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Which slack resources matter? The fit between market orientation and slack resources to innovation

哪種寬裕資源才是必要？市場導向與寬裕資源的配適對創新績效的影響

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Abstract: This research aims to advance our understanding of the relationship market orientation (MO) and innovation performance by identifying unabsorbed and absorbed slack as moderators. Based on a survey of 188 product development projects of Taiwanese hi-tech firms, we find that proactive and responsive MO are positively related to product innovation performance, while only responsive MO is positively related to process innovation performance. In addition, we validate that the relationship between proactive MO and product innovation performance is positively moderated by both unabsorbed and absorbed slack. In particular, unabsorbed slack positively moderates the relationship between proactive MO and process innovation performance, but negatively moderates the relationship between responsive MO and product innovation performance. Overall, our findings suggest that project teams engaging in process or product innovations are likely to yield superior performance when they are matched with right market orientation. If hi-tech firms aim to achieve superior innovation performance, they should endeavor to

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direct their project teams towards right market orientation while simultaneously providing the teams with adequate slack resources.

Keywords: New product development project, market orientation, product innovation, process innovation, slack.

摘要：本研究目的為針對市場導向與創新績效的關係中，確立已吸收和未吸收寬裕資源所扮演的調節角色。本研究採用問卷調查方式，以 188 個臺灣高科技的新產品研發團隊為樣本。本研究使用階層迴歸分析驗證各個研究假設。研究結果顯示： (1)預應性與回應性市場導向皆會對產品創新績效產生正向顯著影響；(2)回應性市場導向會對流程創新績效產生正向顯著影響；(3)在預應性市場導向與產品創新績效關係上，已吸收和未吸收寬裕資源會有著正向的調節效果；(4)在預應性市場導向與流程創新績效關係上，未吸收寬裕資源有著正向的調節效果；(5)在回應性市場導向與產品創新績效關係上，未吸收寬裕資源卻有著負向的調節效果。據此，我們也討論了研究發現所衍生的具體管理意涵與未來研究方向。

關鍵詞：新產品開發專案、市場導向、產品創新、流程創新、寬裕資源。

1. Introduction

To preempt emerging opportunities, companies must endeavor to develop distinctive and innovative products that customers value (Day, 1994). The capability to develop innovation depends on how proficiently firms generate market intelligence and apply it to product designs and problem solving (Atuahene-Gima *et al*., 2005). This behavior is labeled as market orientation (MO), acknowledged as a decisive factor in the performance of innovation activities (Grinstein, 2008; Lukas and Ferrell, 2000; Verhees and Meulenberg, 2004).

MO has been conceptualized as consisting of responsive and proactive aspects. Responsive MO focuses on catering to current customer needs (Jaworski *et al*., 2000; Slater and Narver, 1995), while proactive MO involves discovering and satisfying latent and emerging customer needs (Narver *et al*., 2004). In

practice, firms typically organize new product development (NPD) teams to undertake projects for various innovations, such as process/product innovation. In other words, different NPD teams may require different orientations for matching facets (Ochieng and Prices, 2010). As Smits and Kok (2012) argue, a project team's MO determines whether it can accomplish its expected goals. Specifically, MO represents a philosophy through which team members manipulate resources (Narver and Slater, 1990). The MO types characterize how project teams prioritize their resources for technological innovation (Atuahene-Gima *et al*., 2005). Hence, resource deployment for proactive MO differs from that for responsive MO. Based on the resource-based view it is plausible that the two types of MO exert nuanced influence on a project team's innovation outputs. This is worth investigating, as it can help managers understand which MO behavior is conducive to certain types of innovation, enabling them to lead their teams towards the right orientation. To the best of our knowledge, the literature does not document this issue. The majority of studies examine the relationship between MO and innovation at the firm level, neglecting that project teams generate most innovations. However, considering that NPD teams are the primary units implementing innovation projects, innovation performances more closely relate to the MO of NPD teams than that of firms. Thus, this study aims to complement prior research by empirically validating the relationship between responsive/proactive MO and process/product innovation at the team level.

Notably, the resources required to launch new products continues to increase at a substantial pace (Yamakawa *et al*., 2014). This is primarily because customers demand more functions, entertaining applications, and better quality for new products, which requires more efficient production approaches. For example, in the smartphone industry, the average development cost per product increased by about 40 percent over the past decade (Pham *et al*., 2016). In addition, it is necessary to shorten the time-to-market substantially. For instance, as Apple's OEM suppliers, Foxconn has had to shorten the time-to-market of the iPhone from several months to less than two weeks (Yeung, 2016). In many cases, the resources required for the NPD process greatly exceed the resources available, leading to NPD inefficiency. Scholars observed that the more novel the innovation, the more resources required to cope with uncertainties (Liu *et al*.,

2014). Therefore, "slack" resources, which enable firms to manage uncertainty and exploit novel opportunities, play a pivotal role. Slack refers to the stock of uncommitted resources available to an organization to allocate during a given planning cycle (Nohria and Gulati, 1996). Based on their observations, the amount of slack resources available to NPD project teams may alter the effect of project teams' MO on innovation performance.

Despite the benefits of slack resources, excessive slack resources can deteriorate organizational efficiency (George, 2005; Keegan and Turner, 2002; Nohria and Gulati, 1996; Tan and Peng, 2003). Thus, managers often face the strategic decision of determining the circumstances under which they should maintain necessary surplus resources for responding to unexpected difficulties or unique situations. To optimize resource allocation and utilization, managers must understand the roles that different types of slack resources play in NPD. Thus, from a practical aspect, we can provide guidance to managers by discovering the type of slack resources that will help project teams with responsive/proactive MO substantially in elevating innovation performance. Nevertheless, extant studies do not consider the moderating role of slack resources when investigating the MO-innovation relationship. This study aims to bridge this research gap by examining whether absorbed and unabsorbed slack moderate different MO-innovation performance relationships.

The remainder of this article is structured as follows. Section 2 elucidates the development of the research hypotheses. Section 3 details the empirical research design and the development of the research instrument. Section 4 presents the empirical analysis and results, followed by Section 5 where the research findings are discussed. The article ends with the major conclusions and implications drawn from the study.

2. Theory and hypotheses

2.1 Market orientation and innovation

An innovation refers to the creation of a new product or process, which represents the commercialization of an invention (Myers and Marquis, 1969). A product can be considered new based on its degree of newness, ranging from an

entirely new or discontinuous innovation to a product involving minor adaptations or adjustments that are of an evolutionary or incremental nature (Giffin, 1997; Olson, Orville, and Ruekert, 1995). Product innovation can be described according to several dimensions of newness, the most common of which focuses on the newness of the product in relation to the firm, which emphasizes the newness of the technology and the product category (Brentani, 2001). Process innovation refers to the adoption of new production processes such as those enabled by new technology or new work routines (Neely and Hii, 1999).

Proactive MO involves discovering and addressing latent customer needs by focusing on experimentation and the creation of novel knowledge to develop completely new products (Atuahene-Gima and Ko, 2001). A project team's MO directs the way in which its team members manipulate and leverage knowledge. Thus, proactive MO focuses team members on generative learning, which inspires innovation through the adoption of novel mental models that prepare for breakthrough theories-in-use (Baker and Sinkula, 2002, 2007). In other words, proactive MO shapes a climate within a project team where members are willing to take risks, experiment with novel ideas, and search for new information (Atuahene-Gima and Ko, 2001; Atuahene-Gima *et al*., 2005). Such a team climate is conducive for realizing innovations (Baker and Sinkula, 2007) because innovations require endeavors to probe potential unsatisfied markets and develop completely new products that satisfy the needs of these markets (Narver *et al*., 2004).

Being exposed to this climate, individual team members are more capable of searching for, and being open to, different ideas, thus generating novel, creative, and viable ideas. These ideas in turn can be translated into next-generation technologies or the results of new insights being incorporated into the features and design of new products. Additionally, these ideas can be converted into new process technologies that can be applied in process redesign. In the high-tech industry, firms need to focus on renewing their innovation processes rather than managing processes. The foremost key factor for competitiveness in the semi-conductor industry is the ability to deliver new process technologies with high yields and low cycle times (Banu Goktan and Miles, 2010). For instance, distributed intelligent agent technology has been applied in manufacturing

process planning and scheduling (Merdan *et al*., 2013). It was considered as a promising approach to lower production cost. Taken collectively, proactive MO enhances both product and process innovations by creating a favorable team milieu that encourages team members to engage in generative learning.

H1a: Proactive MO is positively related to product innovation performance.

H1b: Proactive MO is positively related to process innovation performance.

Responsive MO helps a project team to learn how to improve its theory-in-use of what works in the current markets (Atuahene-Gima *et al.*, 2005; Narver *et al*., 2004; Yannopoulos *et al*., 2012). When a NPD team is responsive-oriented, it has a customer-led culture that directs its team members toward adaptive learning (Narver *et al*., 2004). As Slater and Narver (1995) suggest, the success of innovation partly replies upon how effective learning is performed; namely, innovations are also likely to be driven by the minor improvements and adjustments in existing offerings or procedures (Baker and Sinkula, 2007). Collectively, a team with responsive MO that tends to focus on refining and updating market and technological knowledge is also suited for process and product innovations. For example, by conducting adaptive learning activities, a team refines technological knowledge and applies the refined knowledge to improve the NPD procedure in order to accelerate the speed with which new products are brought to market. Specifically, advanced quality control methods can be applied in manufacturing process monitoring, fault diagnosis, etc. (Yu and Lu, 2016). Furthermore, refining or recombining current knowledge allows responsive MO teams to upgrade current products or extend existing product lines. In summary, a team with responsive MO emphasizing well-defined customer segmentations is likely to effectively yield process and product innovations.

H2a: Responsive MO is positively related to product innovation performance.

H2b: Responsive MO is positively related to process innovation performance.

2.2 Slack resources

The underlying assumption of the resource-based view (RBV) is that a firm applies its idiosyncratic resource endowments to sustain and garner competitive

advantage (Barney, 1991; Wernerfelt, 1984). The ability to exploit strategic opportunities or nullify environmental threats varies, depending on each firm's slack or residual resources (Voss *et al*., 2008). Cyert and March (1963) defined "slack" as the difference between resources available to an organization and total necessary expenditures. Bourgeois (1981) further indicated that slack signifies resources in excess of what is required for the efficient operation of a firm. He defined organizational slack as a buffer or cushion of spare resources, such as time, capital, facilities, and human resources. Based on this definition, Bourgeois and Singh (1983) categorized slack into three main components: available slack denotes unexploited resources that are readily available for use, recoverable slack refers to excess costs in a firm that are retrievable when encountering financial difficulties, and potential slack connotes future resources generated by borrowing and accruing debt. Cheng and Kesner (1997) examined how available and recoverable slack affect firms' responses to environmental shifts. Similarly, Geiger and Makri (2006) used available slack and recoverable slack to measure organizational slack, and concluded that slack can influence the process of exploratory and exploitative innovations in technologically intensive firms.

One stream in this research emphasizes the role of managerial discretion in deploying slack resources. For example, Sharfman *et al*. (1988) distinguished between high- and low-discretion slack by conceptualizing organizational slack along a managerial discretion continuum. Various types of organizational slack enable managers to have different levels of discretion and flexibility in coping with internal or external pressures (George, 2005; Sharfman *et al*., 1988). According to George (2005), slack is a potentially usable resource that firms can divert or redeploy to attain organizational goals. He classified organizational slack into four types: low-discretion slack, high-discretion slack, resource availability, and resource demand. The notion of high- and low-discretion slack represents the permanent nature of slack. Slack availability and slack demand consider the ephemeral nature of slack. By adopting high- and low-discretion slack to measure organizational slack, Lin, Cheng, and Liu (2009) discovered that various amounts of slack resources lead firms to formulate distinct international expansion strategies.

Although slack resources have been defined and classified in various manners, the most widely adopted is Singh's (1986) typology, in which slack

resources are distinguished between two types: absorbed slack and unabsorbed slack (e.g., Greve, 2003; Tan and Peng, 2003; Voss *et al*., 2008). Unabsorbed slack comprises organizational resources that are currently uncommitted to specific tasks and which can be easily redeployed, such as financial slack (Tan and Peng, 2003; Voss *et al*., 2008): the amount of cash on hand, liquid assets, reserve funds, and retained earnings. Absorbed slack, in contrast, refers to resources embedded in a firm's existing procedures that would be difficult to redeploy, such as operational slack (Greve, 2003; Voss *et al*., 2008): incompletely leveraged equipment and facilities, surplus production capacity, and skilled employees.

Unabsorbed and absorbed slack vary substantially in how extensively ongoing activities have absorbed them (Voss *et al*., 2008). Managers can readily redeploy unabsorbed slack and commit it to leverage (Singh, 1986; Tan and Peng, 2003; Voss *et al*., 2008). In contrast, managers are considerably more limited in their potential to recover excess levels of absorbed slack, or to redeploy it for exploratory activities because of its structural constraints (Mishina, Pollock, and Porac, 2004). Because unabsorbed slack is more easily redeployed elsewhere, this flexibility-enabling capacity enables increased managerial discretion (Tan and Peng, 2003). For example, agency theorists consider that large cash flows increase managerial discretion, which enables managers to pad the payroll (Davis and Stout, 1992); in other words, resource absorption is associated with managerial discretion. George (2005) indicates that absorbed slack means low discretion, whereas unabsorbed slack signifies high discretion.

Slack mirrors the pool of available resources within an organization in excess of the minimum required to produce a given level of organizational output (Nohria and Gulati, 1996). Studies have applied the RBV to elucidate how organizational slack assists firms in enhancing their innovation (e.g., Geiger and Makri, 2006; Nohria and Gulati, 1996; Voss *et al*., 2008). The presence of slack influences the organizational capability of implementing desired actions and adapting to complex competitive landscapes (Bourgeois, 1981; Cheng and Kesner, 1997; George, 2005). With abundant slack, organizations can afford to experiment with aggressive strategies such as new product introductions or expansion into new markets (Geiger and Makri, 2006; Lin *et al*., 2009). Yang *et al*. (2009) suggest that firms should maintain an appropriate level of budget slack

to stimulate innovative performance. Based on this discussion and using Singh's (1986) typology, we argue that absorbed and unabsorbed slack play moderating roles in the relationships between MOs and innovation performance.

2.3 Moderating role of slack resources

Based on the RBV, the relationship between team MO and innovative performance is likely to vary, depending on the magnitude of specific firm resources, such as slack. Slack refers to a buffer or cushion of actual or potential resources that firms can use to divert or redeploy to attain their objectives (Bourgeois, 1981; Cyert and March, 1963; George, 2005). Slack resources also vary in the extent of absorbability in ongoing activities (Singh, 1986; Tan and Peng, 2003; Voss *et al*., 2008).

Absorbed slack connotes committed resources for specific use and current operations. Unabsorbed slack is uncommitted resources that can be deployed in a discretionary manner (Tan and Peng, 2003; Voss *et al*., 2008). Prior studies have concluded that slack resources are antecedents of firm performance (George, 2005; Tan and Peng, 2003; Yang *et al*., 2009) and innovation (Geiger and Makri, 2006; Keegan and Turner, 2002; Nohria and Gulati, 1996). To generate innovation, firms must cope with the uncertainties and risks involved in innovative projects. Excess slack resources raise R&D expenditures in the pursuit of innovative plans and projects (Nohria and Gulati, 1996; Yang *et al*., 2009).

Slack resources can assist a firm in maintaining stability in changing business environments (Cyert and March, 1963; Singh, 1986). When NPD team members acquire new knowledge and skills, they may require appropriate slack resources to adapt to internal pressures for adjustment, or to buffer the technical core from environmental turbulence (Cheng and Kesner, 1997; Geiger and Makri, 2006; Tan and Peng, 2003), and thereby use the knowledge to develop new products. Consequently, we propose that team MO exerts considerable influence on innovative performance under various levels of absorbed and unabsorbed slack resources. Below, we separately discuss the moderating effects of absorbed and unabsorbed slack on the relationship between MO and innovation.

The moderating effect of absorbed slack on the MO-innovation relationship

NPD involves relatively great uncertainty and variability concerning the innovation process. Therefore, NPD team members should be more open to risk-taking and tolerant of ambiguity. Slack has been considered as an inducement to take risks and experiment with new strategies (George, 2005; Tan and Peng, 2003; Yang *et al*., 2009). Certain types of absorbed slack, such as excess capacity, underused facilities, and employee time spent on the development of innovations, provide sufficient resources for creative thinking and learning (Greve, 2003; Haas, 2006). Specifically, both proactive and responsive MOs are highly involved in knowledge use and learning in NPD; this depends on mutual communication and cooperation between the knowledge disseminator and the recipient. Absorbed slack resources are conducive to reducing potential conflicts and preventing team members from escalatory dissent and unsatisfactory relationships with coworkers and supervisors (Cyert and March, 1963; Keegan and Turner, 2002; Tan and Peng, 2003). Although the absorbed slack has relatively lower managerial discretion, several empirical evidences have revealed that absorbed slack can still serve as an organizational buffer to prevent conflict and promote risk-taking behaviors (e.g. Huang and Chen, 2010; Huang and Li, 2012). Thus, absorbed slack is expected to intensify the relationship between MO and innovation outcomes.

H3a: Absorbed slack positively moderates the relationship between proactive MO and product innovation performance.

H3b: Absorbed slack positively moderates the relationship between proactive MO and process innovation performance.

H3c: Absorbed slack positively moderates the relationship between responsive MO and product innovation performance.

H3d: Absorbed slack positively moderates the relationship between responsive MO and process innovation performance.

The moderating effect of unabsorbed slack on the MO-innovation relationship

Conversely, there are no structural constraints on redeploying unabsorbed slack. Higher unabsorbed slack will motivate project teams to experiment and test more innovative solutions that render their previous ones obsolete (Nohria

and Gulati, 1996). This generative learning behavior is suitable for proactive MO. By studying at the firm level, Lee *et al*. (2016) found that financial slack can help technologically proactive firms to achieve superior performance. In the context of projects, Huang and Li (2012) reported that unabsorbed slack can positively enhance the performance effect of project teams' exploratory learning. Based on these arguments and evidences, unabsorbed slack should also lead to a positive moderating effect for proactive MO.

H4a: Unabsorbed slack positively moderates the relationship between proactive MO and product innovation performance.

H4b: Unabsorbed slack positively moderates the relationship between proactive MO and process innovation performance.

Compared to proactive MO, responsive MO has relatively low unabsorbed slack requirements because it involves much less experimentation. Nevertheless, since the unabsorbed nature of financial slack implies a lack of structural constraints, firms can readily redeploy it to support high-risk explorative experimentation. High levels of unabsorbed slack may induce team leaders to conduct more costly product design and risky experiments to add seemingly rewarded albeit unnecessary features and functions (Liu and Xie, 2014; Nitta, 2006). Nohria and Gulati (1996) also suggest that unabsorbed slack could diminish a firm's discipline in implementing innovative projects in later NPD stages. Likewise, Stan *et al*. (2014) observed that enterprises in a stable circumstance that have excessive unabsorbed slack resources often demonstrate destructive behaviors. Integrating these insights, we extrapolate that unabsorbed slack resources may cause some problems in responsive MO teams that deter innovation as the teams aim at process or product improvements. Conversely, researchers suggest that limited financial slack will instead force responsive MO teams to focus fully on squeezing out smaller but certain returns through well-known processes that rely on existing competencies and resources (Levinthal and March, 1993; Voss *et al.*, 2008). Accordingly, it is plausible that responsive MO will produce inferior innovation performance if matched with higher levels of unabsorbed slack.

H4c: Unabsorbed slack negatively moderates the relationship between responsive MO and product innovation performance.

H4d: Unabsorbed slack negatively moderates the relationship between

responsive MO and process innovation performance.

The proposed relationships among proactive/responsive MO, product/process innovation, and absorbed/unabsorbed slack are shown in Figure 1.

3. Method

3.1 Sample and data collection

Data for this study were collected through a questionnaire survey of the NPD projects in Taiwanese high-tech firms. We used a systematic random sampling procedure to draw a sample of 500 high-tech firms from the Taiwan Manufacturing Business Directory, published by the Chinese Credit Information Service, Ltd. We studied the Taiwanese high-tech industry for two reasons. First, the high-tech industry is characterized by extremely short product life cycles and rapidly changing technologies. Thus, high-tech firms involve themselves heavily in innovative activities to respond to external changes (Geiger and Makri, 2006). Second, Taiwan-made high-tech products have gained significant market shares in global markets (Huang *et al.*, 2015). Accordingly, research evidence from Taiwanese high-tech firms can provide rich insights into NPD.

The unit of analysis was the NPD project team. We first contacted a preliminary informant in each firm (i.e., R&D, engineering, marketing, and project managers) to solicit cooperation, and identify key informants. Information was obtained from these participants to identify appropriate projects, as well as a project leader and a team member directly involved in each project. The NPD projects were screened based on the following two criteria. First, all projects included in the study were launched and completed within the previous three years. Since the data collected was primarily retrospective in nature, the recall time was restricted to three years in an attempt to improve the accuracy of retrospective reports (Miller *et al.*, 1997). Second, products had to have been commercialized and launched into the marketplace at least six months prior to the assessment to ensure NPD performance could be assessed accurately. Finally, 306 eligible projects were identified from 175 companies.

We used the conventional method of back-translation to translate the measures from English to Chinese. Two professional translators independently

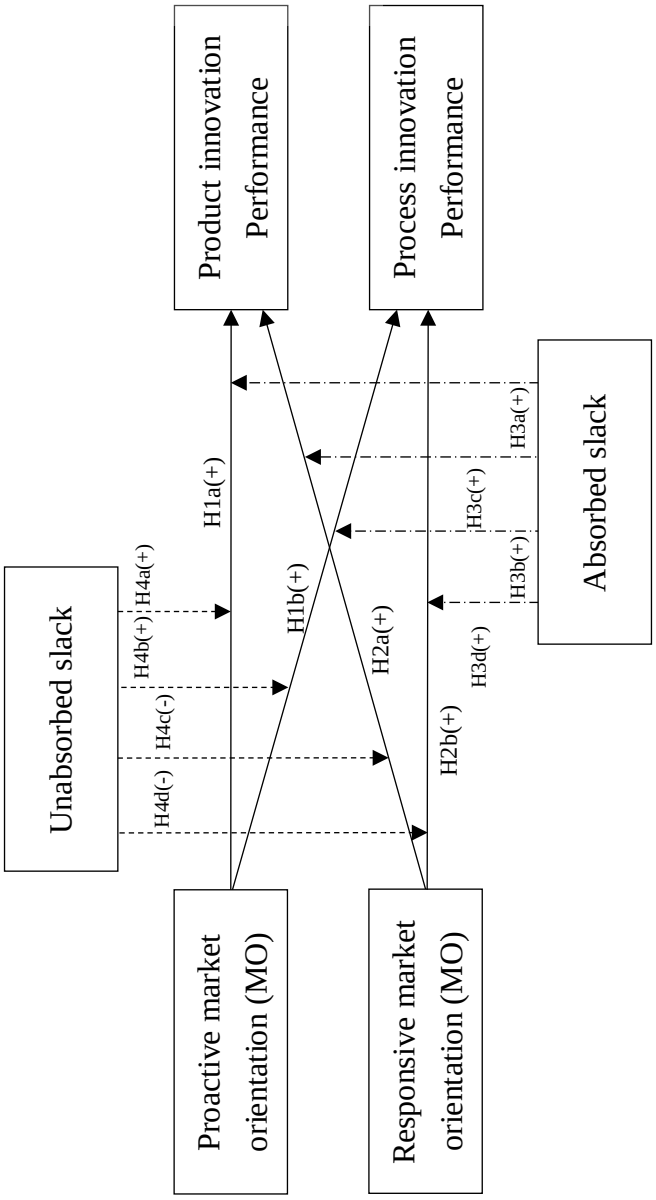

Figure 1
Research model

translated the English questionnaires into Chinese and the Chinese versions were translated back into English. The latter English versions were compared with the original to ensure that no alteration of meaning took place in the translation process. The questionnaires were then pre-tested on 20 managers involved in NPD projects from four Taiwanese high-tech firms. Based on the feedback, we revised the measures and ensured their relevance to the Chinese context. Subsequently, a structured questionnaire was developed and mailed to project leaders Project leaders were asked to answer the questionnaire because they had a broader view of team member behavior than team members (Akgün *et al*., 2007) and were expected to offer more reliable and objective data (Kumar et al., 1993). To encourage participation, all informants were assured that their responses would be kept confidential and presented in an aggregated form only. We also promised to provide a summary of the study results to each respondent.

Altogether, we gathered 188 usable questionnaires on 188 NPD projects (123firms) after excluding 19 questionnaires due to missing data. 64 sample firms have one project and 59 sample firms have more than two project. This represents an effective response rate of 61%. Approximately 15% (19) of the firms had more than 10,000 employees, 44% (54) had between 1001 and 10000, 24% (29) had between 501 and 1000, and 17% (21) had 500 or fewer employees.

We addressed the potential for non-response bias by comparing the respondent firms with a group of 60 randomly selected nonparticipating firms in terms of sales and employee numbers. The information was obtained from the Database of Taiwan Economic Journal, which has been recognized as an authoritative and reliable data source in Taiwan (e.g. Liao *et al*., 2015; Lee *et al*., 2015; Tai, 2017). T-tests demonstrated no significant differences between the mean size (2389.90, 3120.42 t=－1.21, p >0.05) and the mean sales (48.84, 59.76; t=0.89, p >0.05) of respondent and nonparticipating firms, suggesting that non-response bias did not arise as an issue. The tests provided some assurance that the sample of responding firms was representative of the broader population surveyed (Armstrong and Overton, 1977).

3.2 Measures

Table 1 reports the list of multi-item variables adopted herein. We measured these variables with five-point Likert scales (1= “do not agree” to 5=

"completely agree"). Table 2 summarizes the correlation matrix and descriptive statistics for the variables.

Responsive and proactive MO were measured with the scale borrowed from Narver *et al*. (2004). We measured proactive MO by eight items asking the NPD teams to indicate the extent to which they search for and discover latent customer needs. We also measured responsive MO with ten items that tapped the degree to which their search activities were based on expressed customer needs.

Based on Prajogo and Sohal (2006), we measured product innovation performance with four items by asking informants the extent to which the NPD team applied novel technologies to new products. A four-item scale gauged process innovation performance that captures the degree to which the NPD team applied updated technologies to improving the NPD process.

Slack resources denote the buffer or cushion of actual or potential resources available for redeployment and transformation in an organization (George, 2005). Drawing on previous research (e.g., Singh, 1986; Tan and Peng, 2003), this study adopts the distinction between absorbed slack and unabsorbed slack. The absorbed slack consists of three items gauging the extent to which the development of the project is under available capacity, under available human resources, and under available time for developmental activities among members. The unabsorbed slack consists of three questions about whether the supply of the retained earnings, financial resources, and debt financing with banks is sufficient whenever the project team needs them.

We included four control variables because innovation performance may be conditioned on firm size, R&D intensity, industry types and team size. Firm size was measured in terms of the natural logarithm of the number of full-time employees (Luan and Tien, 2017). R&D intensity was measured by the ratio of R&D expenditures to annual total sales. We incorporated industry dummies to control for possible differences between industries (Chou *et al.*, 2016). The sample firms were classified into four industries (i.e. computer and peripheral equipment, optoelectronic, communications and internet, and electronic parts and components). The data were retrieved from the Database of Taiwan Economic Journal. Team size was measured as the number of project team members.

Table 1
Measure validation

Scale	SFL	t-value
Proactive MO (CR=0.94, AVE=0.74)		
1. We try to discover additional needs of our customers of which they are unaware.	0.89	15.65
2. We innovate even at the risk of making our own offerings obsolete.	0.85	14.78
3. We extrapolate key technological, business and customer lifestyle trends to gain insight into what customers in our current market would need in the future.	0.87	15.31
4. We search for opportunities in areas where customers have a difficulty expressing their needs.	0.82	13.73
5. We incorporate solutions to unarticulated customer needs in our new products and services.	0.88	15.57
Responsive MO (CR=0.82, AVE=0.53)		
1. Our objectives are driven primarily by customer satisfaction.	0.73	11.04
2. I believe this project team exists primarily to serve customers.	0.70	10.47
3. We are more customer-focused than our competitors.	0.74	11.14
4. We freely communicate information about our successful and unsuccessful customer.	0.75	11.29
Absorbed slack (CR=0.81, AVE=0.59)		
1. The development of the project is under the available capacity of your company.	0.62	8.83
2. The development of the project is under the available human resources of your company.	0.86	13.22
3. The development of the project is under the available time for development activities among members.	0.80	12.15
Unabsorbed slack (CR=0.82, AVE=0.60)		
1. The supply of retained earnings of your company is sufficient as funds whenever the project needs it.	0.84	12.80
2. The supply of financial resources of your company is sufficient whenever the project needs it.	0.76	11.31
3. The supply of debt financing with banks of your company is sufficient whenever the project needs it.	0. 72	10.58
Product innovation performance (CR=0.87, AVE=0.63)		
1. This project introduced an entirely new product into the markets.	0.75	11.87
2. This project applied latest technologies in the new product.	0.86	14.47
3. This project developed a product with totally new technologies.	0.81	13.42
4. This project experimented with a new product in our local market.	0.74	11.63

Table 1
Measure validation (continued)

Scale	SFL	t-value
Process innovation performance (CR=0.82, AVE=0.53)		
1. This project updated the technologies used in our processes.	0.85	13.68
2. This project adopted the latest technologies in our processes.	0.75	11.67
3. This project improved the speed of our new product development.	0.75	11.56
4. This project refined the methods for new product development.	0.53	7.46

Note: Items were dropped due to their low factor loadings.

Table 2
Correlation matrix and descriptive statistics

Variable	1	2	3	4	5	6	7	8	9
1. Firm size									
2. R&D intensity	0.15								
3. Team Size	–0.06	0.01							
4. Proactive MO	0.28*	0.45*	–0.14						
5. Responsive MO	0.28*	0.50*	–0.13	–0.37*					
6. Absorbed slack	0.42*	0.08	–0.07	0.06	0.23*				
7. Unabsorbed slack	0.03	0.07	0.08	–0.05	–0.15	–0.07			
8. Product innovation performance	0.32*	0.27	–0.06	0.39*	0.34*	–0.04	0.20		
9. Process innovation performance	0.30*	0.46*	–0.09	0.46*	0.53*	0.11	0.18	0.14	
Mean	5.56	0.37	27.23	3.84	3.38	4.02	3.42	3.94	3.47
Standard deviation	1.70	0.29	9.79	0.60	0.68	0.58	0.98	0.48	0.75

Note: * $p < 0.05$ (two-tailed test).

We conducted Harman's single-factor test to address the common method variance issue. Our factor analysis on all the measurement items yielded six factors with eigenvalues greater than 1.0 explaining 68.92% of the total variance. The first factor accounted for 17.57% of the total variance. Neither a single factor nor a general factor accounted for the majority of the covariance in the measures, suggesting that common method variance was not a serious concern (Podsakoff and Organ, 1986). Given that some of our hypotheses were based on interaction effects rather than direct effects, it is unlikely that common method

bias would have produced our results. As methodologists have observed (e.g., Doty *et al*., 1993; Evans, 1985), the complex data relationships shown by predicted interaction effects are not explained by common method bias because respondents are unable to respond in a socially desirable manner by precisely guessing the researchers' interaction hypotheses.

3.3 Measurement model

We adapted Anderson and Gerbing's (1988) two-step procedures developing a measurement model to use a confirmatory factor analysis (CFA) before testing the hypotheses. A six-factor measurement model containing 32 items was estimated. Each item was restricted to load on its *a priori* specified factor and the underlying factors were permitted to correlate (Gerbing and Anderson, 1988). Nine items that cross-loaded on different factors or had standardized factor loadings (SFL) less than 0.5 were removed from the model. Overall, model fit indices (χ^2 (215) = 346.00, p >0.05, SRMR=0.06, RMSEA = 0.05, IFI = 0.95, NNFI = 0.94, CFI = 0.95, GFI = 0.87) suggest that the measurement model fits the data well.

We assessed the reliability and validity of the measures using Fornell and Larcker's (1981) stringent criterion. In Table 1, CFA showed that the composite reliabilities (CR) were all above the threshold of 0.7, demonstrating strong reliability. Each of the 23 indicators loaded significantly onto its intended constructs (p < 0.01) and the average variance extracted values (AVE) exceeded the level of 0.5 (Fornell and Larcker, 1981). Thus, all of the constructs exhibited convergent validity. Discriminant validity is established by verifying that the shared variances between the pairs of constructs are lower than the AVE estimates for the individual constructs (Fornell and Larcker, 1981). The shared variances between pairs of all possible scale combinations range from 0 to 0.28. This is below the AVE estimates for each construct, which range between 0.52 and 0.74. Thus, the criterion for discriminant validity is satisfied.

3.4 Analyses and results

All hypotheses were tested by hierarchical regression analysis. As recommended by Aiken and West (1991), both independent and moderator variables were mean-centered to minimize the threat of multicollinearity in

equations where we created interaction terms. We checked the variance inflation factors (VIFs) for each regression coefficient. The maximum VIF was 2.40, well below the benchmark of 10, suggesting no serious problems of multicollinearity.

Tables 3 and 4 report the results of hypotheses testing. There are base models, reduced models and full models. The base models (Models 1 and 4) include only the control variables. The reduced models (Models 2 and 5) incorporate all variables except interaction terms. The full models (Models 3 and 6) consist of all variables and test the interaction effects. Shapiro-Wilks test indicates that regression residuals of the full modes were normally distributed

Table 3
Results of regression analyses

Variables	Product innovation performance		
	Model 1	Model 2	Model 3
Control Variables			
Firm size	0.28**	0.24*	0.21*
R&D intensity	0.20*	0.03	0.01
Team size	–0.16	–0.12	–0.04
Industry1	0.33**	0.24*	0.19†
Industry2	–0.12	–0.09	–0.01
Industry3	–0.06	–0.10	–0.11
Main effect variables			
Proactive MO		0.31**	0.50***
Responsive MO		0.23*	0.09
Absorbed slack		0.19†	0.11
Unabsorbed slack		0.23*	0.28**
Interactions			
Proactive MO × Absorbed slack			0.20*
Proactive MO × Unabsorbed slack			0.28**
Responsive MO × Absorbed slack			0.02
Responsive MO × Unabsorbed slack			–0.25*
R^2	0.34	0.54	0.64
Adjusted R^2	0.29	0.47	0.56
F	6.04***	7.68***	7.80***
F for $\triangle R^2$		7.02***	4.28**

Note: *N*=188.

† $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Table 4
Results of regression analyses

Variables	Process innovation performance		
	Model 4	Model 5	Model 6
Control Variables			
Firm size	0.21*	0.14	0.16
R&D intensity	0.37**	0.17	0.14
Team size	–0.11	–0.07	–0.10
Industry1	0.18	0.12	0.20†
Industry2	0.04	0.07	0.02
Industry3	0.20†	0.15	0.12
Main effect variables			
Responsive MO		0.30*	0.34*
Proactive MO		0.13	0.08
Absorbed slack		–0.04	–0.10
Unabsorbed slack		0.24*	0.22*
Interactions			
Responsive MO × Absorbed slack			–0.03
Responsive MO × Unabsorbed slack			0.01
Proactive MO × Absorbed slack			–0.10
Proactive MO × Unabsorbed slack			0.23*
R^2	0.32	0.44	0.49
Adjusted R^2	0.27	0.36	0.37
F	5.56***	5.22***	4.21***
F for $\triangle R^2$		3.50*	1.38

Note: *N*=188.

† $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

(W > 0.99, $p = 0.26$; W > 0.99, $p = 0.35$). Based on Breusch-Pagan test (F = 1.94, $p = 0.165$; F = 0.80, $p = 0.78$), there were no issues of heteroscedasticity.

H1a posits that proactive MO is positively related to product innovation performance. As shown in Model 2, the main effect of proactive MO was found to be related positively and significantly to product innovation performance ($\beta = 0.31$, t = 2.78, $p < 0.01$). Thus, H1a is supported. H1b speculates that proactive MO is positively related to process innovation performance. In model 5, the coefficient is non-significant ($\beta = 0.13$, t = 1.08, *n.s.*). Therefore, H1b is nor supported.

H2a postulates that responsive MO is positively related to product

innovation performance. Model 2 shows that the main effect of responsive MO on product innovation performance is significantly positive ($\beta = 0.23$, $t = 2.57$, $p < 0.05$), which supports H2a. H2b predicts that responsive MO is positively related to process innovation performance. Model 5 demonstrates that the main effect of responsive MO is related positively and significantly to process innovation performance ($\beta = 0.30$, $t = 2.34$, $p < 0.05$). Hence, H2b is also supported.

H3a and H3b explore whether absorbed slack moderates the effects of proactive MO on product and process innovation performances. In model 3, the interaction of proactive MO and absorbed slack is positively significant ($\beta = 0.20$, $t = 2.01$, $p < 0.05$). In model 6, the interaction of proactive MO and absorbed slack is not significant ($\beta = -0.10$, $t = -0.89$, *n.s.*). Thus, only H3a is supported.

H4a and H4b hypothesize that unabsorbed slack moderates the effects of proactive MO on product and process and innovation performance. As model 3 shows, the interaction of proactive MO and unabsorbed slack is positively significant ($\beta = 0.28$, $t = 3.05$, $p < 0.01$). In model 6, the interaction of proactive MO and unabsorbed slack is positively significant ($\beta = 0.23$, $t = 2.13$, $p < 0.05$). Accordingly, both H4a and H4b are supported.

H3c and H3d explore whether absorbed slack moderates the effects of responsive MO on product and process and innovation performance. In model 3, the interaction of responsive MO and absorbed slack is not significant ($\beta = 0.02$, $t = 0.24$, *n.s.*). In model 6, the interaction of responsive MO and absorbed slack is also not significant ($\beta = -0.03$, $t = -0.34$, *n.s.*). Therefore, H3c and H3d are refuted.

Finally, H4c and H4d predict that unabsorbed slack moderates the effects of responsive MO on product and process and innovation performance. In model 3, the interaction of responsive MO and unabsorbed slack is negatively significant ($\beta = -0.25$, $t = -2.57$, $p < 0.05$), which supports H4c. In model 6, the interaction of responsive MO and unabsorbed slack is non-significant ($\beta = 0.01$, $t = 0.04$, *n.s.*). Hence, H4d is not supported.

To further interpret the form of these moderating effects, we plotted the significant interactions following the approach proposed by Aiken and West (1991). Figures 2 to 5 present the resulting graphs. Figure 2 displays that when absorbed slack is higher, proactive MO has a stronger, positive relationship with

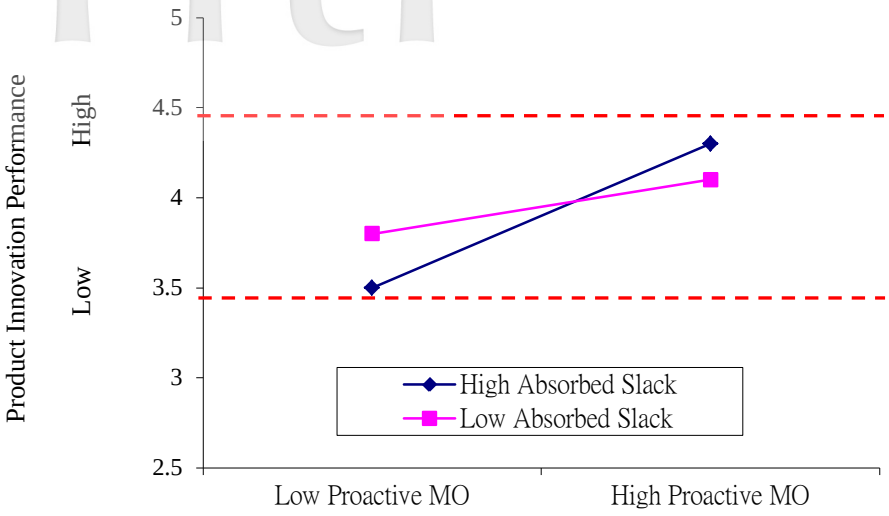

Figure 2
The interaction effect of proactive MO and absorbed slack on product innovation performance

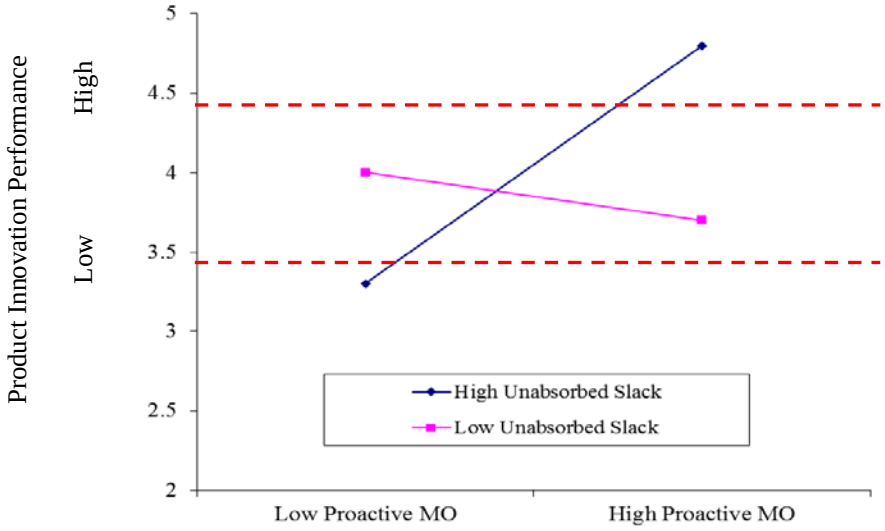

Figure 3
The interaction effect of proactive MO and unabsorbed slack on product innovation performance

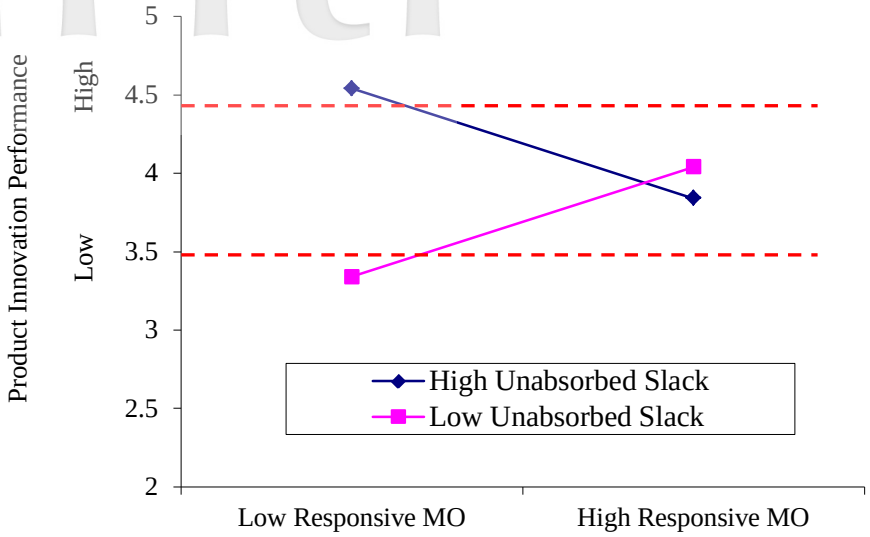

Figure 4
The interaction effect of responsive MO and unabsorbed slack on product innovation performance

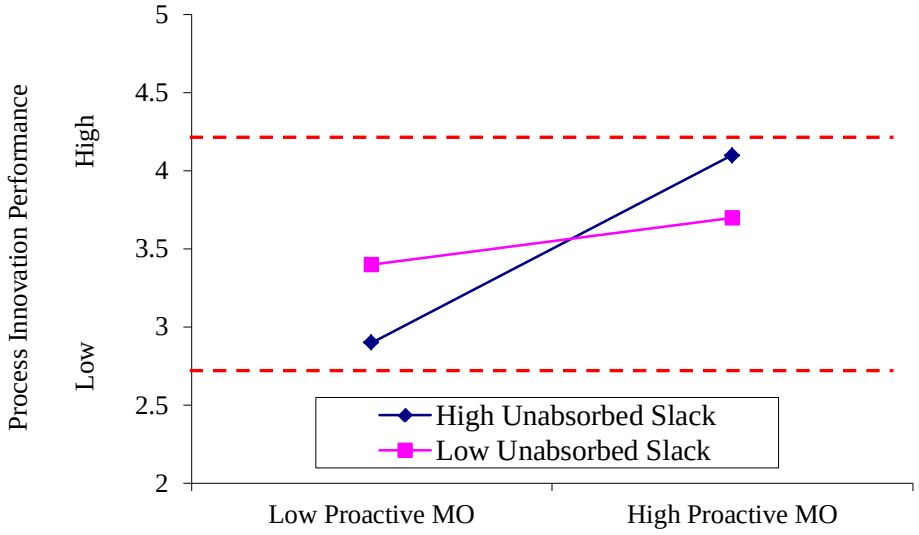

Figure 5
The interaction effect of proactive MO and unabsorbed slack on process innovation performance

product innovation performance, thereby supporting H3a. Likewise, consistent with Hypothesis 3c, Figure 3 demonstrates that the relationship between proactive MO and product innovation performance becomes positive from negative when unabsorbed slack is higher. Figure 4 shows that when unabsorbed slack is higher, the relationship between responsive MO and product innovation performance becomes negative from positive, which supports H4c. As Figure 5 indicates, when unabsorbed slack is higher, proactive MO has a stronger, positive relationship with process innovation performance, thus supporting H4b. We developed a matrix to summarize these results in Table 5.

4. Discussions

While numerous empirical studies have confirmed that MO is conducive to business performance (e.g., Atuahene-Gima *et al*., 2005; Yannopoulos *et al*., 2012), most of these studies analyzed the MO-performance relationship at the firm level, rather than at the team level. In the NPD context, however, firms typically organize multiple teams to undertake different innovations. Few studies have distinguished how NPD teams' responsive and proactive MOs influence the various types of innovation. Based on the RBV, this study contributes to the innovation management and NPD literature by examining the effects of responsive and proactive MO on process and product innovation performances under varying levels of absorbed and unabsorbed slack. In the following subsections, the theoretical and managerial implications are further discussed.

Table 5
The interaction effects of MOs and slack on innovation performances

	Proactive MO	Responsive MO
Absorbed slack	H3a: Product (+)	H3c: Product (*n*)
	H3b: Process (*n*)	H3d: Process (*n*)
Unabsorbed slack	H4a: Product (+)	H4c: Product (−)
	H4b: Process (+)	H4d: Process (*n*)

Note: Positive (+), negative (−), non-significant (*n*).

4.1 Theoretical implications

First, most studies on responsive and proactive MO focus on only one dimension of performance, and explore how the two are related to the same type of performance (e.g., Atuahene-Gima *et al*., 2005; Yannopoulos *et al*., 2012). As discussed previously, teams that work on disparate innovations should use diverse approaches to create requisite market intelligence. Unlike prior studies that have considered performance as a one-dimensional construct, we distinguished between process and product innovation performance. Prior empirical research at the firm level (e.g., Atuahene-Gima, *et al*., 2005) has confirmed that the relationship between proactive/responsive MO and NPD performance is curvilinear. This paper extends the research on MO by applying the insights gained from firm-level MO studies to the team-level. Our findings elucidate that the MO of project teams is highly associated with innovation performance. These findings support the argument of Smits and Kok (2012) that innovation benefits from NPD teams' MO.

Second, our main contribution lies in the identification of potential moderators. To the best of our knowledge, this study represents the first effort to identify absorbed and unabsorbed slack as moderator variables in the associations between MO and innovation performance. The result reveals that both absorbed and unabsorbed slack positively moderate the relationship between proactive MO and product innovation performance. Our finding buttresses the argument that slack enables the pursuit of innovative projects and allows for a greater buffer in experimenting with high-risk projects (Bourgeois, 1981; Cyert and March, 1963). In addition, as expected, unabsorbed slack negatively moderates the relationship between responsive MO and product innovation performance, albeit absorbed slack does not significantly moderate this relationship. This finding is consistent with that of Liu and Xie (2014) that only unabsorbed slack has a negative moderating effect on the relationship between exploitative learning and firm performance. Indeed, our findings can be explained by managerial agency problems. As Nohria and Gulati (1996) caution, abundant slack resources may induce team leaders to conduct unnecessary experiments and thereby lead the team to deviate from the correct learning mode, which is to detrimental product innovation.

Third, regarding the influence on process innovation performance, we find that the effect of responsive MO is positively significant, while that of proactive MO is

not significant. Additionally, only unabsorbed slack has a moderating effect on the relationship between proactive MO and process innovation performance. A plausible explanation for these findings is that since proactive MO typically entails generative learning, its influence on process innovations is relatively weak. Our finding resonates with He and Wong's (2004) finding that exploration, which resembles generative learning, is significantly related to product innovation, but not to process innovation. This is because process innovation is a long learning process, and time- and cost- consuming. Craig and Yetton (1993) observed that radical process innovation requires a minimum of two years, and often up to five years from design to full implementation. Indeed, our findings are in accord with Bauer and Leker (2013) who concluded that managers must allocate a higher share of financial slack resources to explorative innovation activities to achieve maximal new product performance. As Atuahene-Gima *et al*. (2015) have stressed, to realize full learning potential, responsive and proactive MOs need distinct organizational conditions to ensure its positive influence on NPD outcomes; unabsorbed slack can ensure that proactive MO can positively affect process innovation.

Fourth, unexpectedly, neither absorbed nor unabsorbed slack moderates the relationship between responsive MO and process innovation performance. Given the exploitative nature of process innovation that responsive MO focuses on, its expected outcomes are proximate and predictable, and thereby requisite resources can be precisely estimated and projected (Li et al, 2008). Put differently, responsive MO teams are likely to accomplish superior process innovation performance by adhering to their financial budget rather than stretching their resources.

Fifth, although not hypothesized, we find that innovation performances are significantly related to unabsorbed slack rather than absorbed slack. This can be explained in light of the characteristics of the high-tech industry. Similarly, in the context of the high-tech industry, Liu *et al*. (2014) also found that Chinese firms' unabsorbed slack has a stronger positive relationship with innovation than does their absorbed slack. Specifically, the absorbed nature of human resource slack makes it difficult to reallocate in the short term (Voss *et al*., 2008). Unabsorbed slack, on the other hand, is more flexible, which is crucial to supporting innovative projects, especially for high-tech firms heavily involved in innovation activities (Liu *et al*., 2014). Moreover, Voss et al. (2008) assert that absorbed slack does not directly lead to product innovation when the environmental threat is high because structurally

constrained resources offer little flexibility for responding to environmental exigencies. Our finding is reasonable given that the context is the high-tech industry characterized by a high environmental threat.

4.2 Managerial implications

From a practical viewpoint, this study offers guidance on how high-tech firms can effectively assign their slack resources to NPD projects in consideration of responsive versus proactive MO. Our findings indicate that it is necessary, albeit insufficient that NPD teams concentrate on suitable MO behavior if they are interested in employing innovation to elevate performance. Managers must be explicitly aware that slack resources act as a catalyst for unleashing the full innovative potential of teams. For example, when an NPD team engages in breakthrough product innovation, its team leaders should guide the team toward a proactive MO, while simultaneously being supported by sufficient absorbed and unabsorbed slack. In fact, when conducting production innovation that involves risky experiments, NPD teams often experience pressure, uncertainty, and confusion (Akgün *et al*., 2007). This negative milieu reduces the team's ability to accurately understand the latent needs of the customer, and to plan and integrate knowledge to benefit the successful completion of current projects. In this case, both types of slack give managers the discretion and flexibility to manage team pressures (George, 2005; Sharfman *et al*., 1988). However, it is noteworthy that slack also has a dark side. When a firm designates NPD teams to engage in incremental product innovation, it must recognize that high, unabsorbed slack, such as financial slack, may harm product innovation because it can result in the managerial agency problem and lead to improper team behavior. In summary, this study can help managers make judicious decisions when considering the pros and cons of slack resources.

Our findings suggest that managers should deliberate over employing resource allocation strategies that align properly with MOs and innovations. We advise that they can deploy resources based on the combination of responsive/proactive MOs and product/process innovations. While existing innovation management practices are largely derived from established typologies with corresponding resource allocation and performance benchmark metrics (e.g., percentage allocation of R&D expenditure into basic versus applied research or

product versus process innovation), senior managers may need to consider introducing new metrics to prioritize resource allocation and benchmark performance. The proposed matrix (Table 5) in this study could prove a useful starting point towards the development of such new metrics.

4.3 Research limitations

The results of this study should be interpreted with caution because of certain limitations. First, we relied entirely on cross-sectional data, which limited our ability to make causal predictions. Therefore, longitudinal data, despite several inherent problems, might help to increase confidence in the results (Rindfleisch *et al*., 2008). Second, we employed Singh's (1986) typology of slack. Future studies should adopt other typologies such as that of George (2005) to reconfirm the moderating effect of slack. Third, our sample was confined to the hi-tech industry, in which proactive MO and radical innovation are relatively widespread and accepted. Future studies are encouraged to extend the study and its implications to other industries to reinforce confidence in the generalizability of the findings. Fifth, this study explored the effects of proactive and responsive MO on product and process innovation performance. However, the riskiness and difficulty of different product or process innovation projects could be varied. As Ettlie *et al*. (1984) suggest, the innovation types can also be distinguished between radical and incremental: radical represents groundbreaking or maybe even revolutionary ones, whereas incremental stands for an improvement of an already existing process or product. Specifically, both product and process innovation can further be divided into radical or incremental innovation. This can offer a research direction for subsequent MO studies. Finally, our model was relatively simple because the exogenous variables were MO and slack. Future research can expand and enrich our model by including management factors such as transformational versus transactional leadership (Strang, 2011) and the personality traits of leaders (Huang *et al*., 2015).

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