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Full Length Research Paper

The effects of environmental dynamism and team strain on product innovation: The moderating role of perceived diversity climate

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Rapid changes in the technological environment have significantly increased the strain experienced by NPD teams, particularly with regards to developing innovative products that meet both technology and market demands. This study argues that environmental dynamism positively influences the level of team strain but negatively influences product innovation. Moreover, this study further argues that the effect of team strain on product innovation will be positively moderated by perceived diversity in a team climate as it is defined in this study. To test the proposed hypotheses, 87 NPD team leaders and 336 members participated in the study. The results indicate that technology dynamism positively influences team strain and negatively influences product innovation, while market dynamism positively influences both variables. Further, the negative influence of team strain on product innovation is positively moderated by a team's perception with regard to the diversity climate.

Key words: Market dynamism, technology dynamism, team strain, product innovation, perceived diversity climate.

INTRODUCTION

NPD teams performing in turbulent environments are exposed to rapid technology changes, short product cycles, highly competitive markets, and changing customer preferences over time (D'Aveni, 1994). These teams have difficulty detecting meaningful cause-and-effect relationships, forming stable mental models of the marketplace, and mastering new technologies (Akgun et al., 2006; Dickson, 1992). Consequently, they are often confronted with stressful situations as they have to adapt to new or changing customer demands and technical uncertainties (Kim and Wilemon, 2001). This study specifically addresses the research question of how the strain experienced by team members can determine the level of NPD innovation. This study argues that lower levels of new product success are due to greater stress experienced by NPD teams as it can be expected that they have a greater tendency to experience crisis and anxiety during the development of new products. When experiencing crisis and anxiety (Akgun et al., 2007), NPD teams have less ability to transform their knowledge and skills into innovative products.

Although team strain is critical with regard to determining the innovation level of NPD teams, this study also investigates under what conditions crisis and anxiety deliver higher or lower levels of product innovation. Previous studies have noted that work group diversity is crucial in an organization (Homan et al., 2007a). With regard to team functioning, diversity studies have traditionally focused on demographic attributes such as race/ethnicity, gender, age, tenure, and education (van Knippenberg et al., 2004), and a few others have focused on the diversity of information (Jehn et al.,1999; Homan et al., 2007b). A diverse range of information stimulates NPD teams to thoroughly elaborate task-relevant information and use it as part of the decision making process (van Knippenberg et al., 2004), and the consequences are even more favorable when the members share perceptions (Reichers and Schneider, 1990) regarding how the organization should foster and maintain diverse information. This study further argues that shared perceptions regarding informational diversity, moderates the effect of team strain on product innovation.

Based on the earlier discussion, the purpose of this paper is to investigate how team strain determines the level of product innovation. This study not only investigates the importance of the direct effect of team strain, but also under which conditions NPD teams can leverage the level of innovation. This study also examines the moderating role of perceived diversity climate on the influence of team strain on product innovation. The expected contributions of this study are; this study empirically tests the influence of team strain engendered by environmental dynamism on the level of product innovation, while previous studies have mainly discussed its effect on the market success of new products (Akgun et al., 2007; Barczak and Wilemon, 2003; Kim and Wilemon, 2001). Secondly, it argues that market and technological dynamism have different effects on product innovation, in contrast to prior studies that have posited they have effects in common (Akgun et al., 2006; Baum and Wally, 2003). Thirdly, it contributes to the organizational climate literature (Gelfand et al., 2005) in examining how perceived diversity can moderate the effect of team strain on product innovation.

LITERATURE REVIEW

Environmental dynamism

Environmental dynamism is concerned with the amount of uncertainty emanating from the external environment (Baum and Wally, 2003). Uncertainty is created by instability in the environment, which produces deficits in the information needed to identify and understand cause-and-effect relationships (Carpenter and Fredrickson, 2001; Keats and Hitt, 1988). An information deficit affects the way organizations and teams must manage resources to create value. For example, uncertainty in an industry or in potential competitors' actions, affects the type and amount of resources needed in the resource portfolio, the capabilities necessary to outperform rivals, and the leveraging strategies required to gain and maintain a competitive position. Dynamism is reflected by the regularity and amount of change occurring in the environment. Thus, changes in industry structure, the stability of market demand, and the probability of environmental shocks are important elements producing uncertainty (Sirmon et al., 2007).

In the NPD context, external stressors are critical construct that directly affects the way NPD teams perform. Akgun et al. (2006) argued that there are two major external stressors that might influence NPD teams, technological and market dynamism. Technological dynamism refers to the degree that the technology in an industry is rapidly changing. For example, the technological dynamism in the computer industry is higher than that of the steel industry and NPD teams in the former should thus be aware of new product ideas that have been made possible through technological breakthroughs in the computer industry. Market dynamism refers to the degree to which consumers accept or adopt new products or features, which also influence the way NPD teams' behave.

Team strain

In contrast to prior studies that have treated stressors and stress equally (Akgun et al., 2006), this study follows the idea in Jex (1998), which suggested that stressors are conditions that create stress, and strain is the consequence of stress. He further proposed that strain consists of anxiety, crisis, depression, and burnout. This study adopts Jex's (1998) idea and defines team strain as team members collectively feeling crisis and anxiety during NPD projects. At the individual level, Akgun et al. (2007) stated that NPD team strain results not only from individual characteristics, but also from project-related task work, routines and processes, and the characteristics and behavior of other team members. At the team level, strain is a collective reality in team settings that is created or shaped by collective actions, interactions and collaborations. Therefore, the strain perceived by NPD teams is thus embedded in the social system of the group of individuals via their relationships and networks, and is observed in the collective actions of team members (Akgun et al., 2007).

Team crises indicate a sense of urgency and prevent team members from functioning effectively (Akgun et al., 2006). Specifically, team crises distort team members' logical and information processing, making them unable to plan, reason and understand situations accurately, and limiting their prior knowledge on the potential interactions between process and project variables and their consequences (Pauchant and Mitroff, 1990). Team anxiety is a fear of social situations, where individuals perceive themselves to be vulnerable to negative evaluation by others (Verbeke and Bagozzi, 2000). Anxious teams selectively focus on threatening information and tend to interpret ambiguous information in a negative manner. This leads to biases in their judgments and recollections of unpleasant social events, recalling negative information (memory biases), and incorporating negative self-perceptions and metaperceptions (Akgun et al., 2006).

Product innovation

There are many studies that discuss innovation, and researchers have operationalized it from various perspectives. For example, according to Weerawardena and O'Cass (2004), innovation is "the application of ideas that are new to the firm to create added value, either

directly for the enterprise or indirectly for the customers, regardless of whether the newness and the added value are embodied in products, processes, work organization or management, or marketing systems". Other studies have broadened the definition, such as the research of Mone et al. (1998), who defined innovation as "any action that either puts the organization into new strategic domains or significantly alters the way the organization attempts to serve existing customers or constituents". This study defines product innovation as the application of ideas that are new to an organization and customers, which creates added value through the newness or advantages embodied in a newly developed product.

Since the locus of innovation in this study is a new product development team, it focuses on product innovation and adopts the two dimensions presented in Jordan and Segelod (2006); product advantage and product newness. Product advantage refers to customer-perceived superiority as to the quality, benefit, and functionality of a product (Montoya-Weiss and Calantone, 1994). This dimension relates to product uniqueness/ superiority relative to other products on the market (Cooper and Kleinschmidt, 1987). The second dimension is the scope of newness in terms of the extent to which the product is considered to be a new product platform or to contain new features for an existing product that is already being produced (Goldenberg et al., 1999).

Perceived diversity climate

Reichers and Schneider (1990) defined organizational climate as "shared perceptions of the way things are around here". Climate perceptions form a part of individuals' processes for making sense as they interpret their work environment and integrate these into their broader perceptions of climates (Schneider, 1975; Schneider and Reichers, 1983). Schneider and Reichers (1983) emphasized that interpreted conditions and events have a particular referent, and as such, it is most appropriate to refer to a climate for something. This study focuses on team diversity, which is broadly defined as the differences between individuals with regard to any personal attributes that determine how people perceive one another (Ragins and Gonzalez, 2003). Recently, Gelfand et al. (2005) defined a diversity climate as "employees' shared perceptions of the policies, practices, and procedures that implicitly and explicitly communicate the extent to which fostering and maintaining diversity and eliminating discrimination is a priority in the organization".

Although, prior studies mostly considered diversity in terms of demographic attributes (van Knippenberg et al., 2004), this study focuses on the diversity of information (Jehn et al., 1999; Homan et al., 2007). In the context of NPD teams, this study asserts that informational diversity has an even greater role than demographic attributes in enhancing team functioning through greater elaboration of task-relevant information (van Knippenberg et al., 2004). According to Jehn et al. (1999), informational diversity refers to "differences in knowledge basis and perspectives that members bring to the group." Following Gelfand et al. (2005), this study defines perceived diversity climate as team members' shared perceptions of the organizational routines that implicitly or explicitly communicate the extent to which the organization fosters and maintains informational diversity.

Hypotheses development

Even though the role of environmental turbulence as a trigger for the change process is well known (Schein, 1993), scholars have also noted that environmental turbulence can act as a catalyst for change rather than operating as a factor of the change process per se (Edelman and Benning, 1999). In the NPD team context, environmental dynamism creates a shock, whether due to rapidly changing customer tastes and preferences or a similarly disruptive event, such as a new technical discovery. This shock can cause NPD members to enter an emotional state of confusion, helplessness, and intense anxiety, and this may destroy team-process equilibrium since team members are not yet familiar with new relevant facts and are unable to foresee the consequences of their actions (Akgun et al., 2006). The wide variety of stimuli and frequent changes in information due to turbulence also disrupt coordinated thinking and cause communication delays, intragroup conflict, role ambiguity, and decision-making deficiencies (Sommer and Pearson, 2007). Consequently, project team members experience fear, pressure, and uncertainty and feel confused at the prospect of failing to successfully complete a project, factors which could lead to team stress (Akgun et al., 2006). Therefore:

H_1: Market dynamism has a positive influence on team strain.
H_2: Technological dynamism has a positive influence on team strain.

Although Akgun et al. (2006) argued that environmental dynamism has a positive effect on team strain, this study argues that market dynamism and technological dynamism have different roles with regard to product innovation. In the case of market dynamism, since the consumer preferences for product features are changing rapidly, this implies that NPD teams must be aware of the changes as well as be able to apply them to develop new products. Consequently, market dynamism will positively influence the level of product innovation. On the other hand, technological dynamism requires that NPD teams select and apply specific technology and adopt it into newly developed products. Since technology is rapidly

changing, while at the same time standard technology often takes time before being widely adopted by the market, NPD teams have difficulty predicting which technology is best applied to new products. Consequently, the novelty and advantages of new product will be less, since NPD teams have a tendency to be passive until a given standard technology is accepted by the market. Therefore:

H_3: Market dynamism has a positive influence on product innovation.
H_4: Technological dynamism has a negative influence on product innovation.

The inability of NPD teams to plan, reason and understand situations accurately can inhibit the potential integration of prior knowledge into current projects (Pauchant and Mitroff, 1990). Consequently, teams are not able to develop innovative products due to their inability to function effectively (Akgun et al., 2006). In a similar manner, anxious teams tend to interpret unclear information in a negative manner, which can cause biases in their judgments by encouraging the recall and recollection of unpleasant social events and negative self-perceptions (Akgun et al., 2006). Moreover, team anxiety reduces an NPD teams' capability to evaluate alternative options, project procedures and tools, and their ability to interpret new information fairly (Kontogiannis and Kossiavelou, 1999). Furthermore, NPD teams can experience social anxiety when they are not able to complete their tasks (Christensen et al., 2003). In this situation, it is expected that a team's ability to develop innovative products will be reduced. In summary, this study posits that stress has a negative influence on product innovation. Based on the above discussion, this study proposes the following hypothesis:

H_5: Team strain has a negative influence on product innovation.

According to van Knippenberg et al. (2004), a more highly perceived diversity climate leads people to respond more favorably to informational diversity, which increases the level of group functioning in a work environment. This is because greater informational diversity stimulates information processing (Philips et al., 2004), facilitates group problem solving (Tjosvold and Poon, 1998), and increases team effectiveness (Gruenfeld et al., 1996). By having shared perceptions that the organization or the team fosters or maintains informational diversity, team members are more willing to exchange their knowledge, perspectives, or ideas without any worries that they will be dismissed too early. Consequently, the team functions better through the process of informational elaboration among members (Homan et al., 2007).

In addition, although team members may lack the ability to integrate prior knowledge into current projects (Pauchant and Mitroff, 1990), intensifying informational exchange due to a greater perceived diversity climate can enable the development of innovative products. Moreover, the tendency of team members to interpret others' information negatively due to greater anxiety (Akgun et al., 2006) could be reduced due to a greater frequency of exchanging information and more collaboration during the development of new products. As a result, the negative effect of team strain on product innovation tends to be weakened when the members perceive a higher diversity climate. Therefore:

H_6: Team strain will interact with a perceived diversity climate such that the negative effect of team strain on product innovation will be weakened when the members perceive a higher diversity climate.

RESEARCH METHODS

Sampling plan

This study targeted 200 NPD teams from three science parks in Taiwan. Taiwan was chosen due to its high relevance to the phenomenon inside NPD teams, since its firms produce many new products. In addition to that, its dominance of the manufacturing of the world's laptops (almost 90%), the government (Government Information Office of Taiwan, 2009) has also noted that Taiwan is the world's second-largest producer of other information-technology goods, such as semiconductors and optoelectronics products. Further, major global manufacturers; including Intel, HP, Dell, Sony, Microsoft, IBM and Ericsson, have set up around 40 R&D centers in Taiwan, while domestic enterprises operate an additional 100 such centers. Consequently, Taiwan was ranked 6th for patents registered in the U.S. in 2008 (Ministry of Economic Affairs of Taiwan, 2009), and the proportion of R&D conducted by businesses based in Taiwan accounted for 67.20% of the total R&D expenditures in 2006.

Forty-six EMBA students at a university in southern Taiwan participated in the pre-test, and the results indicated that all the items were loaded as expected. Prior the survey, this study contacted the human resources department of each company and requested the addresses for each team leader along with those of the team members. Out of 200 contacted NPD teams, 87 completed and returned questionnaires with follow-up e-mails during a three-month period in early 2010. A total of 336 team members and 87 leaders participated in the formal study, with a response rate of 43.50%.

Research design and construct measurements

The team strain items were modified from Schein (1993) and tested by Akgun et al. (2006); with three items each on team crisis and five items on team anxiety. The measurement items for product innovation were adopted from Jordan and Segelod (2006); product advantage (three items) and product newness (two items). These research constructs were tested using a 7-point Likert scale, in which "one" refers to strongly disagree, and "seven" to strongly agree. The measurement items for market and technological dynamism were adopted from Jaworski and Kohli (1993), Moorman and Miner (1997) and Akgun et al. (2006). Finally, the four items for the perceived diversity climate items were adapted from Gelfand et al. (2005). The last two research constructs were tested by using a 5-point Likert scale, in which "one" refers to strongly disagree, and

"five" to strongly agree. This study required team leaders to give responses on external dynamism, team strain, and product innovation, while perceived diversity climate was responded to by team members. In order to maximize functional and conceptual equivalence during the translation process, the questionnaire was translated using a double translation method and was presented in both English and Chinese. All the research items are presented in Table 1.

As discussed by Feldman and Lynch (1988), respondents were able to use retrieved answers to earlier survey questions as inputs to respond to later questions. Thus, in order to reduce the effect of self-generated validity, this study followed the procedure of Podsakoff et al. (2003) by utilizing counterbalancing question order, with the survey questions not arranged sequentially. Moreover, this study proximally separated the measures by having respondents complete the measurement of the predictor and criterion variables in different response formats (that is, 5-point and 7-point Likert scales).

Respondents' descriptions

The following are the basic attributes of the teams, leaders, and firms examined in this study. Eighty-seven teams participated from 15 companies, and each company consisted of 1 to 17 teams. Most of the teams worked within companies operating in high-tech industries (55.3%), followed by low-tech industries (31.8%), and the rest were in the service industry. All the leaders who participated in this study had long tenure in their companies (more than 6 years, with 80% having more than 10 years), and had been engaged in more than five NPD projects. In order to clarify the complexity of the NPD project, this study also requested team leaders and members to focus on a project that they had been working on in the last six months. Half of the respondents indicated that the project was totally new, and half that, the products were developed based on existing platforms. In terms of team members, the majority had engaged in NPD projects less than five times (70%), and more than sixty-percent had been working in their companies for less than 10 years. Almost seventy-percent of the companies had been established for more than 16 years, and most had yearly sales of more than US$ 250 million (79.7%). Approximately 70% of the firms had less than 2,000 employees, and the rest had more than this.

Data aggregation

In order to determine the appropriate level of analysis, this study followed the suggestion of Schriesheim et al. (1995) by performing a within-group similarity or agreement index (r_{wg} : James et al., 1993). r_{wg} assessed inter-rater reliability in judgments with a single group of 'judges' (respondents) on a single variable (challenge/hindrance stressors, team unlearning, and team conflict) about a single referent, that is, a team. If the expected agreement was not present (r_{wg} > 0.70 was the suggested value to represent a 'good' amount of within-group inter-rater agreement; James et al., 1993), the variable was then considered an individual unit-level variable (George, 1990).

The r_{wg} estimates of within-group inter-rater reliability were derived for the perceived diversity climate. The mean value of the r_{wg} coefficients for perceived diversity climate was 0.71 (ranging from 0.21 to 0.89), and twenty groups with the 77 r_{wg} coefficients did not meet the agreement criterion. Therefore, the r_{wg} results justified aggregation of the variables reported by team members. In addition, r_{wg} was employed for external dynamism, team strain, and product innovation to test the within-group inter-rater reliability of each team and their leaders. The results indicated that the mean value of the r_{wg} coefficients for team strain was 0.57 (ranging from 0.26 to 0.83), and only nineteen groups with the 87 r_{wg} coefficients met the agreement criterion. Further results indicated that the mean value of the r_{wg} coefficients for team strain was 0.48 (ranging from 0.21 to 0.73), and only twenty-one groups with the 87 r_{wg} coefficients met the agreement criterion. Moreover, the mean value of the r_{wg} coefficients for product innovation was 0.51 (ranging from 0.25 to 0.69), and only nineteen groups with the 87 r_{wg} coefficients met the agreement criterion. Based on these results, this study employed the team level for analysis.

RESULTS

Reliability and validity of measurement constructs

The construct validity was assessed using the guidelines in Anderson and Gerbing (1988). Firstly, the exploratory factor analysis for all the items resulted in factor solutions, as expected theoretically. The Cronbach's α for each coefficient was greater than 0.700. Secondly, we used confirmatory factor analyses (CFA) to assess the convergent validity of the measures. Most of the item loadings exceeded 0.600; and each indicator t-value exceeded 10 ($p < .001$), thus satisfying the CFA criteria (Hair et al., 2010). One item was discarded (item 1 of the hindrance stressor) due to low factor loading and item-to-total correlation.

The overall fit supported the measurement model, and the χ^2 fit statistic was 532.752 with 231° of freedom, and the *p*-value was 0.080. The root mean squared error (RMSEA) was 0.089, and the comparative fit index (CFI) was 0.893. All these figures supported the overall measurement quality given a particular sample and number of indicators (Gerbing and Anderson, 1992), and the measures thus demonstrated adequate construct validity and reliability.

The results are presented in Table 1. To assess the potential impact of common method bias in the present study, the discriminant validity was tested in three steps. First, a Harman one-factor test was conducted (Podsakoff and Organ, 1986) which loaded all the variables into a principal component factor analysis. The results revealed that no single factor dominated (seven factors were generated with 72.869% of the total variance, and factor 1 was only 18.484% of the variance). Second, the variance-extracted percentages for any two factors were compared with the square of the correlation estimate between them (Fornell and Larcker, 1981). Table 2 reports the interfactor correlations and their squared values.

Table 1. Research items, factor loadings, and Cronbach's α.

Research Variables	Factor loadings	Composite reliability
I. **Environmental dynamism -** Jaworski and Kohli (1993), Moorman and Miner (1997), and Akgun et al. (2006)		
A. *Technology dynamism*		0.737
The technology in this industry is changing rapidly.	0.640	
A large number of new product ideas have been made possible through technological breakthroughs in this industry.	0.699	
Technological changes provide big opportunities in this industry.	0.859	
B. *Market dynamism*		
Customers' preferences change quite a bit over time.	0.795	0.827
Customers tend to look for new products all the time.	0.692	
Competitors offer new products frequently.	0.649	
Competition among competitors in this industry is very intense.	0.792	
II. **Team strain -** Schein (1993) and tested by Akgun et al. (2006)		
A. *Team crisis*		0.810
My team members feel that there is a crisis in the company or division (e.g., lower sales, profits) that this project would help solve.	0.883	
My team members feel that there is a crisis in the environment (concerning competitors, suppliers, or legal regulations) that this project would help alleviate.	0.876	
My team members feel that there is a crisis with customers or potential customers that this project would help solve.	0.821	
B. *Team anxiety*		0.853
The team members feel great pressure from company executives to launch this product successfully.	0.745	
The team members feel their jobs could be in jeopardy if this project fails.	0.723	
Overall, team members feel great pressure to succeed on this project.	0.878	
The team members feel great pressure from the environment to launch this product successfully.	0.845	
The team members feel great pressure from customers to develop this product.	0.847	
III. **Product innovation -** Jordan and Segelod (2006)		
A. *Product advantage*		0.831
Many features are different to those of the most similar previous products.	0.873	
The product has better performance compared to the closest available competing product in the market.	0.882	
The product design is very innovative.	0.874	
B. *Product newness*		0.723
New product platform for customers	0.815	
New product platform for competitors.	0.819	

Table 1. Contd.

IV. **Perceived diversity climate –** Gelfand et al. (2005)		0.827
The team makes it easy for people with different opinions or ideas to fit in and be accepted.	0.807	
Where I work, team members are chosen in advance without regard to their opinions or ideas.	0.693	
The team leader demonstrates through their actions that they accept different opinions or ideas.	0.836	
I feel that my team leader does a good job of managing people with diverse opinions or ideas.	0.892	

χ^2df) = 532.752 (231); p = 0.080; CFI (RMSEA) = 0.893 (0.089).Italicized research items were deleted due to low factor loadings.

Table 2. Means, standard deviations, and correlations.

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
Type of industry	1.812	0.645	n.a.	0.011	0.027	0.056	0.039	0.006	0.000	0.002	0.021	0.086
Sales	3.750	0.557	-0.105	n.a.	0.000	0.018	0.037	0.012	0.012	0.023	0.000	0.005
Project complexity	1.598	0.493	0.164	0.011	n.a.	0.003	0.020	0.177	0.021	0.078	0.218	0.000
Technology dynamism	3.762	0.735	0.237	0.136	0.054	0.733	0.269	0.150	0.290	0.183	0.065	0.103
Market dynamism	4.037	0.708	0.197	0.192	-0.140	0.519	0.732	0.231	0.158	0.347	0.183	0.033
Team crisis	4.969	0.900	0.080	0.110	-0.421	0.387	0.481	0.760	0.387	0.122	0.098	0.005
Team anxiety	5.423	0.985	0.010	0.107	-0.146	0.539	0.398	0.622	0.742	0.079	0.112	0.037
Product advantage	4.992	1.050	0.049	0.150	-0.279	-0.428	0.589	-0.349	-0.281	0.774	0.513	0.047
Product newness	4.657	1.161	0.144	0.009	-0.467	-0.254	0.428	-0.313	-0.335	0.716	0.589	0.069
Perceived diversity climate	3.433	1.314	0.293	0.072	-0.019	0.321	0.182	0.073	0.192	0.216	0.262	0.743

Correlation values greater than 0.200 is significant at p < .05, correlation values greater than 0.280 is significant at p < .01. Values at diagonal are AVE. Values below diagonal are inter-factor correlation, and values above diagonal are squared inter-factor correlation. n.a. refers to not available.

It shows that each of the variance-extracted estimates was greater than the corresponding inter-factor squared correlation estimates (that is, had values above the diagonal). Finally, an χ^2 - difference test was performed for each pair of factors that had correlation values above 0.500 (six cases) by using the common method factor. All cases resulted in a significant difference, which further indicated that the pairs were not collinear (Anderson and Gerbing, 1988). Therefore, discriminant validity among the research constructs was further confirmed.

To test the hypotheses, this study used structural equation modeling with the maximum likelihood estimation method. Because of the complexity of the model, second-order factors were used. Given the measurement validity of the overall research variables, this technique reduced model complexity and could be used for structural model analysis and hypotheses testing (Anderson and Gerbing, 1988). The model had an χ^2 = 114.361 with 38° of freedom, the CFI = 0.934; the RMSEA = 0.083; and the p-value = 0.110; which suggested that the model fit the data. To assess whether the proposed model was better than a rival one, a comparison of the fit indices was undertaken (Bagozzi and Yi, 1988). The rival model was developed by asserting that market and technological dynamism mainly influence team strain, while team strain is the only variable that influences product innovation. The model generated an χ^2 (df) = 148.211 (41), and the CFI (RMSEA) = 0.766 (0.174). The second rival model

Table 3. The moderating effects of task and relational conflicts.

Dependent variables	Dependent variable: Product innovation			
	Product newness		Product advantages	
	M1	M2	M3	M4
Control variables				
Type of industry	0.121	0.118	0.145	0.076
Sales	0.009	0.007	0.269*	0.184^{+}
Type of project	-0.352***	-0.253*	-0.329**	-0.138
Main effects				
Team crisis (TC)	-0.323**	-0.315**	-0.319**	-0.307**
Team anxiety (TA)	-0.290**	-0.284**	-0.284**	-0.273**
Perceived diversity climate (PDC)		0.187^{+}		0.213*
Interaction effects				
TC x PDC		-0.191*		-0.205*
TA x PDC		-0.207*		-0.216*
R^2	0.266	0.487	0.151	0.370
ΔR^2	0.221	0.046	0.219	0.075
ΔF	7.509	5.951	13.189	7.951
Sig.	0.001	0.017	0.001	0.008

$^{+}$Represents p < 0.10; * represents p < 0.05; ** represents p < 0.01.

assumed that all the research variables are directly related to product innovation. The model generated an χ^2 (df) = 172.552 (41), and the CFI (RMSEA) = 0.713 (0.193), which suggested that the proposed model performed better than did the rival ones.

The first hypothesis predicted that market dynamism has a positive influence on team strain, and the results supported this (β = 0.302, p = 0.043). The second hypothesis predicted that technological dynamism has a positive influence on team strain, and the results were also consistent with this (β = 0.503, *p* < 0.001). Hypothesis 3 posited that market dynamism has a positive influence on product innovation, and again, the results indicated that there is a positive influence of market dynamism on product innovation (β = 0.520, p < 0.001). Hypothesis 4 posited that technological dynamism negatively influences product innovation, and although it was not significant, the directional influence did not support this (β = -0.286, p = 0.098). The Hypothesis 5 predicted that team strain negatively influences product innovation, which was also indicated by the results (β = -0.583, p < 0.001).

In order to test the moderating effects proposed in H_6 and H_7, this study used a hierarchical regression, since the predictor (team strain) and moderator (perceived diversity climate) were measured by using continuous variables. The use of a regression can retain the continuous nature of the variables without losing information or reducing the power to detect the interaction effects (Aiken and West, 1991). However, there is the possibility that variables might correlate with each other (high multicollinearity), and thus, this study applied the centering method to reduce these effects (Frazier et al., 2004). In addition, based on suggestions from previous studies (Akgun et al., 2006; Hoegl and Parboteeah, 2005), this study employed three control variables inside the regression equations: type of industry, sales, and project complexity.

The results presented in Table 3 show that perceived diversity climate had a direct significant effect on product newness (β = 0.187, p = 0.087; M2). Further, perceived diversity climate moderates the effects of team crisis (β = -0.191, p < 0.05; M2) and team anxiety (β = -0.207, p <.05; M2) in a significant manner (ΔR^2 = 0.046, ΔF= 5.951, p = 0.017). There was also a significant positive influence of perceived diversity climate on product advantages (β = 0.213, p < 0.05; M4). Further results indicated that the effects of team crisis (β = -0.205, p < 0.05; M4) and team anxiety (β = -0.216, p < 0.05; M4) were positively moderated by perceived diversity climate in a significant manner (ΔR^2=0.075, ΔF = 7.951, p = 0.008). Therefore, H_6 and H_7 were supported.

Following the procedure of Aiken and West (1991), Figure 2 depicts the moderating effect of perceived diversity climate. The first Figure indicates that experiencing more crisis reduced the level of product newness, regardless of the level of perceived diversity

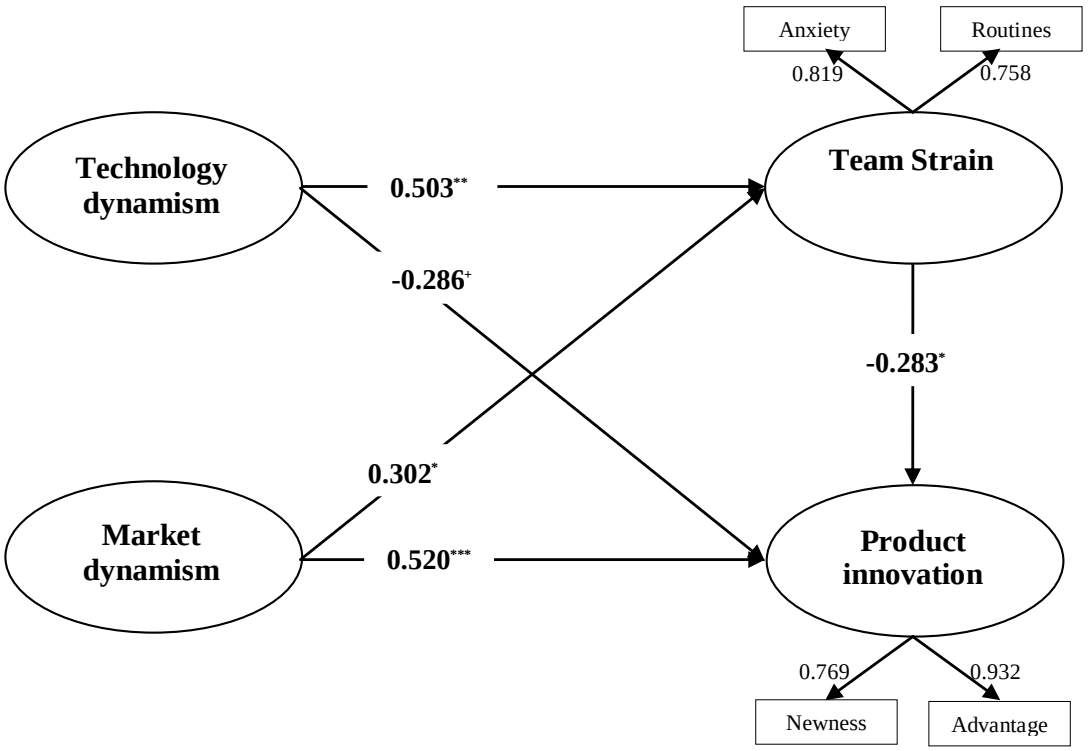

Figure 1. Result of path model; χ^2 (df) = 114.361 (38), CFI (RMSEA) = 0.934 (0.083), p = 0.10; $^+$ refers to p <.10, * refers to p < 0.05, ** refers to p < 0.01.

climate ($\overline{Y}_{HDC}$ = 4.393 and $\overline{Y}_{LDC}$ = 4.354). Interestingly, when the team experienced less crisis and at the same time perceived that the diversity climate was high, the level of product newness increased dramatically ($\overline{Y}_{HDC}$ = 5.412).

In contrast, although the NPD teams were experiencing less crisis, perceiving a low diversity climate decreased their level of product newness close to the condition where they were experiencing more crisis ($\overline{Y}_{LDC}$ = 4.469). A similar pattern was also found regarding team anxiety, which is shown in the Figure 2. Product newness reached the highest level when the teams experienced less anxiety and at the same time perceived a higher diversity climate ($\overline{Y}_{HDC}$ = 5.450), and dramatically decreased when the teams perceived a lower diversity climate ($\overline{Y}_{LDC}$ = 4.423). In the case of more anxiety, there was no significant difference between a high and low perceived diversity climate ($\overline{Y}_{HDC}$ = 4.355 and $\overline{Y}_{LDC}$ = 4.399).

The third Figure indicates that experiencing more crisis significantly led to lower product advantage when a team perceived either a higher ($\overline{Y}_{HDC}$ = 4.753) or lower diversity climate ($\overline{Y}_{LDC}$ = 4.678). Product advantages reached the highest level when the teams experienced less anxiety and at the same time perceived a higher diversity climate ($\overline{Y}_{HDC}$ = 5.791), and dramatically decreased when the teams perceived a lower diversity climate ($\overline{Y}_{LDC}$ = 4.746).

The Figure 2 also depicts a similar pattern. Specifically, experiencing more anxiety reduced the level of product advantages, regardless of the level of perceived diversity climate ($\overline{Y}_{HDC}$ = 4.723 and $\overline{Y}_{LDC}$ = 4.722). Interestingly, when the team experienced less anxiety and at the same time they perceived that the diversity climate was high, the level of product newness increased dramatically ($\overline{Y}_{HDC}$ = 5.820). In contrast, although the NPD teams were experiencing less crisis, perceiving a low diversity climate decreased their level of product newness close to the condition in which they were experiencing more anxiety ($\overline{Y}_{LDC}$ = 4.701).

DISCUSSION

The results indicated that market and technological

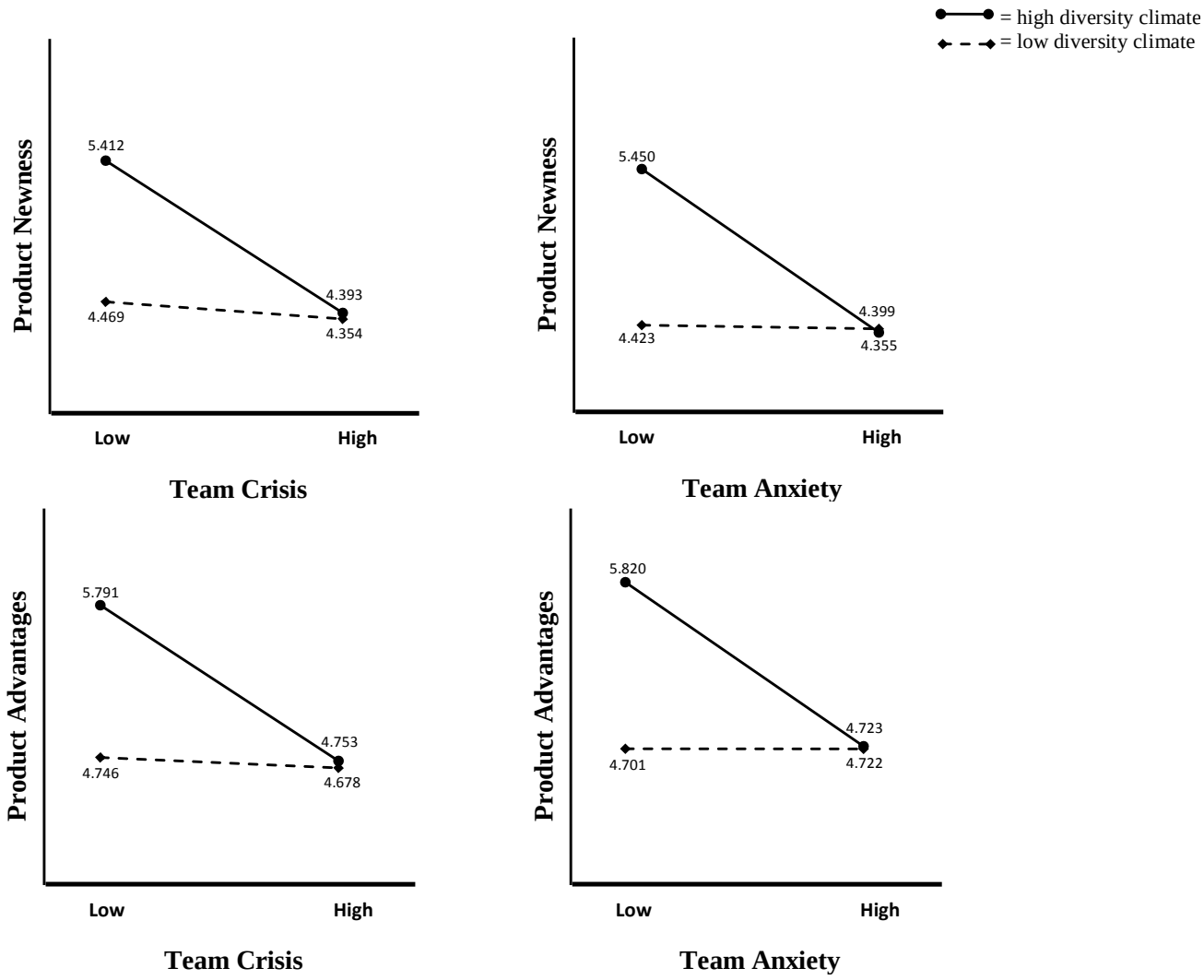

Figure 2. The Moderating effect of perceived diversity climate.

dynamism do indeed positively influence the level of team strain. The rapid changing of consumer preferences or disruptive technologies created uncertainty among team members and heightened the level of team crisis and anxiety. The findings were consistent with the notion of Akgun et al. (2006), who suggested that environmental dynamism creates disequilibrium, in terms of social harmony as well as with regard to cognitive coordination inside NPD teams, and causes team members to be unable to foresee the consequences of their actions. The findings also concur with the notion of Edelman and Benning (1999), who indicated that environmental turbulence causes organizations and their subunits to face threats of performance gaps, work stress, accusations, blame being placed among team members, and feelings of anxiety and crisis. Therefore, the first research question addressed in this study has been answered with the conclusion that both technology and market dynamisms determine the level of team strain and product innovation.

The second finding indicated that market and technological dynamisms have different consequences on product innovation, which is not in line with Akgun et al. (2006). Because firms place a high level of emphasis on customer preferences, rapidly changing markets require NPD teams to be aware that the preferences for new products will be different from those for previous ones. Consequently, NPD teams will select from a wide range of diverse possible features to be applied into newly developed products, and thus, will increase the newness and advantages of the items. In contrast, technological dynamism requires NPD teams to select and apply specific technology and to adopt it into newly developed products. Without a clear item which technologies should be selected, teams tend to wait and see what will be the new standards. Consequently, NPD

teams generally adopt less innovative technology in newly developed product.

The third finding indicated that team strain negatively influences the level of product innovation. Although this finding is not consistent with the results of Akgun et al. (2006), who found that team crisis and anxiety have a positive influence on the NPD success, this study argues that the NPD teams' inability to integrate prior knowledge into current projects (Pauchant and Mitroff, 1990) reduces their ability to develop innovative products. Moreover, anxious teams tend to interpret unclear information in a negative manner (Akgun et al., 2006), which in turn reduces their ability to evaluate alternative options objectively (Kontogiannis and Kossiavelou, 1999). Consequently, the level of product innovation will be lower.

Finally, the fourth finding indicated that greater perceived diversity climate weakens the negative influence of team strain on product innovation. As described earlier, experiencing team strain, causes NPD teams to be unable to process information effectively. Based on the idea of van Knippenberg et al. (2004), a higher perceived diversity climate leads people to respond more favorably through extensive knowledge exchanges, and thus increases the level of work group functioning. Consequently, the level of product innovation is higher when NPD teams perceive the climate to be more diverse. This finding also answers the second research question, revealing that greater perceived diversity climate could positively leverage the effects of team strain on product innovation.

Implications

This study has implications for practitioners as well as for academics. For practitioners, the findings imply that managing environmental dynamism is necessary to manage NPD team strain. Moreover, R&D managers should be able to direct NPD teams to place more emphasis on the market rather than technological dynamism. The reason is that, market dynamism provides rich and useful information to predict consumer need and thus any new features or designs introduced in newly developed products which are based on consumer preferences will lead to greater product innovation and market success. Secondly, managers should encourage and support proactive changes in belief and routines to better respond to environmental shifts. In addition, managers are advised to plan project activities in a flexible manner that allows changes as the project evolves (Thomke and Reinertsen, 1998). Moreover, another practical solution is coaching the team in lateral (creative) thinking based on the work of de Bono (1970), which is trainable, involves many members of the organization, and tends to lead to creative solutions. Thirdly, R and D managers should be aware that NPD teams have a significant probability of experiencing anxiety and crisis related to their assignment. Consequently, they need to carefully transform team strain into positive energy that will lead to an unlearning process (Akgun et al., 2006) that will further result in more innovative products. Finally, the findings implied that R&D managers should implicitly and explicitly communicate the organizational policies, practices, and procedures that demonstrate high regard placed on diversity, particularly with regard to information. By doing so, there will be no worries and fears among the NPD team members when they need to propose some changes to the accepted way of developing innovative products.

In addition to these managerial implications, this study has several theoretical ones. First, this study contributes to the team strain literature (Akgun et al., 2007; Barczak and Wilemon, 2003; Kim and Wilemon, 2001) in that, experiencing crisis and anxiety leads to less innovative products. Second, this study contributes to the environmental dynamism literature (Akgun et al., 2006; Baum and Wally, 2003) in that, market and technological dynamism has the opposite consequences on product innovation. Specifically, market dynamism leads to more innovation, while technological dynamism leads to less. Third, this study contributes to the organizational climate literature (Gelfand et al., 2005) by examining how a perceived diversity climate can moderate the negative effect of team strain on product innovation. By asserting the concept of informational diversity, this study shows that maintaining diversity, either implicit or explicit, through organizational routines is beneficial to the development of innovative products.

Limitations and future research directions

Although these research results are compelling, several limitations exist. Firstly, this study asserts that team strain or a diversity climate could be present in any industry. Consequently, this study refers to general, rather than specific, product innovation (Prajogo and Ahmed, 2006; Tjosvold et al., 2004). In order to increase the generalizability of the findings, future studies could discuss innovation in specific industries, such as software (Hoegl and Parboteeah, 2006) or high-tech industries (Akgun et al., 2006) to improve the validity of the findings. Secondly, this study agrees with Barczak and Wilemon (2003) that, stress could also be rooted in internal (relationship) conflict among team members. However, since this study focuses only on the stress engendered by the external environment, it does not specifically discuss the stress rooted in relationship conflict. Future studies could elaborate the issue of stress originating from outside and inside the NPD team to provide more comprehensive views of how it could affect their effectiveness. Finally, this study mainly employs a cross-sectional method to discuss the antecedents and consequences of strain. Employing multiple case studies

with a longitudinal time frame could reveal the importance of context (Siggelkow, 2007) for team strain and how teams cope with it.

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