HUMAN PERFORMANCE, *17*(4), 397–414

Individual and Contextual Dynamics of Innovation-Use Behavior in Organizations

Jin Nam Choi
Faculty of Management
McGill University

The innovation literature suggests that both organizational context and individual characteristics influence employees' innovation-use behavior. However, the question of how contextual factors and individual characteristics operate together to predict innovation-use behavior has remained ambiguous. This study examined 2 plausible ways that individual and perceived contextual variables can interplay to predict innovation-use behavior: mediation and moderation. The results, based on 191 employees of an electronics company, showed that 2 of the 3 relationships between perceived organizational context and innovation-use behavior were partially mediated by individual characteristics. In addition, in 1 of the 3 relationships examined, individual and contextual variables interacted to predict innovation-use behavior. This study contributes to the literature by conceptually integrating and empirically investigating the interplays between individual and contextual factors beyond their independent contributions to innovation-use behavior.

Innovation researchers have often assumed that implementing an innovation is a simple routine that naturally follows any adoption decision or creative initiation of an innovation. However, as Clayton (1997) astutely pointed out, "Great ideas often fail not in the conception but in the implementation. Having a great idea is only the beginning of, not the answer to the problem" (p. 11). Large-scale empirical studies have shown that the risk of implementation failure is substantial (e.g., Leonard-Barton, 1988). The chances of benefiting from an innovation depend as much on *how* it is implemented as on *whether* it is implemented (DeSanctis & Poole, 1994). Most studies of innovation implementation have attended to organizational

Requests for reprints should be sent to Jin Nam Choi, Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, Quebec, Canada H3A 1G5. E-mail: jinnam.choi@mcgill.ca

factors, such as organizational structure, support systems, leadership, and organizational culture (Clayton, 1997; Klein & Sorra, 1996; Zalesny & Vecchio, 1997). Empirical studies, however, have shown that individual employees' reactions to a particular innovation often determine the ultimate success of implementation efforts (Hartwick & Barki, 1994; Leonard-Barton, 1988).

To explain individual-level processes of innovation implementation, researchers have examined the cognitive processes that determine people's affective and behavioral responses to innovations. For example, the technology acceptance model (Davis, 1989) posits that a person's behavioral intention to use an innovation and actual usage of that innovation are determined by two factors: perceived ease of use and perceived usefulness of the innovation. Social cognitive theory (Compeau, Higgins, & Huff, 1999) endorses a similar set of beliefs, including technology self-efficacy and outcome expectations, to explain innovation use.

Other researchers have offered theoretical models that incorporate both individual characteristics and contextual factors to explain individuals' innovation use. For example, the "social influence model of technology use" (Fulk, Steinfield, Schmitz, & Power, 1987) suggested that a person's technology use is influenced by both individual and contextual variables, including personal attitude toward the use of the technology, perceived task requirements, evaluation and reward systems, and important others' (e.g., coworkers and supervisors) attitudes and behaviors. The theory of planned behavior (Ajzen, 1991) also posits that both personal attitudes and social norms contribute to innovation-use behavior.

Unfortunately, empirical studies have rarely examined individual and contextual factors together, and when they do, they have simply attended to independent effects of contextual and individual factors. The existing theories and empirical investigations thus remain ambiguous about how these two sets of variables are related to each other in shaping innovation-use behavior. This dearth of studies exploring the linkages between individual and contextual factors is problematic because human behavior is both a function of person and context and a function of their *interrelationships* (e.g., person-environment fit, Edwards, 1996; actor-structure dualism, Conrad & Haynes, 2001). Addressing this gap, this study conceptually elaborates the way individual characteristics and perceived contextual factors play together to predict innovation-use behavior. Specifically, I propose two plausible functions that link individuals to their context with respect to innovation-use behavior. These alternative functions are then empirically tested using data from an electronics company.

THIS STUDY

Given the lack of prior systematic investigations of the interrelationships between individual and contextual factors regarding innovation-use behavior, it is impor-

tant to isolate critical dimensions that are relevant to both individual and context and also predictive of the target behavior. To explain human behavior in general, scholars have long used constructs such as values (Rokeach, 1973), attitudes (Fishbein & Ajzen, 1975), and behavioral capacity to engage in the behavior (Ajzen, 1991). Most existing theories of innovation use have focused on attitudes toward or outcome expectations for a particular innovation (e.g., perceived usefulness, Davis, 1989; outcome expectation, Compeau et al., 1999) and efficacy belief or actual abilities related to using the innovation (e.g., perceived ease of use, technology self-efficacy). Although individual values have been largely ignored in this literature, they might have significant implications for innovation use because of their fundamental influence on human behavior (Meglino & Ravlin, 1998; Rokeach, 1973). These individual characteristics (values, attitudes, and efficacy–abilities) could be promoted by supportive organizational contexts such as innovative organizational culture (Reger, Gustafson, Demarie, & Mullane, 1994), organizational climate or norms that support the innovation (Klein & Sorra, 1996), and adequate supply of resources such as technical support (Clayton, 1997).

Combining these individual and contextual dimensions, this study focuses on three pairs of conceptually related contextual and individual factors (see Figure 1), including (a) innovative organizational culture and innovative personal values, (b) supportive norms and positive attitudes toward the innovation, and (c) technical support and technical abilities of using the innovation. Instead of exploring all possible interrelationships between these three sets of variables, I propose that individual and contextual variables that share the underlying content dimensions (e.g., values, attitudes, abilities) are interrelated in a theoretically meaningful way because compatible dimensions of person and environment tend to have reciprocal effects on each other in predicting individual outcomes (Edwards, 1996).

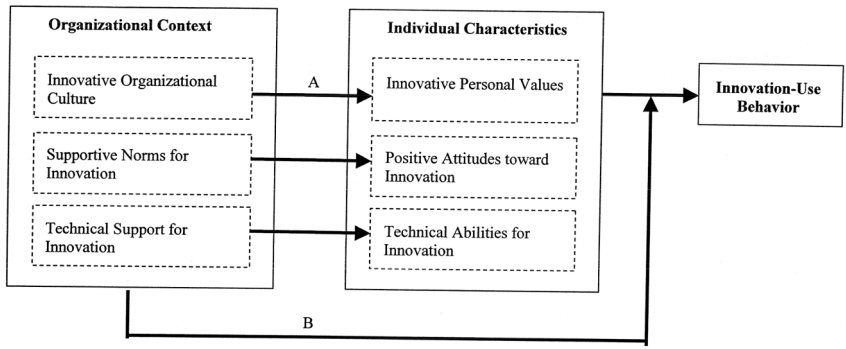

FIGURE 1 Conceptual framework.

In terms of specific functions linking individual and contextual factors, this study examines two plausible ways in which the two sets of variables can be connected: (a) mediation, in which perceived contextual factors (e.g., innovative organizational culture) shape pertinent individual characteristics (e.g., innovative personal values), which in turn directly predict innovation-use behavior (Arrow A in Figure 1); and (b) moderation, in which the strength of the relationship between individual characteristics and innovation-use behavior is modified by relevant contextual factors (Arrow B in Figure 1).

Supporting the mediational hypothesis, Deci and Ryan (1985) maintained that rather than serving as the direct determinant of behavior, contextual factors influence behavior through psychological meaning ("functional significance") that individuals attach to them. The same context, therefore, can exert dramatically different impacts on human behavior depending on how individuals construe and respond to it. Of particular interest here is the extent to which individual characteristics mediate the relationships between contextual factors and innovation-use behavior of employees. On the other hand, it has been widely documented that the relationship between individual trait and behavior is modified by the situation (Murtha, Kanfer, & Ackerman, 1996). It seems plausible to assume that an employee who likes a new information system is more likely to actually use it when her supervisor or peers also endorse the system. Each pair of variables considered in this study and respective hypotheses are presented later.

Innovative Organizational Culture and Innovative Personal Values

The first contextual factor considered in this study is organizational culture, defined as "a system of shared values (that define what is important) and norms that define appropriate attitudes and behaviors for organizational members (how to feel and behave)" (O'Reilly & Chatman, 1996, p. 160). When employees perceive that their organization endorses innovative values, such as risk taking, openness in communication, and autonomy (O'Reilly, 1989), they may be more likely to accept and actually use an innovation. Likewise, employees who hold these innovative values as their personal work values may respond more positively to new ideas or practices than those whose work values are less supportive of innovations. As a social context for employees, an organization's culture may affect its members' personal values. In fact, organizational members often adjust their personal values to socially accepted ones to present positive images to others (impression management, Leary & Kowalski, 1990). Thus, innovative organizational culture may be positively related to employees' innovative personal values, which in turn may mediate its relationship to innovation-use behavior.

H1A: Innovative organizational culture and innovative personal values are positively related to innovation-use behavior. The relationship between innovative organizational culture and innovation-use behavior is mediated by innovative personal values.

Another plausible hypothesis is that the relationship between individual values and innovation-use behavior can be moderated by organizational culture as perceived by employees. Studies of person-organization fit have shown that employees report increased job satisfaction and organizational commitment when their values are congruent to organizational culture (O'Reilly, Chatman, & Caldwell, 1991). In a similar fashion, innovative organizational culture may boost the relationship between innovative personal values and innovation-use behavior.

H1B: Innovative organizational culture moderates the relationship between innovative personal values and innovation-use behavior, such that the stronger the innovative organizational culture, the stronger the relationship between innovative personal values and innovation-use behavior.

Supportive Norms for Innovation and Positive Attitudes Toward the Innovation

The social psychology literature has shown that both social norms and personal attitudes predict human behavior (Fishbein & Ajzen, 1975; Trafimow, 2000). In implementing innovations, supportive norms in the form of implicit and explicit encouragement for a particular innovation from important others (e.g., top management, direct supervisor, colleagues) may promote employees' innovation-use behavior (Zalesny & Vecchio, 1997). In addition, employees' positive attitudes toward the innovation also render innovation-use behavior more likely (Hartwick & Barki, 1994). Norms supportive of an innovation may increase a person's positive attitudes toward it through various mechanisms of social influence, including socialization and social information processing (Salancik & Pfeffer, 1978).

H2A: Supportive norms and positive attitudes are positively related to innovation-use behavior. The relationship between supportive norms and innovation-use behavior is mediated by positive attitudes.

As Murtha et al. (1996) suggested, a situation that is consistent with a particular trait strengthens the relationship between the trait and corresponding behavior. In a similar vein, the link between positive attitudes and actual behavior consistent with the attitudes can be constrained (under nonsupporting situation) or facilitated (under supporting situation) by social norms. Social psychological studies have shown that personal attitudes can be more easily manifested as a public behavior

when individuals believe that social expectations are consistent with their attitudes (Trafimow, 2000).

H2B: Supportive norms moderate the relationship between positive attitudes and innovation-use behavior, such that the stronger the supportive norms, the stronger the relationship between positive attitudes and innovation-use behavior.

Technical Support and Technical Abilities of Using the Innovation

Adequate supplies of technical support in terms of training programs and technical assistance increase the actual use of an innovation (Clayton, 1997). To be willing to perform innovation-use behavior, employees may need to possess technical abilities (e.g., skills, knowledge, and experience) that are necessary to implement the innovation. For example, advanced manufacturing technologies (AMTs) based on computerized systems effectively eliminate simple, routine tasks and increase the complexity of the remaining jobs (Dean, Yoon, & Susman, 1992). As a result, implementing AMTs often requires increased technical abilities, which may threaten employees who feel that they do not have adequate skills (e.g., computer literacy) to use the new technology (Dean et al., 1992). For those innovations that require substantial skills and knowledge, organizations often provide training or mentoring programs, technical manuals, and continuous technical assistance to better prepare employees by enhancing their skill levels (Clayton, 1997). This informs the following hypothesis.

H3A: Technical support and technical abilities are positively related to innovation-use behavior. The relationship between technical support and innovation-use behavior is mediated by technical abilities.

It is also possible that technical support operates as a moderator of the relationship between technical abilities and innovation-use behavior (Murtha et al., 1996). Individuals are less likely to conduct innovation-use behavior when they face severe situational constraints, such as inadequate technical support or lack of opportunities to use the innovation (Klein & Sorra, 1996). The amount of technical support, therefore, may either constrain (under insufficient support) or boost (under sufficient support) the relationship between technical abilities and innovation-use behavior.

H3B: Technical support moderates the relationship between technical abilities and innovation-use behavior, such that the greater the technical support, the stronger the relationship between technical abilities and innovation-use behavior.

METHOD

Research Setting and Data Collection

To test the present hypotheses, a field study was conducted in a Korean electronics company. Through several meetings with managers, "Six Sigma" was identified as the target innovation for this study because it had been introduced to the organization recently (within the preceding 6 months) and was regarded as a current and important management agenda item within the company. Six Sigma refers to a set of interventions and statistical tools that are designed to dramatically increase the quality of products and services. A process with Six Sigma capability indicates that the process variation is reduced to the extent that no more than 3.4 units per million fall outside of the acceptable quality range—that is, almost defect-free performance.

Of the 900 employees of the company, the immediate target group for Six Sigma comprised 320 white-collar professional workers, including engineers, managers of manufacturing teams, and support staff. In addition to the company-wide campaign promoting Six Sigma tools and philosophies, more than half the target employees had taken a 3- or 5-day workshop on Six Sigma and about one fourth of the target employees had participated in Six Sigma-related projects at the time of this data collection. Even without formal exposure to Six Sigma through training or projects, most employees had numerous opportunities to familiarize themselves with Six Sigma through extensive documentation and peer training on the job.

Based on the information collected from the interviews with employees and Six Sigma experts within the organization, a survey instrument was developed and administered to all employees involved in the implementation of Six Sigma. Of the 203 employees who completed the survey (response rate = 63%), 191 participants provided usable data. This sample included 91% men with a mean age of 34 years (SD = 5.45) and an average organizational tenure of 8 years (SD = 4.99). Thirty percent of the sample was composed of managers or general managers. In terms of functional background, 48% of the participants were involved in manufacturing-related tasks, followed by 38% in research and development, 8% in sales and marketing, and 6% in distribution and other support functions.

Measures

Except for the demographics and other control variables, all the measures were based on multiple items with acceptable internal consistencies.

Control variables. To take into account systematic variations in individual responses, five individual difference variables were included as control measures.

Four demographic variables were assessed using standard survey questions: age in years, gender (0 = women, 1 = men), tenure with the company in years, and hierarchical position (1 = associate, 2 = assistant manager, 3 = manager, 4 = general manager). An additional control variable was the extent to which the participant had been formally exposed to Six Sigma (0 = no exposure, 1 = formal training, 2 = formal training and project participation).

Innovative organizational culture. Drawing on O'Reilly's (1989) six values supporting organizational innovations, six value statements ($\alpha = .90$) were developed for this study: (a) "being flexible enough to take risks and introduce changes" (risk taking), (b) "developing and experimenting with new ways of problem solving" (change orientation), (c) "sharing all information with colleagues" (openness in communication), (d) "having a common sense of direction with coworkers" (sharing common goals), (e) "having ownership of one's work and being responsible for results" (autonomy), and (f) "being oriented toward implementing changes" (belief in action). Participants rated the degree to which these value statements were regarded as important in their organization on a 6-point scale ranging from 1 (*not at all important*) to 6 (*very important*).

Innovative personal values. The same items developed to measure innovative organizational culture were used to assess the degree to which each participant personally held innovative work values. This time, however, participants were instructed to rate the importance of those six value statements ($\alpha = .90$) regarding their own personal values on a 6-point scale ranging from 1 (*not at all important*) to 6 (*very important*).

Supportive norms. The degree to which important others (i.e., top managers, direct supervisor, and colleagues) supported the use of Six Sigma was assessed by a 4-item scale ($\alpha = .85$) including items such as "The top management firmly supports Six Sigma activities" and "My direct supervisor explicitly encourages the use of Six Sigma tools." Each item was followed by a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*).

Positive attitudes. Participants' attitudes toward implementing Six Sigma were measured by a 3-item index ($\alpha = .90$) including "I believe that Six Sigma leads to positive changes in my job," "I believe that Six Sigma will improve my performance at work," and "I want to fully implement Six Sigma in my task." The response format was a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*).

Technical support. A two-item scale ($\alpha = .75$) of technical support addressed two aspects of organizational support for technical issues: (a) training ("I

have received enough training for Six Sigma") and (b) technical assistance ("I have adequate technical assistance related to Six Sigma"). This scale and the subsequent measures were rated on a 6-point scale ranging from 1 (*not at all true*) to 6 (*very true*).

Technical abilities. Through interviews with Six Sigma experts, I identified five critical abilities for implementing Six Sigma (e.g., ability to quantify the question in hand and capacity to apply statistical techniques). Five items ($\alpha = .87$) were used to measure participants' technical abilities for Six Sigma (e.g., "I can quantify problems in numerical terms and collect data to solve the problem," "I can interpret statistical results and make inferences from them").

Innovation-use behavior. Based on interviews with Six Sigma experts, potential forms of implementing Six Sigma were identified and transformed into items, resulting in a 6-item scale ($\alpha = .95$) of innovation-use behavior (e.g., "I perform my daily tasks using Six Sigma tools," "Six Sigma activities are well integrated into my daily operation," "I have changed my work procedures according to Six Sigma").

RESULTS

All variables included in this study were collected from a single source in a cross-sectional manner. These data are thus subject to the same method bias, which may cause problems such as social desirability, consistency motif of respondents, and resulting boosted correlations among variables (Podsakoff & Organ, 1986). To address this concern, I checked psychometric properties of the seven study variables by conducting a confirmatory factor analysis using EQS (Bentler, 1995) following the procedure suggested by Anderson and Gerbing (1988). I created a measurement model by using the 32 items as indicators of the seven latent factors and allowing all covariances among the seven factors. The results suggest that the fit of this measurement model regarding the observed data was acceptable, $\chi^2(314, N = 191) = 3{,}200.36$, $p < .001$ (normed fit index = .92, comparative fit index = .93, adjusted goodness of fit index = .91, root mean squared error of approximation = .056). All items were significantly loaded to their corresponding latent factors (all $p < .001$), indicating convergent validity of the current measures. In addition, no confidence intervals of interfactor covariances (phi) included a value of 1 (all $p < .01$), suggesting discriminant validity of the measures. Although the results of this confirmatory factor analysis do not eliminate concerns and potential problems associated with these self-report data, they indicate that the current measures have adequate psychometric properties and possess acceptable empirical distinctiveness. Table 1 reports descriptive statistics of the present data.

TABLE 1
Means, Standard Deviations, and Correlations Among Scales

	M	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Gender	.91	.29	—											
2. Age	33.65	5.45	.46	—										
3. Company tenure	8.30	4.99	.24	.80	—									
4. Hierarchical position	2.01	1.05	.25	.68	.63	—								
5. Exposure to Six Sigma	.79	.77	.11	.11	.05	.12	—							
6. Innovative culture	3.94	.86	.07	.10	.20	.10	.01	—						
7. Innovative values	4.82	.63	.15	.20	.25	.18	.16	.37	—					
8. Supportive norms	4.17	.96	.14	.17	.17	.17	.22	.40	.34	—				
9. Positive attitudes	4.10	1.07	.18	.22	.26	.16	.26	.40	.40	.58	—			
10. Technical support	3.34	1.08	.22	.20	.20	.19	.38	.33	.23	.58	.60	—		
11. Technical abilities	4.03	.75	.29	.29	.28	.34	.23	.36	.48	.45	.46	.52	—	
12. Innovation-use behavior	3.40	1.00	.25	.24	.22	.19	.28	.37	.25	.61	.69	.76	.55	—

Note. $r = .16$, $p < .05$; $r = .20$, $p < .01$; $r = .26$, $p < .001$.

Analysis of Mediation

The hypotheses involving mediated relationships were directly tested by mediational analyses using stepwise-hierarchical regressions. Hierarchical regressions for testing a relationship between Y and X mediated by Z include two regression equations:

$$Y = a_1 + b_1X + e_R$$
$$Y = a_2 + b_2X + b_3Z + e_F$$

The first model, a reduced model, tests the direct effect of X on Y. The second model, a full model, tests whether the relationship between X and Y is stable, controlling for Z. A complete mediation is assumed when b_1 and b_3 are statistically significant and b_2 becomes insignificant with the presence of Z (James & Brett, 1984). A complete mediation of a contextual factor's effect on behavior by an individual characteristic, however, may be rare. In the case of "partial" mediation, b_2 may remain statistically significant but should be reduced to a statistically significant degree as compared to b_1 (Raudenbush & Sampson, 1999). Therefore, a direct test of the presence of mediation involves a statistical test of the difference between b_1 and b_2. A statistically significant value of $b_1 - b_2$ (hereafter noted as "d") thus indicates the presence of mediation. According to Clogg, Petkova, and Haritou (1995), the significance of d (i.e., $b_1 - b_2$) is determined by its standard error, which can be calculated by a formula $s(d) = [s^2(b_2) - s^2(b_1)\sigma_F^2/\sigma_R^2]^{1/2}$, where $s^2(b_2)$ = squared standard error of b_2, $s^2(b_1)$ = squared standard error of b_1, σ_F^2 = error variance (mean-squared error) of the full model, and σ_R^2 = error variance of the reduced model. The significance test based on t-statistic from $d/s(d)$ allows direct tests of the hypotheses involving mediation.

Innovative organizational culture and innovative personal values. Table 2 reports three sets of hierarchical regression equations that test these hypotheses. Every equation includes five control variables (gender, age, company tenure, hierarchical position, exposure to Six Sigma) that may influence the relationships between the predictors and the criterion variable. The first two equations in Model 1 (reduced and full) test Hypothesis 1A that innovative personal values mediate the relationship between innovative organizational culture and innovation-use behavior. In both equations, innovative organizational culture was a significant predictor of innovation-use behavior. However, innovative personal values failed to significantly increase the explained variance in the full model ($\Delta R^2 = .00$, *ns*), and the amount of reduction in regression coefficients of innovative organizational culture was not statistically significant ($d = .02$, $t = .54$). Overall, these data did not support Hypothesis 1A.

TABLE 2
Hierarchical Regression Analyses for Variables Predicting Innovation-Use Behavior

	Model 1			*Model 2*			*Model 3*		
Predictors	*Reduced*	*Full*	*Interaction*	*Reduced*	*Full*	*Interaction*	*Reduced*	*Full*	*Interaction*
Gender	.54*	.53*	.53*	.48*	.35	.31	.23	.18	.18
Age	.01	.01	.01	.00	.00	.00	.01	.01	.01
Company tenure	.01	.01	.01	.02	.00	.00	.01	.00	.00
Hierarchical position	.02	.02	.02	.03	.02	.02	–.02	–.03	–.03
Exposure to Six Sigma	.33***	.32***	.32***	.19*	.10	.12	–.01	–.01	–.01
Innovative culture	.40*** (.08)	.38*** (.08)	.39*** (.08)						
Innovative values		.07 (.11)	.06 (.11)						
(Innovative culture × innovative values)			–.05 (.11)						
Supportive norms				.56*** (.06)	.31*** (.06)	.28*** (.06)			
Positive attitudes					.45*** (.06)	.50*** (.06)			
(Supportive norms × positive attitudes)						.15*** (.05)			
Technical support							.68*** (.05)	.60*** (.05)	.42 (.25)
Technical abilities								.28*** (.07)	.14 (.21)
(Technical support × technical abilities									.04 (.06)
R^2	.26***	.26***	.26***	.42***	.56***	.59***	.58***	.61***	.61***
ΔR^2		.00	.00		.14***	.03**		.03***	.00
d		.02			.25***			.08***	
s(d)		(.03)			(.03)			(.02)	

Note. Entries are unstandardized regression coefficients. Standard errors appear in parentheses.
*$p < .05$, **$p < .01$, ***$p < .001$.

Supportive norms and positive attitudes. The reduced and full models in Model 2 in Table 2 test Hypothesis 2A. In both models, supportive norms were significantly related to innovation-use behavior. In the full model, adding positive attitudes significantly increased the explained variance ($\Delta R^2 = .14$, $p < .001$). Moreover, the regression coefficient for supportive norms decreased significantly from the reduced model to the full model ($d = .25$, $t = 7.64$). The size of d (.25) amounted to 45% of the regression coefficient for the reduced model (.56), indicating that almost half of the total effect of supportive norms on innovation-use behavior could be explained by (or mediated by) individuals' positive attitudes toward the innovation. Hypothesis 2A was supported.

Technical support and technical abilities. The first two models in Model 3 test Hypothesis 3A. Technical abilities, when added to the full model, significantly increased the explained variance ($\Delta R^2 = .03$, $p < .001$). Also, the d value for technical support was statistically significant ($d = .08$, $t = 3.48$). Supporting Hypothesis 3A, the results showed that a substantial portion of the relationship between technical support and innovation-use behavior was mediated by technical abilities.

Analysis of Moderation

Hypotheses 1B, 2B, and 3B suggest that individual characteristics and contextual factors interact to predict innovation-use behavior in such a way that the relationship between individual characteristics and innovation-use behavior will become stronger as the corresponding contextual factors become higher. Moderated regression analyses were conducted to test these hypotheses by adding interaction terms of individual and contextual variables to the full models appearing in Table 2. The moderation hypotheses would be supported when the added interaction term significantly increases the explained variance in innovation-use behavior (i.e., significant change in R^2) and when the direction of interaction is consistent with the expected pattern.

Three interaction equations in Table 2 show that the present data supported only Hypothesis 2B, rejecting Hypothesis 1B and Hypothesis 3B. The interaction term of supportive norms and positive attitudes explained a significant amount of variance in innovation-use behavior ($\Delta R^2 = .03$, $p < .01$) above and beyond the main effects. Figure 2 visually depicts this interaction effect, where the strength of the relationship between positive attitudes toward the innovation and innovation-use behavior was moderated by supportive norms. This figure was created following the procedure suggested by Aiken and West (1991), in which separate regression analyses were conducted for two subgroups with strong (1 *SD* above the mean) and weak (1 *SD* below the mean) supportive norms. As hypothesized, the relationship

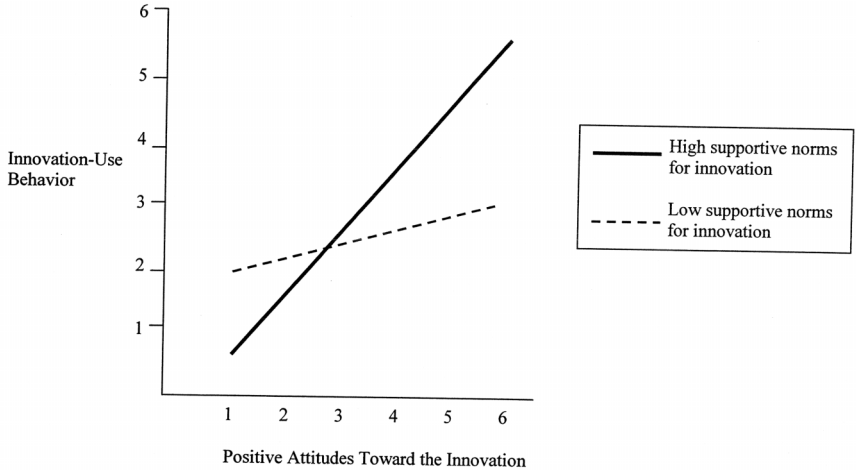

FIGURE 2 Effects of the interaction of supportive norms for innovation and positive attitudes toward the innovation on innovation-use behavior.

between positive attitudes and innovation-use behavior was stronger when supportive norms were strong than when they were weak.

DISCUSSION

This study examined how contextual and individual factors act in combination to predict employees' innovation-use behavior. Because successful implementation of most innovations depends on personal acceptance and use by organizational members, understanding individual-level dynamics of innovation use is critical for both researchers and managers. This study bridges the gap between existing studies focusing on macro-level factors (e.g., culture, climate, leadership; Clayton, 1997; Klein & Sorra, 1996; Zalesny & Vecchio, 1997) and those exclusively attending to individual cognitive processes (e.g., beliefs, attitudes; Compeau et al., 1999; Hartwick & Barki, 1994) by suggesting potential linking mechanisms that might conceptually integrate individual and contextual variables in the context of innovation implementation. The results showed that two of the three relationships between contextual factors and innovation-use behavior were partially but significantly mediated by individual characteristics. Also, in one of the three pairs, individual and contextual factors interact to predict innovation-use behavior. This study offers initial empirical findings concerning the interrelationships between individual and contextual factors beyond their independent contributions to innovation-use behavior.

Since Davis (1989) demonstrated that intention to use an innovation is predicted by user attitudes and behavioral control without any contribution from subjective norms, individual-level studies of innovation implementation have unduly focused on individual beliefs or attitudes, ignoring social or contextual influences on innovation use. Along with recent calls for revision of the Technology Acceptance Model by including subjective norms (Venkatesh & Morris, 2000), these results suggest that contextual factors have unique effects on innovation-use behavior after controlling for the effects of individual characteristics. Moreover, these findings indicate that individual and contextual factors are interrelated in a rather complicated way including mediation and moderation. Future studies should theoretically identify distinct mechanisms through which different sets of individual and contextual variables are linked to each other in predicting innovation-use behavior. It would also be intriguing to test different relational patterns involving individual and contextual factors in introducing different types of innovations (e.g., routine versus radical innovations or technical versus administrative innovations; Nord & Tucker, 1987).

In addition, the results suggest that the connection between individual and contextual factors could be closer for variables that are immediately related to the target behavior. Of the three pairs of individual and contextual variables (see Figure 1), two pairs of variables (supportive norms–positive attitudes, technical support–technical abilities) directly addressed the target innovation (Six Sigma). In these two pairs of variables, the mediational relationships were significant in both cases, and one of the two interaction terms was significant. In contrast, for the pair that was rather general (e.g., innovative organizational culture–innovative personal values), neither mediation nor moderation was observed (see Model 1 in Table 2). This pattern indicates the possibility that individual and contextual factors may relate to each other to different degrees depending on their relevance or proximity to the target behavior.

In a practical sense, the study suggests that managers and change agents need to develop implementation strategies that take into account the distinct dynamics between organizational context and employee characteristics. Until now, the basic assumption has been that implementation tools such as training or incentive (Clayton, 1997; Klein & Sorra, 1996; Nord & Tucker, 1987) would be effective regardless of employee characteristics such as skill level or motivational state. These findings, however, indicate that, though some organizational factors (e.g., innovative culture) may promote innovation use behavior regardless of the related individual characteristic (innovative values), other organizational factors predict the innovation use partially through their impacts on relevant individual characteristics. Furthermore, creating desirable organizational context characteristics such as social expectations for innovation use might not be effective when employees' personal states such as attitudes do not coincide with them. By gaining a more sophisticated understanding of how individual and contextual factors act together in the

context of innovation implementation, managers and change agents should be able to more effectively introduce changes into their organizations.

These findings, however, may suffer from limited generalizability because they are based on the data collected from an electronics company in a single culture. The validity of these findings in other cultures (e.g., the United States, Europe) and other industries (e.g., banking, retailing) remains in question. The collectivistic or context-dependent nature of Asian countries (Triandis, 1994) could render these participants more subject to influences from their social contexts. Therefore, the role of organizational context might be more pronounced in this study than it would be in other cultures. Further studies exploring the same phenomenon in other cultural and industrial settings would extend our understanding of this issue.

Another limitation of this study arises from the fact that these findings are based on cross-sectional self-report data. The results of the confirmatory factor analysis indicate that these measures have adequate psychometric properties, and intercorrelations among study variables were not very high. Nevertheless, the results should be interpreted with caution because of fundamental problems associated with self-report data (Podsakoff & Organ, 1986). In addition, the causal directions among variables cannot be determined from the data. For example, positive attitudes toward Six Sigma could be the consequence of successful performance of innovation-use behavior, rather than the cause (cf. efficacy-performance spirals; see Lindsley, Brass, & Thomas, 1995). These and other variables in this study are likely to be linked by dynamic and complex causality, influencing each other over time through multiple feedback loops.

Finally, these findings must be qualified by the fact that the results were based on employees from the same organization who share a similar context for implementing the target innovation. Given that the context is inherently a global construct and that contextual influences conceptually refer to cross-level phenomena, a more stringent test would include multilevel data collected from multiple organizations representing different contexts.

In justifying these mediation and moderation hypotheses, a critical assumption was a top-down influence from context to individual; employees' technical abilities might be increased by technical support from the organization, and a person's attitude might be manifested as a behavior under a supportive social environment. Although numerous studies (Salancik & Pfeffer, 1978) have shared the same assumption, researchers have also observed the reverse processes from individual to context ("structuration"; DeSanctis & Poole, 1994). For example, it is possible that a substantial influx of innovative individuals may reshape the value orientation of the organization. Moreover, when employees are not well-prepared to use an innovation, organizations face a greater need to provide more training and technical assistance. A sophisticated model addressing the relationship between individual and context, therefore, should address dynamic interactions and mutual feedback loops linking them over a period of time. Future studies should address this issue

and further our understanding of the roles of and dynamics involving contextual factors and individual characteristics.

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