of this study yields four factors with eigenvalues greater than one that account for 81.5% of the total variance, and the first factor accounts for 24.0% for the variance. Since a single factor does not emerge and one general factor does not account for most of the variance, common method bias is unlikely to be a serious problem in the data (Podsakoff and Organ, 1986).

3.2. Measures

3.2.1. Innovation performance

Following the distinction of previous researches (e.g., Damanpour, 1991; Ibarra, 1993), the present study adopts two dimensions of innovation performance including administrative and technical innovation performance. A seven-item scale, based on the work of Ibarra (1993), reflects the extent to which firms are satisfied with the achievements in their development and implementation of innovation activities. This study examines the dimensionality of our measures by conducting a principal components factor analysis with varimax rotation. The results support two factors of innovation performance that have eigenvalues greater than 1 and explain 82.17% of the variance, as shown in Appendix Table A1. Each item loads on its appropriate factor with primary loadings exceeding 0.81 and cross-loadings lower than 0.42. The Cronbach's alpha coefficients in parentheses indicating the internal consistency reliability of the measures in the two factors are both above the suggested value of 0.70 (Hair et al., 1998). The administrative factor includes four items to measure the extent of responsiveness to environmental changes and the degree of innovative administration in terms of planning procedures, process control systems, and integrated mechanisms ($\alpha=0.919$). The technical factor consists of three questions to measure the extent to which the firm develops new technologies, incorporates technologies into new products, and facilitates new processes to improve quality and lower cost ($\alpha=0.896$).

3.2.2. Strategic human resource practices

Drawing upon previous researches (e.g., Youndt et al., 1996; Collins and Clark, 2003; MacDuffie, 1995; Tannenbaum and Dupuree-Bruno, 1994), this study adapts five aspects, including staffing, training, participation, performance appraisal, and compensation, in the construct of strategic human resource practices with development of a sixteen-item scale. The study examines the dimensionality of the measures by conducting a principal components factor analysis with varimax rotation. The results support five factors with eigenvalues greater than 1 and explain 80.56% of the variance, as shown in Appendix Table A2. Each item loads on its appropriate factor with primary loadings greater than 0.60, and cross-loading lower than 0.43. The Cronbach's alpha coefficients in parentheses indicating the internal consistency reliability of the measures in the five factors are all above the suggested value of 0.70 (Hair et al., 1998). The staffing factor consists of three items regarding selectivity in hiring, selection for expertise and skills, and selection for future potential ($\alpha=0.815$). The training factor includes four items to indicate the availability of formal training activities, comprehensive training policies and programs, training for new hires, and training for problem-solving ability ($\alpha=0.897$). The participation factor consists of three indicators reflecting the degree to which firms allow the employees to make decisions; provide the employees the opportunity to suggest improvements into their work; and value the voices of the employees ($\alpha=0.762$). This study uses three items, including developmental focus, results-based appraisal, and behavior-based appraisal, to measure the performance appraisal factor ($\alpha=0.903$). The compensation factor includes three items that address the degree to which there are profit sharing, incentive pay, and the link between performance and reward ($\alpha=0.934$).

3.2.3. Knowledge management capacity

The knowledge management capacity construct consists of eight items to indicate the extent of knowledge management capacity of the firm. This study examines the dimensionality of the measures by conducting a principal components factor analysis with varimax rotation. The results support three factors with eigenvalues greater than 1 and explain 86.12% of the variance, as shown in Appendix Table A3. According to the previous studies (e.g. Lin and Lee, 2005; Gold et al., 2001), these three factors of knowledge management capacity construct are knowledge acquisition, sharing, and application. They appropriately represent the knowledge management capacity items, whereby primary loadings exceeding 0.77 and cross-loading lower than 0.45. The Cronbach's alpha coefficients in parentheses indicating the internal consistency reliability of the

measures in the three factors are all above the suggested value of 0.70 (Hair et al., 1998). The knowledge acquisition factor consists of three items, with respondents indicating the extent to which they obtain knowledge from customers, partners, and employees ($\alpha=0.908$). The knowledge sharing factor is a three-item scale to reflect the degree to which the knowledge is openly shared between supervisors and subordinates, between colleagues, and between units ($\alpha=0.886$). The two indicators in knowledge application factor are the effective management and utilization of knowledge into practical use ($\alpha=0.919$).

3.2.4. Control variables

Firm size and age may influence innovation performance because different size and age may exhibit different organizational characteristics and resource deployment. Also, firms in different industries may behave differently in innovation. Therefore, this study includes these variables as control variables to measure potential effects. This study measures firm size as the amount of annual sales in million NT dollars and calculates firm age as the number of years from the founding date. Two dummy variables for the industry type indicate whether a firm belongs to manufacturing industry (1=yes, 0=no) or high-tech industry (1=yes, 0=no).

4. Analysis and results

This study attempts to understand the relationships among strategic HR practices, knowledge management capacity, and innovation performance. Table 1 displays the means, standard deviations, and correlations of all variables. This study uses variance inflation factors (VIFs) to examine the effect of multicollinearity. The values of the VIF associated with the predictors show a range from 1.24 to 2.70, which fall within acceptable limits (Hair et al., 1998), suggesting no need for concern with respect to multicollinearity.

Table 2 presents the results of regression analysis regarding the effects of strategic HR practices and knowledge management capacity on innovation performance. Models 1a and 1b in Table 2 are the base models that include the control variables. Models 2a and 2b capture the direct effects of strategic HR practices on the dependent variable. They are both significant at the $p<0.001$ level ($R^2=0.62$ and 0.58) and explain an additional 55.0% of variance over what the control variables alone explain. Coefficients of staffing, participation, and performance appraisal are positive and significant for administrative innovation performance ($p<0.001$, $p<0.05$, and $p<0.01$, respectively). Similarly, staffing, participation, and compensation have positive and significant effects on technical innovation performance ($p<0.01$). These findings indicate that firms would achieve a higher level of innovation performance if they have well-developed staffing, participation, performance appraisal, and compensation practices. Accordingly, the results moderately support Hypothesis 1, which states that strategic HR practices relate positively to innovation performance.

Table 3 shows the results of regression analyses of the effects of strategic HR practices on knowledge management capacity. Models 5a, 5b, and 5c are the base models that include the control variables only. Models 6a, 6b, and 6c show the relationships between strategic HR practices and knowledge management capacity. These three models are all significant at the $p<0.001$ level ($R^2=0.60$, 0.61, and 0.58, respectively) and explain an additional 51.0, 57.0 and 56.0% of variance over what the control variables alone explain. Coefficients of staffing and participation are positive and significant for knowledge acquisition, sharing, and application ($p<0.001$). Similarly, training has positive and significant effects on acquisition ($p<0.05$) and application ($p<0.001$). Coefficients of compensation are positive and significant for knowledge sharing ($p<0.001$) and application ($p<0.05$). These findings indicate that firms would achieve a higher level of knowledge management capacity if they seek to attract and select "premium workers", invest more in training programs, give employees more opportunities of participation, and align compensation system to encourage employees to contribute their knowledge and expertise. Accordingly, the results moderately support Hypothesis 2, which states that strategic HR practices relate positively to knowledge management capacity.

Table 1
Means, standard deviations, and correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Firm age	4.55	2.06													
2. Firm size	5.12	1.93	0.32												
3. Industry type [a]	0.41	0.49	0.31	0.09											
4. Industry type [b]	0.21	0.41	−0.39	−0.11	−0.43										
5. Knowledge acquisition	5.38	0.90	0.08	0.06	0.17	−0.29									
6. Knowledge sharing	5.45	0.90	−0.01	0.06	0.13	−0.13	0.59								
7. Knowledge application	5.17	1.05	−0.03	−0.01	0.03	−0.11	0.64	0.59							
8. Staffing	5.64	0.72	−0.06	0.11	0.01	−0.20	0.61	0.62	0.59						
9. Training	5.18	1.06	0.06	0.16	0.02	−0.21	0.54	0.35	0.54	0.35					
10. Participation	5.29	0.96	0.10	0.17	0.22	−0.25	0.66	0.66	0.61	0.55	0.49				
11. Performance appraisal	5.21	1.14	−0.07	0.03	0.22	−0.18	0.53	0.44	0.44	0.45	0.60	0.47			
12. Compensation	5.02	1.20	−0.10	0.06	0.14	−0.07	0.53	0.58	0.54	0.43	0.58	0.51	0.69		
13. Administrative innovation	5.27	0.87	−0.06	0.04	0.19	−0.14	0.68	0.66	0.63	0.60	0.48	0.56	0.62	0.58	
14. Technical innovation	5.04	1.06	−0.04	−0.05	0.15	−0.01	0.65	0.60	0.62	0.46	0.34	0.51	0.44	0.53	0.69

$n=146$ (two-tailed test). Correlations with absolute value greater than 0.16 are significant at $p<0.05$, and those greater than 0.21 are significant at $p<0.01$.

[a] Dummy variable coded as manufacturing industry, 1; otherwise, 0.

[b] Dummy variable coded as high-tech industry, 1; otherwise, 0.

Table 2
Results of regression analyses of innovation performance

Variable	Administrative innovation				Technical innovation			
	Model 1a	Model 2a	Model 3a	Model 4a	Model 1b	Model 2b	Model 3b	Model 4b
Control variables								
Firm age	−0.20*	−0.02	−0.12	−0.06	−0.07	0.07	0.01	0.02
Firm size	0.08	−0.05	0.04	0.02	−0.04	−0.16*	−0.08	−0.06
Industry type [a]	0.20*	0.13	0.14*	0.12	0.19	0.12	0.14*	0.10
Industry type [b]	−0.13	0.08	0.04	0.07	0.03	0.18*	0.21**	0.18*
HR practices								
Staffing		0.34***		0.10		0.23**		0.07
Training		0.09		0.02		0.01		0.13
Participation		0.15*		0.10		0.27**		0.03
Performance appraisal		0.25**		0.28**		0.02		0.05
Compensation		0.12		0.04		0.29**		0.12
Knowledge management								
Knowledge acquisition			0.36***	0.26***			0.39***	0.42***
Knowledge sharing			0.31***	0.30***			0.24***	0.22*
Knowledge application			0.21**	0.18*			0.25**	0.28**
R^2	0.07	0.62	0.58	0.67	0.03	0.58	0.43	0.59
F	2.81*	32.05***	20.68***	22.88***	1.22	26.65***	11.47***	15.86***

$n=146$ (two-tailed test). Standardized coefficients are reported.
*$p<0.05$, **$p<0.01$, ***$p<0.001$.
[a] Dummy variable coded as manufacturing industry, 1; otherwise, 0.
[b] Dummy variable coded as high-tech industry, 1; otherwise, 0.

Next, we examine how knowledge management capacity affects innovation performance. Models 3a and 3b in Table 2 are both significant at the $p<0.001$ level ($R^2=0.58$ and 0.43) and explain an additional 51.0 and 40.0% of variance over what the control variables alone explain. The positive and significant coefficients of knowledge acquisition ($p<0.001$), sharing ($p<0.001$) and application ($p<0.01$) for both administrative and technical innovation performance suggest that firms would get a better innovation performance when firms well develop their knowledge management capacity in acquisition, sharing, and application. In summary, all three factors of knowledge management capacity have the expected signs and also have significant effects on innovation performance. Accordingly, the results support Hypothesis 3.

The study follows Baron and Kenny's (1986) procedure to analyze the mediating effect of knowledge management capacity between strategic HR practices and innovation performance. The first step is to examine the relationship between independent variable and the dependent variable. As models 2a and 2b in Table 2 show, four strategic HR practices factors relate significantly to innovation performance. The second step is to examine the effect of the mediator, knowledge management

Table 3
Results of regression analyses of knowledge management

Variable	Knowledge acquisition		Knowledge sharing		Knowledge application	
	Model 5a	Model 6a	Model 5b	Model 6b	Model 5c	Model 6c
Control variables						
Firm age	−0.06	0.08	−0.13	0.03	−0.09	0.03
Firm size	0.04	−0.10	0.08	−0.05	−0.01	−0.16*
Industry type [a]	0.07	0.03	0.11	0.02	0.01	0.01
Industry type [b]	−0.28**	−0.06	−0.14	0.03	−0.15	0.08
HR practices						
Staffing		0.31***		0.34***		0.34***
Training		0.19*		0.11		0.29***
Participation		0.31***		0.40***		0.29***
Performance appraisal		0.07		0.07		0.14
Compensation		0.09		0.35***		0.20*
R^2	0.09	0.60	0.04	0.61	0.02	0.58
F	3.51**	22.83***	1.45	23.30***	0.74	20.54***

$n=146$ (two-tailed test). Standardized coefficients are reported.
*$p<0.05$**$p<0.01$***$p<0.001$.
[a] Dummy variable coded as manufacturing industry, 1; otherwise, 0.
[b] Dummy variable coded as high-tech industry, 1; otherwise, 0.

capacity, on the independent variable, strategic HR practices. The results of models 6a to 6c of Table 3 indicate that four strategic HR practices factors have positive and significant effects on knowledge management capacity. The third step is to examine the relationship between mediator and the dependent variable. Models 3a and 3b of Table 2 show that all three knowledge management capacity factors have significant and positive effects on innovation performance. The fourth step is to include the mediator, knowledge management capacity, in the models to examine whether it reduces the effects of the antecedents to non-significance. As models 4a and 4b in Table 2 show, the coefficients for knowledge management capacity factors are positive and significant, indicating the direct effect of knowledge management capacity on innovation performance. Further, knowledge management capacity significantly reduces the effects of strategic HR practices factors on the dependent variable, most of them to non-significance. The findings indicate that the inclusion of the knowledge management capacity factors attenuates the relationships between strategic HR practices and innovation performance. Thus, knowledge management capacity plays a mediating role between strategic HR practices and innovation performance, supporting the mediation effect in Hypothesis 4.

5. Discussion and conclusions

This study examines the role of knowledge management capacity in the relationship between strategic HR practices and innovation performance. Our results indicate that strategic HR practices relate positively to knowledge management capacity, which in turn relate positively to innovation performance. The findings show support for the mediating effect of knowledge management capacity on the relationship between strategic HR practices and innovation performance. Strategic HR practices work their beneficial effects on innovation performance through the capacity in knowledge acquisition, sharing, and application. These findings highlight the critical roles of human resource management and knowledge management in the process of innovation. The practical implication of the results is that managers need to actively manage their firm's human capital through variety of strategic HR practices to stimulate its capability in managing knowledge acquisition, sharing, and application. Furthermore, a better level of knowledge management capacity can stimulate creative and innovative thoughts that may eventually lead to better innovation performance. To facilitate the link of strategic HR practices and favorable innovation performance, managers first need to recognize the importance of knowledge management capacity. Then they should utilize strategic HR practices to cultivate a better level of knowledge management capacity which in turn will result in favorable innovation outcomes.

The findings of this study contribute to the theoretical development of a conceptual model for explaining the relationships among strategic HR practices, knowledge management capacity, and innovation performance. Few studies in the literature examine the relationships and this deficiency is serious because of the increasing importance of innovation. Accordingly, from the knowledge-based view, this study builds up the conceptual model and hypotheses to indicate the mediating role of knowledge management capacity between strategic HR practices and innovation performance. The second contribution of this study is the derivation of empirical support for the model's prediction using data from actual cases. Although prior research recognizes the importance of human resource management in the innovation process, but few studies empirically examine the effects (Jiménez-Jiménez and Sanz-Valle, 2005; Laursen and Foss, 2003). This study contributes to the literature by empirically examining the relationships among strategic HR practices, knowledge management capacity, and innovation performance. The results prove that the use of strategic HR practices including staffing, employee participation, performance appraisal systems, and incentive-based compensation positively explains the firm's innovation performance; however, knowledge management capacity acts as a mediator to attenuate these positive relationships. Thus, we demonstrate that knowledge management capacity is a mediating mechanism through which strategic HR practices benefit innovation performance. The findings of this study fill the gap in the literature that is lack of empirically examining the mediating roles of knowledge management in the relationships between strategic HR practices and innovation performance.

This study has some limitations. The first limitation is the possible endogeneity problem, due to the self-selection behaviors of the firms, emerging from the fact that not all firms are perfectly free to do their knowledge management and human resource practices choices given the particular contingencies they face (Wooldridge, 2002; Hamilton and Nickerson, 2003). Accordingly, this study addresses the problem as a possible limitation. Secondly, a problem common to the organizational-level study concerning whether an individual response can represent the intended firm-level situations may exist. To alleviate this problem, this study asks the executives who are familiar with the topic to complete the questionnaire. However, this problem may still exist as a limitation of this study. In addition, this study uses self-report data which may have the possibility of common method variance. Though the Harman one-factor test does not indicate it to be a significant problem, the issue may still exist. Future research can benefit from using objective measures for innovation performance that can be independently verified. Fourth, this study did the *t*-statistics and chi-square test to verify that the non-response bias is not a significant issue. However, the low return rate of the survey is still a potential limitation in this study. In addition, since this study only investigates Taiwanese firms, potential cultural limitation may exist and future research can do the empirical work in different cultural contexts to generalize or modify the concepts. The last limitation is the use of a cross-sectional research design. Although the results are consistent with theoretical reasoning, the cross-sectional design may not rule out causality concerning the hypothesized relationships. Future research might address this issue by using longitudinal design in drawing causal inferences.

To conclude, human resources are valuable assets for firms desiring to achieve superior innovation and sustainable competitive advantages. The viewpoints of this study highlight the crucial importance of the mediating role of knowledge management capacity when examining the relationship between strategic HR practices and innovation performance.

Appendix

Table A1
Results of factor analysis of "innovation performance" items

Items	Factors	
	1	2
Administrative innovation		
Responsiveness to environmental changes	0.87	0.33
Innovative administration in planning procedures	0.85	0.36
Innovative administration in process control systems	0.83	0.19
Innovative administration in integrated mechanisms	0.82	0.31
Technical innovation		
Developing new technologies	0.17	0.92
Incorporating technologies into new products	0.42	0.82
Facilitating new processes to improve quality and cost	0.37	0.81
Eigenvalue	3.20	2.55
Common of variance(%)	45.76	36.41
Total variance(%)	45.76	82.17

Table A2
Results of factor analysis of "strategic human resource practices" items

Items	Factors				
	1	2	3	4	5
Training					
Availability of formal training activities	0.86	0.18	0.07	0.02	0.17
Availability of comprehensive training policies and programs	0.84	0.25	0.20	0.14	−0.02
Availability of training for new hires	0.79	0.12	0.25	0.13	0.18
Availability of training for problem-solving ability	0.66	0.28	0.41	0.02	0.29
Compensation					
Profit sharing	0.23	0.86	0.24	0.19	0.12
Incentive pay	0.21	0.80	0.37	0.06	0.21
The link between performance and reward	0.30	0.77	0.28	0.15	0.24
Performance appraisal					
Developmental focus	0.18	0.32	0.83	0.23	0.14
Results-based appraisal	0.22	0.43	0.76	0.11	0.04
Behavior-based appraisal	0.34	0.19	0.76	0.18	0.22
Staffing					
Selectivity in hiring	−0.02	0.00	0.14	0.91	0.08
Selection for expertise and skills	0.13	0.13	0.18	0.80	0.26
Selection for future potential	0.24	0.34	0.06	0.67	0.22
Participation					
Employees were allowed to make decisions	−0.00	0.32	0.07	0.11	0.86
Employees were allowed to suggest improvements into work	0.27	0.14	0.11	0.29	0.70
Employees' voices were valued by the organization	0.36	−0.00	0.28	0.29	0.60
Eigenvalue	3.20	2.77	2.56	2.31	2.06
Common of variance(%)	20.00	17.29	15.97	14.43	12.87
Total variance(%)	20.00	37.29	53.26	67.69	80.56

Table A3
Results of factor analysis of "knowledge management capacity" items

Items	Factors		
	1	2	3
Knowledge acquisition			
Knowledge was obtained from customers	0.84	0.16	0.36
Knowledge was obtained from partners	0.81	0.45	0.16
Knowledge was obtained from employees	0.78	0.42	0.24

Table A3 (*continued*)

Items	Factors		
	1	2	3
Knowledge sharing			
Knowledge was shared between supervisors and subordinates	0.29	0.81	0.23
Knowledge was shared between colleagues	0.28	0.81	0.29
Knowledge was shared between units	0.33	0.77	0.34
Knowledge application			
Effectively managing knowledge into practical use	0.24	0.28	0.90
Effectively utilizing knowledge into practical use	0.33	0.38	0.81
Eigenvalue	2.53	2.42	1.93
Common of variance(%)	31.63	30.31	24.18
Total variance(%)	31.63	61.94	86.12

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