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The interaction effects of supplier involvement and social media on innovation performance

Full Paper Submission

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ABSTRACT

Drawing on social network theory, we posit that social media enhances the effect of supplier involvement on new product development (NPD) performance. To test the hypotheses, we used a longitudinal survey of 367 manufacturing firms. The results support the expectations that the use of social media increase NPD performance.

KEYWORDS: Supplier involvement, New product development performance, Social media

INTRODUCTION

The supply chain literature has recognized the increasing importance of involving external parties such as supplier involvement in the new product development (NPD) process. Recently, the process of leveraging a variety of networked tools or technologies to support supplier involvement in innovation processes implies the use of a social media approach (Rapp et al., 2013). Social media refers to online services that support social interactions among users through highly accessible and scalable web-based publishing techniques (Chua and Banerjee, 2013).

Supplier involvement includes all the activities that suppliers can provide from a simple consultation of product concept to full responsibility for component design, systems, or processes to be provided (Smets et al., 2013). This research specifically focuses on supplier involvement as knowledge sharing during the NPD process. This aspect of supplier involvement is particularly important because NPD activities vary across NPD stages, and, thus, require knowledge sharing between buyers and suppliers (Jespersen, 2012). For simplicity, we refer to knowledge sharing from the supplier during the NPD process as “supplier involvement” in the remainder of this manuscript.

In terms of knowledge sharing, social media may be particularly suited to supplier involvement, because social media provides specialized discussion platforms that enable managers to more efficiently share knowledge among suppliers and buyers (Rapp et al., 2013). In this way, managers could be able to more easily incorporate suppliers into their innovation processes and generate more productive performance outcomes. However, how social media enhances NPD performance of supplier involvement remains unclear.

Building on social network theory (Uzzi, 1996), we aim to explore this question. Specifically, building on social network theory, referring to a network of people gathered by a series of relationships that is established based on social relationships (Uzzi, 1996), we posit

that social media substantially enhances the NPD performance of supplier involvement because firms are interconnected with one another and embedded in various external social networks. Because a firm's own knowledge base alone may not be sufficient to obtain diversified knowledge, the firm can use social media to enlarge, capture, and deploy knowledge resources from suppliers, which increase buyers' NPD performance.

Our findings extend supply chain research related to supplier involvement, and help managers understand the effects of social media. In the next section, based on our discussion of how social media facilitate the impact of supplier involvement on NPD performance, we develop hypotheses. We then test our hypotheses on a longitudinal survey of 367 manufacturing firms. We conclude with a discussion of implications and further research into product innovation.

LITERATURE REVIEW

The innovation process has been considered a process of knowledge management (Joshi and Sharma, 2004), and the knowledge-based view (KBV) has been used to examine knowledge management processes in organizations (Grant, 1996). For this research, we use KBV as a theoretical perspective to understand the relationship between supplier involvement and NPD performance.

Basically, the KBV conceptualizes firms as institutions for developing and integrating knowledge (Grant, 1996). In this line, knowledge develops within buyer firms from experiential learning and transfers within and across firms, allowing for value creation (Mu et al., 2008). As social media technologies become more advanced, suppliers' knowledge should be more substantial (West and Bogers, 2014). Given that buyers and suppliers have different domains of knowledge, they enhance product innovation efforts by bringing their distinct knowledge together and combining their expertise (Cheung et al., 2011). Therefore, when supplier involvement increases, the NPD performance of buyers is expected to increase. Importantly, as the use of social media allows interactions between suppliers and buyers to be improved (Rapp et al., 2013), the buyers with complementary knowledge acquired from supplier involvement should be able to create better NPD performance outcomes. Therefore, we hypothesize that:

H1. Within the social media environment, supplier involvement is positively related to innovation performance.

Traditionally, surveys, interviews, or other market research tools have supplied firms with knowledge about customer needs to improve organizational innovation processes (Vinerean et al., 2013). Recent advanced technologies such as online brand communities enable users to be highly informed. (Nambisan and Nambisan, 2008). These new technologies also enable firms to integrate external parties' unique knowledge into their innovation process (Nambisan and Baron, 2009), among which social media have recently gained prominence.

According to Kaplan and Haenlein (2010), social media is a group of Internet-based applications that build on the technical foundations of Web 2.0 that allow the creation and exchange of user-generated content. Musser and O'Reilly (2006, p. 4) define Web 2.0 as "a set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet - a more mature, distinctive medium characterized by user participation, openness, and network effects." The exclusive aspects and immense popularity of social media have revolutionized innovation practices such as supplier involvement or open innovation (Rapp et al., 2013; West and Bogers, 2014).

An example of social media is a firm that uses a social network service as a discussion venue for its NPD (e.g., a discussion venue in Facebook, Twitter, Line, WhatsApp, or Instagram etc.). In terms of supplier buyer collaboration, buyer firms can follow their suppliers' discussions about their new products for real-time feedback, while supplier firms can offer new ideas, market knowledge, or technical knowledge for current products or future new products. Thus, social media is a venue that enables buyer firms to encourage suppliers to share their knowledge through effective interactions between suppliers and buyers (Kaplan and Haenlein, 2010). Social network theory suggests that, through interaction, firms develop social capital, which provides a source of knowledge advantage for firms by offering access to external resources and knowledge (Raisch et al., 2009). As such, firms increasingly rely on external partners to access new knowledge that is not available internally. The use of social media in the supplier network provides buyer firms with access to diverse knowledge (Weinberg and Pehlivan, 2011). As a result, the use of social media can be viewed as an important source for buyer firms to acquire valuable external knowledge from suppliers.

Although the important role of social media is recognized, how it facilitates the effect of supplier involvement is under-examined. A review of supplier involvement literature suggests that supplier involvement provides direct access to suppliers' knowledge (Jespersen, 2012), and its effect depends on whether buyer firms can achieve efficient knowledge sharing. In addition, deepened relationships resulting from social capital in supplier involvement can enhance the motivation of suppliers to share their proprietary knowledge (Carey et al., 2011; Oke et al., 2013). In this regard, social media functions as a vital role to affect the efficacy of knowledge sharing between buyer firms and their suppliers for following two reasons.

First, social media provides frequent interaction platforms that facilitates knowledge sharing of supplier involvement (Rapp et al., 2013). Because tacit knowledge is difficult to be articulated, its transfer requires deep interactions between buyers and suppliers (Reagans and McEvily, 2003). Second, social media facilitates collaboration among partners and motivates them to deepen their relationships (Cao and Zhang, 2011), which helps buyer firms overcome difficulties associated with diverse suppliers' knowledge integration in their NPD process. Therefore, whether supplier involvement within the social media environment can enhance NPD performance may depend on how buyer firms use social media. This information leads to the following Hypothesis:

H2. Social media moderates the effect of supplier involvement on NPD performance, such that in the presence of high social media, performance gains of firms based on supplier involvement are greater.

RESEARCH METHODS

We collected data from manufacturing industries to test the hypotheses. The initial set of respondents came from a commercial list provider (China Credit Information Service, 2012) who provided contact information of the Top 1000 Taiwan-based manufacturing firms.

As with previous studies in developing economies (e.g., De Luca and Atuahene-Gima, 2007), we collected the data on-site, so that we could clarify respondents' questions and ensure that the questionnaires collected were complete and usable. We recruited trained interviewers to conduct on-site surveys, who presented the questionnaires to the respondents with each interview lasting around one-half hours. To reduce the potential for common method bias (Podsakoff et al., 2003, p. 898), we obtained different information from multiple sources in each firm. Specifically, NPD managers of buyer firms were asked to provide data regarding supplier involvement and product innovativeness, while marketing managers were asked to provide data regarding social media. In addition, this study was designed to collect data longitudinally over

three waves of data collection, early-2014, early-2015, and early-2016, through separate surveys. We collected data longitudinally at three points in time because, according to Rindfleisch et al. (2008), three years is an appropriate compromise between enhancing causal inference by performing temporal order in the empirical design.

Overall, we obtained 367 usable questionnaires resulting in an effective response rate of 46.2%. Of the 367 firms, the average annual sales revenue was \$7.7 million US. The average number of employees was 1273. These respondents had a mean industry experience of 9.2 years and a mean firm experience of 7.6 years. The firms in the sample were distributed by sector as follows. 81 firms were information technology (22.1%), 72 firms came from automobiles (19.6%), 67 firms were chemicals (18.2%), 49 firms were textiles (13.3%), 46 firms represented machinery (12.5%), 37 firms were energy (10.1%), and 15 firms were in other sectors (4.1%).

To check for non-response bias, we obtained secondary data (firm size, firm age, and sales) from the business research firm (China Credit Information Service 2012) for 97 randomly selected, nonparticipating firms, those with unwillingness to participate or reluctance to disclose information. Analyses of variance indicated no significant differences between the two groups on firm size ($F = 1.04$), firm age ($F = 0.87$), and sales ($F = 0.96$) in the year of 2014.

Measures

We measured the perceptual items with a seven-point scale, where the anchor of 1 indicates “strongly disagree” and 7 indicates “strongly agree”.

To measure *supplier involvement*, we developed a four-item scale based on Cai et al. (2010) and Feng et al. (2010). It assesses the extent to which suppliers are involved in the buyer firms’ NPD process from the perspective of knowledge sharing. For *social media*, since the supply chain literature does not offer any valid scales for social media, scale items were adapted from Agnihotri et al. (2009) with three items. *NPD performance* was measured by product innovativeness, and a four-item scale was adapted from Durmuşoğlu and Barczak (2011).

We controlled for sources of heterogeneity in firm characteristics, including firm size and firm age. Firm size was measured as the number of employees. Firm age was measured as the number of years the firm has been in business operations. Finally, environmental turbulence, both market and technical, was included as a control variable and was measured based on a four-item scale as per similar innovation studies (e.g. De Luca and Atuahene-Gima, 2007).

DATA ANALYSIS AND RESULTS

We first computed the kurtosis and skewness of each item to test for nonnormality (Hair et al., 2010). The largest kurtosis value is below the recommended maximum value of 2.00, and the largest skewness value falls below 5.00. Both results suggest that all items are within the range of normality. Next, we employed the Kaiser-Meyer-Olkin (KMO) measure to test sampling adequacy, and Bartlett’s test of sphericity to test correlation matrix (Hair et al., 2010). Both tests yielded satisfactory results, with a KMO value of 0.814 exceeding the recommended value of 0.60 (Kaiser, 1974), and the Bartlett’s test reaching significance at the $p < 0.001$ level.

The reliability was then measured and the results indicate that the Cronbach’s alpha values for all constructs are well above the threshold value of 0.7 recommended by Nunnally (1978). Finally, to refine the measures, a principal component analysis was conducted with varimax rotation, and evaluation of the eigenvalues was used to identify the number of factors to retain. All initial eigenvalues are greater than one. The remaining items explain 67.2% of the

variance, and all items load on the right factor, generally with high factor loadings. Throughout this process, the items load as expected.

For the measurement models, the results of factor analysis indicate that all factor loadings are significant ($p < 0.01$) and all are well above the recommended value of 0.5 (see Appendix). To establish construct validity, we examined both convergent and discriminant validity. Composite reliability is an indicator of the shared variance among the observed variables used as an indicator of a latent construct (Fornell and Larcker, 1981). The results of all indicators exceed the usual 0.70 benchmark (Hair et al., 2010).

Discriminant validity was assessed by using the Fornell and Larcker (1981) procedure and an alternative procedure recommended by Anderson and Gerbing (1988). As shown in Table 1, for each construct the value of the square root of each average variance extracted (AVE) is greater than the values of the inter-construct correlations. In addition, the confidence interval does not include 1.0 by plus or minus two standard errors around the correlation between the constructs (Anderson and Gerbing, 1988), and the Chi-square test between any two constructs is significant ($p < 0.001$). Accordingly, the measures in this study are uni-dimensional and possess convergent and discriminant validity. Table 1 shows descriptive statistics, correlations, and AVEs of constructs.

Table 1 Basic descriptive statistics and correlation matrix

Variables	1	2	3	4	5	6
1. Supplier involvement	.80					
2. Social media	.06	.79				
3. Product innovativeness	.25*	.12	.81			
4. Firm size	.11	.07	.10	--		
5. Firm age	.15	.11	.28*	.15	--	
6. Environmental uncertainty	.27*	.33**	.34**	.09	.11	.82
Mean	5.11	4.92	5.32	1273	13.4	5.26
Standard deviation	2.06	1.59	2.02	383	3.98	1.94

NPD: new product development ** $p < 0.01$; * $p < 0.05$; $N = 367$

Bold figures on the diagonal are the square root of the AVE

Hypotheses testing

Using hierarchical moderated regression, the results shown in Table 2 indicate that supplier involvement has a significant positive effect on product innovativeness ($\beta = 0.30$; $p < 0.01$), supporting H1. In addition, the results for this analysis, in Model 2 of Table 2, reveal that supplier involvement is positively related to product innovativeness ($\beta = 0.30$, $p < 0.01$), supporting H2.

We performed another additional analysis to clarify the potential curvilinear relationship between supplier involvement and product innovativeness because we have reason to expect that the effect of external knowledge sharing on product innovativeness appears to be nonlinear over time (see Laursen and Slater, 2006). As such, we probe this possibility by using a squared term, in which a positive sign for the coefficient of the squared term indicates a U-shaped relationship, while a negative sign indicates an inverted U-shaped relationship (Aiken and West, 1991).

The results for this analysis, in Model 2 of Table 2, reveal that supplier involvement is positively related to product innovativeness ($\beta = 0.30$, $p < 0.01$), and the coefficient for supplier involvement squared is negative and significant ($\beta = -0.19$, $p < 0.05$), suggesting that the link between supplier involvement and product innovativeness is inverted U-shaped relationships. We then assessed the model with the interaction variable of social media. As Model 3 in Table 2 shows, the interaction between social media and supplier involvement positively affects product innovativeness ($\beta = .26$, $p < 0.01$), and supplier involvement squared interacts is also positively

related to product innovativeness ($\beta = 0.20$, $p < 0.05$). The results suggest that social media strengthens the positive effects of and alleviates the negative effects of supplier involvement on product innovativeness.

Table 2 Results of hierarchical moderated regression

	Product innovativeness		
	Model 1	Model 2	Model 3
Firm size	0.05 (0.71)	0.03 (0.41)	0.02 (0.23)
Firm age	0.07 (1.02)	0.04 (0.57)	0.06 (0.92)
Environmental uncertainty	0.10 (1.23)	0.13 (1.57)	0.12 (1.48)
Supplier involvement (SI)		0.30** (3.18)	0.27** (2.88)
Social media		0.23** (2.57)	0.26** (2.73)
SI squared		-0.19* (2.16)	-0.11 (1.43)
SI \times Social media			0.26** (2.69)
SI squared \times Social media			0.20* (2.21)
Adjusted R ²	0.12**	0.20**	0.30**
ΔR^2		0.08**	0.10**
F-value	3.68**	4.39**	5.34**

Standardized coefficients are presented with *t*-value in parentheses

* $p < 0.05$; ** $p < 0.01$ (N=367)

DISCUSSION AND CONCLUSIONS

Theoretical implications

This study contributes to the existing literature in the following ways. First, previous research has suggested that further advancement in the field of supplier involvement requires linking empirical research with established theories (Rapp et al., 2013; Yenyurt et al., 2014). We connect supplier involvement with social network theory and advance a mechanism that identifies the usefulness of social media for firms attempting to employ supplier involvement for their innovation purposes. Previous research (Kaplan and Haenlein, 2010) has called for employing social media that may make the best use of external knowledge in firms' innovation process. The results of our study provide empirical evidence for the effectiveness of employing social media. Therefore, this study not only lends support to the importance of supplier involvement in the innovation process (Singh and Power, 2009; Carey et al., 2011; Oke et al., 2013), but also validates the assumption that social media is a key element in innovation development. These findings contribute to the social network theory by illustrating the positive effect of social media.

Second, our study adds to supplier involvement literature by showing the NPD performance of supplier involvement. Although most researchers agree that supplier involvement help firms improve NPD performance (e.g., Lawson et al., 2015; Smets et al., 2013; Yenyurt et al., 2014), our additional analyses indicate that supplier involvement is not always positively related to NPD performance of product innovativeness. Instead, supplier involvement has an inverted U-shaped relationship with product innovativeness. This finding enriches extant literature by demonstrating a possible disadvantage of supplier involvement. Importantly, we also advance extant literature (Rapp et al., 2013; Yenyurt et al., 2014) by confirming empirically that social media helps firms' supplier involvement sustain their product innovativeness. Our findings provide new evidence that social media acts as a facilitator for firms to benefit from supplier involvement in their NPD process.

Managerial implications

Our findings provide important implications for firms to leverage their social media to enhance the effectiveness of supplier involvement. Managers of buyer firms should proactively use social media to encourage their suppliers to get involved in their NPD process. In particular, our findings suggest that firms should direct more attention to the dimension of knowledge sharing in terms of supplier involvement. By interacting and communicating with suppliers through social media during the NPD process, firms can effectively obtain knowledge resources from suppliers and help establish close supplier relationships that generally improve their NPD performance.

In addition, firms should recognize that the value of their supplier involvement will change over time in terms of product innovativeness, and, thus, must understand how to leverage such benefit of supplier involvement in varied chronological phases. Firms that continuously rely on supplier involvement should be aware that, although this helps to create superior product innovativeness, over time they may suffer from its negative effect. Managers should anticipate this result and make a careful trade-off in order to optimize NPD performance. With this concept in mind, managers should regularly check the effectiveness of product innovativeness against supplier involvement. Meanwhile, managers can use the social media approach to diminish the negative effects of supplier involvement. By using social media, managers can not only strengthen the deployment of supplier involvement but also alleviate the negative effect of supplier involvement. Especially, pursuing high product innovativeness is a key successful factor for firm sustainability performance (Song and Thieme, 2009), social media provides managers with a promising way to tackle this critical problem.

Limitations and future research

First, this study focuses on the analysis of supplier involvement as knowledge sharing across NPD stages. Future research may use a more fine-grained understanding of supplier involvement to examine a specific NPD stage. For example, to incorporate supplier involvement into the commercialization stage of NPD through social media may help buyer firms overcome difficulties in new product launch activities.

Second, while this study investigates the interaction effect between social media and supplier involvement, academic understanding of effective social media is still limited. To broaden an understanding of such, research involving national and cultural factors relating to supplier attitudes about NPD projects (Kumar, 2014) should be investigated. Therefore, the authors recommend future research investigating this issue by comparing the effectiveness of social media and supplier involvement in regions/countries with varying degrees of cultures.

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