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THE RELATIONSHIP BETWEEN HUMAN CAPITAL MANAGEMENT AND PERFORMANCE

Considerable evidence suggests that human resource management (HRM) practices and systems make an important contribution to organizational performance (e.g., Delery & Doty, 1996; Huselid, 1995). Within this area of research, empirical studies have reported a positive effectiveness of high-involvement HR systems, generally conceptualized as a set of distinct but interrelated HRM practices that together select, develop, retain, and motivate a workforce (Delery, 1998; Way, 2002). The common theme in the literature is of HRM skills that utilize information, motivation, and latitude, to develop a workforce which contains a source of competitive advantage (Guthrie, 2001). Compared to traditional employee management, high-involvement HR systems focus on encouraging high employee participation, comprehensive training and developmental appraisal (Bae & Lawler, 2000).

Unfortunately, the dynamics surrounding the HR-performance link are not well understood (e.g., Becker & Gerhart, 1996; Delery & Shaw, 2001; Wright & Sherman, 1999). First, prior research is theoretically undeveloped and has not specified the mediating effects of human capital between high-involvement HR systems and performance. Lepak and Snell (1999) proposed the HR architecture model, arguing that, as different kinds of human capital that vary in importance to a firm's competitiveness, the HR practices used to manage them are likely to vary. However, empirical examination of HR systems regarding human capital remains limited. Second, most research supports the moderating effect of business strategy, but neglects somewhat the impact of leaders' social capital. Social capital might provide the ability to leverage the productivity of the team's internal resource base (Florin, Lubatkin, & Schulze, 2003). In addition, empirical evidence of HR-performance links is based largely on blue-collar workers in manufacturing plants (Appelpabum, Bailey, Berg, & Kalleberg, 2000; Ichniowski, Kochan, Levine, Olson, & Strauss, 1996); less research focuses on R&D teams in high-technology firms. Most empirical studies on HR-performance link are at the organizational level; however, relatively little research focuses on cross-level. Whether the high-involvement HR systems have equivalent effects on teams needs more attention, particularly regarding the R&D teams, which belong to the specific and valuable resources of high-technology firms (Lepak & Snell, 2002). Thus, extension of previous findings to the R&D teams is needed.

Therefore, the purpose of this study is to investigate the relationships involved in high-involvement HR systems and R&D team performance. Furthermore, we elaborate a theory of how high-involvement HR systems allow R&D teams to build the specific human capital that leads to better team performance. We also explore the

moderating effect of team leaders on the HR-performance link, emphasizing that team leaders' social capital will leverage the effectiveness of R&D teams.

THEORY AND HYPOTHESES

High-involvement systems have been defined in various ways, but they generally include two dimensions: relatively high skill requirements, and an incentive structure that enhances motivation and commitment (Appelbaum et al., 2000; Delery & Doty, 1996; Huselid, 1995). Classic mass production approaches, by contrast, emphasize low skill requirements, and few incentives for discretionary effort. Skill requirements include staffing and training, both of which focus on enhancing employees' competency and specific capability (e.g., Bae & Lawler, 2002; Batt, 2002). In contrast, the human resource incentives are performance appraisal and compensation, which can enhance firm-specific human capital (e.g., Batt, 2002; Youndt et al., 1996).

Empirical studies have shown that high-involvement systems are associated with performance in manufacturing plants (Appelbaum et al., 2000; Arthur, 1992, 1994; Ichniowski et al., 1996; MacDuffie, 1995; Youndt, Snell, Dean, & Lepak, 1996). Few quantitative studies of high-involvement systems in R&D team settings of high-technology firms exist, but one study on top management team (TMT) did find that training, performance assessment and reward practices were associated with higher financial performance (Collins & Clark, 2003).

In this study, we extend past work by developing the argument that high-involvement HR systems allow a R&D team to build R&D human capital, which in turn influences team effectiveness. Below, we draw upon human capital theory and the resource-based view to elaborate the relationships among high-involvement HR systems, R&D human capital and team effectiveness.

The Theoretical Bases: Human Capital Theory and the Resource-Based View

We have defined human capital as the combination of knowledge, skills, talent and experience of employees which can produce added value for organizations. It is a source of innovation and strategic renewal, whether it stems from brainstorming in a research lab, day-dreaming at the office, disposing of old files, re-engineering new processes, improving personal skills or developing new ideas in a sales representative's little black book (Lin, 2003). Human capital theory suggests that organizations develop resources internally only when investments in employee skills are justifiable in terms of future productivity (Becker, 1964; Tsang, Rumberger, & Levine, 1991). These theorists also raise the possibility that firms may internalize employment when they can do so without investing in employee development. However, if employee productivity is not expected to exceed investment costs,

organizations likely will secure these skills from the labor market. The higher the potential for employee contribution, the more attractive human capital investments will be (Snell & Dean, 1992). Thus, human capital investment rests on a comparison of the expected returns of employee productivity. Moreover, HR systems constitute investments in human capital (cf. Flamholtz & Lacey, 1981; Perry, 1991), and human capital with specific values to firms need different HR systems to manage and accumulate (Lepak & Snell, 1999).

The resource-based view has been used as the theoretical grounding within most of the research which posits that HR systems can have a positive impact on performance (Wright, Dunford, & Snell, 2001). The valuable, rare, inimitable, and nontransferable competency within a firm constitutes the core workforce who contribute their knowledge and efforts to produce superior employee output (Way, 2002). Moreover, HR systems can aid in eliciting superior employee output via the bundle of HR practices selecting, developing, and retaining of a workforce comprised of individuals who possess human capital with specific values to firms and teams.

Thus, human capital means not only employee skills and knowledge that enhance productivity, but also the unique and valuable resource which can be accumulated by HR systems. However, organizations should recognize the core human capital, and be able to invest in it (Delery & Shaw, 2001). Lepak and Snell (2002) indicated that knowledge workers, those "people who use their heads more than their hands to produce value" (Horibe, 1999, p. xi), are viewed as the uniquely valuable human capital. The most significant example is the R&D employee, whose knowledge and competency we called R&D human capital. To justify the relationship between HR systems and human capital, we concentrate our attention on R&D human capital.

Human Capital as a Mediating Mechanism

The argument for a direct link between human resource practices and employee performance in R&D team settings hinges on the idea that high-involvement systems help R&D employees develop the kind of R&D human capital -- technical knowledge, innovativeness, and adaptation -- that enables them to develop new products efficiently. R&D-specific human capital is important because these R&D employees assimilate external information (Ancona & Caldwell, 1992), and generate new ideas for product and technology development. To conform to the requirements of schedule and budget, an R&D team needs to possess technical knowledge and a positive work attitude in order to contribute competency and effort. Innovativeness, referring to the production of ideas, products, or procedures that are novel and potentially useful to organizations (Amabile, 1996), can improve the quality of problem-solving and implement ideas efficiently. R&D employees also need to recognize and interpret

changes in order to adjust and align themselves with the extra- and intra-organizational environments, which is called adaptation (Daft & Weick, 1984).

The two dimensions of high-involvement HR systems help employees to acquire this R&D human capital. First, high-involvement systems emphasize the selective hiring of employees with high general skills (or formal education) plus an investment in initial training. This combination provides the R&D team with a skilled workforce capable of ongoing learning. The capacity to learn is critical because in current external environments, intense competition and pressure of time to market lead to constant innovation in the process of product development. R&D employees need to adapt to environmental changes and generate new ideas, based on their technical knowledge, and continue to design qualitative products.

The second dimension of high-involvement systems includes HR incentives such as developmental focus, result-based appraisal, and skill-based pay. Performance assessment and compensation practices emphasize that the higher your performance, the more you gain. The link of performance and compensation can induce R&D employees' motivation to enhance their technical knowledge, innovativeness, and adaptation to accumulate R&D human capital of the team.

In turn, R&D human capital -- technical knowledge, innovativeness, and adaptation -- is viewed as an important resource of R&D teams. According to the resource-based view, through the realization of R&D human capital, R&D teams can induce the processes of knowledge integration and creation, which will increase team performance. Hence, the following is proposed:

Hypothesis 1. R&D human capital will mediate the relations between high-involvement human resource practices and team performance.

Exploring the Moderating Effect of Social Capital

Social capital theory was founded on the premise that a network provides value to its members by allowing them access to the social resources that are embedded within the network (Seibert, Kraimer, & Liden, 2001). For R&D employees, the combination of crossing team boundaries, and interactions with outsiders to build social capital, expands opportunities for accessing and collecting information of product development (Tushman & Scanlan, 1981). Also, Ancona and Caldwell (1992) have shown that teams need to manage "boundary-spanning" relationships with outsiders in order to pull in important information and political resources that help increase the team's effectiveness. Moreover, it is the leaders -- the officers, managers and supervisors -- that take on these boundary-spanning activities (Voelker & Inderrieden, 2001). Thus, we regard boundary-spanning activities of team leaders as teams' social capital.

Social capital theory implies that social resources have important direct and indirect effects. Coleman (1988) argued that the productive potential of social capital lies in its ability to enhance human capital. Bouty (2000) interviewed 36 R&D scientists, finding that social capital is helpful for exchanging information and resources with external actors. Through the interactions and crossing of boundaries with outsiders, R&D teams can solve work-related problems and accumulate competency and human capital (Tushman & Scanlan, 1981; Sparrowe et al., 2001). Additionally, outsiders acknowledge the boundary-spanning role of team leaders who are in almost constant communication with team members. According to Ancona and Caldwell (1992), team leaders' boundary-spanning behaviors, such as building the positive image and scouting information for teams, can promote access to important resources necessary to maintain and improve performance, as well as quick responses to challenges that arise (Oh, Chung, & Labianca, 2004). Thus, social capital -- team leaders' boundary-spanning behaviors -- not only enhances human capital, but also influences the effects of high-involvement HR systems on human capital. Because of the access to necessary information and resources resulting from social capital, the high-involvement HR system can exploit its effectiveness for the accumulation of human capital, particularly when team leaders display more boundary-spanning behaviors. Hence, the following is proposed:

Hypothesis 2. Social capital will moderate the relation of high-involvement HR systems to R&D human capital in such a way that R&D teams with higher social capital will enhance the effects of high-involvement HR systems on R&D human capital more than for those with less social capital.

METHODS

To understand the dynamics of the HR-team effectiveness relation, we not only studied extant literature related to HR, human capital and social capital, but also supplemented this knowledge with fieldwork in a few companies. We used these two sources to develop the theoretical model that addresses the research question. This exercise provided a richness of contextual detail permitting grounded specification of the framework and constructs. With this accomplished, we collected data that would allow us to test our framework and hypotheses.

Sample

We contacted 52 R&D managers by e-mail and telephone, and 26 agreed to participate in this survey. The sample consisted primarily of R&D team leaders. Of the 89 R&D teams, 62 responded to the survey (a response rate of 69 percent), within a mean of 2-3 teams per firm. Of the 62 respondents, 59 were male, and the average

age was 37.68 years. The majority (91.5 percent) of the respondents had completed at least 2 years of college education with an average organizational tenure of 6.49 years and industrial experience of 10.62 years. The profile of demographics is shown in Table 1.

Insert TABLE 1 About Here

Measures

High-involvement HR systems. We developed a measure of high-involvement HR systems based on a review of the relevant literature, but especially the prescriptions of Lawler (1992) and the empirical work of Bae and Lawler (2000), Delery and Doty (1996), and Youndt et al. (1996). The high-involvement HR systems used in this study focused on the four most commonly recognized areas of HRM: staffing, training, performance appraisal, and compensation. Staffing practices included selective staffing and selection for technical and problem-solving skills. Training practices included training for professional skills, training for problem-solving skills, and comprehensive training. Performance appraisal included developmental focus, result-based performance appraisal, and achievement of individual goals. Compensation included skill-based pay and promotion based on professional skills. Results of a maximum likelihood factor analysis with oblique rotation yielded a one-factor solution that explained 33.54 % of the variance. Fabrigar et al. (1999) showed that an oblique rotation produced considerably fewer cross loadings than did varimax rotation for the same data. That is, the oblique rotation resulted in a superior simple structure where each factor has a subtlety of variables with high loadings, and the rest with low loadings (Conway & Huffcutt, 2003). The Cronbach's α of high-involvement HR system was 0.82 in this study.

We followed the procedures used by MacDuffie (1995), Osterman (1994) and Arthur (1992, 1994) to combine these HR practices into the aggregate index reflecting the high-involvement HR system. Such an additive approach to combining HR practices into an index suggests that firms can improve performance either by increasing the number of practices they employ within the system or by using the practices in an HR system in a more comprehensive and widespread manner. This approach is conceptually and empirically better than a multiplicative approach to creating HR systems because it does not reduce the index value to zero if a single HR practice is absent from a system. Instead, the absence of a practice only weakens the net effect of the system (Youndt et al., 1996).

Human capital. We developed a measure of human capital based on reviews of relevant literature and interviews of 10 R&D managers and engineers, but especially

with reference to the specifications of Lin (2003). 24 items were generated from interviews following Lin's (2003) human capital indicators: employee skill and attitude, innovativeness, and adaptation. To confirm the fit of dimensions and items, we invited 2 senior academics and 2 practitioners who have been experts for over 10 years to rate on a "strongly disagree" (1) to "strongly agree" (5) scale. We deleted those items that over 2 persons evaluated below 3 on this point scale. We also calculated the inter-rater agreement of r_{wg} (James et al., 1993) as the deleting criterion that each item should have an index greater than .80.Following the two criterion, 10 items were deleted.

Human capital was measured by 14 items rated on a 5-point scale (1, strongly disagree to 5, strongly agree). Results of a maximum likelihood factor analysis with oblique rotation yielded a three-factor solution that explained 51.63 % of the variance, matching the proposed three dimensions: employee skills and attitude, innovativeness, and adaptation. Employee skills and attitude refer to professional competency and work attitude beneficial to R&D work, which were measured by 6 items ($\alpha = .84$). Sample items included: "My team is professional enough to complete work" and "My team will do the best and make the most effort to achieve the goal". Innovativeness refers to the competency of improving work-related problems creatively, and developing new ideas, which was measured by 5 items ($\alpha = .77$). Sample items included: "My team often proposes constructive suggestions for product development and technology" and "My team often uses the new technology to solve work-related problems". Adaptation refers to the competency of adjusting to the changing work and environments, which was measured by 3 items ($\alpha = .80$). Sample items included: "Most members of my team can make good adjustments when they are assigned new projects" and "Most members of my team can complete work efficiently even when they are assigned several projects".

Boundary-spanning behaviors. We adapted Ancona and Caldwell's (1992) external activity scale to measure the extent to which team leaders enacted boundary-spanning behaviors for teams. Boundary-spanning behaviors were measured by 7 items. Respondents were asked to indicate on a 5-point scale (1, strongly disagree to 5, strongly agree). Sample items included: "I often protect my team from outside interference", "I often 'talk up' the importance of my team to outsiders", and "I often scan the environment inside and outside of the organization for market/technical information". Results of a maximum likelihood factor analysis with oblique rotation yielded a one-factor solution that explained 36.88 % of the variance. The Cronbach's α of high-involvement HR system was 0.79 in this study.

Creative performance. This was assessed using 7 items developed by Lovelace, Shapiro, and Weingart (2001). Innovativeness and constraint adherence were used to

assess the performance of R&D teams. Items were rated on a 5-point scale (1, strongly disagree to 5, strongly agree). Sample items were: "The innovativeness of work outcomes is high" and "The developmental schedule is controlled well conforming to the goal". Results of a maximum likelihood factor analysis with oblique rotation yielded a one-factor solution that explained 40.01 % of the variance. The Cronbach's α of high-involvement HR system was 0.82 in this study.

Control variables. To reduce the likelihood that team leaders' industrial experiences would confound relations examined in this study, we measured and controlled leaders' industrial tenure (in years). We control team size for the possibility of influencing a variety of processes and outcomes (e.g., Borman, Ilgen, & Klimaoski, 2003). Also, to control for differences among the 26 companies, we used two kinds of company variables, dummies and company codes (single variable for 1 = Company 1, 2 = Company 2, etc.). Results of the two kinds of control variables weare the same. For the sake of simplicity, we only reported the results of company codes.

Concerns of Common Method Variances

Because of self-reported scales, common method variance was a concern in this study. Several preventive and control actions w ere taken for decreasing the inflated relations. First, reversed items were used in the questionnaire to reduce acquiescence bias. Second, the different response formats for the dependent and independent variables were used to mitigate response bias. Third, from a check, it was found that all measurement items were not loaded on the same factor and the first non-rotated factor that was based on all the measurement items accounted for only 25% variance of the total. That is, the first factor explains far less variance and has fewer variables loaded on it than one would expect with strong method bias. These results indicate that common method variance may not be a big concern for inflating the relationship between independent and dependent variables (Podsakoff, MacKenzie, & Podsakoff, 2003; Podsakoff & Organ, 1986).

RESULTS

Table 2 shows the means, standard deviations, and intercorrelations of all variables included in this study. Team size was the only control variable significantly correlated with employee skills and attitude ($r = -.38$, $p<.01$). The three dimensions of human capital -- employee skills and attitude, innovativeness, and adaptation -- were positively and significantly related to each other ($r = .40$ to $.61$, $p<.01$). As seen in Table 2, the largest correlation among predictor and dependent variables was .71. There is no definitive criterion for the level of correlation that constitutes a serious multicollinearity problem among the independent variables. The general rule of thumb is that it should not exceed .75 (Tusi, Ashford, Claire, & Xin, 1995, p. 1531).

This level of correlation does not suggest a serious problem of multicollinearity in this study. Furthermore, we performed a regression diagnostic test and the results revealed a variance inflation factor (VIF) ranging from 1.02 to 1.77. Our VIF values were much lower than the recommended cut-off threshold of 10 (Hair, Anderson, Tatham, & Black, 1992), suggesting the absence of multicollinearity in the data.

Insert TABLE 2 About Here

We predicted that human capital (Hypothesis 1) would mediate the HR-performance relation. If a variable is to be considered a mediator of an outcome, four conditions should be met: (1) the independent variable involved should make a significant contribution to the outcome, (2) the independent variable should make a significant contribution to the mediator, (3) the mediator should make a significant contribution to the outcome, and (4) when the influence of the mediator is held constant, the contribution of the independent variable to the outcome should become non-significant (Baron & Kenny, 1986).

We tested hypotheses using hierarchical regression analyses. We first introduced into the equation the block of control variables, followed by the appropriate independent and mediating variables. As shown in Model 1 of Table 3, no control variable made a significant contribution to creative performance ($R^2 = .05$, $p>.05$). Controlling for company, team size and leaders' industrial tenure, the high-involvement HR system (Model 2) made a significant contribution to creative performance ($\beta= .29$, $p < .05$). Human capital -- innovativeness and adaptation-- also significantly predicted creative performance ($\beta= .58$, $p < .01$; $\beta= .25$, $p < .05$), which is presented in Model 3. Employee skills and attitude were the only personal factors that did not make significant contributions to creative performance. Following Baron and Kenny's (1986) approach to studying the mediation effects, the first two steps shown in Models 2 and 3 have been supported. Next, we found that the high-involvement HR system was associated with higher levels of innovativeness and adaptation ($\beta= .39$, $p < .01$; $\beta= .49$, $p < .01$) presented in Models 5 and 6. The final step needed to show that human capital (innovativeness and adaptation) mediates the relationship between high-involvement HR system and creative performance. This required consideration of whether the addition of innovativeness and adaptation eliminates the effect of a high-involvement HR system on creative performance. If it does eliminate the effect, then it is plausible that the mechanism, which drives a high-involvement HR system to result in higher creative performance, itself derives from an enhancement of human capital, particularly innovativeness and adaptation. Results in Model 4 show that the addition of innovativeness and adaptation does

eliminate the significance of high-involvement HR system for predicting creative performance. As stated above, employee skills and attitude did not positively relate to high-involvement HR system and creative performance. Therefore, Hypothesis 1 was partly supported.

Insert TABLE 3 About Here

Hypothesis 2 predicts that leaders' boundary-spanning behaviors moderate the HR-human capital relations in such a way that leaders enacting more boundary-spanning behaviors will induce more effectiveness of a HR system on human capital. To counter problems of multicollinearity in tests of interaction terms, we centered all independent variables before creating the interaction terms (see Jaccard, Turrisi, & Wan, 1990). We entered controls, a high-involvement HR system and leaders' boundary-spanning behaviors into four regression equations predicting employee skills and attitude, innovativeness, adaptation, and creative performance. In Table 4, the interaction term accounted for a marginally significant amount of unique variability only in innovativeness ($\Delta R^2 = .06$, $p<.05$). As shown in Table 3, only the interaction of the high-involvement HR system and leaders' boundary-spanning behaviors (HR×BS) were significant ($\beta= .27$, $p<.05$), offering part support for Hypothesis 2. Figures 1, produced from the slope and intercept data in the regression output (Cohen & Cohen, 1983), supports the expected shape of the hypothesized interaction. Figure 1 illustrates that when leaders enacted relatively more boundary-spanning behaviors (i.e., high BS), a high-involvement HR system was positively related to creative performance. In contrast, when leaders' boundary-spanning behaviors were relatively low (i.e., low BS), the magnitude of the positive relationship was reduced.

Insert TABLE 4 and FIGURE 1About Here

DISCUSSION

We began this study with relatively little empirical research examining the mediating effect of human capital on the HR-performance relation. Most research exploring the mediators focuses on the proxy of human capital, such as turnover and productivity (e.g., Guthrie, 2001; Way, 2002); little explores the contents and multiple dimensions of human capital. This study generates three dimensions of human capital -- employee skills and attitude, innovativeness, and adaptation -- and finds the mediating effects of innovativeness and adaptation between the relations of high-involvement HR system and performance. Compared to past research, this study

focuses on the R&D team, rather than the whole organization, explaining the HR-human capital-performance relations at another level to complement research gaps because organizations should more attention to the unique workgroup with high strategic value (Lepak & Snell, 2002). Furthermore, we investigated the moderating effect of leaders' boundary-spanning on the relation of high-involvement HR system tohuman capital. Results showed that when leaders enacted more boundary-spanning behaviors, the R&D team would arouse more effectiveness of the high-involvement HR system on innovativeness.

We explored the contributions of human capital to team performance and the extent to which multiple dimensions of human capital mediated the association between high-involvement HR system and creative performance. Consistent with arguments in previous studies (e.g., Batt, 2002), our results showed that innovativeness and adaptation made a positive, significant contribution to creative performance. In addition, our research was the first to empirically establish the effectiveiness of human capital in explaining the HR-performance association. Specifically, results showed that when the influence of innovativeness and adaptation was controlled, the previously described statistically significant "main effects" occurring between HR system and creative performance became non-significant.

As shown in our study, contrasted with innovativeness and adaptation, employee skills and attitude failed to make a significant contribution to creative performance. One explanation is that we focus on creative performance that emphasizes the extent of product innovation and constraint adherence (Lovelace et al., 2001) rather than task performance. Innovativeness and adaptation of R&D teams are more adequate for creative performance. Thus, the dimension of human capital, employee skills and attitude, is not related to creative performance.

Guzzo and Dickson (1996) suggested that the expanding research interest of teams is in context. The oft-cited recognition that, historically, the bulk of psychological research has examined teams in the absence of consideration of their contexts, is giving way to more frequent studies of teams in naturalistic settings, such as organizations, especially the influence of aspects of the teams' environments. In organizations, such environmental factors could include intraorganizational factors such as reward practices and the informational system. In this study, we investigated whether high-involvement HR system is helpful for enhancing human capital, and in turn, increases creative performance. Most empirical studies focus on the effects of reward structure on team performance; however, the configuration of HR practices, as a HR system, might have a stronger impact than single practice. It is argued that bundles of HR practices would enhance team effectiveness more effectively. Thus, one important practical implication is that organizations should adopt the

high-involvement HR system to create specific R&D human capital.

This study also contributes to the literature on team internal process and external activities. Organizational teams cannot rely solely on either internal process or external activities because these two perspectives might promote each other through their subsequent impact on team functioning and outcomes (Choi, 2002), especially for R&D teams. R&D teams with high capacity for crossing team boundaries may be an antecedent of effective knowledge transfer or successful organizational learning (Ancona & Caldwell, 1992; Choi, 2002). Consistent with the argument, this study found that leaders' boundary-spanning behaviors, such as build-up of positive image and collect information for teams, positively moderated the relationship of high-involvement HR system and innovativeness. It implies that leaders' boundary-spanning behaviors do not waste limited resources of R&D teams, but complement the effectiveness of high-involvement HR system on R&D human capital -- innovativeness.

Limitations and Future Research

A few limitations of this study should be noted. First, results of this study need to be interpreted carefully on R&D human capital. The three dimensions and 14 items of R&D human capital were developed in this study, so the proof of construct validity is narrow. However, research on mediators of human capital mostly measured quit rate or productivity as proxies of human capital (e.g., Batt, 2002; Way, 2002). It reflected the general human capital across different workgroups in organizations. This study compensated for this gap by proposing three dimensions of R&D human capital with uniqueness and strategic value in organizations. Future research can supplement the contents, increase more dimensions and items, and intensify the validation with more empirical studies.

Second, we conducted the research in Taiwan rather than in one of the western nations (such as the United States and Great Britain) that often serve as the context for boundary-spanning studies. It may be that different results would be obtained in different countries. On the other hand, the fact that some of our results were generally consistent with those obtained in previous studies (e.g., Batt, 2002; Snell & Dean, 1992) adds weight to their generalibility and suggests that our new findings might apply cross-culturally as well.

Third, the present study is limited to cross-sectional phenomena of R&D teams' organizational behavior, so causality cannot be unambiguously concluded. We can only conclude that our findings are a feasible explanation of the observed relationships in the data. Rather, the direction of paths in our model relies on prior empirical results and theoretical arguments (e.g., Batt, 2002; Snell & Dean, 1992). Therefore, the reasoning and causal direction in this study should be logical.

Collecting longitudinal data would be a step toward making causal inferences about the relationships in the study.

Finally, self-reported studies may give rise to the inflated relationships due to common method variances. We conducted several methods to check the possibility of common method variances. Results of factor analysis showed that this was not a serious problem in our study. To avoid the possibility of common method variances, using multiple data sources would alleviate some of the concern.

In summary, our findings are consistent with well established research regarding HR system, human capital and organizational performance -- that organizations adopting the high-involvement HR system on R&D teams will enhance specific R&D human capital, and, in turn, increase higher creative performance of teams. Yet, our study goes beyond this and suggests that leaders enacting more boundary-spanning behaviors will arouse the effectiveness of high-involvement HR system on R&D human capital, resulting in more innovativeness. Taken together, the results of this study highlight the fit of the high-involvement HR system and leaders' boundary-spanning behaviors on the accumulation of R&D human capital.

TABLE 1 Profile of Demographics

Demographics		Frequency[a]	Valid Percent (%)
Gender	Male	57	96.6
	Female	2	3.4
	Total	59	100
Age	Under 30 years	9	15.8
	31-35 years	17	29.8
	36-40 years	10	17.6
	41-45 years	13	22.8
	Above 45 years	8	14
	Total	57	100
Education	High school	4	6.8
	College	32	54.2
	Master	18	30.5
	Ph.D	5	8.5
	Total	59	100
Tenure	Under 1 year	5	8.8
	1-3 year	18	31.6
	4-6 years	15	26.3
	7-10 years	5	8.7
	Above 10 years	14	24.6
	Total	57	100

Note: [a] Frequency is excluded the missing data.

TABLE 2 Means, Standard Deviations, and Correlations among Variables[a]

Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1. Company	--	--	--								
2. Team size	5.21	1.98	-.20	--							
3. Leaders' industrial tenure	10.62	6.01	-.24	-.06	--						
4. High-involvement HR system	3.75	.45	-.11	.08	.22	(.82)					
5. Employee skills and attitude	4.17	.47	.11	-.38**	.20	.40**	(.84)				
6. Innovativeness	3.81	.54	-.07	.01	.08	.45**	.48**	(.77)			
7. Adaptation	3.77	.52	-.03	-.06	.20	.49**	.50**	.61**	(.80)		
8. Leaders' boundary-spanning behaviors	3.80	.47	.05	.10	.14	.37**	.20	.49**	.28*	(.79)	
9. Creative performance	3.74	.47	.01	-.02	.23	.32*	.47**	.71**	.62**	.30*	(.82)

[a]Cronbach's α coefficients are on the diagonal.

*p＜.05; **p＜.01

TABLE 3 Results of Regression Analyses Testing Mediation Effects of Human Capital[a]

	Creative performance				Human capital[b]	
Variables	**M1**	**M2**	**M3**	**M4**	**M5[c]**	**M6[d]**
Control variables						
Company	.80	.11	.11	.10	-.01	-.01
Team size	.06	.02	.09	.11	-.06	-.04
Leader's industrial tenure	.21	.20	.08	.07	.07	.21
Independent variables						
High-involvement HR system		.29*		-.10	.39**	.49**
Mediators						
Employee skills and attitude			.09	.12		
Innovativeness			.53**	.54**		
Adaptation			.25*	.29*		
Model F	.94	6.19	12.70	26.30	9.84	19.60
R^2	.05	.13*	.58**	.59**	.15**	.29**
ΔR^2		.08*	.53**	.54**	.14**	.23**

Note: [a] The entries in the table are the standardized βs. *p＜.05; **p＜.01.

[b] The regression coefficients are the second regression after controlling other variables.

[c] M4 is the regression of innovativeness.

[d] M5 is the regression of adaptation.

TABLE 4 Results of Regression Analysis Testing Moderation Effects of Leaders' Boundary-spanning Behaviors[a]

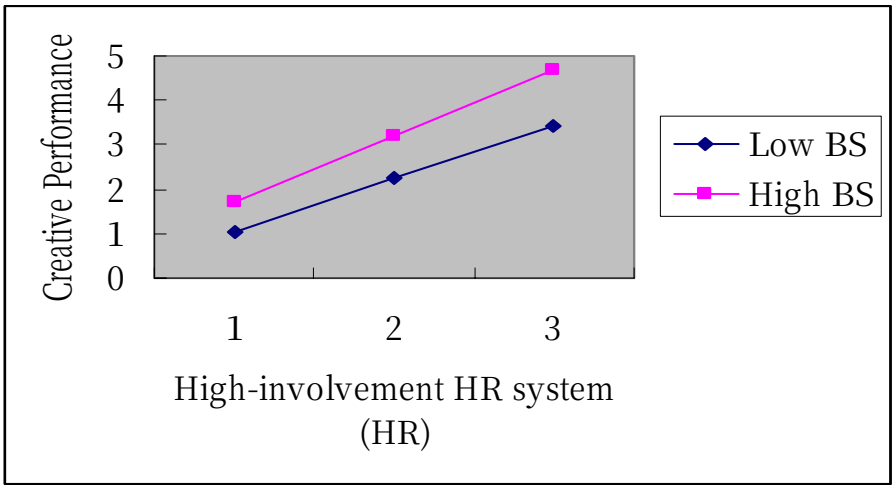
	Employee skills and attitude	**Innovativeness**	**Adaptation**	**Creative performance**
Control variables				
Company	.12	-.07	.02	.09
Team size	-.37**	-.09	-.04	.01
Leader's industrial tenure	.20	-.01	.19	.15
Independent variables				
High-involvement HR system (HR)	.35**	.29*	.52**	.25*
Moderator				
Leaders' boundary-spanning behaviors (BS)	.06	.48**	.04	.26*
Interaction Term				
HR×BS	-.06	.27*	.23	.24
Model F	4.34	4.74	4.55	2.32
R^2	.32**	.34**	.33**	.20*
ΔR^{2b}	.01	.06*	.04	.04

Note: [a] The entries in the table are the standardized βs of the third regression.

[b] ΔR^2 is calculated as the increment of R^2 compared to the former which regressed on control variables, independent variable and moderator.

*p＜.05; **p＜.01.

FIGURE 1 The effects of leaders' boundary-spanning behaviors (BS) on the relationship between high-involvement HR system (HR) and creative performance.



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