When marketing and manufacturing departments integrate: The influences of market newness and competitive intensity

Abstract

Although the effect of marketing-manufacturing integration on new product development (NPD) performance has been extensively studied, the question about how this integration is affected during the different stages of NPD remains unclear, especially when a firm faces a new market. In this study, we use resource dependence theory as the theoretical framework and collect survey-based data from manufacturing firms in China to investigate how market newness can affect marketing-manufacturing integration during the different stages of NPD. Our results indicate that market newness has a positive relationship with marketing-manufacturing integration during NPD's different stages, with this relationship being stronger in the early stages than in the subsequent ones. We also examine the effect of such integration during the early stages of NPD on the integration on subsequent stages of NPD. Moreover, we further investigate the moderating role of competitive intensity on the positive effect of market newness on marketing-manufacturing integration. Our findings suggest that a positive moderating effect is more prominent during the early and the final stages of NPD than during the intermediate ones. Our results provide a dynamic perspective on marketing-manufacturing integration and highlight the need for matching the appropriate level of integration with the different NPD stages.

Keywords market newness; marketing-manufacturing integration; competitive intensity; new product development

1 Introduction

There is wide consensus that innovative new products promote firms' performance (Menguc and Auh, 2006; Wuyts *et al*., 2004). However, successfully developing a new product constitutes a highly challenging task (Gourville, 2006), mainly because, during new product development (NPD), a single department within the firm is likely to lack the necessary resources and/or capabilities (Zhao et al., 2018). As Leenders *et al*. (2003) proposed, the NPD process is essentially an information processing activity. The distinguishing feature is information sharing among several functions with different information resources within the firm (Zhang and Doll, 2001), through which information from the market, customers, and technologies are synthesized and translated into product design (Moenaert *et al*., 1994). Therefore, it is crucial for a firm to effectively integrate different departments (Brettel *et al*., 2011; Eng and Ozdemir, 2014; Olson *et al*., 2001; Song *et al*., 1997, Troy *et al*., 2008) and translate various resources into new capabilities in order to fulfill customer demands and create value in the market (Sirmon *et al*., 2007).

While a large number of past studies in NPD focus on R&D-marketing integration (e.g., Griffin and Hauser, 1996; Gupta *et al*., 1986; Leenders and Wierenga, 2008; Moenaert *et al*., 1994) and R&D-manufacturing integration (e.g., Liker *et al*., 1999; Nihtilä, 1999; Swink and Nair, 2007), practitioners and scholars suggest that marketing and manufacturing departments should also work closely during NPD (Calantone *et al*., 2002; Gerwin and Barrowman, 2002; Hausman *et al*., 2002; O'Leary-Kelly and Flores, 2002; Ruekert and Walker Jr, 1987).

Intuitively, if the product, the target customers, and the market are all new to the firm, which we refer to as *market newness* (Dahlqvist and Wiklund, 2012; Danneels and Kleinschnidt, 2001; Molina-Castillo and Munuera-Aleman, 2009), the firm faces high environmental uncertainty (Min et. al., 2006). Since the personnel in marketing and manufacturing departments have distinct objectives due to different tasks and responsibilities, as described by the resource dependence theory (Pfeffer, 1987), information sharing, as well as collaboration and communication, are necessary

between the marketing and manufacturing departments (Deane *et al*., 1991; Clark, 1996). Cross-functional integration between the marketing and manufacturing departments can facilitate resolving potential conflicts between the two departments (Balasubramanian and Bhardwaj, 2004; Song and Swink, 2009), reduce NPD cycle time (Griffin, 1997), enable the firm to gain more competitive advantages (Swink and Song, 2007), and increase the firm's prospects of success in the new market (Paiva, 2010).

However, in response to market newness, it is still unclear if the level of marketing-manufacturing integration (MMI) needs to be high across all NPD's different stages. Furthermore, the timing of MMI remains unclear too. Griffin (1997) argued that cross-functional integration should be implemented early in the NPD process, while Haque *et al*. (2003) suggested that such integration is more desirable during NPD's later stages when the new product is being produced or under postproduction reviews. Song and Swink (2009) found that MMI starts in NPD's early stages, and will continue and influence the later stages.

Moreover, competition introduces extra complexity to the relationship between market newness and MMI. Because intense competition increases the need to integrate and exploit resources and capabilities in different functions, it prompts the marketing and manufacturing departments to work more closely together during an NPD (Hausman *et al*., 2002; Karmarkar, 1996). However, it remains unclear how competitive intensity can affect the impact of market newness on MMI across NPD's different stages or not.

Considering the above, several important operational questions emerge: How can market newness impact MMI during the different stages of NPD and how does competitive intensity moderate such an impact? Resource dependence theory provides a useful framework to analyze these relationships (Pfeffer and Salancik, 1978), since its main premise is that organizations tend to manage and reduce uncertainty by establishing collaborations among different functional units within them (e.g., Gupta *et al*., 1986; Ruekert and Walker, 1987; Olson *et al*., 1995) or with different organizations

(e.g., Casciaro and Piskorski, 2005; Hillman *et al*., 2009). Similarly, in our study, we examine the relationship between uncertainty created by market newness and the degree of MMI during the different stages of NPD.

Specifically, we consider the four NPD stages – business and market analysis, technical development, product testing, and product commercialization (Urban and Hauser, 1993) and first investigate the impact of market newness on MMI during these different stages. Our results indicate that market newness promotes MMI during the first, second and the fourth stage of NPD. Next, we compare these effects among the four stages and investigate the impact of MMI during the early stages of NPD on the later stages. Our results show that the impact of market newness is stronger during business and market analysis than other stages, and MMI during market and business analysis and product testing promotes such integration in the subsequent stages. Finally, we combine MMI and competition into one framework and explore the moderating effects of competitive intensity on the link between market newness and MMI during the different stages of NPD. Our results reveal that the impact of market newness on MMI is more prominent in the presence of high competitive intensity during the first (i.e., market and business analysis) and last stage (i.e., product commercialization) of NPD.

This study offers a number of significant contributions to NPD and MMI literature. First, while the existing literature focuses on the resulting effects of MMI in NPD (i.e., Kong et al. 2015), this study takes a different perspective by unveiling the antecedents of MMI throughout the NPD process. Specifically, we first examine and compare the differentiated effect of market newness on MMI during the different stages of NPD, and how competition can intensify this effect, therefore highlighting the need for managers to make better use of the timing of MMI across different stages of NPD when implementing such integration. Second, we indicate how MMI during the initial stages of NPD can affect the integration during the later stages, enabling managers to more efficiently implement such integrations in NPD.

In Section 2, we develop our hypotheses. We then present our research methodology

and our results in Sections 3 and 4 respectively. In Section 5 we discuss our findings and robustness checks. Finally, in Section 6, we present our conclusions and limitations and suggest opportunities for future research.

2 Research Hypotheses

Our study can be related to resource dependence theory (Pfeffer and Salancik 1978) according to which organizations try to manage dependency and reduce uncertainty by increasing the level of coordination among all relevant partners of an operation (Gruner and Homburg, 2000). In order to do so, firms establish links either with other organizations (Ulrich and Barney 1984, Casciaro and Piskorski, 2005; Hillman *et al*., 2009) or among the different departments of theirs (Gupta *et al*., 1986; Ruekert and Walker, 1987; Olson *et al*., 1995). In this study, we focus on the integration of manufacturing and marketing departments and examine how it can be affected by market newness and competition.

MMI is defined as "the coordination of the timing and substance of functional strategies and development activities performed by marketing and manufacturing in new product development" (Swink and Song, 2007). Furthermore, it is considered to be involved in each of NPD's four stages: business and market analysis, technical development, product testing, and product commercialization (Urban and Hauser, 1993).

We depict the theoretical framework in Figure 1 to represent the relationships investigated in this research. It shows the impact of market newness on MMI, the influence of MMI in early stages on subsequent stages, and the moderating effect of competitive intensity. Based on resource dependence theory, we next develop our hypotheses.

[Insert Figure 1 about Here]

2.1 Market newness and MMI

In the stage of business and market analysis, the firm's objectives are to analyze the market, identify opportunities, and determine the desired product features (Urban and Hauser, 1993). At this very early NPD stage, due to market newness, the firm is

uncertain about the market, customers, emerging technological development, etc. (Zhang and Doll, 2001); therefore, the process is typically imprecise and characterized by *ad hoc* decisions (Montoya-Weiss and O'Driscoll, 2000). This is often referred to as "front-end fuzziness" (Smith and Reinertsen, 1991; Khurana and Rosenthal, 1997; Alam, 2006; Verworn, 2009). Suggested by resource dependence theory (Pfeffer and Salancik, 1978), such fuzziness, rooted in the complexity and uncertainty brought by market newness, leads to higher interdependency between the marketing and manufacturing departments, requiring the firm to change its organizational routines.

Since MMI can facilitate communication, enhance idea exchange, and further increase both the speed and quality of the information flow between the two interdependent departments, a higher level of market newness will require a higher degree of MMI to improve the effectiveness of managing the fuzziness and challenges posed by market newness (Brentani and Reid, 2012). When a firm enters a new market, how to serve the new market does not constitute a sole marketing question. Specifically, when the level of market newness is high, serving the new market may require new product features, which may demand in turn substantially different capabilities in manufacturing. By implementing MMI and synthesizing the two departments' knowledge and resources, both departments can understand more clearly the constraints on each other's capabilities and therefore minimize resistance during NPD (Kim and Wilemon, 2002). More specifically, for marketing personnel, knowing the manufacturing department's constraints is helpful for identifying what is feasible regarding the targeted market. Moreover, manufacturing personnel can also inform marketing personnel about capacity or the possibility of adopting new technologies, ensuring that marketing personnel are aware of what the firm can offer before approaching potential customers. Hence, as predicted by resource dependence theory, to successfully conduct business and market analysis, both marketing and manufacturing departments should work more closely to support and share resources with each other. We therefore expect that:

H1a. Market newness is positively related to MMI in business and market analysis.

In the technical development stage, the focus is to transform the product concept into an actual product (Urban and Hauser, 1993). During this stage, manufacturing personnel are likely to focus on a few key features to maintain production and cost efficiency, while marketing personnel may want to add more features to the product to better address customers' requirements in the new market. The resource dependence perspective, suggests that such a tradeoff in the decision-making process can increase interdependence between the marketing and manufacturing departments, consequently reinforcing the need for them to cooperate and make decisions together. MMI is therefore considered to be essential during the technical development stage (Brettel *et al*., 2011). Nonetheless, as the level of market newness increases, it becomes even more important for manufacturing and marketing personnel to work together to decide the key features that are both indispensable in the market and achievable in manufacturing (Nemetz and Fry, 1988). In response to market newness, manufacturing and marketing personnel may need to work through several iterations together to reach an agreement on the new product's final technical details. Thus, as market newness increases, communication and integration between the marketing and manufacturing departments are essential to facilitate problem-solving and coordination. Based on these arguments, we hypothesize that:

H1b. Market newness is positively associated with MMI in technical development.

During the product testing stage, the major task is to test the product with customers to determine their acceptance of the new features (Urban and Hauser, 1993). Marketing personnel should encourage customers to try the product, collect testing data, and communicate customer feedback to manufacturing personnel. This becomes more challenging when the level of market newness is high, as customers may not know exactly what they want and may change their requirements (Workman Jr, 1995). Hence, modifications to the new product may be required (Gruner and Homburg 2000). In this regard, the marketing department provides a critical bridge between customers and the manufacturing department, translating testing results into possible product modifications.

Resource dependence theory posits that the degree of interdependence and the flow of information between the marketing and manufacturing departments during the product testing stage may be greater in response to the uncertainty and difficulty posed by market newness (Olson *et al*., 1995). As MMI can increase the efficiency of communication and help the manufacturing department to better understand customers' needs (Song *et al*., 1998), we thus propose that:

H1c. Market newness is positively related to MMI in product testing.

At the product commercialization stage, the firm's focus is on deciding how to launch the new product and finalizing manufacturing and marketing plans (Urban and Hauser, 1993). For the marketing department, selling new products to a new market can increase the difficulty of accurately estimating demand. This inaccurate demand information presents further challenges to the manufacturing department: producing too many products may result in a high inventory level and low production capacity flexibility, while producing too few may result in losing sales and not maximizing the economy of scale. Triggered by demand uncertainty, such interdependency reinforces the need for MMI (O'Leary-Kelly and Flores, 2002). Through communication and cooperation with marketing department, the manufacturing department can promptly adjust its production plan in response to demand fluctuation (Swink and Song, 2007). Similarly, to reduce excess inventory, the marketing department can also choose to pursue additional advertising to stimulate customer demand. We thus propose the following hypothesis:

H1d. Market newness is positively related to MMI in product commercialization.

2.2 The influence of MMI in early stages on late stages

Through integration in the early NPD stages, manufacturing and marketing personnel are able to deal with resource dependencies (Song and Swink 2009). Such an integration allows them to develop more effective working relationships over time (Moanert et al. 1994). Furthermore, as NPD moves from discussing a product concept to producing a physical product, manufacturing and marketing personnel need to re-evaluate their decisions together and increase their interactions since early product conceptual

decisions create various constraints that need to be considered at the later stages (Olson *et al*., 1995). Resource dependency theory suggests that these constraints increase mutual interdependence and therefore the need for MMI during the later stages of the NPD process (Song and Swink 2009).

The current literature mainly focuses on the internal influence of MMI in different NPD stages (Griffin, 1997; Haque *et al*., 2003; Song and Swink, 2009). The existing conclusions may need to be revised when the influence of external factors, such as marketing newness, are taken into account. Market newness may lead to a higher degree of MMI in all four NPD stages whereas the integration in the earlier stages may not cause a higher level of integration in the later NPD stages. Therefore, this research revisits the effect of early stage MMI on subsequent stages. However, our focus is not simply on re-examining these hypotheses but rather on consolidating them by considering the external factor of market newness.

H2a-f: MMI in an early NPD stage is positively associated with MMI in the subsequent stages of NPD.

2.3 The timing of MMI

Since we propose that the positive impact of market newness on MMI is significant in the four NPD stages, the magnitude of this effect also merits investigation. As MMI is not cost-free, increasing the level of MMI in all NPD stages may not be efficient for the firm because the level of MMI may not need to be equally high in all NPD stages. For example, Atuahene-Gima and Evangelista (2000) observed that too much marketing influence can divert attention from technical issues in the production stage and may, thus, increase the risk of product defects. This indicates that the timing of MMI is also important (Kong *et al*., 2015; Swink and Song, 2007).

From a resource dependence view, because market newness brings higher uncertainty and complexity to NPD, this creates more interdependency and requires a higher level of MMI in the firm. Olson *et al*. (1995) proposed that newness can be considered as "a reflection of the amount of relevant experience" that a firm's personnel have. In the early stages of NPD, as the firm has little experience regarding the product, customers,

and market, the participation of specialists with different expertise is more desirable, leading to interdependencies and the need for cooperation between marketing and manufacturing. As NPD proceeds, the involved personnel can accumulate experience from working on the new product, leading communication between the two departments to become smoother and more efficient. Therefore, when NPD reaches its subsequent stages, once the product has been specified and production has started, MMI becomes less desirable. We, thus, propose that:

H3. The positive impact of market newness on MMI is higher in the earlier stages and lower in the later stages of NPD.

2.4 The moderating effect of competitive intensity

Changes in the environment, such as intense competition, are forcing firms to reconsider their traditional ways of developing products (Takeuchi and Nonaka, 1986). The uncertain market environment caused by intense competition has resulted in organizational capabilities becoming the primary basis for firms; integrating the knowledge possessed by different functions within the firm is the essence of organizational capability (Grant, 1996). Resource dependence theory suggests that a firm's marketing and manufacturing departments can become more dependent on each other in the presence of competition, emphasizing both the quality and speed of information sharing between them. The quality of information sharing helps to generate product advantage (Henard and Szymanski, 2001), while the speed of information sharing contributes to the competitive advantage (Millson *et al*., 1992), both of which can be enabled by MMI. We, therefore, argue that competitive intensity influences the link between market newness and MMI in the four NPD stages for the following reasons.

First, in the business and market analysis stage, under intensive competition, matching the right product with the right segmented market is more challenging in a new market. This requires the firm carefully choose product technical attributes for the targeted customers by taking into account competitors' choices of product attributes (Lukas and Ferrell, 2000). Due to competition, customers also have more choices and

can easily switch from one firm to another. In this case, the firm faces even more pressure, in deliberating over market newness, to provide the right product with the desired attributes to attract the targeted customers. Support from the manufacturing side thus becomes more crucial to help marketing personnel accurately and promptly define the details of the new product in order to obtain a better position in a competitive environment. Hence, marketing and manufacturing personnel should work more closely when analyzing the new market and deciding new product attributes under intense competition; we, thus, propose that:

H4a. The impact of market newness on MMI in business and market analysis is stronger when the level of competitive intensity is higher.

Second, in the technical development stage, a high level of competition emphasizes the importance of meeting customers' requirements, and the firm has a stronger incentive to finish technical development earlier to gain competitive advantage (Vesey, 1991). This intensifies the tradeoff between the performance and speed of NPD (Cohen *et al*., 1996). From a resource dependence view, it becomes more important for the two departments to work together to avoid potential conflicts. More specifically, developing the new product faster may result in abandoning a few important features and sacrificing product performance; thus, the communications and cooperation between marketing and manufacturing departments become more crucial. Therefore, we propose that:

H4b. The impact of market newness on MMI in technical development is stronger when the level of competitive intensity is higher.

Third, during the stage of product testing, faced with new features of the product, customer demand is more uncertain and they may change their minds (Castaño, 2008). Enabled by competition, customers can also compare different firms' products, leading to more modification requests for the new product (Gruner and Homburg, 2000). The firm should, pay more attention to these modification requests and quickly modify their own products to gain competitive advantages. In this case, marketing and manufacturing personnel need to work more closely and react more promptly.

Therefore:

H4c. The impact of market newness on MMI in product testing is stronger when the level of competitive intensity is higher.

Finally, in the stage of product commercialization, market newness, coupled with intense competition, makes it more difficult for marketing personnel to decide the timing of the new product's launch (Benedetto, 1999). Launching the new product earlier can gain first mover advantage in the new market, but gives manufacturing personnel less time for preparation and production. Conversely, while launching the new product later can give manufacturing personnel more time to develop the new product, customers may have already purchased from the competitors who launched their product earlier. Considering the interdependency between the two departments during the decision-making process, resource dependence theory suggests that MMI can facilitate cooperation between marketing and manufacturing personnel to help the firm remain agile. Hence, we propose that:

H4d. The impact of market newness on MMI in product commercialization is stronger when the level of competitive intensity is higher.

3. Research Method

In our study, we employed questionnaire-based survey method. It is considered as an appropriate approach to examining the hypothesized relationships for several reasons. First, the purpose of this study is to examine the impact of market newness on MMI in NPD's different stages, the moderating role of competitive intensity and the effect of MMI on early stages on MMI on subsequent ones. Thus, a quantitative method is more appropriate than a qualitative one (Huo et al., 2016). Second, we can tailor the measures more precisely to answer a specific research question using survey approach compared with using secondary data (Roth, 2007). Hence, a questionnaire-based survey approach allows us to develop measurement scales based on our understanding of market newness, competitive intensity and MMI. Furthermore, top managers familiar with the questions are identified as informants to ensure the quality of self-reported data (Huo et al., 2016). In this study, we collected data from Chinese firms to test our hypotheses.

We choose Chinese firm for two main reasons. First, existing literature mainly focuses on U.S. firms (e.g. Swink and Song, 2007; Song and Swink, 2009), and MMI is often considered to be more critical in NPD in an individualistic culture (Zhao et al., 2011), therefore, there is a need to test and validate the existing findings in a different context. As an increasing number of Chinese firms have recognized the importance of cross-functional integration in NPD, and Chinese firms place emphasis on collectivism culture, Chinese firms thus provide an ideal setting to investigate MMI (Zhang et al., 2016). Second, our choice for Chinese companies is also due to the feasibility of data collection from such companies. As a result, we collected data from Chinese firms to examine the hypothesized relationships.

In the following sections, we present the questionnaire design, the data collection process, as well as several procedures to ensure reliability and validity.

3.1 Measures

Whenever possible, we adopted or adapted validated scale items from existing studies. We operationalized the constructs and measurement items using a seven-point Likert scale. The constructs and measurement items are presented in Appendix A. To develop our measures, we reviewed the existing literature. We first established the English questionnaire, and then conducted the translation/back-translation procedures to ensure cross-cultural equivalence. The items were reviewed by three researchers and five managers, and a pre-test was conducted using a sample of eight firms in Xi'an, China. We further revised the questionnaire to make it more reliable according to the feedback. For this research, the unit of analysis is an NPD project, because it is easier to monitor a specific project's operations management (Wagner, 2010). We asked the respondents to choose a recently completed NPD project that they were most familiar with. We requested each respondent to complete the questionnaire according to the selected project.

Market newness. A three-item scale was adapted from Molina-Castillo and Munuera-Aleman (2009) to measure market newness. The informants were asked to assess the extent to which the product, the customers, and the market are new to their firms.

Competitive intensity. A five-item scale was adopted from Auh and Menguc (2005) to assess competitive intensity. The respondents were asked to indicate competitive intensity using these measures.

MMI in NPD. The MMI in the four stages of NPD – business and market analysis, technical development, product testing, and product commercialization – was measured by five, four, five, and four items respectively, similar to Kong *et al*. (2015), Song and Swink (2009), and Swink and Song (2007). The respondents were requested to evaluate the degree to which the marketing department and the manufacturing department were integrated when conducting activities at each NPD stage.

Control variables. Firm size and firm age may influence MMI (Luca and Atuahene-Gima, 2007). More specifically, we controlled for firm's size and age because smaller or younger firms usually have unclear boundaries between different departments while larger or long-lasting firms often have departments with clearly defined boundaries and responsibilities. This can impact the measure of MMI. We measured firm size by taking the natural logarithm of the number of employees. We calculated the natural logarithm of the number of years since the firm was founded to measure firm age. Since the level of MMI may vary in different industries and regions (Song and Parry, 1997). We also included five industry dummies to control the potential influences of industry, as different industries may require different levels of MMI in their NPD. The five industries are: metal products, machinery, electrical machinery and equipment, communication and computer-related equipment, and instruments and related products. We combined other industries, each having a very small number of observations, and treated this category as our baseline. Finally, we controlled for the industrial region. In this study, we strategically selected five different provinces to collect the data: Guangdong, Jiangsu, Beijing, Shandong, and Shaanxi. These five provinces locate in distinct parts of China and reflect different levels of economic and market development, and such heterogeneity may also lead to different levels of MMI during NPD. We believe that Guangdong, Jiangsu, Beijing, Shandong, and Shaanxi are representative of China's economic development with varying levels of the market economy. This

strategic selection should capture various economic development and market formation stages in China. The industrial region was measured using four dummy variables, with Shaanxi as the baseline.

3.2 Data collection

We randomly selected 750 firms from the published industry directories available in the university library as our sampling frame. We first called the selected firms to gain the contact information of key respondents, with reference to the study's subject matter. The questionnaire, accompanied by a cover letter explaining the research purpose and confidentiality of this study, was then sent to the identified target respondents. We also suggested that if the respondent felt that it was difficult for them to answer certain questions, they could request help from appropriate colleagues. In addition, we used follow-up phones and mails to increase the response rate.

Overall, the data from 214 firms was used in our formal analysis, representing a response rate of 28.5%. It is comparable to previous research using survey data in cross-functional integration (e.g., 19% in Leenders and Wierenga, 2008) and new product development (e.g., 24% in Jayaram, 2008). Among the respondent firms, 17.8% were from Guangdong, 15.9% were from Jiangsu, 24.8% were from Shandong, 18.2% were from Beijing, and 23.3% were from Shaanxi. According to China Statistical Yearbook and existing studies (e.g., Huo et al. 2016), Table 1 shows the industry and number of employees of the sampled firms. As we allowed the respondents to seek help from appropriate colleagues, the actual respondents may not be the initial respondent that we contacted, and the respondents held various positions in the surveyed firms. In the sample, 65 respondents were the CEO/president of the firm, while the remaining 149 were the managers of either the marketing or the manufacturing department. The average age of respondents was 40.62 years (SD = 9.9). The average tenure in this position was 6.16 years (SD = 5.29).

[Insert Table 1 about Here]

3.3 Bias testing

We compared industry, ownership type, number of employees, and sales growth of the

responding with the non-responding firms to assess potential non-response bias. The *t*-test results revealed no significant difference. We also assessed non-response bias by splitting our sample into early and late responses based on the time taken to return the questionnaire (Armstrong and Overton, 1977). The *t*-test indicated insignificant differences, revealing that non-response bias was not serious.

To estimate the possible influence of common method bias, we employed Harman's single-factor test (Podsakoff *et al*., 2003). Six factors were proposed, and the largest variance explained was merely 18.1%. Thus, common method bias would not be an issue in our research. Moreover, we performed confirmatory factor analysis (CFA) for Harman's one-factor analysis (Podsakoff *et al*., 2003). The model fit indices of this model were χ^2 (209) = 3329.91 (compared with χ^2(194) = 472.36 for the CFA model). Thus, several different factors exist, which reaffirms that common method bias is not an issue.

3.4 Reliability and validity

We assessed the reliability of the constructs using Cronbach's alpha and composite reliability (CR). As presented in Table 2, the six Cronbach's alpha values were greater than 0.70, thus, satisfactory (Fornell and Larcker, 1981). The CR values ranged from 0.896 to 0.975, which are higher than 0.70. This further indicates satisfactory internal consistency.

[Insert Table 2 about Here]

We also evaluated content validity, convergent validity, and discriminant validity. We established the content validity of the constructs by reviewing the existing literature, while we assessed the convergent validity and discriminant validity following the approach from Fornell and Larcker (1981). To test the convergent validity, we linked each item to its expected construct, and freely estimated the covariances among different constructs. The model fit was acceptable (χ^2 (194) = 472.36, RMSEA = 0.074, NNFI = 0.92, CFI = 0.94 and SRMR = 0.069) (Hu and Bentler, 1999). Further, all factor loadings in Table 2 were statistically significant. These results indicated satisfactory convergent validity. We examined discriminant validity via comparing the construct's

average variance extracted (AVE) values with the shared variance between this construct and the other constructs (Fornell and Larcker, 1981). As presented in Table 3, the square root of AVE value is higher than the correlations for each construct. These results suggested good discriminant validity.

[Insert Table 3 about Here]

4. Analysis and Results

We conducted hierarchical linear regressions to verify the hypotheses. To reduce the potential influences of multicollinearity, we mean-centered the independent and the moderating variables before producing the interaction term. In Models 1, 4, 7, and 10, the control variables included firm size, firm age, regions (using dummy variables), and industry types (using dummy variable). Table 4 presents the results of our analysis. Models 1, 2 and 3 present our results for MMI at the stage of business and market analysis. At model 1, we include only the controls variables. At model 2, we add market newness and competitive intensity. The adjusted R^2 is significantly increased and an F-test indicated that model 2 is superior to model 1 at 0.1% level ($p<0.001$). The coefficient of market newness is significantly positive at 0.1% level ($p < 0.001$) providing full support for H1a. At model 3 we add the interaction term of market newness and competitive intensity. The adjusted R^2 is further increased and an F-test indicated that model 3 is superior to model 2 at 5% level. The interaction term is significant at 5% level ($p<0.05$) providing full support for H4a.

Models 4, 5 and 6 present our results for MMI at the stage of technical development. At model 4 we include only the controls variables. At model 5 we add MMI at business and market analysis, market newness and competitive intensity. The adjusted R^2 is significantly increased and an F-test indicated that model 5 is superior to model 4 at 0.1% level ($p<0.001$). The coefficient of market newness is significantly positive at 0.1% level ($p < 0.001$) providing full support for H1b and the coefficient of MMI at business and market analysis is significantly positive at 0.1% level ($p < 0.001$) providing full support for H2a. At model 6, we add the interaction term of market newness and competitive intensity. The adjusted R^2 is not increased and the interaction term is

insignificant providing no support for H4b.

[Insert Table 4 about Here]

Models 7, 8 and 9 present our results for MMI at the stage of product testing. At model 7, we include only the controls variables. At model 8, we add MMI at business and market analysis, MMI at technical development, market newness and competitive intensity. The adjusted R^2 is significantly increased and an F-test indicated that model 8 is superior to model 7 at 0.1% level ($p<0.001$). The coefficient of market newness is insignificant providing no support for H1c. The coefficient of MMI at business and market analysis is significantly positive at 0.1% level ($p < 0.001$), providing full support for H2b, and the coefficient of MMI at technical development is insignificant, providing no support for H2d. At model 9, we add the interaction term of market newness and competitive intensity. The adjusted R^2 is not increased and the interaction term is insignificant providing no support for H4c.

Finally, models 10, 11 and 12 present our results for marketing-integration at the stage of product commercialization. At model 10, we include only the controls variables. At model 11, we add MMI at business and market analysis, MMI at technical development, MMI at product testing, market newness and competitive intensity. The adjusted R^2 is significantly increased and an F-test indicated that model 11 is superior to model 10 at 0.1% level ($p<0.001$). The coefficient of market newness is significantly positive at 5% level ($p<0.05$), providing full support for H1d. The coefficient of MMI at business and market analysis is significantly positive at 5% level ($p < 0.05$) providing full support for H2c, the coefficient of MMI at technical development is insignificant providing no support for H2e and the coefficient of MMI at product testing is significantly positive at 0.1% level ($p<0.001$) providing full support for H2f. At model 12, we add the interaction term of market newness and competitive intensity. The adjusted R^2 is further increased and the interaction term is significantly positive at 5% level ($p<0.05$) providing full support for H4d.

We also hypothesized that the positive relationship between market newness and MMI is higher in the early stages and lower in the later stages of NPD. To test these

hypotheses, we conducted a series of *t*-tests: the results indicated that the impact of market newness on MMI in business and market analysis is significantly higher than that in technical development ($p<0.05$), product testing ($p<0.001$), and product commercialization ($p<0.001$). However, differences in the impacts of market newness on MMI in the second, third, and fourth stages are insignificant. Thus, H3 is partially supported.

Overall, our results provide full support for H1a, H1b and H1d, indicating that market newness is positively and significantly associated with MMI in the stage of business and market analysis, technical development and product commercialization, respectively. However, H1c is not supported, indicating that the relationship between market newness and MMI in product testing is not significant. A potential explanation is that MMI in product testing may be driven mainly by such integration at the earlier NPD stages, such as business and market analysis, but not by the external factor of market newness.

In addition, our results provide full support for hypotheses H2a, H2b and H2c, suggesting that a higher degree of MMI at business and market analysis is related to higher degrees of MMI at each of the three subsequent stages. However, H2d and H2e are not supported indicating that MMI at technical development is not positively associated with MMI at product testing and product commercialization. A possible explanation is that MMI in technical development may be mainly driven by the external factor, market newness, and we indeed observe that H1b is supported, namely, market newness is positively associated with MMI in technical development. Such high level of MMI generated by the external factor market newness may not be able to pass down to the later stages. Therefore, neither H2d nor H2e is supported. Finally, H2f is fully supported indicating that the association between MMI in the stage of product testing and product commercialization is positive and significant. After considering the impact of market newness, our findings are consistent with Swink and Song (2009)'s study regarding the relationships between MMI in the stage of business and market analysis and in the subsequent stages. However, our results are different from Swink and Song

(2009) regarding the relationships between MMI in the stage of technical development and in all subsequent stages, and the relationship between MMI in the stage of product testing and product commercialization.

Moreover, our results indicate that the moderating role of competitive intensity is not always significant at every stage of NPD. Specifically, H4a and H4d are fully supported indicating that competitive intensity has a significant and positive moderating impact on the link between market newness and MMI at business and market analysis and product commercialization. However, H4b and H4c are not supported, indicating that the moderating effect of competitive intensity on MMI at technical development and product testing is insignificant. A potential explanation could be that during technical development, companies tend to rely on their skills rather than the competition and the market (Cooper, 1993; Gruner and Himburg, 2000). Hence there is no significant moderating effect of competition on the positive relationship between market newness and MMI during these stages.

Finally, following Aiken and West (1991), we further examined the details of these two significant moderating effects. Simple slopes were computed at high and low levels of competitive intensity. In the contexts of both high ($\beta = 0.646$, $p < 0.001$) and low ($\beta = 0.432$, $p < 0.01$) competitive intensity, the relationships between market newness and MMI at business and market analysis are positive and significant at 0.1% and 1% respectively. In the context of high competitive intensity, the relationship between market newness and MMI at product commercialization is positive and significant at 0.1% ($\beta = 0.297$, $p < 0.001$), whereas in the context of low competitive intensity, it becomes insignificant ($\beta = 0.055$, $p > 0.10$). These results are depicted in Figures 2 and 3.

[Insert Figure 2 about Here]

[Insert Figure 3 about Here]

5. Discussion

5.1 The optimal timing of MMI

The current literature suggests two opposing approaches for the timing of MMI during

NPD: an increasing or a decreasing path. In support of the increasing path of integration, Haque *et al*. (2003) and Olson *et al*. (2001) argued that when a new product project moves from its conceptual early stages to more concrete later stages, the firm may face difficulties associated with the respective requirements and contributions, thus necessitating greater coordination of activities and decisions between the marketing and manufacturing departments. Conversely, supporting the decreasing path, Griffin (1997) suggested that such integration should be implemented early in the NPD process, as solving problems and issues at late stages usually incur a higher cost and are more time consuming than doing so at early stages. In addition, Song and Swink (2009) proposed that whether a firm should choose an increasing or a decreasing path of MMI depends on whether the new product is innovative or not: an increasing path works better for highly innovative products, whereas a decreasing path works better for less innovative ones.

However, in this study, by taking into account the antecedent factors of market newness and competition, the timing of MMI can be more complex than a monotonic path suggested by the existing literature. Our results reveal that, first, market newness has a significant and positive effect on MMI in the earlier stages (i.e., business and market analysis and technical development) and the last stage (i.e., product commercialization) of NPD, but not in the intermediate stage (i.e., product testing). Second, the positive moderating effect of competitive intensity is also significant in the first stage (i.e., business and market analysis) and the last stage (i.e., product commercialization) of NPD, but not in the two intermediate stages (i.e., technical development and product testing). Third, comparing the magnitude of market newness's impact on MMI in NPD's different stages, the impact in the first stage is significantly stronger than that in the other three stages.

The results indicate that, as NPD starts from perceiving customer demand in the market and ends with delivering the new product to meet their demand, the uncertainty associated with market newness and competition will have a higher impact when the firm interacts more directly with the market, namely during the first stage, business and

market analysis, and the last stage, product commercialization. And the impact of market newness and competition is lower during the intermediate stages, i.e., technical development and product testing. This is because, during technical development, companies tend to rely on their skills rather than the market (Cooper, 1993; Gruner and Himburg, 2000). And for product testing, it is affected less by the market newness than the stage of the actual product launch. Therefore, the marketing and manufacturing departments work more closely at the beginning and end of NPD, but not during the intermediate stages.

The findings in this study also have practical implications. When facing a high level of market newness, managers should take into account the different stages of NPD when implementing MMI. Specifically, managers need to acknowledge the dynamic nature of MMI during an NPD process and determine the appropriate degree of integration over the various stages. Since the cost associated with MMI should not be ignored (O'Leary-Kelly and Flores, 2002), this integration may not simply be a case of more-is-better. Moreover, our study suggests that managers should take into account market newness more in the initial and final stages of NPD than in the intermediate stages. Since the effect of MMI differs from one stage to another, firms need to deliberate over the choice of a temporary project-based function (Hobday, 2000) or a permanent and dedicated function in which marketing and manufacturing personnel work together (Dekkers *et al*., 2013).

5.2 The effect of competition

In this study, we consider competition as a moderator in the regression models and the moderating effect of competition is only significant at the first (business and market analysis) and last (product commercialization) stage of NPD. It is also important to notice that the direct effects of competitive intensity on MMI differ in each of NPD's four stages. According to Table 4, the coefficient of competitive intensity is significantly positive at 5% level ($p<0.05$) in Models 3, 5 and 6, while in Models 2, 8, 9, 11 and 12, the coefficient is insignificant. The results indicate that competition is positively associated with MMI in NPD's first stage (business and market analysis) and

second stage (technical development), but not in the third (product testing) or fourth (product commercialization) stage. Therefore, when responding to intense competition, firms need to consider the differentiated effects of competition during different NPD stages.

5.3 Different types of respondents

The respondents in this study held various positions in their firms. Within the 214 firms finally employed in the analysis, 65 of the respondents were CEO/ president of their firms and 149 were managers from either the marketing or manufacturing department. Further ANOVA analysis shows that the size of the firms in which managers responded is larger than the firms in which CEOs responded ($p < 0.01$); thus, the CEO/president is more likely to be the individual respondent when the firm size is small. For small firms, departmental boundaries may be unclear, enabling the CEO/president to be more familiar with the integration between different departments (Morash *et al.*, 1996). Conversely, in medium-sized and large firms, managers from the corresponding departments are often more knowledgeable about the integration.

We also conducted ANOVA analysis to compare the level of other constructs, and the results are shown in Appendix B. As a robustness check, we repeated our analysis separately for the two types of respondents in our sample (i.e., one for CEO/presidents and one for managers). Tables 6 and 7 of Appendix B provide the results of these analysis. More specifically, Table 6 provides the results using only CEO/presidents respondents. These result provide full support for H1a, H1b, H2a, H2b, H4c and H4d, partial support for H2c, H2f and H3 and no support for the rest of our hypotheses. Compared with the supported hypotheses from our main analysis, we, therefore, get no support for H1d and H4a and partial support for H2c and H2f. We believe that the main reason for this difference is the dramatic decrease of our sample size (214 vs. 65). Nonetheless, the fact that we get support for some of our hypotheses using such a small sample makes us confident that these results are robust. Table 7 provides the results using only manager respondents. The results provide full support for H1a, H1b, H1d, H2a, H2b, H2f and H4a and partial support for H2c and H3. Compared with the

supported hypotheses from our main analysis, we get no support for H4d and partial support for H2c. Similarly, this may be because of the decrease in our sample size (214 vs. 149).

5.4 Reverse causal relationship

Although the hypothesis that market newness has a positive impact on MMI is mainly supported by the data, rival hypotheses may exist. For example, a higher level of MMI may enable the firm to pursue market opportunities with high uncertainty, giving rise to the possible reverse causal relationship between MMI and market newness. This study mitigated the possibility of this rival hypothesis in several ways. First, the existing literature generally shows that market newness increases MMI, rather than those firms with a high level of MMI trying to pursue marketing with a high level of newness (Millson, 2013). Second, our interviews with the respondents in our survey suggest that market newness is one of the most important preexisting factors leading to MMI. Thus, our research hypotheses are developed on a theoretical and practical, rather than statistical, basis.

5.5 Robustness checks using structural equations modeling (SEM)[1]

Finally, we repeated our analysis employing partial least square structural equations modeling (SEM). As shown in Appendix C, our findings are qualitatively the same as our main analysis in Table 4 (i.e., they are the same in terms of hypotheses support), which makes us confident that our results are robust and consistent with both approaches.

6. Conclusions

Although there are a number of studies examining the effect of MMI on new product performance suggesting a firm should implement MMI, because it may improve new product performance, the decision on such an integration should be made before the evaluation of new product performance. Furthermore, little is known about what causes the different levels of MMI at different NPD stages. In this study, we focus on the antecedent factors of MMI and explore how market newness impacts the level of MMI

[1] We would like to thank one of the reviewers for this suggestion.

at the four different NPD stages, as well as how competition moderates that effect. Our findings reveal that market newness is positively associated with MMI in three of the four NPD stages (business and market analysis, technical development and product commercialization). Next, examining the moderating role of competitive intensity in MMI, our results indicate that competitive intensity increases the positive relationship between market newness and MMI during the early and late stages, but not during the intermediate stages of NPD. In contrast to the existing literature, which suggests a monotonic path of MMI during NPD, our findings suggest a more complex path for the timing of MMI during NPD, based on the effects of market newness and competition. Therefore, we highlight the importance of a dynamic perspective on MMI and emphasize the need to match the appropriate level of cross-functional integration to each particular NPD stage when implementing MMI.

As in all empirical studies, ours has its limitations. First, our dataset depends upon information from a single respondent in each firm, and the respondents hold different positions in their respective firms. Although no common method bias was detected, using multiple respondents from each firm can be more beneficial. As MMI involves two departments, marketing and manufacturing personnel may have different perspectives and can value such an integration differently. Therefore, future research could be conducted to further validate our findings based on data collected from multiple respondents from both marketing and manufacturing departments within the same firm. In future work, the asymmetry of the interdependence between the two departments during NPD could also be investigated. Second, our analysis suggests that, in response to market newness, the level of MMI should be higher at NPD's initial and final stages, as the firm has less experience regarding the product and the market, thus, requires cooperation between the marketing and manufacturing departments (Olson *et al*., 1995). However, as our study is cross-sectional, while this approach is useful for testing hypotheses, it does not take into account the firm's previous experience with NPD. For example, some firms may have already integrated their marketing and manufacturing departments in previous NPD projects, and such experience on

integration can be transferred from one project to another. Thus, future research could conduct longitudinal studies to explore how MMI is established and how it can evolve over time and across different NPD projects. Third, this study considers the NPD stages as independent sets of activities over time and did not trace actual performance of the new product in the market, mainly because such data was not available in our sample. However, the execution of these stages can quite likely be concurrent. Hence, future studies could also examine the effect of market newness on MMI when there is an overlap between different stages, as well as monitoring the actual performance of the new product. By including product performance in such an analysis, future studies could provide useful insights on the optimal timing of MMI regarding the success of a product. Finally, our data did not contain information regarding technology newness. Thus, an interesting extension could be investigating technology newness on MMI during the different stages of NPD and comparing the results with the effect of market newness.

Despite its limitations, our study contributes to the existing literature of NPD and MMI and offers important insights for both academic scholars and practitioners. By investigating the differentiated impacts of market newness on MMI during the different stages of NPD and the moderating effects of competitive intensity on these impacts, we provide useful insights for managers to better implement MMI during NPD.

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Appendix A. List of measurement items

Market newness

MN1: The new product aims at new customers to our firm that we had not sold before

MN2: The market for the new product is new or different from the market we normally sell into

MN3: The new product represents a new product category that we had not sold before

Competitive intensity

CI1: Competition in our industry is cutthroat

CI2: Any action that a company takes, others can make a response swiftly

CI3: Price competition is a hallmark of our industry*

CI4: One hears of a new competitive move almost every day

CI5: Our competitors are relatively strong

MMI in business and market analysis

BMA1: Analyzing the potential competition

BMA2: Conducting the detail market research

BMA3: Determining the desired product features

BMA4: Analyzing the potential customer needs

BMA5: Assessing the required investment, time, and risk of the project

MMI in technical development

TD1: Preliminary engineering, technical, and manufacturing assessments or studies

TD2: Building the product to designated specifications

TD3: Establishing criteria for judging the product performance and market acceptance

TD4: Approving the final product designs

MMI in product testing

PT1: Planning testing sites, methods, schedules, responsibilities, and costs

PT2: Executing prototype testing with customers*

PT3: Selecting customers for test marketing*

PT4: Test marketing/trial selling prior to launch

PT5: Analyzing the findings from the pretests

MMI in product commercialization

PC1: Completing the detail plans for manufacturing

PC2: Completing the detail plans for marketing

PC3: Launching the product in the market-selling, promoting, and distributing*

PC4: Establishing over-all direction of the commercialization of the product

* Items are deleted after reliability or validity analysis.

Appendix B. Analysis of Different Types of Respondents

Table 5. Results of ANOVA analysis

Variables	CEO/ president respondent	Manager respondent	*F* value	*p* value
Number of employees	538.077	1092.282	7.356	0.007
Market newness	4.921	4.820	0.547	0.460
Competitive intensity	5.054	5.000	0.130	0.719
MMI in business and market analysis	5.274	5.069	2.463	0.118
MMI in technical development	4.627	4.639	0.005	0.944
MMI in product testing	5.149	5.018	0.925	0.337
MMI in product commercialization	5.164	5.070	0.646	0.423

Table 6. Results of CEO/ president respondent group

	Business and market analysis			Technical development			Product testing			Product commercialization		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Firm size	0.400**	0.195	0.196†	0.343*	0.056	0.059	0.165	-0.083	-0.097	0.243†	0.111	0.134
Firm age	-0.017	-0.012	-0.008	-0.047	-0.047	-0.038	0.036	0.045	0.017	0.067	0.031	0.057
Metal products	0.154	0.074	0.071	0.162	0.047	0.041	0.366*	0.269*	0.287*	0.161	0.017	-0.028
Machinery	0.103	-0.071	-0.073	0.110	-0.036	-0.043	0.044	-0.055	-0.031	0.184	0.132	0.112
Electrical machinery and equipment	0.161	0.015	0.020	-0.030	-0.221*	-0.210†	-0.005	-0.125	-0.153	0.105	-0.043	-0.001
Communication and computer-related equipment	0.006	0.025	0.023	-0.046	-0.037	-0.042	0.033	0.037	0.055	-0.230†	-0.230*	-0.253*
Instruments and related products	-0.022	-0.089	-0.089	-0.133	-0.178†	-0.179†	-0.090	-0.099	-0.090	-0.087	-0.102	-0.102
Shandong	-0.187	-0.071	-0.070	-0.170	-0.018	-0.015	-0.070	0.052	0.044	-0.278*	-0.196†	-0.193†
Beijing	-0.057	0.194	0.184	-0.243	-0.067	-0.090	-0.083	0.020	0.102	-0.120	-0.028	-0.118
Guangdong	-0.225	-0.192	-0.201	-0.076	0.073	0.052	-0.089	0.031	0.103	-0.300*	-0.123	-0.203†
Jiangsu	-0.061	-0.092	-0.093	-0.134	-0.118	-0.119	0.010	0.034	0.044	-0.161	-0.117	-0.131
Business & market analysis					0.477***	0.474***		0.466**	0.458**		0.293†	0.257
Technical development								0.023	0.064		0.101	0.056
Product testing											0.254†	0.349**
Market newness (MN)		0.669***	0.653***		0.411**	0.374*		0.191	0.302		0.121	-0.016
Competitive intensity (CI)		0.062	0.078		-0.048	-0.009		0.003	-0.128		-0.274*	-0.134
MN * CI			0.031			0.074			-0.257*			0.275*
F-value	1.575	4.626***	4.222***	1.665	7.796***	7.255***	1.476	3.434***	3.755***	2.364*	4.994***	5.616***
R^2	0.246	0.541	0.542	0.257	0.686	0.690	0.234	0.513	0.556	0.329	0.625	0.670
Adjusted R^2	0.090	0.414	0.413	0.103	0.598	0.594	0.076	0.363	0.408	0.190	0.500	0.551
R^2 change	-	0.295***	0.001	-	0.429***	0.004	-	0.278***	0.043*	-	0.296***	0.045*

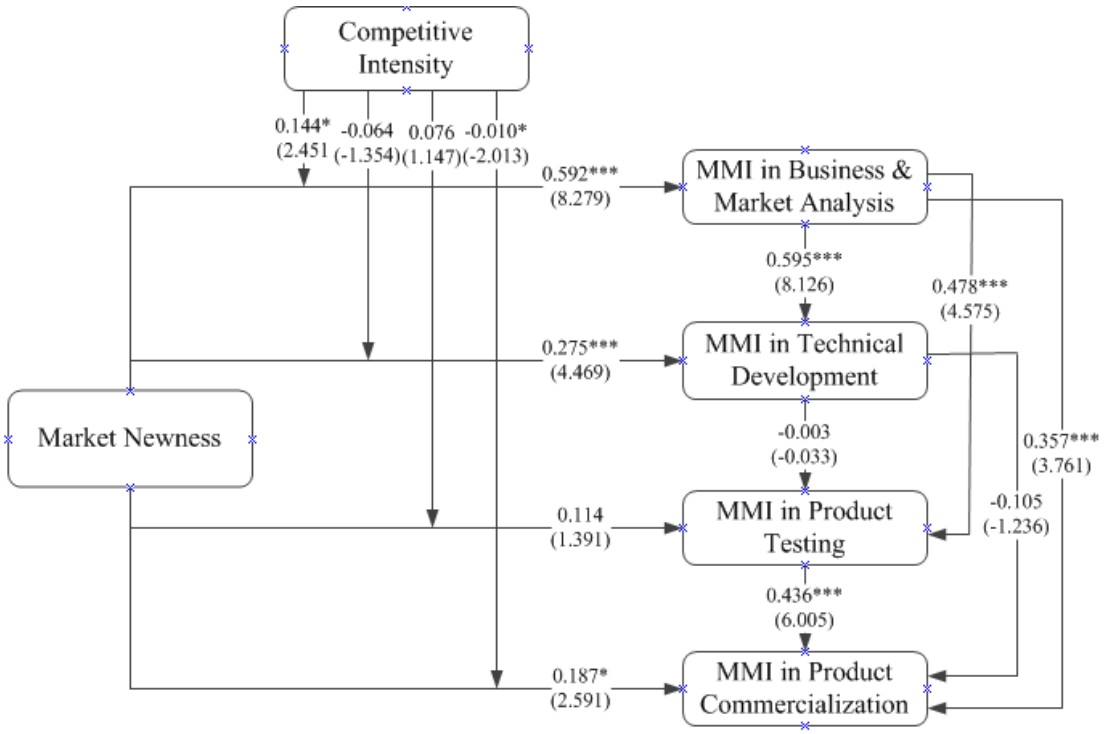
Note: † α=0.10; * α=0.05; ** α=0.01; *** α=0.001.

Table 7. Results of manager respondent group

	Business and market analysis			Technical development			Product testing			Product commercialization		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Firm size	0.208*	0.050	0.047	0.171	-0.033	-0.033	0.097	-0.011	-0.011	0.152	0.027	0.027
Firm age	-0.042	0.030	0.029	-0.105	-0.056	-0.056	-0.031	0.009	0.009	0.031	0.067	0.068
Metal products	-0.001	-0.040	-0.032	0.032	0.023	0.021	0.103	0.089	0.088	0.095	0.037	0.038
Machinery	0.116	-0.022	-0.017	0.178†	0.070	0.069	0.089	-0.012	-0.013	0.206*	0.113	0.113
Electrical machinery and equipment	0.010	-0.032	-0.045	0.004	-0.027	-0.022	0.057	0.057	0.058	0.083	0.039	0.035
Communication and computer-related equipment	0.003	-0.035	-0.024	0.000	-0.023	-0.026	-0.007	-0.006	-0.007	0.077	0.066	0.069
Instruments and related products	-0.004	-0.087	-0.082	-0.043	-0.072	-0.073	0.281**	0.274**	0.273**	0.339***	0.174*	0.175*
Shandong	-0.258	-0.132	-0.115	0.059	0.291***	0.287***	-0.081	0.023	0.023	-0.201†	-0.060	-0.058
Beijing	-0.035	0.016	0.024	0.112	0.145*	0.142*	0.072	0.100	0.099	-0.081	-0.080	-0.079
Guangdong	-0.135	-0.058	-0.071	0.005	0.126†	0.132†	-0.005	0.058	0.059	-0.155	-0.098	-0.103
Jiangsu	-0.066	0.016	0.025	0.022	0.107	0.103	-0.032	-0.007	-0.008	-0.106	-0.047	-0.044
Business & market analysis					0.590***	0.601***		0.490***	0.493***		0.201†	0.189†
Technical development								0.053	0.052		-0.104	-0.099
Product testing											0.475***	0.476***
Market newness (MN)		0.549***	0.527***		0.168*	0.170*		0.132	0.133		0.184*	0.182*
Competitive intensity (CI)		0.163*	0.194*		0.190**	0.177*		-0.129	-0.131		0.064	0.074
MN * CI			0.135*			-0.046			-0.011			0.037
F-value	1.731	9.993***	9.847***	0.756	16.909***	15.793***	1.173	5.368***	4.997***	2.316*	11.210***	10.523***
R^2	0.122	0.490	0.507	0.057	0.639	0.640	0.086	0.377	0.377	0.157	0.576	0.577
Adjusted R^2	0.052	0.441	0.456	0.019	0.601	0.600	0.013	0.307	0.302	0.089	0.525	0.522
R^2 change	-	0.368***	0.017*	-	0.581***	0.002	-	0.291***	0.000	-	0.419***	0.001

Note: † α=0.10; * α=0.05; ** α=0.01; *** α=0.001.

Appendix C. SEM Analysis Results



Note: Test statistics are provided in the brackets.

Figure 4. SEM results

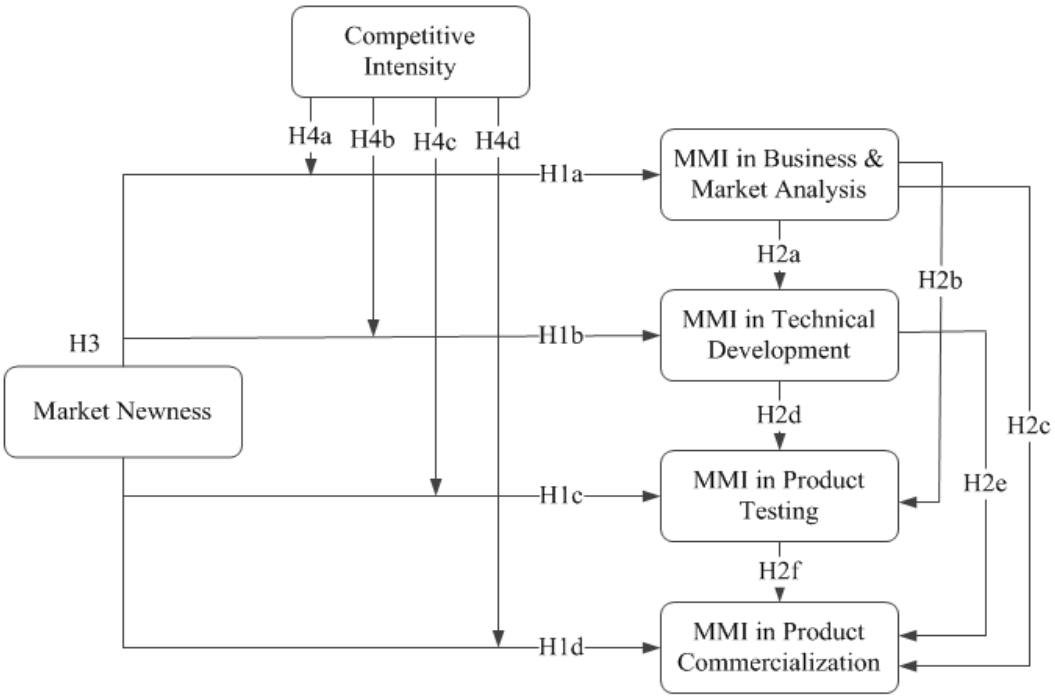


Figure 1. Conceptual model

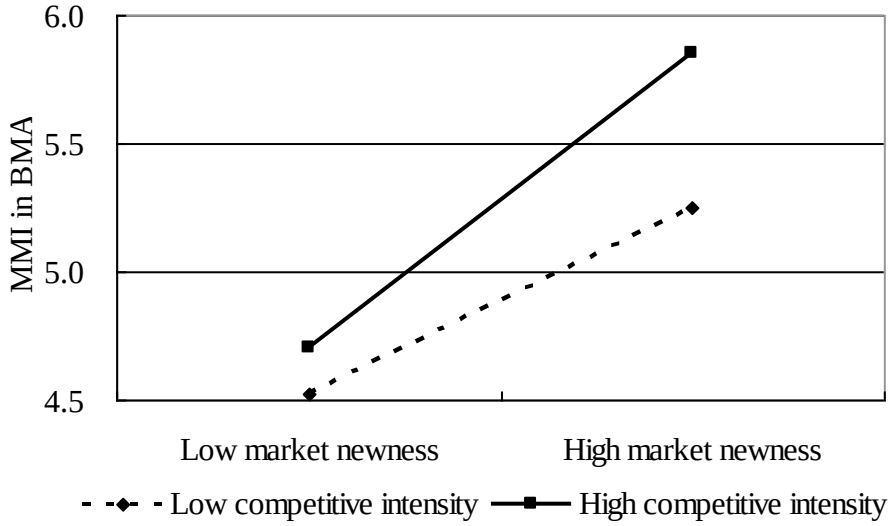


Figure 2. The moderating effect of competitive intensity on the relationship between market newness and marketing-manufacturing integration in business and market analysis

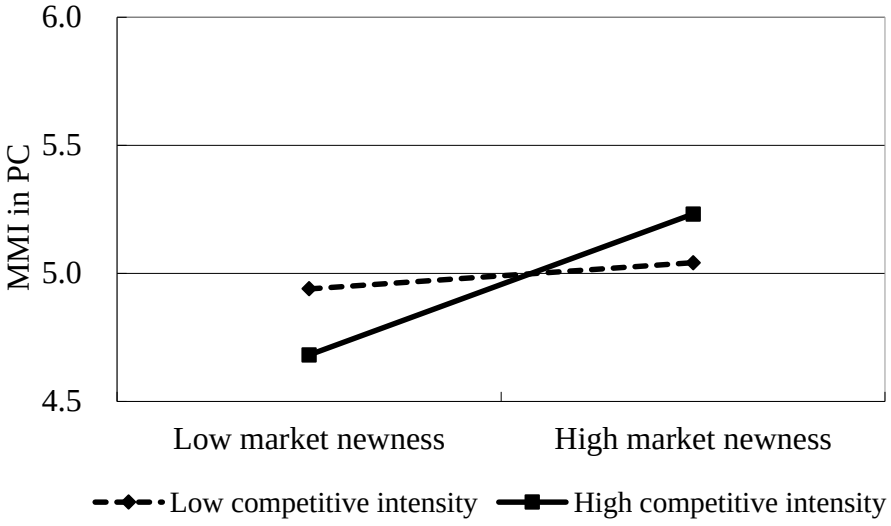


Figure 3. The moderating effect of competitive intensity on the relationship between market newness and marketing-manufacturing integration in product commercialization

Table 1. Profile of sampled firms

	Total	Shandong	Shaanxi	Beijing	Guangdong	Jiangsu
Sample size	214	53	50	39	38	34
Industry (%)						
Metal products	9.81	16.98	10.00	2.56	2.63	14.71
Machinery	19.16	13.21	34.00	10.26	10.53	26.47
Electrical machinery and equipment	25.70	16.98	20.00	28.46	34.21	23.53
Communication and computer-related equipment	7.48	5.67	4.00	15.38	13.16	0.00
Instruments and related products	12.15	5.67	10.00	12.82	21.05	14.71
Others	25.69	41.50	22.00	20.51	18.41	20.58
Number of employees (%)						
Less than 50	11.68	1.89	18.00	20.51	7.89	11.76
50-99	18.69	26.42	12.00	17.95	23.68	11.76
100-299	27.10	41.51	24.00	23.08	26.32	14.71
300-999	18.69	20.75	10.00	17.95	21.05	26.47
1,000-1,999	9.35	1.89	16.00	2.56	10.53	17.65
2,000-4,999	8.88	3.77	14.00	7.69	5.26	14.71
≥ 5,000	5.61	3.77	6.00	10.26	5.26	2.94

Table 2. Construct measures reliability and validity analysis

Construct	Item	Standardized factor loading	Cronbach's alpha	Composite reliability
Market newness	MN1	0.92	0.904	0.916
	MN2	0.97		
	MN3	0.75		
Competitive intensity	CI1	0.84	0.902	0.905
	CI2	0.69		
	CI4	0.88		
	CI5	0.94		
MMI in business and market analysis	BMA1	0.94	0.963	0.964
	BMA2	0.92		
	BMA3	0.90		
	BMA4	0.93		
	BMA5	0.90		
MMI in technical development	TD1	0.97	0.975	0.975
	TD2	0.96		
	TD3	0.94		
	TD4	0.94		
MMI in product testing	PT1	0.88	0.941	0.920
	PT4	0.93		
	PT5	0.95		
MMI in product commercialization	PC1	0.90	0.923	0.896
	PC2	0.93		
	PC4	0.85		

Note: The items, CI3, PT2, PT3 and PC3, are deleted after reliability or validity analysis.

Table 3. Descriptive statistics and correlation matrix

	Mean	SD	1	2	3	4	5	6	7	8
1. Firm size	5.715	1.572								
2. Firm age	2.446	0.787	0.500***							
3. Market newness	4.851	0.921	0.202**	0.054	**0.887**					
4. Competitive intensity	5.016	1.005	0.286***	0.173*	0.440***	**0.841**				
5. MMI in business and market analysis	5.131	0.883	0.257***	0.145*	0.639***	0.438***	**0.919**			
6. MMI in technical development	4.635	1.127	0.195**	0.054	0.633***	0.432***	0.626***	**0.953**		
7. MMI in product testing	5.058	0.915	0.063	0.035	0.428***	0.219**	0.551***	0.441***	**0.920**	
8. MMI in product commercialization	5.098	0.790	0.158*	0.136*	0.520***	0.237***	0.578***	0.440***	0.631***	**0.896**

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The square root of AVE is on the diagonal.

Table 4. Regression analysis results

	Business and market analysis			Technical development			Product testing			Product commercialization		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Firm size	0.242**	0.082	0.078	0.214*	-0.010	-0.010	0.102	-0.040	-0.039	0.161*	0.046	0.044
Firm age	-0.050	-0.003	-0.001	-0.096	-0.045	-0.045	-0.023	0.014	0.013	0.016	0.047	0.049
Industry: metal products [a]	0.033	-0.014	-0.011	0.083	0.045	0.045	0.171*	0.139*	0.137*	0.116	0.021	0.022
Industry: machinery	0.091	-0.033	-0.036	0.125	0.021	0.021	0.051	-0.029	-0.027	0.170*	0.089	0.087
Industry: electrical machinery and equipment	0.078	-0.001	-0.003	-0.012	-0.089	-0.089†	0.043	-0.011	-0.010	0.101	0.040	0.038
Industry: communication and computer-related equipment	-0.008	-0.013	-0.010	-0.041	-0.041	-0.041	-0.020	-0.012	-0.013	-0.024	-0.013	-0.011
Industry: instruments and related products	-0.016	-0.082	-0.080	-0.064	-0.082	-0.082	0.156*	0.149*	0.149*	0.192*	0.104	0.102
Region: Shandong [b]	-0.264**	-0.147*	-0.135*	-0.047	0.169**	0.169**	-0.121	0.014	0.008	-0.247**	-0.129	-0.120
Region: Beijing	-0.057	0.058	0.052	-0.017	0.065	0.065	0.030	0.085	0.088	-0.104	-0.067	-0.072
Region: Guangdong	-0.164*	-0.109	-0.122	-0.034	0.082	0.082	-0.019	0.072	0.083	-0.181*	-0.124*	-0.139*
Region: Jiangsu	-0.053	-0.024	-0.016	-0.024	0.024	0.024	-0.002	0.026	0.021	-0.090	-0.076	-0.069
Business & market analysis					0.552***	0.552***		0.481***	0.494***		0.206*	0.183*
Technical development								0.058	0.058		-0.011	-0.012
Product testing											0.426***	0.436***
Market newness (MN)		0.578***	0.554***		0.253***	0.253***		0.130	0.139		0.187*	0.173*
Competitive intensity (CI)		0.118	0.151*		0.124*	0.124*		-0.053	-0.076		-0.056	-0.023
MN * CI			0.105*			0.001			-0.071			0.101*
F-value	2.837**	14.406***	13.845***	1.933*	23.463***	21.788***	1.169	7.715***	7.335***	2.895**	14.196***	13.765***
R^2	0.134	0.484	0.495	0.072	0.622	0.623	0.060	0.369	0.373	0.136	0.535	0.545
Adjusted R^2	0.087	0.450	0.459	0.022	0.596	0.596	0.009	0.323	0.323	0.089	0.500	0.505
R^2 change	-	0.350***	0.011*	-	0.550***	0.001	-	0.309***	0.004	-	0.399***	0.010*

Note: * α=0.05; ** α=0.01; *** α=0.001; [a] "Other industries" is the base; [b] Shaanxi is the base.