The Effects of Multi-Sources of Stress on the Effectiveness of NPD Team: The Moderating Effects of Task Familiarity

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Abstract: Few studies discuss comprehensively about the antecedents and consequences of stress among NPD teams. This study asserts that NPD teams often experience stress (crisis and anxiety) during the development of new product. Prior studies suggest that team stress could reframe teams' routines and beliefs, but negatively influence the level of product innovation. There are three sources of team stress identified in this study: external, challenge, and hindrance stressors. Moreover, this study proposes that the effects of team stress on team effectiveness will be moderated by task familiarity. Task familiarity refers to innovation tasks that NPD team pursue, whether incremental innovation (high familiarity - exploitation) or radical innovation (low familiarity exploration. The proposed hypotheses are tested on nearly 200 NPD teams in Taiwan, and the results further confirm the predictions. This study expects that propositions developed in this study can be provided as a fundamental references material for both academicians and professionals to manage stress in NPD teams to generate innovative products.
Keywords: external stressors, challenge stressors, hindrance stressors, team strain, team reframing, and product innovation

INTRODUCTION

According to Griffin (1997), the average success rate of NPD in USA was about 59%, whereas 100 ideas lead to 15.2 successful new products. Recent study conducted by Ozer and Chen (2006) by using cross-sectional survey in Hong Kong found that the success rate of NPD in Hong Kong is 44.91%, and 100 ideas only lead to 2.15 successful new products. The authors argue that Hong Kong firms use less NPD process, and this is the main reason why US firms seem to be more successful in NPD. In addition, according to Griffin (1997), US firms spend on average 23.8 months to develop an "innovative" new product, however Hong Kong firms from different industries spend on average 12.94 months to develop it (Ozer & Chen, 2006). It is reflecting the fast pace of doing business in Hong Kong, on the other hand, decrease their success level of NPD (Ozer, 2006).

Despite the fact that NPD processes support the performance of NPD in the market, only few studies discuss about why NPD are failed. One stream argues that NPD teams fail because they employ their existing beliefs and routines (Akgun, Lynn, and Byrne, 2006). Based on dynamic capabilities perspective (Teece, Pisano, and Shuen, 1997), this study asserts that the success of NPD depends on team's abilities to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. These abilities refers to team reframing (Drazin, Glynn, and Kazanjian, 1999) or unlearning (Akgun, Lynn, and Byrne, 2006) as members' attitude to learn and adopt new routines and capabilities. The reframing concept originated from March's organizational adaptation theory (Cyert and March, 1963) and Lewin's (1951) organizational change theory. Organizational adaptation theory argues for the influences of environmental forces and strategic choices to organization's response to change. Adaptation theory notes that flexible organizations usually respond to threats and opportunities, which were created by environmental change, by altering organizational strategies and structures to enhance performance and prospects for survival. Both organizational adaptation and change theories involve reframing.

Prior studies have identified that team reframing is influenced by the level of team crisis and anxiety – team strain (Akgun, Byrne, Lynn, and Keskin, 2007; Akgun et al., 2006; Jex, 1998). According Kim and Wilemon (2001), project team members in NPD are often confronted with stressful situations as they have to adapt to new or changing customer demands, technical uncertainties, organizational ambiguities, and encounter various types of conflicts. Many previous studies have examined the importance of reframing merely in the conceptual framework, and most of prior studies views innovation process as results of existing routines and beliefs reside within organization or team (e.g., Zollo and Winter, 2002; Nahapiet and Ghoshal, 1998). This study argues that the probability to create innovative products will be very low if NPD team employs their existing beliefs and routines. In order to produce innovative products while at the same time develop new product successfully in the market, team should change their existing beliefs and routines, i.e., reframing (Akgun et al., 2006).

Indeed, a person's feelings and perceptions of a stressor are determined not only by his/her individual characteristics, but also by things such as project-related task works, routines and processes. At the team level, stress perceived by team members is embedded in the social system of the group of individuals via their relationships and networks, and is apprehend in the collective actions of team members (Akgun et al., 2007). Based on that, this study asserts that there are two sources of stress related with work-context: challenge and hindrance stressors (Cavanaugh, Boswell, Roehling and Boudreau, 2000). Challenge stressors refer to stressful demands

viewed by NPD team as obstacles to be overcome in order to learn and develop innovative products. Hindrance stressors refer to stressful demands viewed by NPD team as unnecessarily thwarting personal growth and goal attainment. Moreover, this study asserts that stressors also originate from the external environment as demonstrated by Akgun et al. (2006). They further argue that the rapid changing of technology and market could become the sources of stress experienced by NPD team.

Moreover, this study proposes that different types of innovation task that NPD teams had could moderate the effects of team strains on the level of team reframing, product innovation, and NPD performance. Specifically, when NPD teams require to develop newly category of product (radical innovation), they are less familiar with their tasks (Espinosa, Slaughter, Kraut, and Herbsleb, 2007) which will increase their level of strain. As a consequence, the level of product innovation and NPD performance will be reduced, but the probability that NPD teams reframe their current beliefs and routines will increase. On the contrary, when NPD teams require developing new product based on the existing platform (incremental innovation), their level of familiarity will be high (Espinosa et al., 2007) which will reduce their level of strain. As a result, the negative effects of anxiety and crisis that the NPD teams have on product innovation and NPD performance tend to be low compare to when they are less familiar. However, NPD teams tend to reduce their willingness to reframe their existing beliefs and routines when they are less than more familiar with the assignment.

Based on above discussions, this study has several objectives as follow: First, to evaluate the effects of multiple stressors on the level of team strain. Second, to examine the different effects of team strain on the willingness of NPD team to reframe their beliefs and routines, and level of product innovation. Third, to evaluate the moderating effect of team familiarity toward current tasks on the effects of team strain on team reframing and product innovation.

Specifically, the research framework of this study is depicted in Figure 1.

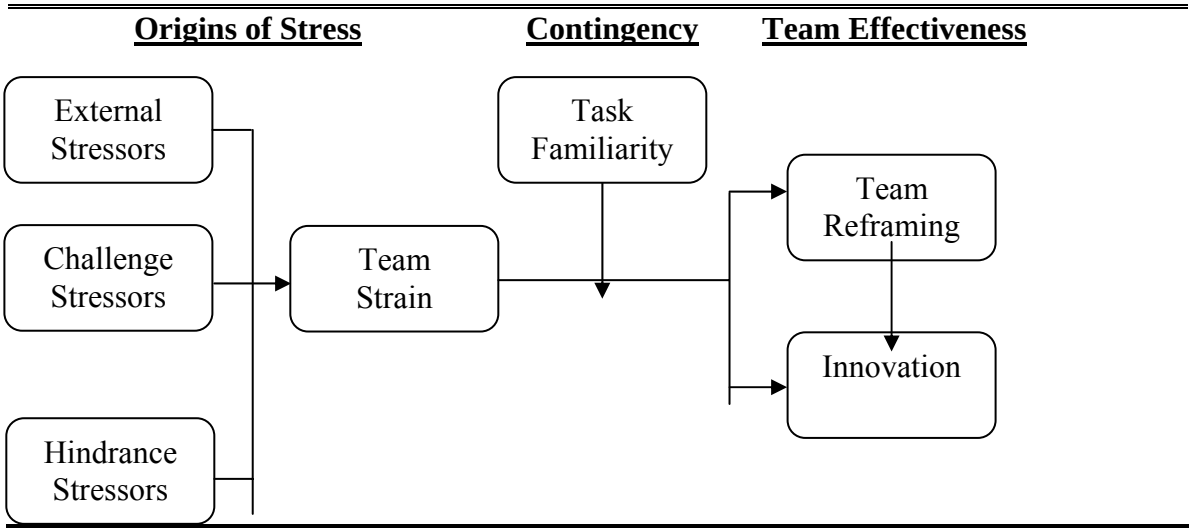

Figure 1. The research framework of this study

HYPOTHESES DEVELOPMENT

The multiple sources of stress

Even though the trigger role of environmental turbulence for the change process is well known (e.g., Schein, 1993), scholars have also noted that environmental turbulence can act as a catalyst for change rather than be a factor of the change process per se (Edelman and Benning, 1999). In the NPD team context, environmental turbulence, whether due to rapidly changing customer tastes and preferences or a similarly disruptive event such as a new technical discovery creates a shock. This shock can cause NPD members an emotional state of confusion, helplessness, and intense anxiety; and this misfit may destroy team-process equilibrium as team members are not yet familiar with the 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 completing the project, which could lead to team stress (Akgun et al., 2006).

As discussed before, the nature of stressors have different effects on team strain (Jex, 1998). On the one hand, scholars have consistently reported negative relationships between performance and stress associated with factors such as role ambiguity, role conflict, and hassles (e.g., Beehr, Jex, Stacy, & Murray, 2000; Fox, Spector, & Miles, 2001). On the other hand, scholars have occasionally reported positive relationships between performance and stress associated with the level or the demands of the work itself (e.g., Beehr et al., 2000; Sargent & Terry, 2000). This pattern of findings is consistent with research suggesting that stress may be distinguished as to whether it is appraised as hindering or promoting mastery, personal growth, or future gains (Folkman & Lazarus, 1985;

Lazarus & Folkman, 1984; Boswell et al., 2004). Scholars have differentiated the former type of stress (henceforth, *hindrance stress*) from the latter type of stress (henceforth, *challenge stress*) with respect to important attitudes and behavior (e.g., Beehr et al., 2001; Boswell et al., 2004; Cavanaugh et al., 2000). However, there has been no research in which hypotheses have been made about the effects of the two stressors on team strain. This study posits that when the members of NPD experience challenge stressors, their level of crisis and anxiety will be reduced. However, when their stressors are dominated by hindrance stressors, their level of team strain will be high. Based on that, the following propositions are developed:

H_1: The level of NPD team strain are positively influenced by (a) external stressors, (b) challenge stressors, and (c) hindrance stressors

The effects of team strain

According to Drazin et al. (1999), when a team experiences a crisis, team members (including managerial and technical staff) can shift, alter, or discard their common beliefs to establish a new collective order to resolve the crisis. A crisis can affect the functioning of a NPD team by (1) narrowing the cognitive processes of individuals; (2) hindering their ability to plan, reason, and understand the situation effectively; (3) fostering a sense of inadequacy of the combination of unexpected linkages between variables, such as market, technology, people, and process; and (4) limiting individuals' prior knowledge on the potential interactions between process and project variables and their consequences (Pauchant and Mitroff, 1990). In response, a cognitive defensive mechanism, which promotes a flexibility to cope with a current situation, maybe activated during the project because team members are required to act quickly and are threatened with losing prestige and potentially their jobs. The activation of cognitive defensive mechanisms refers to the definition of team reflexivity. When NPD team members realize that there is a need to constantly reflect and contemplate by assessing the most current environment in order to apply the best action (Hoegl and Parboteeah, 2006), they tend to reframe or change their existing routines and beliefs to cope with feelings of stress and pressure, to avoid losing the control of a complex NPD process, and to improve the systematic effectiveness of the NPD project (Akgun et al., 2006).

Based on the writings on cross-functional team integration (Kahn, 1996; Millson and Wilemon, 2006) and structuration theory (Giddens, 1984), stress is socially distributed in teams and denotes the collective awareness of individuals of stressors as a result of perceived conditions or happenings in the project's processes. Thus, stress is a collective reality in team settings which might hinders team members to function effectively (Akgun et al., 2006). In the context of NPD, team anxiety reduces the team members' capability to evaluate the alternative options, project procedures and tools, and the ability to interpret new information fairly (Kontogiannis and Kossiavelou, 1999), which will reduce the ability for team to develop innovative products.

H_2: Team strain has positive influence on the level of (a) team reframing and (b) product innovation

The effects of team reframing on product innovation

The innovation of the product should offer advantages to the customers, which refers to customer-perceived superiority as to quality, benefit, and functionality and it has been noted as a strategic factor that drives new product success (Montoya-Weiss & Calantone, 1994). Moreover, product innovation has been suggested as a major determinant of new product performance (Griffin & Page, 1996; Im & Workman, 2004). Recent study conducted by Zhou (2006) indicated that product innovation will lead to better new product performance. Moreover, by comparing with imitation strategy, this cross-industry survey indicated that product innovation is superior to imitation strategy. The reason is because innovative products always offer newness relative to the competitor.

NPD teams with fixed routines can diminish chances of success in the development and subsequent launch of a new product because the team cannot integrate new information (e.g., market, technical, regulatory) effectively. Project routines facilitate fixed responses to any information in a manner that requires little thought, which Ashforth and Fried (1988, p. 305) refer to as ''mindlessness'' or ''reflexive sense-making.'' This is similar to the notion of habitual routines that Gersick and Hackman (1990, p. 69) define as occurring ''when a group repeatedly exhibits a functionally similar pattern of behavior in a given stimulus situation without explicitly selecting it over alternative ways of behaving.'' Productive changes become impossible when the status quo is reinforced by fixed routines as determined by project default plans and authoritarian procedures. In contrast, as Imai, Nonaka, and Takeuchi (1988) noted, one of the strengths of Japanese product development teams is their flexible product development process that allows them to adapt their strategies to changing environments. Similarly, Iansiti (1995) argued that extreme turbulence requires flexibility and responsiveness, especially in the development of new products and technologies. Teams can cope with turbulent conditions by ''embracing change'' (p. 38) during the product development process and systematically altering a project's definitions, directions, and product architectures.

Incorrect beliefs or mindsets tend to incorporate errors in judgment and actions because team members alter the perception of reality to fit their schema, which helps to describe people's willingness to focus on information that supports their current beliefs (Rousseau, 2001). Fixed beliefs lead to perception rigidity or inaccurate causal attributions, which make teams slower to recognize changes (and problems) (Dickson, 1992). Thus, a team belief structure-a common understanding that binds team members to particular course of action—might not permit adequate or accurate processing of new information emerging from the environment and is likely to inhibit its incorporation into new project activities under turbulent conditions. Eliminating team memory, which is a charac-

teristic of unlearning, alters or dismisses obsolete information, thus allowing the processing of new knowledge and making teams more flexible in their actions and behaviors under turbulent conditions.

This study proposed that newness could be generated when the NPD team changes their beliefs and routines. When the team experienced success in the past, usually they will adopt similar beliefs and routines to develop the new product. However, this process will not generate new ideas, because they develop based on similar ideas platform. Therefore, in order to develop newly product (in terms of features or advantages), the team should adopt new beliefs and routines in the innovation process. Furthermore, Song and Montoya-Weiss (1998) found that really new products outperform incremental products in this capacity. By emphasizing on innovation, a firm invests substantially in R&D and aims to be the first to bring the innovative product to market (e.g., Green, Barclay, & Ryans, 1995; Schnaars, 1994).

H_3: Team reframing has positive influence on the level of product innovation

The moderating effects of task familiarity

Previous studies seem to intuitively propose that familiarity with the task improves team performance; however, the empirical evidences are not so clear (Espinosa et al., 2007). Summarizing the mixed results in the familiarity literature, Harrison and colleagues (Harrison et al. 2003) conjectured that the effects of familiarity on team performance may differ depending on the nature of the task itself. Similarly, Argote and colleagues (Argote et al. 1995, Reagans et al. 2005) also concluded that the task matters when studying the effects of familiarity. Their experimental study shows that team performance increased with task experience and decreased with task complexity; performance on simpler tasks improved more strongly with task experience than on more complex tasks. They also found that team member turnover had a negative effect on performance but this effect was weaker with more complex tasks, possibly because teams with higher turnover were more innovative (Argote et al. 1995).

In addition, as discussed before, NPD team may reframe their beliefs and routines when they experience crisis and anxiety to resolve (Drazin et al., 1999). Similarly, Akgun et al. (2006) found that NPD teams tend to revise or change their existing routines and beliefs to cope with feelings of stress and pressure, to avoid losing the control of a complex NPD process, and to improve the systematic effectiveness of the NPD project. The effects of crisis and anxiety will be strengthened when the familiarity of NPD teams toward their current tasks are low than high. In other words, when NPD teams assigned to develop radical innovative products, their familiarity toward the assignment is low (Espinosa et al., 2007). As a consequence, they might not rely on their existing beliefs and routines to complete their assignment. Therefore, the probability to reframe their beliefs and routines will be higher when they are less familiar with their tasks than more familiar.

H_4: The positive effects of team strain on team reframing are strengthened when NPD teams are more familiar than less familiar with the tasks

Furthermore, previous discussions also posit that team strain negatively influence the level of newness and advantage that new products offered. The newness of new product developed by the NPD team tends to be low when they experienced crisis and anxiety during the assignment. In similar manners, the advantages that offered by newly developed product will be less when the NPD teams experience strains. The negative effects of team strain tend to be strengthened when the assignment given to the NPD teams are complex, and when NPD teams are less familiar with. On the contrary, when NPD team assigned to develop new products based on existing platforms, the negative effects of team strain on product innovation will be weakened.

H_5: The negative effects of team strain on product innovation are strengthened when NPD teams are more familiar than less familiar with the tasks

METHODS

Online and offline questionnaire surveys will be distributed to 100 R&D team of new product development (NPD team, which consist of 1 team leader and several team members), totally 500 respondents from Hsin Chu, Taichung and Tainan Science Park. The survey material included a cover letter from researcher and university-addressed. Respondents were asked to express their opinions about their sources of stressors, team strain, team reframing, product innovation, as well as task familiarity to follow up and to ask for their responses. Respondents will promise to complete anonymity of any information that they submitted. Because of the nature of the data collection (i.e., cold-email, demanding, and lengthy surveys that required distribution to specific social referents by NPD team managers, NPD team members, and/or R&D managers), this study offered a “lucky draw” incentive for each of 5 people at an international five-star hotel in Hsinchu, Taichung, and Tainan, respectively.

Survey questionnaire items were designed based on the review of literature and qualitative study. For external stressors, there were two factors of external stressors: technological (three items) and market dynamism (four items). The items are adopted from Jaworski and Kohli (1993), Moorman and Miner (1997) and Akgun et al. (2006). For challenge stressors, potential items (six items) were generated from Cavanaugh et al. (2000) and tested by Boswell et al. (2004). For hindrance stressors, potential items (five items) were modified from the items developed by Cavanaugh et al. (2000) and LePine et al. (2004). There are two factors for team stressors, team crisis (three items) and team anxiety (five items). The items were adopted from Schein (1993) and tested by Akgun et al. (2006).

Team reframing has two factors: team beliefs (four items) and routines changes five items). The items are adopted from Weber and Crocker (1983), Moorman and Miner (1997), and tested by Akgun et al., 2006. Product innovation has two dimensions: product advantage (three items) and newness (two items). Potential questionnaire items were adopted from Jordan and Segelod (2006). Finally, task familiarity has four items which were adopted from Moorman and Miner (1997) and Brockman and Morgan (2006).

Out of 600 respondents, 198 questionnaires from NPD team members and 54 of NPD team leaders were completed. Twenty-one responses were dropped due to incomplete answers. The information and electrical industry is the majority industries in this study. More than 40% of the firms' histories were between 10 to 15 years, and more than 60% of the firms had the employee number below 500 and, above 50% of the firms' capital was above 150 million USD. Furthermore, upon examination of the ratio of expenditure on research and development and on new product development, more than 70% of the firms were below 5%.

Measurement Reliability and Validity

The construct validity is assessed using principal component factor analysis. All loadings exceed .60 and each indicator t-value exceeds 7.00 ($p < .001$). Coefficient α exceeds .70 for each factor. All support the overall measurement quality (Hair et al., 2006), and these measures demonstrate adequate convergent validity and reliability. Because the same respondents are used to collect information on the independent and dependent variables, a common method bias may occur. Following Podsakoff et al. (2003), this study assesses whether a common method bias exists by performing a Harman one-factor test that loads all the variables into a principal component factor analysis. The factor analysis results reveal that a solution accounts for 83.47% of the total variance, and factor 1 accounts for 18.14% of the variance. Because a single factor did not emerge and factor 1 did not explain most of the variance, a common method bias is unlikely to be a concern in the data.

The discriminant validity is tested in two steps. First, compare the variance-extracted percentages for any two factors with the square of the correlation estimate between these two factors (Fornell and Larcker, 1981). Table 1 reports the interfactor correlation and its squared value. Each of the variance-extracted estimates is greater than the corresponding inter-factor squared correlation estimates (i.e., values below the diagonal). Second, the $\chi 2$-difference test was performed for each pair of factors (a total of 17 tests in overall data for correlation values above 0.50), and in every case resulted in a significant difference, which further indicates that the pair is not collinear (Anderson and Gerbing, 1988). Therefore, the results show each factor has no problems with discriminant validity. Moreover, the correlations between factors were consistent and indicate nomological validity.

RESULTS AND DISCUSSIONS

Multiple regressions are used to test the proposed hypotheses. The results indicated that three sources: external stressors, challenge stressors and hindrance stressors are significantly contributed to team strain. As predicted, team strain positively influence on the levels of team reframing, however, it negatively influence team level of product innovation. Interestingly, the greater level of team reframing contributes positively on the level of product innovation. By using hierarchical multiple regressions, further results confirm that task familiarity moderate the positive effects of three sources of team stressors on team strain.

This study also proposes to examine the effects of team strain on team reframing, product innovation, and NPD performance. Moreover, the moderating effects of team familiarity with current project and perceived fairness on the effects of team strain on team reframing, product innovation, and NPD performance are examined.

The research promises to contribute our understandings of NPD practices by developing comprehensive model that encompassed the antecedents and consequences of team strain (crisis and anxiety) on the success of new product development. The antecedents include external stressors (rapid changing of technology and market) and internal team stressors (hindrance and challenge stressors). The three antecedents are proposed to be mediated by team strain before some changes of team's routines and beliefs applied by team. This study asserts that team's reframing will have some effects on the product innovation. The second purpose of this study is to evaluate the moderating effects of team familiarity toward the tasks being assigned to on the effects of team's strain on team reframing, product innovation, and NPD performance.

Several suggestions could be made for academic and business practitioners. First, how to create NPD team change their beliefs and routines is the key issue for product innovation. Second, to promote team reframing in the dynamic NPD process, managing team strain by understanding three sources of team stressors: external, hindrance, and challenge stressors could be a starting point for R&D Manager. Moreover, managers should understand that the degree of familiarity toward task can moderate the effects of team stressors on team strain as well as on team reframing and product innovation.

Although these research results are compelling, several limitations exist in this study. These limitations suggest areas and directions for further research. The cross-sectional research design, the composition of the sample, and the response rates all serve to temper the results of this study. First, as this study adopts the cross-sectional research design which examines NPD team leader's opinions at one point in time, the directional relationships as shown in the study results should be inferred with high caution. Future longitudinal research is suggested to confirm the results of the cross-sectional research. Second, as the respondents of this study only consist of NPD team members of the science park in Taiwan, the generalizability of the study results should be limited to these groups of population. Future studies could use the same questionnaire or the questionnaire in an abbreviated form to conduct surveys for other enterprise in different part of the world to confirm the validity and generalizability of these findings.

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