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The impact of external involvement on new product market performance

An analysis of mediation and moderation

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Abstract

Purpose – The purpose of this paper is to bridge the gap in understanding the effects of external involvement on new product market performance. Particularly, the authors investigate the mediating effects of speed-to-market of new products and moderating effects of information technology (IT) implementation.
Design/methodology/approach – This study is based on the high-performance manufacturing (HPM) project database collected from 366 manufacturing plants in ten countries and three representative industries. The hierarchical regression analysis is employed to explore the relationships in the model.
Findings – The empirical findings indicate that speed-to-market of new products positively and significantly mediates the relationship between customer involvement and new product market performance. The results also demonstrate that IT implementation moderates the relationship between external involvement and speed-to-market of new products. More importantly, the findings reveal that supplier involvement is less likely to lead to the enhancement of speed-to-market if the firm is not able to establish a higher level of IT implementation.
Practical implications – This analysis uncovers the way of how customer and supplier involvement are related to new product market performance, and highlights the importance of IT implementation in absorbing and exploiting external resources.
Originality/value – This paper moves us from a simplistic understanding of external involvement to a more nuanced and complex model which is closer to reality. The obtained findings highlight the importance for manufacturers to establish speed advantage of new products and implement IT as an enabler.

Keywords Customer involvement, IT implementation, New product market performance, Speed-to-market of new products, Supplier involvement

Paper type Research paper

1. Introduction

In today's dynamic and uncertain environment, new product development (NPD) activities are extending from an individual firm to the entire supply chain (Hoegl and Wagner, 2005; Ren and Hu, 2015). For NPD process, effective customer and supplier involvement plays an increasingly crucial role in acquiring and leveraging external resources and knowledge (Homburg and Kuehnl, 2014; Petersen *et al.*, 2003). There are an extensive body of literature highlight the advantages of external involvement, such as product quality enhancement (Feng and Wang, 2013; Perols *et al.*, 2013), development costs reduction (Liker and Choi, 2004), and innovation speed improvement (Koufteros *et al.*, 2005). However, among the vast studies with respect to the relationship between external involvement and new product market performance, the findings obtained by different researches are inconsistent. Many studies posit that

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customer and supplier involvement contribute to focal firms' competitive advantage and exert positive influence on market performance (Koufteros *et al.*, 2005; Lau, 2011; Tavani *et al.*, 2013). While some other studies report that the involvement of external partners increases operational uncertainty and security issues, which may bring extra management costs and compromise the performance outcomes (Kessler and Chakrabarti, 1999; Primo and Amundson, 2002). Thus, efforts to simplify and clarify this conflicting is necessary from both a practical and research perspective.

On the basis of a systematic review of the relevant literature, we suggest three plausible sources of this inconsistency. First, many prior studies solely focus on one dimension of external involvement or simply perceive external involvement as a holistic construct, ignoring that different types of external involvement may impact performance differently. Moreover, little work is reported to empirically investigate the potential mediators between external involvement and new product market performance. The understanding about the specific way of how external involvement influencing performance is still very limited. Lastly, the majority of previous findings rely on a single region, which constrict a wider applicability and generalizability of the results.

To fill these gaps, we conduct this study to examine the impacts of customer and supplier involvement on new product market performance. In this study, the speed-to-market of new products is introduced as a mediator between external involvement and market performance. Facing hyper-competitive markets and shorter product updating cycle, the pace of launching and developing new products will have impact on the core competitive strength and survival of an enterprise (Carbonell and Rodriguez, 2006; Sorescu and Spanjol, 2008). A quicker speed-to-market of new products can help the firms establish a first-mover advantage and hence sustain high levels of profits and long-term technology leadership. By involving external partners into the process of NPD, manufacturing firms will be exposed to substantial knowledge and resources. As suggested by the resource-based view (RBV) and knowledge-based view (KBV), this external information is valuable to improve the firms' overall capabilities and fasten the speed-to-market of new products (Barney, 1991; Grant, 1996). Therefore, the speed-to-market of new products may act as a mediator between external involvement and performance outcomes.

Furthermore, to establish a detailed picture of how firms benefit from external involvement, we introduce information technology (IT) implementation as a moderator into the relationship between external involvement and speed-to-market of new products. The information obtained from outside partners does not directly translate into realistic plans and measures for the NPD team, which need to be processed and transformed by the firm's IT systems (Banker *et al.*, 2006; Bendoly *et al.*, 2012; Nambisan, 2003). IT implementation can facilitate information flows among the supply network and ensure a rapid response to firm's demands. Recently, increasing emphasis has been put on IT implementation because the effects of external involvement may be discounted in the absence of effective IT implementation. In other words, IT implementation may moderate the relationship between external involvement and speed-to-market. In summary, we propose and develop a model consisting of the two sub-dimensions of external involvement, speed-to-market of new products, IT implementation and new product market performance. The model is explored using data collected from 366 high-performance manufacturing (HPM) plants which distribute in ten countries.

The remainder of this study is structured as follows: first, the conceptual model and hypotheses are developed in next section. The research methodology and data analysis are presented in Section 3, followed by the analysis results and discussion. In the closing section, we present the implications, contributions, limitations, and directions for future research.

2. Literature review and hypotheses development

From the perspective of RBV and KBV, firms can absorb external ability in the process of NPD through customer and supplier involvement. Such involvement has the potential to improve the speed-to-market of new products and then strengthen market performance. Moreover, the impacts of external involvement on speed-to-market of new products may be moderated by IT implementation. In this section we provide some literature and theory background, introduce a theoretical framework for our study and then derive various hypotheses that will be tested (Figure 1).

2.1 External involvement and speed-to-market of new products

In this study, we define external involvement as the extent to which firms involve their customers and suppliers in NPD process. With the reality of dispersed resource and complicated technology, more and more firms come to realize the importance of external involvement. By embedding external involvement into their NPD projects, manufacturers will have access to richer technology and market information (Bendoly *et al.*, 2012). While the determinants and associated performance implications of external involvement has been investigated extensively, a dearth of studies link external involvement with speed-to-market of new products. The speed-to-market of new products is employed to measure the core capability of a firm in developing and launching new products. It is particularly important for firms operating in a turbulent marketplace with shorter product life cycle and customers' fast-changing customization needs. Also as argued by Stalk (1988), the speed-to-market of new products substantially influences the market success of new products and firm competitive advantage. However, the subject of speed-to-market of new products has not been well assessed so far.

There are many factors exerting influence on speed-to-market, such as emphasis on speed, top management support, and project-related characteristics. In this study, we focus on the impacts of two sub-dimensions of external involvement (i.e. customer and supplier involvement) on speed-to-market of new products. Customer involvement contributes to the speed-to-market of new products in several ways. First, the involvement of corporate-level customers in product design phase enables firms to acquire core information about customer preferences and market needs (Lagrosen, 2005; Nambisan, 2002; Ohern and Rindfleisch, 2010; Un *et al.*, 2010), thus minimizing the

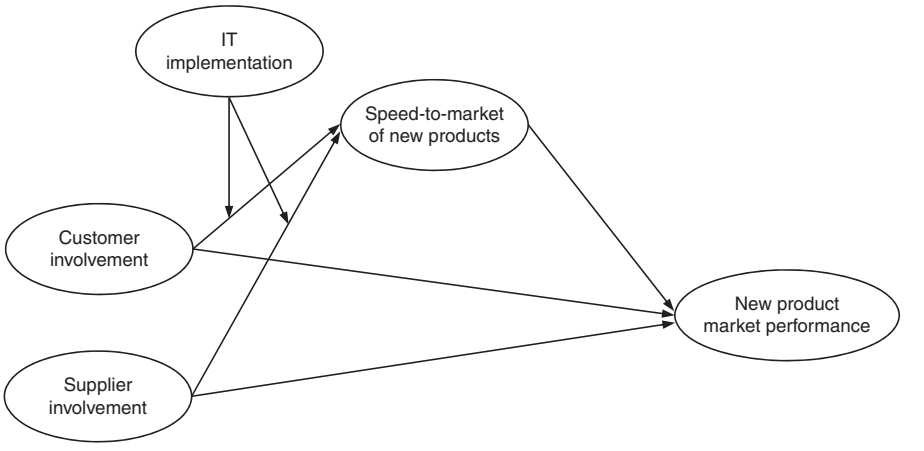

Figure 1.
Conceptual model

time related to market research. Further, through the regular interaction and mutual exchange with customers, the problem-solving and quick-adjusting capability of firms can be enhanced. Customers could provide first-hand feedback about product experience and point out potential problems, which can help firms make adjustments and corrections in time (Cooper and Kleinschmidt, 1995; Svendsen *et al.*, 2011; Urban and Von Hippel, 1988). Third, firms can obtain imperative complementary knowledge and assets by including customers in NPD process. The NPD efficiency will be largely improved when the knowledge obtained by customers are shared freely.

Another important source of information and capability outside organizations originate from upstream suppliers. Suppliers know well about the properties and details of components and raw material; cooperation with suppliers will reduce the possibilities of design errors (Handfield *et al.*, 1999; Wagner, 2010). Closely connecting with suppliers also provide firms with novel ideas for product design and production (Nieto and Santamaría, 2007; Ragatz *et al.*, 2002). In addition, suppliers possess the skills and expertise needed by NPD. Their participation in NPD can quicken the speed-to-market of new products by enriching the knowledge pool and providing urgent technical solutions (Zhang *et al.*, 2015). Furthermore, the delivery efficiency will be intensified by incorporating suppliers into the logistics network, resulting in a faster speed-to-market. Building upon above discussion, we formulate the following hypotheses:

H1a. Customer involvement positively influences speed-to-market of new products.

H1b. Supplier involvement positively influences speed-to-market of new products.

2.2 Speed-to-market of new products and market performance

There are various performance measures in use and this variation may lead to complex results. Given that profit holds a central position in firm management, market performance consistently appears as the most important indicator to measure new products. Hence, we linked speed-to-market of new products with market performance and try to reveal the inter-relationships between them.

Prior studies suggest that speed-to-market of new products can promote market performance in three major ways. As customers prefer to purchase new products and even pay a premium price for them, bringing products to market quickly means extra sales and profits. An earlier entry to the market also help the firms occupy the market rapidly and extend the product life spans. At the same time, the viscosity and satisfaction of customers is also enhanced (Droge *et al.*, 2000). Additionally, a quicker speed-to-market over competitors enable firms to obtain and maintain an industry-leading position, which will ensure firms to have more say over important issues like standard establishment and specification formulation (Brown and Lattin, 1994; Sánchez and Pérez, 2003). This can lead to a snowball effect in which the firms with higher speed can continuously enlarge their technical advantage and market share. Moreover, minimizing the time in product development will allow for substantial cost reductions. With a shorter development cycle, firms are able to reduce daily payload and R&D investments (Chen *et al.*, 2005). To elaborate, increasing the speed-to-market of new products will contribute to the market performance improvement. Based on the above understanding, the following hypothesis can be put forward:

H2. Speed-to-market of new products positively influence new product market performance.

2.3 The mediating role of speed-to-market of new products

With respect to the mediating role of speed-to-market, several studies have provided some hints. Pilar and Devashish (2009) posit that NPD speed plays as a mediator between customer involvement and competitive superiority. And McNally *et al.* (2011) reveal the mediating role of time-to-market between external integration and firm performance. More recently, Feng *et al.* (2014) confirm that the time-to-market of new products is a missing link between external involvement and operational performance. This implies that speed-to-market of new products may be an intermediate outcome of effective external involvement that ultimately leads to performance improvement. External involvement can provide firms with key information and knowledge, and then firms store and integrate these complementary resources into NPD process to improve firms' capability and competence. The NPD speed will be accelerated with the help of external involvement, which means firms can develop and launch new products faster than competitors. If firms establish a speed advantage, they will have the chance to open up new markets and take initiative in fierce competition. Thus, the speed-to-market of new products mediates the relationship between external involvement and market performance. By investigating its mediating role, we can unpack the black-box of how external involvement influencing market performance. The above discussion leads to the following hypotheses:

H3a. The relationship between customer involvement and new product market performance is mediated by speed-to-market of new products.

H3b. The relationship between supplier involvement and new product market performance is mediated by speed-to-market of new products.

2.4 The moderating role of IT implementation

As external involvement and market performance is linked by speed-to-market of new products, another crucial question arises: under what conditions can external involvement be successfully translated into speed advantage? According to organization learning theory and information processing theory, we introduce IT implementation as a moderator to further explore the relationships. IT implementation can be defined as a set of technical specifications designed to facilitate the coordination of inter-firm processes and integration within vertical industry sectors or partners (Chen and Paulraj, 2004a, b; Li *et al.*, 2009). Drawing on RBV and KBV, it can be employed to measure the specialized ability and capability of a firm to effectively leverage and absorb external resources (Wu *et al.*, 2006). A lot of benefits can be associated with IT implementation, such as rapid and reliable information acquisition, knowledge richness, decreasing information ambiguity and increasing accessibility and availability of key knowledge (Huo *et al.*, 2015; Jin, 2006). Successful IT implementation increases the likelihood that external expertise and knowledge will be better handled and assimilated, thereby quicken the speed-to-market of new products. By contrast, a lower IT implementation means that firms cannot filter and screen useful information effectively, thus the time related to NPD will be longer and hinder the speed-to-market of new products. Against that, firms need to establish and maintain a relatively high level of IT implementation to get the most out of external involvement. Considering the important role of IT implementation in extracting and integrating knowledge into time advantage, following hypotheses are proposed to examine potential moderation effects:

H4a. IT implementation positively moderates the relationship between customer involvement and speed-to-market of new products.

H4b. IT implementation positively moderates the relationship between supplier involvement and speed-to-market of new products.

3. Research method

3.1 Data collection

The data used in this study were taken from the HPM project of 2013-2015, which was conducted by a group of researchers in the Americas, Europe, and Asia (Cao *et al.*, 2015; Lai *et al.*, 2012; Zhao *et al.*, 2013). The data set in the HPM project had 366 manufacturing enterprises in total and were selected on the basis of recommendations from local universities and governments. To present a global perspective, these firms are from ten countries (i.e. Brazil, China, Finland, Germany, Israel, Italy, Japan, South Korea, Spain, and Sweden) and three industries (i.e. electronics, machinery, and transportation components) (Schroeder and Flynn, 2001). The samples can provide abundant evidence about the world's major manufacturing centers and the selected industries that widely participate in external involvement practices. From the perspective of NPD, these selected industries exhibited a relatively high level of customer and supplier involvement. Besides, the plants each have at least 250 employees, because smaller companies seldom have an IT system or engage in IT implementation activities.

Phone calls to the prospective plants were made and then followed up by a mail survey sent to the respective plant managers. A plant research coordinator was then appointed to distribute and collect the questionnaires. To encourage participation, each questionnaire was accompanied by a cover letter that briefly introduced the project, ensured confidentiality, and stated that a free report would be provided to the response company. The response rate was about 65 percent of the plants contacted in each country, indicating that non-response bias is not a big issue for this study. Table I provides a breakdown of the sample by country and industry, and Table II reports plant profiles.

In addition, common method variance was minimized by the use of multiple-informant approach. Each plant participating in the HPM project received a batch of 23 questionnaires, distributed to different respondents considered the best informed about the topic, including supervisors, managers, and laborers (see Table III). To obtain the

	Industry			
Regions	Electronics	Machinery	Transportation components	Total
Brazil	5	7	9	21
China	34	38	11	83
Finland	11	12	10	33
Germany	11	25	18	54
Israel	21	5	0	26
Italy	7	17	5	29
Japan	6	7	9	22
South Korea	8	5	13	26
Spain	7	8	11	26
Sweden	4	4	1	9
Taiwan	26	9	2	37
Total	140	137	89	366

Table I. Sample distribution by country and industry

Characteristics of firms	Frequency	%
Firm age (years)		
< 5	17	4.64
5-9	30	8.20
10-19	85	23.22
20-49	135	36.89
50-99	78	21.31
Over 100	21	5.74
Sales ($000)		
< 10	51	13.93
10-49	74	20.22
50-99	52	14.21
100-499	95	25.96
500-999	25	6.83
Over 1,000	69	18.85
R&D expense (sales)		
< 1	69	18.85
1-4	178	48.63
5-10	79	21.59
Over 10	40	10.93

Table II.
Profiles of responding plants

Respondents	Number of respondents per plant
Plant accounting manager	1
Direct labor	10
Human resources manager	1
Information systems manager	1
Production control manager	1
Inventory manager	1
Member of product development team	1
Process engineer	1
Plant manager	1
Quality manager	1
Supervisor	3
Plant superintendent	1
Total respondents per plant	23

Table III.
Distribution of questionnaires at each sample plant

most comprehensive responses, the same item was administered to different respondents and questions with multiple responses were averaged into a single value (Venkatraman and Grant, 1986). The appointed research coordinator in each firm was responsible to collect the questionnaires once they were finished.

3.2 Survey measures

A questionnaire was designed and refined through consulting research peers and practitioners. The questionnaire was first developed in English, and then translated into the local language in each country by a local member of the research team. To guarantee conceptual equivalence, it was then back-translated into English by a different local professor and checked against the original English version for accuracy.

Next, we conducted a pilot test with ten randomly selected firms to examine the questionnaire for ambiguities validity of the measures. Based on their feedback, some revision and refinement was undertaken to improve clarity and revise any unclear wording. The scales and items were developed based on the existing literature which had underwent rigorous pilot tests. When there was no available item for a subject, new items were developed based on the interviews and discussions with practitioners. Table AI provides the perceptual measurement scales, along with their descriptive statistics (means and standard deviations). A multiple-item, five-point Likert-type scale (1 = "strongly disagree"; 3 = "about the same"; 5 = "strongly agree") was employed for all constructs. A full description for the research's employed scales are listed in Appendix and the measurement item design is described as follows.

Customer and supplier involvement were measured using four items, respectively. External involvement was assessed as the extent to which customers and suppliers are involved in NPD programs, adapted from the studies of Chen and Paulraj (2004a, b) and Feng *et al.* (2010). These items evaluate a plant's ability to work together with customers and suppliers. They capture the vertical linkages across supply chain activities involving suppliers and customers. Managers of supply chain, customer service, and purchasing were asked to respond these questions.

Speed-to-market of new products was measured using a scale to assess the degree to which a company is capable of introducing new products to market faster than industry average. Regarding IT implementation, it was measured by the items developed by Chen and Paulraj (2004a, b). In this study, we focus IT implementation mainly on the electronic transactions and communication within the supply network (Xu *et al.*, 2014). The respondents were asked to indicate the presence of IT implementation competes with their peers in the industry. And IT implementation measurement for customers and supplier communication is measured as one construct.

With respect to new product market performance, there are a variety of scales in use. To suit our study, we developed and modified the measures proposed by Lu and Yang (2004) and Nakata *et al.* (2006). These scales encompass profits, market share, and return on investment relative to competitors, which is in line with traditional economic indicators (Song and Parry, 1997). According to the recommendations of managers, we added overall success as a new indicator to measure market performance of new products. Members of the NPD team, process engineers, and plant superintendents process engineers were asked to answer these questions.

To avoid any unjustifiable influence of alternative factors, we included four control variables in our analysis – industry, region, firm size, and R&D expense. Companies in different industries may face different levels of competition and have different levels of NPD performance. Similarly, companies in different regions may have various economic development levels. In this study, we set two industries as dummy variables, with electronics serving as the basic industry. The region measure was defined as ten dummy variables, with Brazil as the base. We used these dummy variables to control differences across different types of industries and regions (Eisenhardt and Tabrizi, 1995). Firm size was measured by annual sales, we controlled this variable because larger firms are more likely to build comprehensive IT systems and NPD-related practices (Sánchez and Pérez, 2003). The third possible confounding effect relates to R&D expense. It is an indicator of the willingness of the firm to invest in innovation management and NPD process. Consistent with prior research, firm size and R&D expense were transformed by taking the natural logarithm to alleviate univariate non-normalities and account for non-linear effects (Flynn *et al.*, 2010; Zhao *et al.*, 2008, 2011).

3.3 Construct reliability and validity

The Cronbach's α value and composite reliability (CR) are widely accepted reliability measures. The recommended criterion for them is 0.70 and 0.60, respectively (Fornell and Larcker, 1981; Nunnally and Bernstein, 1994). The results shown in Table IV indicate that Cronbach's α value of each construct ranged between 0.828 and 0.861. Their CR ranged from 0.881 to 0.906. In addition, the corrected item-total correlation (CITC) values ranged from 0.752 to 0.864, which are within the threshold of 0.30 suggested by Kerlinger (1986). Therefore, the Cronbach's α values, CR and CITC values indicate sufficient reliability of the measures (Flynn *et al.*, 1990; Nunnally and Bernstein, 1994).

Construct validity can be defined as the extent to which the scales reflect and measure the theoretical construct, including content validity, convergent validity, and discriminant validity (Carmines and Zeller, 1979). In this section, the content validity was validated by feedback from executives, the pilot test as well as referring to extensive literature. And the convergent validity was assessed by the method of confirmatory factor analysis (CFA) suggested by Fornell and Larcker (1981). By conducting CFA, each item was linked to its corresponding construct and the covariance among the constructs was estimated. The results indicated that the overall measurement model was acceptable and good ($\chi^2(109) = 292.16$, RMSEA = 0.069, NNFI = 0.94, CFI = 0.95, and SRMR = 0.055). All factor loadings were highly significant and above 0.50, which indicated convergent validity for the constructs. Besides, the average variance extracted (AVE) results ranged between 0.655 and 0.707, which further demonstrated adequate convergent validity (Fornell and Larcker, 1981).

To test discriminate validity, χ^2 difference tests were conducted for all the constructs in pairs to determine whether the constrained model (correlation fixed as 1.0) was significantly worse than the unconstrained estimated model (correlation estimated freely). As is displayed in Table V, all the χ^2 differences between the fixed and unconstrained model were significant at the 0.001 level, indicating adequate discriminant validity (Anderson and Gerbing, 1988). Next, we calculated the shared

Construct	Item code	Factor loading	CITC	Cronbach's α	CR	AVE
Customer involvement	CI1	0.844	0.770	0.831	0.881	0.665
	CI2	0.790	0.811			
	CI3	0.799	0.799			
	CI4	0.828	0.765			
Supplier involvement	SI1	0.854	0.810	0.828	0.886	0.661
	SI2	0.839	0.771			
	SI3	0.801	0.752			
	SI4	0.755	0.799			
IT implementation	IT1	0.734	0.793	0.855	0.883	0.655
	IT2	0.830	0.774			
	IT3	0.916	0.823			
	IT4	0.744	0.864			
New product market performance	NPMP1	0.789	0.855	0.861	0.906	0.707
	NPMP2	0.875	0.797			
	NPMP3	0.877	0.796			
	NPMP4	0.819	0.839			

Notes: Fit indices: χ^2 (109) = 292.16, RMSEA = 0.069, NNFI = 0.94, CFI = 0.95, SRMR = 0.055

Table IV. Results of confirmatory factor analysis

variance between all possible pairs of constructs to determine whether they were lower than the AVE for the individual construct (Fornell and Larcker, 1981). As shown in Table VI, the square root of the AVE was greater than all corresponding correlations, providing further evidence of discriminant validity.

4. Data analysis and results

Hierarchical regression analysis was applied to examine the model and its related hypotheses. To mitigate the potential threat of multi-collinearity, all independent variables constituting interaction terms were mean-centered (Aiken and West, 1991). The indicator of largest variance inflation factor, is 1.589, well below the 10.0 cutoff (Mason and Perreault, 1991; Neter *et al.*, 1996). Hence, the multi-collinearity is not prominent for this study. We assess the explanatory power of each set of variables by including them in the model block by block.

The regression results were presented in Table VII. *H1a* and *H1b* posit a direct, positive relationship between two sub-dimensions of external involvement and speed-to-market of new products. As shown in Model 2, the effect of customer involvement on speed-to-market of new products is statistically significant ($\beta = 0.206$, $p < 0.001$), which supports *H1a*. The coefficient for supplier involvement is positive but not significant ($\beta = 0.109$, $p > 0.05$). Thus, *H1b* is not supported. The empirical results also verify *H2* (Model 7), indicating speed-to-market of new products has positive and significant impacts on market performance ($\beta = 0.473$, $p < 0.001$). In other words, a quicker speed-to-market of new products will bring firms higher market performance.

Moreover, a three-step mediated regression analysis was adopted to investigate the possible mediating role of speed-to-market of new products. First, we regress the mediator (speed-to-market of new products) on the independent variables (customer involvement and supplier involvement). Following that, the dependent variable of new product market performance was regressed on the independent variables. Finally, the

Constructs	SI	CI	IT	STM
Supplier involvement (SI)				
Customer involvement (CI)	170.88			
IT implementation (IT)	184.54	240.70		
Speed-to-market of new products (STM)	197.37	192.71	334.99	
New product market performance (NPMP)	184.86	175.47	201.21	161.65

Note: All the χ^2 differences are significant at the 0.001 level

Table V. Discriminate validity: χ^2 differences

Constructs	Mean	SD	CI	SI	IT	STM	NPMP
Customer involvement (CI)	3.923	0.689	*0.815*				
Supplier involvement (SI)	3.670	0.742	0.424***	*0.813*			
IT implementation (IT)	3.074	0.989	0.307***	0.122*	*0.809*		
Speed-to-market of new products (STM)	3.219	0.854	0.281***	0.232***	0.046	–	
New product market performance (NPMP)	3.451	0.645	0.304***	0.296***	0.154**	0.517***	*0.841*

Notes: Numbers in italics on the diagonal indicate the square root of AVE. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table VI. Mean, standard deviations and correlations of the constructs

Table VII.
Results of regression analysis

Variables	Speed-to-market of new products				New product market performance		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Machinery dummy	−0.093 (−1.572)	−0.077 (−1.333)	−0.066 (−1.158)	−0.064 (−1.119)	−0.126 (−2.131)*	−0.104 (−1.844)	−0.068 (−1.369)
Transportation components dummy	−0.014 (−0.229)	−0.005 (−0.081)	−0.011 (−0.187)	−0.009 (−0.157)	−0.075 (−1.218)	−0.063 (−1.076)	−0.061 (−1.179)
China dummy	−0.097 (−0.517)	−0.176 (−0.952)	−0.170 (−0.900)	−0.176 (−0.930)	0.227 (1.202)	0.122 (0.676)	0.204 (1.281)
Finland dummy	−0.504 (−2.197)*	−0.402 (−1.787)	−0.380 (−1.697)	−0.368 (−1.652)	−0.240 (−1.041)	−0.103 (−0.468)	0.131 (0.672)
Germany dummy	−0.542 (−2.393)*	−0.401 (−1.801)	−0.399 (−1.798)	−0.368 (−1.657)	−0.599 (−2.636)**	−0.409 (−1.880)	−0.223 (−1.155)
Israel dummy	−0.150 (−0.597)	−0.082 (−0.333)	−0.118 (−0.485)	−0.132 (−0.541)	0.097 (0.385)	0.192 (0.801)	0.230 (1.090)
Italy dummy	−0.602 (−2.452)*	−0.463 (−1.912)	−0.485 (−2.019)*	−0.429 (−1.785)	−0.562 (−2.281)*	−0.378 (−1.598)	−0.032 (−0.153)
Japan dummy	−0.547 (−1.935)	−0.529 (−1.919)	−0.523 (−1.910)	−0.532 (−1.940)	−0.352 (−1.243)	−0.330 (−1.224)	0.047 (0.195)
South Korea dummy	−0.164 (−0.635)	−0.114 (−0.453)	−0.114 (−0.453)	−0.089 (−0.352)	−0.305 (−1.178)	−0.235 (−0.953)	−0.181 (−0.837)
Spain dummy	−0.120 (−0.397)	−0.093 (−0.313)	−0.117 (−0.398)	−0.130 (−0.439)	−0.355 (−1.169)	−0.308 (−1.060)	−0.265 (−1.035)
Sweden dummy	−0.617 (−1.731)	−0.451 (−1.291)	−0.506 (−1.456)	−0.505 (−1.453)	−0.396 (−1.108)	−0.169 (−0.494)	0.041 (0.137)
Taiwan dummy	−0.325 (−1.494)	−0.416 (−1.952)	−0.417 (−1.956)	−0.406 (−1.911)	−0.402 (−1.843)	−0.495 (−2.251)*	−0.285 (−1.540)
Firm size	−0.014 (−0.444)	−0.009 (−0.301)	−0.002 (−0.052)	−0.002 (−0.064)	−0.024 (−0.766)	−0.018 (−0.601)	−0.014 (−0.519)
R&D expense	0.065 (2.174)*	0.066 (2.257)*	0.068 (2.336)*	0.069 (2.369)*	0.020 (0.668)	0.021 (0.721)	−0.010 (−0.404)
Customer involvement		0.206 (3.545)***	0.215 (3.607)***	0.195 (3.381)***		0.210 (3.729)***	0.113 (2.236)*
Supplier involvement		0.109 (1.948)	0.099 (1.723)	0.112 (2.002)*		0.189 (3.431)***	0.135 (2.762)**
Speed-to-market of new products							0.473 (10.277)***
IT implementation			0.045 (0.817)	0.052 (0.949)			
Customer involvement × IT implementation			0.133 (2.240)*				
Supplier involvement × IT implementation				0.162 (2.895)**			
R^2	0.070	0.139	0.154	0.162	0.069	0.179	0.377
R^2 change		0.069	0.015	0.023		0.110	0.198
$F(d, f)$ change		14.155***	3.185*	4.863**		22.057***	108.814***

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

dependent variable was regressed on the independent variables and the potential mediator simultaneously. If the independent variable is linked with the mediator and dependent variable, and the mediator impacts the dependent variable, we can say that there exists mediating effect. At the same time, the relationships between the independent variables and the dependent variable must be weaker when the mediator is added compared with when it is not. Further, complete mediation exists if the relationship between independent variable and the dependent variable becomes insignificant when the mediator is controlled for. While partial mediation exists if the significant relationship between the independent variable and the dependent variable becomes smaller. Results of the stepwise regression analysis are depicted in Table VII.

We conduct mediation analysis according to the above method and steps. In Model 2, only customer involvement is significantly related to speed-to-market of new products ($\beta = 0.206$, $p < 0.001$). In Model 6, customer involvement and supplier involvement, respectively, are significantly associated with new product market performance ($\beta = 0.210$, $p < 0.001$; $\beta = 0.189$, $p < 0.001$). When speed-to-market of new products was added to the regression model (Model 7), we find that the relationships between customer involvement, supplier involvement, and new product market performance become weaker ($\beta = 0.113$, $p < 0.05$; $\beta = 0.135$, $p < 0.01$). These findings represent that the speed-to-market of new products partially mediates the relationship between customer involvement and new product market performance. Therefore, *H3a* is supported and *H3b* is not supported.

The moderating effects of IT implementation were examined and results are shown in Models 3 and 4 ($\beta = 0.133$, $p < 0.05$; $\beta = 0.162$, $p < 0.01$). *H4a* and *H4b* were also confirmed. The connections between external involvement and speed-to-market of new products will be stronger when the level of IT implementation is higher. Therefore, we would expect that IT implementation factors can moderate the relationship between customer/supplier involvement and speed-to-market, in which the higher degree of IT implementation, the stronger the relationship between the external involvement and speed-to-market. Figure 2 illustrates these significant moderating effects.

5. Discussions and implications

This study presents empirical evidence about the relationships among external involvement, speed-to-market of new products, IT implementation, and new product market performance. We propose and test a conceptual model using data collected from ten countries and three industries. A summary of the primary results according to initial hypotheses are as follows:

- speed-to-market of new products partially mediates the relationship between customer involvement and new product market performance;
- IT implementation positively and significantly moderates the relationship between external involvement and speed-to-market; and
- supplier involvement is less likely to lead to the enhancement of speed-to-market if the firm is not able to establish a higher level of IT implementation.

5.1 Discussions

Customer involvement shows strong and significant correlation with speed-to-market of new products. This implies that customer involvement can be seen as a bridging strategy to access to the critical resource of information on customer needs

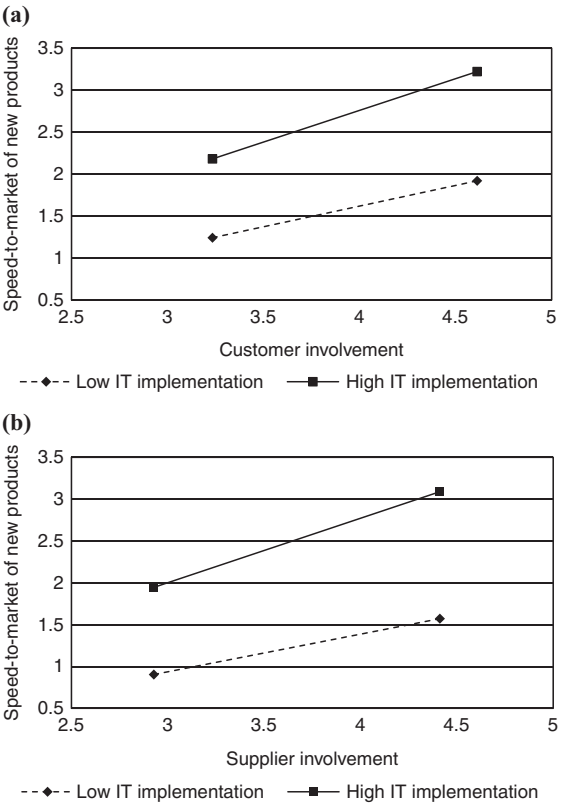

Figure 2.
The moderating effect of IT implementation

(Salomo *et al.*, 2003), which help reduce development time to bring new products to market. However, the obtained results show that the coefficient for supplier involvement is positive but not significant. One possible explanation could be that supplier involvement is associated with higher transaction costs and more intensive activities, such as negotiating, planning, coordinating, monitoring, and enforcing buyer-supplier relationships. If these activities cannot be conducted efficiently, this may distract the firms from internal tasks and consume extra resources that could be used to accelerate NPD process.

Our findings reveal that speed-to-market of new products serve as a mediator between customer involvement and market performance. This means that outside resources and knowledge from customers were first integrated into NPD process by firms to accelerate speed-to-market, and then contribute to market performance. More specifically, customer involvement enables firms to have more information about customer concerns, preferences, and a better prediction of product trends. Where the level of customer involvement is low, the speed-to-market of new products tends to decrease. Although supplier involvement can provide firms with specialized knowledge regarding raw materials and components, which is important for reducing design errors and avoiding detours in NPD. However, the mediating effect of speed-to-market between supplier involvement and market performance is non-significant. The non-significant effects can be due to supplier involvement

include more time consuming activities which may increase the complexity of NPD projects and prolong NPD cycle. So far, existing research has identified that customer and supplier involvement are linked with many aspects of new product advantage such as quality, problem-solving ability and uniqueness, while speed-to-market of new products has not yet been explicitly examined as such an outcome. Therefore, by revealing the chained relationship from external involvement to speed-to-market of new products and market performance, we find an underlying pathway through which the profit of external involvement is achieved.

To deepen our understanding, we further indicate that the link between external involvement and speed-to-market of new products is not straightforward and is contingent on IT implementation. The findings show that the information gathered from external partners should be processed systematically, so that the acquired information can facilitate NPD and promote speed-to-market. IT implementation is linked with the ability of the firm to recognize the value and assimilate external knowledge. An organization lacking IT implementation will encounter difficulties in the process of integrating and applying external knowledge, which means they have limited absorptive capabilities. Without effective IT implementation, the massive unprocessed information may exert detrimental effects on speed-to-market. Put in another way, the effects of external involvement depend on the level of IT implementation. Especially for supplier involvement, a higher level of IT implementation can remarkably strengthen the relationship between supplier involvement and speed-to-market. On one side, IT implementation can help firms share production planning, inventory, and forecasting information with their suppliers, thus reduce lead time and shorten development cycle. On the other side, IT implementation can make the communication process between buyers and suppliers be more smooth and time saving through extensive adoption of information systems. Therefore, the degree of IT implementation exerts influence on the relationship between supplier involvement and speed-to-market of new products.

5.2 Contributions and implications

Our findings provide important real-world implications for practitioners. Along with the increasing competition intensity, speed-to-market of new products is attracting more and more attention from manufacturers. For managers, this paper demonstrates that bringing new products to market quickly is an important intermediate step in converting external involvement into financial gains. In this uncertain and rapidly changing business environment, the management should shift some of their focus from traditional quality or cost orientation to a speed orientation. Managing speed will bring firms many advantages and mangers should adopt more speed-based strategy in NPD process. Furthermore, managers should also be aware of the importance of IT implementation as it is a key factor that affects the outcomes of external involvement. For firms aiming to establish competitive advantage and improve their market performance, the management should invest more to develop advanced IT platforms and eliminate IT implementation barriers in the firm. Particularly, in the process of supplier involvement, more attention should be paid to IT implementation to quicken speed-to-market of new products. An effective IT implementation can help firms communicate with suppliers more timely and targeted.

This study also conveys valuable theoretical contributions to the existing literature. First, the results contribute to explain the mixed findings about the relationship between external (customer and supplier) involvement and new product market

performance. While the topic of external involvement has been subject to rigorous research and many associated benefits have been identified, there still exists a basic question of whether external involvement is indeed fruitful and how firms can profit from it. By introducing speed-to-market of new products as a mediating variable, we answer the question of how external involvement matters. Second, it is one of the first studies to explore the moderating role of IT implementation, which provide managers with more insights into the impacts of external involvement. The obtained results demonstrate that IT implementation positively and significantly moderates the relationship between external involvement and speed-to-market of new products. Thus, IT implementation can be viewed as a crucial complementary asset for external involvement, only firms with a higher degree of IT implementation that can effectively transform external involvement into speed advantage. This study conveys insightful contributions for understanding whether and under what conditions external involvement can boost speed-to-market of new products.

6. Limitations and future research directions

This study utilizes hierarchical regression analysis to explore how external involvement influences new product market performance through speed-to-market of new products, and the moderating effects of IT implementation. Although the findings in this research contribute to both literature and practice, several limitations should be noted. First, IT implementation is not the only contingency factor that exists between external involvement and speed-to-market of new products. In the future, it would be interesting to include other contingency factors such as organizational culture and strategic orientation. Additionally, the data are collected from world-class manufacturers, while these firms may have greater advantages in resource acquisition. Future research may validate and check the generality of the model by including more SMEs. Moreover, we mainly focus on market performance of NPD, to obtain more valuable insights, future studies can investigate some other dimensions of performance implications. Finally, follow-up studies can include more items relating to IT implementation when measuring its moderating role, thus enhancing our understanding on how to profit from customer and supplier involvement. There are many indicators that can serve either as enablers or barriers to IT implementation, such as organizational culture, top management support, and technical level. In order to lead to practical guides and solutions, this requires further research.

References

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage, Newbury Park, CA.

Anderson, J.C. and Gerbing, D.W. (1988), "Structural equation modeling in practice: a review and recommended two-step approach", *Psychological Bulletin*, Vol. 103 No. 3, pp. 411-423.

Banker, R.D., Bardhan, I.R., Chang, H. and Lin, S. (2006), "Plant information systems, manufacturing capabilities, and plant performance", *MIS Quarterly*, Vol. 30 No. 2, pp. 315-337.

Barney, J.B. (1991), "Firm resource and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 3, pp. 99-120.

Bendoly, E., Bharadwaj, A. and Bharadwaj, S. (2012), "Complementary drivers of new product development performance: cross-functional coordination, information system capability, and intelligence quality", *Production & Operations Management*, Vol. 21 No. 4, pp. 653-667.

Brown, C.L. and Lattin, J.M. (1994), "Investigating the relationship between time in market and pioneering advantage", *Management Science*, Vol. 40 No. 10, pp. 1361-1369.

Cao, Z., Huo, B., Li, Y. and Zhao, X. (2015), "The impact of organizational culture on supply chain integration: a contingency and configuration approach", *Supply Chain Management: An International Journal*, Vol. 20 No. 1, pp. 24-41.

Carbonell, P. and Rodriguez, A.I. (2006), "The impact of market characteristics and innovation speed on perceptions of positional advantage and new product performance", *International Journal of Research in Marketing*, Vol. 23 No. 1, pp. 1-12.

Carmines, E.G. and Zeller, R.A. (1979), *Reliability and Validity Assessment*, Sage, Beverley Hills, CA.

Chen, I.J. and Paulraj, A. (2004a), "Towards a theory of supply chain management: the constructs and measurements", *Journal of Operations Management*, Vol. 22 No. 2, pp. 119-150.

Chen, I.J. and Paulraj, A. (2004b), "Understanding supply chain management: critical research and a theoretical framework", *International Journal of Production Research*, Vol. 42 No. 1, pp. 131-163.

Chen, J., Reilly, R.R. and Lynn, G.S. (2005), "The impacts of speed-to-market on new product success: the moderating effects of uncertainty", *IEEE Transactions on Engineering Management*, Vol. 52 No. 2, pp. 199-212.

Cooper, R.G. and Kleinschmidt, E.J. (1995), "Benchmarking the firm's critical success factors in new product development", *Journal of Product Innovation Management*, Vol. 12 No. 5, pp. 374-391.

Droge, C., Jayaram, J. and Vickery, S. (2000), "The ability to minimize the timing of new product development and introduction: an examination of antecedent factors in the North American automobile supplier industry", *Journal of Product Innovation Management*, Vol. 17 No. 1, pp. 24-40.

Eisenhardt, K.M. and Tabrizi, B.N. (1995), "Accelerating adaptive processes: product innovation in the global computer industry", *Administrative Science Quarterly*, Vol. 40 No. 1, pp. 84-110.

Feng, T. and Wang, D. (2013), "Supply chain involvement for better product development performance", *Industrial Management & Data Systems*, Vol. 113 No. 2, pp. 190-206.

Feng, T., Sun, L. and Zhang, Y. (2010), "The effects of customer and supplier involvement on competitive advantage: an empirical study in China", *Industrial Marketing Management*, Vol. 39 No. 8, pp. 1384-1394.

Feng, T., Sun, L., Sohal, A.S. and Wang, D. (2014), "External involvement and firm performance: is time-to-market of new products a missing link?", *International Journal of Production Research*, Vol. 52 No. 3, pp. 727-742.

Flynn, B.B., Huo, B. and Zhao, X. (2010), "The impact of supply chain integration on performance: a contingency and configuration approach", *Journal of Operations Management*, Vol. 28 No. 1, pp. 58-71.

Flynn, B.B., Sakakibara, S., Schroeder, R.G., Bates, K.A. and Flynn, E.J. (1990), "Empirical research methods in operations management", *Journal of Operations Management*, Vol. 9 No. 2, pp. 250-284.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 29-50.

Grant, R.M. (1996), "Toward a knowledge-based theory of the firm", *Strategic Management Journal*, Vol. 17 No. 2, pp. 109-122.

Handfield, R.B., Ragatz, G.L., Petersen, K.J. and Monczka, R.M. (1999), "Involving suppliers in new product development", *California Management Review*, Vol. 42 No. 1, pp. 59-82.

Hoegl, M. and Wagner, S.M. (2005), "Buyer-supplier collaboration in product development projects", *Journal of Management*, Vol. 31 No. 4, pp. 530-548.

Homburg, C. and Kuehnl, C. (2014), "Is the more always better? A comparative study of internal and external integration practices in new product and new service development", *Journal of Business Research*, Vol. 67 No. 7, pp. 1360-1367.

Huo, B., Zhang, C. and Zhao, X. (2015), "The effect of IT and relationship commitment on supply chain coordination: a contingency and configuration approach", *Information & Management*, Vol. 52 No. 6, pp. 728-740.

Jin, B. (2006), "Performance implications of information technology implementation in an apparel supply chain", *Supply Chain Management: An International Journal*, Vol. 11 No. 4, pp. 309-316.

Kerlinger, F. (1986), *Foundations of Behavioral Research*, Holt, Rinehart, and Winston, New York, NY.

Kessler, E.H. and Chakrabarti, A.K. (1999), "Speeding up the pace of new product development", *Journal of Product Innovation Management*, Vol. 16 No. 3, pp. 231-247.

Koufteros, X., Vonderembse, M. and Jayaram, J. (2005), "Internal and external integration for product development: the contingency effects of uncertainty, equivocality, and platform strategy", *Decision Sciences*, Vol. 36 No. 1, pp. 97-133.

Lai, F., Zhang, M., Lee, D.M.S. and Zhao, X. (2012), "The impact of supply chain integration on mass customization capability: an extended resource-based view", *IEEE Transactions on Engineering Management*, Vol. 59 No. 3, pp. 443-456.

Lagrosen, S. (2005), "Customer involvement in new product development: a relationship marketing perspective", *European Journal of Innovation Management*, Vol. 8 No. 4, pp. 424-436.

Lau, A.K. (2011), "Supplier and customer involvement on new product performance: contextual factors and an empirical test from manufacturer perspective", *Industrial Management & Data Systems*, Vol. 111 No. 6, pp. 910-942.

Li, G., Yang, H., Sun, L. and Sohal, A.S. (2009), "The impact of IT implementation on supply chain integration and performance", *International Journal of Production Economics*, Vol. 120 No. 1, pp. 125-138.

Liker, J.K. and Choi, T.Y. (2004), "Building deep supplier relationships", *Harvard Business Review*, Vol. 82 No. 12, pp. 102-112.

Lu, L.Y.Y. and Yang, C. (2004), "The R&D and marketing cooperation across new product development stages: an empirical study of Taiwan's it industry", *Industrial Marketing Management*, Vol. 33 No. 7, pp. 593-605.

Mcnally, R.C., Akdeniz, M.B. and Calantone, R.J. (2011), "New product development processes and new product profitability: exploring the mediating role of speed to market and product quality", *Journal of Product Innovation Management*, Vol. 28 No. 1, pp. 63-77.

Mason, C. and Perreault, W. (1991), "Collinearity, power, and interpretation of multiple regression analysis", *Journal of Marketing Research*, Vol. 28 No. 3, pp. 268-280.

Nakata, C., Im, S., Park, H. and Ha, Y.W. (2006), "Antecedents and consequence of Korean and Japanese new product advantage", *Journal of Business Research*, Vol. 59 No. 1, pp. 28-36.

Nambisan, S. (2002), "Designing virtual customer environments for new product development: toward a theory", *Academy of Management Review*, Vol. 27 No. 3, pp. 392-413.

Nambisan, S. (2003), "Information systems as a reference discipline for new product development", *MIS Quarterly*, Vol. 27 No. 1, pp. 1-18.

Neter, J., Kutner, M.H., Nachtsheim, C.J. and Wasserman, W. (1996), *Applied Linear Statistical Models*, 4th ed., McGraw-Hill, New York, NY.

Nieto, M.J. and Santamaría, L. (2007), "The importance of diverse collaborative networks for the novelty of product innovation", *Technovation*, Vol. 27 No. 6, pp. 367-377.

Nunnally, J.C. and Bernstein, I.H. (1994), *Psychometric Theory*, 3rd ed., McGraw-Hill, New York, NY.

Ohern, M.S. and Rindfleisch, A. (2010), "Customer co-creation: a typology and research agenda", *Review of Marketing Research*, Vol. 6, pp. 84-106.

Perols, J., Zimmermann, C. and Kortmann, S. (2013), "On the relationship between supplier integration and time-to-market", *Journal of Operations Management*, Vol. 31 No. 3, pp. 153-167.

Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (2003), "A model of supplier integration into new product development", *Journal of Product Innovation Management*, Vol. 20 No. 4, pp. 284-299.

Pilar, C. and Devashish, P. (2009), "Customer involvement in new service development: an examination of antecedents and outcomes", *Journal of Product Innovation Management*, Vol. 26 No. 5, pp. 536-550.

Primo, M.A. and Amundson, S.D. (2002), "An exploratory study of the effects of supplier relationships on new product development outcomes", *Journal of Operations Management*, Vol. 20 No. 1, pp. 33-52.

Ragatz, G.L., Handfield, R.B. and Petersen, K.J. (2002), "Benefits associated with supplier integration into new product development under conditions of technology uncertainty", *Journal of Business Research*, Vol. 55 No. 5, pp. 389-400.

Ren, S.J. and Hu, C. (2015), "An empirical analysis of inter-organisational value co-creation in a supply chain: a process perspective", *Production Planning & Control*, Vol. 26 No. 12, pp. 1-12.

Sánchez, A.M. and Pérez, M.P. (2003), "Cooperation and the ability to minimize the time and cost of new product development within the Spanish automotive supplier industry", *Journal of Product Innovation Management*, Vol. 20 No. 1, pp. 57-69.

Salomo, S., Steinhoff, F. and Trommsdorff, V. (2003), "Customer orientation in innovation projects and new product development success – the moderating effect of product innovativeness", *International Journal of Technology Management*, Vol. 26 Nos 5-6, pp. 442-463.

Schroeder, R.G. and Flynn, B.B. (2001), *High Performance Manufacturing: Global Perspectives*, John Wiley and Sons, New York, NY.

Song, X.M. and Parry, M.E. (1997), "The determinants of Japanese new product successes", *Journal of Marketing Research*, Vol. 34 No. 1, pp. 64-76.

Sorescu, A.B. and Spanjol, J. (2008), "Innovation's effect on firm value and risk: insights from consumer packaged goods", *Journal of Marketing*, Vol. 72 No. 2, pp. 114-132.

Stalk, G. (1988), "Time – the next source of competitive advantage", *Harvard Business Review*, Vol. 66 No. 4, pp. 41-51.

Svendsen, M.F., Haugland, S.A., Grønhaug, K. and Hammervoll, T. (2011), "Marketing strategy and customer involvement in product development", *European Journal of Marketing*, Vol. 45 No. 4, pp. 513-530.

Tavani, S.N., Sharifi, H., Soleimanof, S. and Najmi, M. (2013), "An empirical study of firm's absorptive capacity dimensions, supplier involvement and new product development performance", *International Journal of Production Research*, Vol. 51 No. 11, pp. 3385-3403.

Un, C.A., Cuervo-Cazurra, A. and Asakawa, K. (2010), "R&D collaborations and product innovation", *Journal of Product Innovation Management*, Vol. 27 No. 5, pp. 673-689.

Urban, G.L. and Von Hippel, E. (1988), "Lead user analyses for the development of new industrial products", *Management Science*, Vol. 34 No. 5, pp. 569-582.

Venkatraman, N. and Grant, J. (1986), "Construct measurement in organizational strategy research: a critique and proposal", *Academy of Management Review*, Vol. 11 No. 1, pp. 71-87.

Wagner, S.M. (2010), "Supplier traits for better customer firm innovation performance", *Industrial Marketing Management*, Vol. 39 No. 7, pp. 1139-1149.

Wu, F., Yeniyurt, S., Kim, D. and Cavusgil, S.T. (2006), "The impact of information technology on supply chain capabilities and firm performance: a resource-based view", *Industrial Marketing Management*, Vol. 35 No. 4, pp. 493-504.

Xu, D., Sun, L. and Huo, B. (2014), "Relationships between intra-organizational resources, supply chain integration and business performance: an extended resource-based view", *Industrial Management & Data Systems*, Vol. 114 No. 8, pp. 1186-1206.

Zhang, Y., Wang, L. and Gao, J. (2015), "Supplier collaboration and speed-to-market of new products: the mediating and moderating effects", *Journal of Intelligent Manufacturing*, doi: 10.1007/s10845-014-1021-5.

Zhao, L., Huo, B., Sun, L. and Zhao, X. (2013), "The impact of supply chain risk on supply chain integration and company performance: a global investigation", *Supply Chain Management: An International Journal*, Vol. 18 No. 2, pp. 115-131.

Zhao, X., Huo, B., Flynn, B.B. and Yeung, J.H.Y. (2008), "The impact of power and relationship commitment on integration between manufacturers and customers in a supply chain", *Journal of Operations Management*, Vol. 26 No. 3, pp. 368-388.

Zhao, X., Huo, B., Selen, W. and Yeung, J.H.Y. (2011), "The impact of internal integration and relationship commitment on external integration", *Journal of Operations Management*, Vol. 29 No. 1, pp. 17-32.

Further reading

Loehlin, J. (1998), *Latent Variable Models: An Introduction for Factor, Path, and Structural Models*, Lawrence Erlbaum Associates, Mahwah, NJ.

Narasimhan, R. and Jayaram, J. (1998), "An empirical investigation of the antecedents and consequences of manufacturing goal achievement in North American, European and Pan Pacific firms", *Journal of Operations Management*, Vol. 16 No. 2, pp. 159-176.

Appendix

Measurement items	Mean	SD
Customer involvement		
CI1. Our customer can put forward improving suggestions for our new products	4.095	0.779
CI2. We consult and refer to our customer' opinions about product prototypes in NPD process	3.871	0.863
CI3. We have a strong consensus that customer involvement is needed in product design and development	3.752	0.885
CI4. We established continuous improvement programs that include our customer	3.974	0.854
Supplier involvement		
SI1. Our supplier can put forward improving suggestions for our new products	3.881	0.972
SI2. We consult and refer to our supplier' opinions about product prototypes in NPD process	3.684	0.881
SI3. We have a strong consensus that supplier involvement is needed in product design and development	3.508	0.927
SI4. We established continuous improvement programs that include our supplier	3.608	0.872
IT implementation		
IT1. There are direct computer-to-computer links with supplier and customer	2.927	1.299
IT2. Inter-organizational coordination is achieved using electronic links	3.153	1.163
IT3. We have electronic mailing capabilities with our supplier and customer	3.567	1.077
IT4. The information equipment we share with our supplier and customer adheres to the general standard and the same code	2.650	1.189
Speed-to-market of new products		
STM1. We have a quicker speed to introduce new products to market than industry average	3.219	0.854
New product market performance		
Compared with the competitors, how to express your plant's recently launched products in the following targets?		
NPMP1. Market share	3.471	0.816
NPMP2. Profitability	3.369	0.775
NPMP3. Return on investment (ROI)	3.344	0.788
NPMP4. Overall commercial success	3.618	0.686

Table AI. Construct measurement

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