ABSTRACT

This article proposes a theoretical model to understanding how and why customer participation can promote project performance. The research model was empirically examined by collecting data from 245 software development projects. The research found that knowledge integration mediates the positive relationship between customer participation and project performance. Additionally, project complexity strengthens the main effect of customer participation and an indirect effect of knowledge integration was found. Theoretical and managerial implications for project management and research limitations are also discussed.

KEYWORDS: customer participation; knowledge integration; project complexity; project performance

INTRODUCTION

Major changes in marketing trends show that just adopting customer orientation is not enough; organizations must obtain more information and knowledge from customers to create values that can meet their individual and dynamic needs (Prahalad & Ramaswamy 2000; Chan, Yim, & Lam, 2010; Eisingerich, Auh, & Merlo, 2014; Chang & Taylor, 2016). Encouraging customer participation may demonstrate the next frontier in improving competitive effectiveness for projects in organizations (Bendapudi & Leone, 2003), which reflects a major change from a goods-centered to a customer-centered logic in marketing (Vargo & Lusch, 2004; Chan et al., 2010). Customer participation can provide sellers with the knowledge of personalized requirements and solutions, which leads an organization to getting more customers involved in new product development (Fang, 2008; Chang & Taylor, 2016). Therefore, closely linking the customer to the seller during the development process is argued to be a key factor in the success of a new product (Terwiesch & Loch, 1999; Fang, Palmatier, & Evans, 2008).

Both practical and academic domains have realized that new products can benefit from customer participation. For example, Muji, a Japanese clothing company, revealed that the sales of products from the feedback and ideas of customers were five times higher than products based on professional designers’ ideas in the last three years (Nishikawa, Schreier, & Ogawa, 2013). Researchers also realize that customer participation is critical to the functioning of new production (e.g., software project), which has led to a proliferation of research focusing on how to improve project performance through encouraging customers to be involved in new product development (Prahalad & Ramaswamy, 2000; Bendapudi & Leone, 2003; Fang, Palmatier, & Evans, 2008; Chen et al., 2010; Chang & Taylor, 2016). Although the matter of whether customer participation can affect project performance has received the attention of numerous researchers, it still falls short in exploring the process through which it is linked to project performance (Bendapudi & Leone, 2003; Chan et al., 2010). This suggests that examining the process of transmitting the effects of customer participation has been recognized as crucial in advancing the understanding of this matter. Yet, empirical examinations of such processes remain scarce and have thus provided a piecemeal and incomplete understanding of how customer participation impacts project performance and insight that doesn’t necessarily apply to project teams. The key focus of this study is to accumulate knowledge on the role of customer participation in new project development. More specifically, this article aims to address three core research issues:

1. To examine the mediating role of knowledge integration in the relationship between customer participation and project performance.

Customer Participation and Project Performance: A Moderated-Mediation Examination

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2. To test the effect of the extent of project complexity on the relationship between customer participation and project performance.

3. To examine whether the indirect effect of customer participation on project performance via knowledge integration is moderated by project complexity.

Regarding the first research issue, both managerial practice and scholars believe that customer participation promotes new project performance but leaves the linkage of customer participation to project performance unclear. This article reveals that customer participation impacts project performance through knowledge integration. Thus, this article reveals knowledge on explicating the mediating mechanisms through which customer participation promotes new project success and provides information for further studies targeted at improving project performance.

This research investigates how project complexity influences the impact of customer participation on the knowledge integration of a new project team, which informs the second research issue. Results show that increasing the complexity of a project strengthens the relationship between customer participation and knowledge integration. Furthermore, it offers managerial direction on how the complexity of a project increases the impact of customer participation.

The effect of customer participation on project performance is more complicated than is first apparent. Thus, this study further examined whether or not project complexity moderates the mediating effect of knowledge integration on the customer participation–project performance relationship. The result suggests that increasing the complexity of a project strengthens the indirect effect of customer participation on project process performance via knowledge integration. It provides us with evidence that helps us clarify the intermediate process between customer participation and project performance.

The theoretical expectation was empirically examined by collecting data from 245 software projects. In the following section, this study first develops the conceptual model and hypotheses. Second, this article discusses the data collection procedures, measure operationalization, and analyses strategies. Finally, the results, theoretical and managerial implications, and research limitations are presented.

**Theory and Hypotheses**

**Customer Participation and Project Performance**

We have mastered the detailed knowledge of the gravitational field of the definition of customer participation, which takes several forms and levels—from firm production to customer production (Meuter & Bitner, 1998). Because our target is to comprehend project performance when customers are involved in the project process, we do not consider the production of enterprises and customers (e.g., self-service technologies). We adopt the previous definition of customer participation (i.e., professional project services) by conceptualizing customer participation as a behavioral construct that measures the extent to which customers provide or share information and knowledge, make suggestions, and become involved in decision making during the value co-creation and delivery process (Auh, Bell, McLeod, & Shih, 2007; Bolton & Saxena-Iyer, 2009; Hsieh, Yen, & Chin, 2004).

Some studies have confirmed that software project process and product performance should be evaluated at the end of the project (Nidumolu, 1996). It is valuable to appraise both the process performance and product performance, because the project may create conflict between the efficiency of the process and product quality (Nidumolu, 1996). For example, processes that are rigidly controlled and lead to rigid adherence to source budgets (e.g., cost and time), may lead to incomplete function and reduce the flexibility of the long-term software project to address users’ short-term needs. Process performance can be described as the extent to which the development processes of software were managed and the interactive quality between project team members and customers during the development processes of software (Cooprider & Henderson, 1990; Nidumolu, 1996). Product performance was evaluated according to three facets: technical performance of the products, how well the software fulfills the needs of customers, and adaptability to the changing customer needs of the products (Cooprider & Henderson, 1990; Nidumolu, 1996).

A crucial benefit when customers participate in new software project development is the preferred access to useful information about customer needs, because project customer participation can provide feedback on product requirements (Lee, Reinicke, Sarkar, & Anderson, 2015; Chang & Taylor, 2016; Basten, Stavrou, & Pankratz, 2016). If the customer is involved in new project development (e.g., idea generation), he or she can express his or her preferences and needs accurately through face-to-face discussions, or meetings (Urban & Von Hippel, 1988; Fang, 2008). Such communication can improve the possibility of appreciating the related knowledge of project members and customers (Fang et al., 2008). From the view discussed earlier, customer participation means that he or she can provide market and technological information to the project team (Gupta, Raj, & Wilemon, 1986). The project team and customer’s own respective information, technological, and even social resources facilitate smooth implantation of the project. Only by integrating these resources together effectively can the promotion of the processes software project development run smoothly. After these resources have been combined, the joint result can be generated to the processes of new project development. In other words, the combined information and resources will be more valuable. It is more important...
Customer Participation and Project Performance

that shared information and resources lead the software project team to obtain more tacit knowledge that promotes effective operation during the process of new project development. This can raise the efficiency of project implementation, thereby saving cost and time (Wang, Lee, Fang, & Ma, 2017).

According to resource-based theory (Pfeffer & Salancik, 1978), the customer and project team rely on each other during the new project development process. This means not only that customers need product-related resources within the project team for solutions to promoting product quality; the project team also relies on customers, because they decide how to allocate resources that are beneficial to project success (Prabdalad & Ramaswamy, 2004). Some scholars have argued that project development is a process that combines different capabilities and resources to search solutions for customer's needs (Gadrey, Gallouj, & Weinstein, 1995). Djellal and Gallouj (2001) stated that the customer's technology and capability are crucial resources for new project development. The project team and customer represent technology and the market, respectively, which means that they hold complementary and heterogeneous resources for project development. Therefore, the more that resource-sharing activities occur between the project team and customer, the more heterogeneous resources can be accessed. This will significantly broaden the useful resources of project teams and enhance the performance of a new project (Sundbo, 1998). Taken together, we propose the following hypotheses:

**Hypothesis 1:** Customer participation at the project level enhances project performance.

**Hypothesis 1a:** Customer participation at the project level enhances project process performance.

**Hypothesis 1b:** Customer participation at the project level enhances project product performance.

Customer Participation and Knowledge Integration

Product development is a prime example of how project team members exploit and integrate diverse knowledge fields in order to originate new ideas (Song & Dyer, 1995; Gemünden, 2015). The success of new project development always requires diverse, complementary sources (e.g., knowledge) (Henderson & Clark, 1990; Nickerson & Zenger, 2004; Obstfeld, 2005; Tiwana, 2008). A project solution is described as a combinatorial innovation (Obstfeld, 2005; Tiwana, 2008), which means that a project solution needs to integrate novel ideas and knowledge. At present there are several studies, which have defined the concept of knowledge integration from the project level based on Grant’s (1996) conceptualization (e.g., Carlile & Rebentisch, 2003; Okhuysen & Eisenhardt, 2002; Sabherwal & Becerra-Fernandez, 2005; Tiwana & McLean, 2005; Tiwana, 2008). According to their opinions, knowledge integration was defined as the combinatorial process, which utilizes specialized knowledge from different alliance partners at the project level.

When customers participate in new project development they can strengthen the use of essential information and knowledge. If customers participate in new project development, which can increase the chances of interaction, they can facilitate information disclosure and promote mutual loyalty (Starbuck, 1992). Customer demand and market information guide the project team in finding solutions that address customer demand and enhance the motivation of project team members and customers to integrate knowledge. By embracing the customers' available heterogeneous resources, the software project team broadens their horizons rather than narrowing any existing ones (Djellal & Gallouj, 2001); creates opportunities for the new integration of diverse perspectives in different professional areas (Sabherwal & Irmacecera-Femandez, 2005); and then promotes the integration and application of heterogeneous knowledge, which contribute to creating software project value. Taken together, we propose the following hypothesis:

**Hypothesis 2:** Customer participation positively relates to knowledge integration at the project level.

Knowledge Integration and Project Performance

Knowledge integration is included in the entire process of new project development (Morris, 2013). During the process of new project development, both parties (project team and customer) form a common viewpoint of what and how the product should progress through knowledge integration (Lin & Chen, 2006). In order to explain this opinion, Tiwana (2008) provided a case about an internet-based logistics system of how and what kind of knowledge was integrated. Tiwana (2008) pointed out that this logistics heuristics, developed by a shipping company, requires various partners to be involved, including a software company (master ‘software objects’), GPS manufacturer (master satellite positioning), and cartographer (master street-level mapping). The diversified expertise of these fields was jointly effective during different stages (e.g., conceptualization, design, and implementation) of the innovative product.

The project team with the greater extent of knowledge integration means that different alliance partners will be easier to cross-fertilize and will succeed in finding solutions to new project development (Tiwana, 2008). Knowledge integration is beneficial to promoting the recognition and integration of new demanding information from different participants while the project is in progress. Moreover, knowledge integration benefits the correction of misalignment in a constant state of changing external environments and customer demand for information in the process of new project development, which in turn enhances project performance (Tiwana, 2008). Empirical
Evidence has examined the positive relationship between knowledge integration and project performance, including studies from Faraj and Sproull (2000); Patnayakuni, Rai, and Tiwana (2007); and Tiwana and McLean (2005), which found that there are positive correlations between the effective integration of varied knowledge and products during the software project development process, which leads to our third hypothesis:

**Hypothesis 3:** Knowledge integration relates positively to project performance at the project level.

**Hypothesis 3a:** Knowledge integration relates positively to project process performance at the project level.

**Hypothesis 3b:** Knowledge integration relates positively to project product performance at the project level.

The Mediating Effect of Knowledge Integration

As discussed earlier, this article proposes that customer participation is positively associated with knowledge integration (Hypothesis 2), which in turn correlates with project performance (Hypothesis 3), suggesting that customer participation affects project performance via its effects on knowledge integration. New project development needs the connection and cooperation between project team members and customers outside of the firm (Faraj & Sproull, 2002). Social ties and interactions offer project team members the opportunity to acquire others’ (e.g., customers) knowledge (Tiwana & Mclean, 2005; Lin & Chen, 2006). Project team learning from customers and exchanging knowledge enable them to address needs and problems, thereby avoiding mistakes (Faraj & Sproull, 2000; Tiwana & Mclean, 2005). Knowledge is recognized as stickiness and tacitness, and is not easy to proactively disperse among different individuals (Grant, 1996; Hansen, 1999; Tsai, 2002). Through customer participation, the information and knowledge gathered by close connections and interactions can be disseminated throughout the project and integrated to shared language and memory by project team members (Nahapiet & Ghoshal, 1998; Szulanski, 2000; Adler & Kwon, 2002; Chua, 2002).

When information and knowledge are integrated effectively, project team members tend to better transfer and make use of knowledge to develop new products effectively and promote valuable innovation outcomes and performance (Gold & Arvind Malhotra, 2001; Sarin & McDermott, 2003; Argote, McEvily, & Reagans, 2003). Accordingly, we infer that knowledge integration plays a mediating role in the relationship between customer participation and project performance. Therefore, the following hypothesis is proposed:

**Hypothesis 4:** Knowledge integration will mediate the relationship between customer participation and project performance.

**Hypothesis 4a:** Knowledge integration will mediate the relationship between customer participation and project process performance.

**Hypothesis 4b:** Knowledge integration will mediate the relationship between customer participation and project product performance.

The Moderating Effect of Project Complexity

Hypothesis 2 argued the direct relationship between customer participation and knowledge integration, but it didn’t discuss the boundary of the effect. We believe that project complexity (e.g., the radicalness or degree of innovativeness) has a noteworthy effect on the relationship between customer participation and knowledge integration. This has been corroborated by a minority of researchers who suggested that a new project development process should be characterized by the extent of project complexity (Damanpour, 1991; Dewar & Dutton, 1986; Kessler & Chakrabarti, 1999; Olson, Walker, Ruekerf, & Bonnerd, 2001). According to the extent of project complexity, the innovative activities and efforts will be involved in the respective new project development process, which means that the requirements of each project are distinctive (Mehta et al., 2008). Generally speaking, innovative projects should establish more preferred opportunities in the market for differentiation and furnish more advanced superiority, which will lead to a superior competitive advantage, subsequently positively affecting project outcomes (Fang, 2008; Ignatius, Leen, Ramayah, Hin, & Jantan, 2012). More innovative products also correlate with greater risk notwithstanding. Because those projects channeled the firm into uncertain markets and technical circumstances, the possibility of an unanticipated event is higher (Mu, Peng, & MacLachlan, 2009). In contrast, less innovative products are more familiar to the organization; their risk is lower and so coordination is easier with respect to R&D resources and skills (Cooper & Kleinschmidt, 1993). Accordingly, this can improve the probable success of the product.

Ignatius et al. (2012) proposed and observed that the extent of innovativeness be recognized as a typical manifestation of project complexity, which impacts the outcomes of new product development. A complex project can mean uncertainty to the company, suggesting that project team members require more effort to solving problems, relying on more information and knowledge sources (e.g., customers). However, projects with low-level complexity undergo a more passive, routine-based system learning, which limits feedback (Nonaka & Takeuchi, 1995; Slater & Narver, 1998). Needless to say, projects with high-level complexity need project members to interact with customers because they can provide useful information and knowledge to project members, which can promote and channel the project team to collect and integrate...
Customer Participation and Project Performance

useful information and knowledge to ensure successful implement of the project (Chang & Taylor, 2016).

Consequently, varying degrees of customer participation are anticipated for varying levels of project complexity. To support this argument, Fang et al. (2008) argue that customer participation is potentially detrimental to new product performance and suggests that customer participation must be tailored in terms of different projects. According to this research, the impact of customer participation on knowledge integration is expected to vary as the extent of project complexity moves from high to low. Organizational information processing theory shows that the tasks involved in product development projects, vary in their levels of uncertainty, including lack of information and knowledge about the accurate ways of accomplishing the task. Overall uncertainty level of the task was often recognized as a typical manifestation of new technology in a project (Tatikonda & Rosenthal, 2000)

Overall, high-level complex projects (e.g., higher in technological novelty) undergo more complex processes in new project development and require sufficient information and knowledge to abate the uncertainty and ambiguity as well as the unknown conjuncture of the project.

Therefore, customers outside of the company inquire about the project’s knowledge resource to format new information and knowledge that can be acquired and exploited by project members. The more resources there are for project knowledge, the more preferred is the capability of solving problems related to the high complexity of the project. In other words, the high level complexity of a project requires that great knowledge resources be involved in customers’ knowledge, which includes technical and professional competency to confront the perplexities of new project development. The project with the higher level complexity requires more customer participation in new project development to provide greater information and knowledge to abate uncertainty and mature core capabilities for the project team (Thamhain, 2013). As a result, project members will then be encouraged to collect and integrate information and knowledge to ensure successful implementation of the project. Since the level of project complexity has a contingent impact on the relationship between customer participation and knowledge integration, this study anticipates that:

Hypothesis 5: The impact of customer participation on knowledge integration is greater for projects with higher levels of project complexity.

The Moderated Mediating Effect of Knowledge Integration

In conclusion, this article proposes that project complexity not only moderates the relationship between customer participation and knowledge integration, it also moderates the mediating effect of customer participation on project performance via knowledge integration. We propose the hypothesis that knowledge integration mediates the positive relationship between customer participation and project performance (H4), and project complexity positively moderates the relationship between customer participation and knowledge integration (H5). Combining the logic of the two hypotheses, we propose that project complexity moderates the mediating effect of customer participation on project performance via knowledge integration (H6), which was one of the types of moderated-mediator models in Edwards and Lambert’s (2007) research. Although there are many forms of mediating effect models being moderated, in this research, we predict: (1) knowledge integration mediates the positive relationship between customer participation and project performance (H4); (2) project complexity moderates the relationship between customer participation and knowledge integration (H5); therefore, project complexity will moderate the original mediating effect (the mediating effect of customer participation on project performance via knowledge integration) (H6). This article proposes the following hypothesis, and Figure 1 depicts our theoretical model:

H6: Project complexity moderates the mediating effect of customer participation on project performance via knowledge integration, such that the mediating effect is stronger when the level of project complexity is high rather than low.

Methodology

Sample and Data Collection

This research collected data from software projects through a professional data survey corporation (e-Data Power) in Beijing and the authors’ social networks. We received 260 completed questionnaires from project team leaders; the final data included 245 software projects after removing 15 questionnaires due to excessive missing data. Overall, the valid response rate was 94.231%. The average number of days needed for developing software is 443.999 (S.D. = 667.993); most software projects were new projects (73.061%), others were IT solutions for customers.

We explained to the participants the importance of truthful answers for scientific research and ensured confidentiality by guaranteeing that only the researchers would see the individual answers. The software project leader completed a survey containing items for all variables, such as customer participation, project complexity, knowledge integration, project performance, and control variables (e.g., the duration, cost, scale, and type of project).

Operationalization Measures

The research involved five constructs at the project level: customer participation, project complexity, knowledge integration, process performance, and product performance; all measures used five-point scales, ranging from 1 = “strongly disagree, extremely small, or almost never” to 5 = “strongly agree, extremely big, or always” to collect data.
Customer participation was operationalized by five items adopted from Chan et al. (2010) and Auh et al. (2007): Customers spent much time sharing information about their needs and opinions with the project members during the service process (CP1); customers put a lot of effort into expressing their personal needs to the project members during the service process (CP2); customers always provided suggestions to the project members for improving the service outcome (CP3); customers have a high level of participation in the service process (CP4); and customers are very much involved in deciding how the services should be provided (CP5). The Cronbach's alpha value of this scale was 0.727.

We measured knowledge integration using the five-item scale adopted from Tiwana (2008), which included project members competently blending new project-related knowledge with what they already know (KI1); project members spanning several areas of expertise to develop shared project concepts (KI2); and project members synthesizing and integrating their individual expertise at the project level (KI3). The Cronbach's alpha value of this scale was 0.630.

Project process performance was measured according to six items developed by Nidumolu (1996). We asked the project leader to answer this question: How do you evaluate the project and software that were delivered on each of the following items in terms of your experience on the project? The measure used five-point scales, ranging from 1 = “very poor” to 5 = “very good”; the six items are as follows: control over project costs (PcP1), control over project schedule (PcP2), overall knowledge acquired by the project through the project (PcP3), overall control exercised over the project (PcP4), quality of communication between the project members and users (PcP5), and users’ feelings of participation in the project (PcP6). The Cronbach’s alpha value of this scale was 0.821.

Project product performance was operationalized based on five items according to Nidumolu (1996). We asked the project leader to answer this question: How do you evaluate the project and software that were delivered on each of the following items in terms of your experience on the project? The measure used five-point scales ranging from 1 = “very poor” to 5 = “very good.” The five items were: control over project costs (PdP1), control over project schedule (PdP2), overall knowledge acquired by the project through the project (PdP3), overall control exercised over the project (PdP4), quality of communication between the project members and users (PdP5), and users’ feelings of participation in the project (PdP6). The Cronbach’s alpha value of this scale was 0.762.

Project complexity was operationalized based on two items from Ignatius et al. (2012) and the following questions were asked: (1) How new was the product configuration (PC1)? And (2) How new were the product technologies in this project (PC2)? The Cronbach’s alpha value of this scale was 0.641.

Control Variables: In this article, we controlled for project duration (Nidumolu, 1995), budget (Mitchell, 2006), scale (Tiwana, 2008), and type to rule out alternative explanations for project performance. All four control variables were measured with a single item. The project duration was obtained by calculating the date of the project. Budget was measured according to one item: Compared with another similarly sized project, the budget of this project was ____. The measure used five-point scales, ranging from 1 = “very tight” to 5 = “very slack.” Scale was measured according to one item: Compared with another similarly sized project, the number of project members is ____. The measure used five-point scales ranging from 1 = “very few” to 5 = “a great many.” Project type was measured by
Customer Participation and Project Performance

a dummy variable, new project development, coded as 0 and solutions for customers, coded as 1.

Nunnally (1978) stated that a Cronbach’s alpha value exceeding 0.6 was an acceptable level of measurement scale. The Cronbach’s alpha value of all five variables in this research exceeded 0.6, suggesting that the reliability levels of all five are acceptable.

Analyses Strategy
This research tested our hypotheses using hierarchical multiple regression analysis with STATA 12.0. We followed Anderson and Gerbing’s (1988) two-step procedures to test the hypothesized model depicted in Figure 1. This article first confirmed the measurement model using signal level CFA. The items for customer participation, project complexity, knowledge integration, and project performance were specified at the project level. The authors of this article then performed CFA in SEM and examined $\chi^2$, GFI, IFI, TLI, CFI, RMSEA, and SRMR to assess measurement model fit; then we compared the model with various alternative models to ensure the best good fit of the model with various alternative measurement models.

Second, this research examined the direct relationship hypothesized above through each path coefficient in hierarchical regression. Then the authors tested the mediation effects linking customer participation and project performance (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Each path coefficient in the chain should be significant and it is one of the best methods to test mediation effects because it balances Type I error and statistical power (MacKinnon et al., 2002). Next, we calculated the product terms of these path coefficients to evaluate the indirect effect of customer participation on project performance via knowledge integration, the significance of which supports the mediation effect.

Results
Confirmatory Factor Analyses
Table 1 shows that the baseline measurement model fits the data well: $\chi^2$ (179) = 278.408, $p < 0.01$, GFI = 0.901, IFI = 0.935, TLI = 0.922, CFI = 0.933, RMSEA = 0.048, SRMR = 0.054. In addition, all of the factor loadings were significant, which demonstrated that convergent validity can be accepted. The alternative measurement models, including two four-factor models (Model 2—combining customer participation and knowledge integration; Model 4—project process performance and project product performance, respectively), two three-factor models (Model 3—customer participation and knowledge integration were combined, and project process performance and project product performance were combined; Model 4—knowledge integration, project process performance, and project product performance were combined), and one two-factor model (Model 5—customer participation, knowledge integration, project process performance, and project product performance were combined). Table 1 reveals that no alternative models yielded better chi-square or fit index of the baseline model, indicating a good fit of the baseline measurement model. Thus, the distinctiveness of the five constructs in this study was supported.

Descriptive Statistics
Table 2 shows the means, standard deviations, and correlations for all the variables in this study, presented at their appropriate levels. Table 2 shows that customer participation was positively

<table>
<thead>
<tr>
<th>Model</th>
<th>Factors</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>$\chi^2/DF$</th>
<th>$\Delta \chi^2/\Delta$ DF</th>
<th>GFI</th>
<th>IFI</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>SRMR</th>
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<tbody>
<tr>
<td>Baseline Model</td>
<td>Five factors</td>
<td>278.408</td>
<td>179</td>
<td>1.555</td>
<td>—</td>
<td>0.901</td>
<td>0.935</td>
<td>0.922</td>
<td>0.933</td>
<td>0.048</td>
<td>0.054</td>
</tr>
<tr>
<td>Model 1</td>
<td>Four factors: CP and KI were combined</td>
<td>329.637</td>
<td>183</td>
<td>1.801</td>
<td>12.807**</td>
<td>0.879</td>
<td>0.903</td>
<td>0.887</td>
<td>0.902</td>
<td>0.057</td>
<td>0.602</td>
</tr>
<tr>
<td>Model 2</td>
<td>Four factors: Process and Product were combined</td>
<td>328.196</td>
<td>183</td>
<td>1.793</td>
<td>12.448**</td>
<td>0.881</td>
<td>0.904</td>
<td>0.888</td>
<td>0.903</td>
<td>0.57</td>
<td>0.057</td>
</tr>
<tr>
<td>Model 3</td>
<td>Three factors: CP and KI, Process, and Product were combined</td>
<td>378.411</td>
<td>186</td>
<td>2.034</td>
<td>14.286**</td>
<td>0.860</td>
<td>0.873</td>
<td>0.854</td>
<td>0.871</td>
<td>0.065</td>
<td>0.063</td>
</tr>
<tr>
<td>Model 4</td>
<td>Three factors: KI, Process, and Product were combined</td>
<td>370.368</td>
<td>186</td>
<td>1.991</td>
<td>13.137**</td>
<td>0.868</td>
<td>0.878</td>
<td>0.860</td>
<td>0.876</td>
<td>0.064</td>
<td>0.063</td>
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<tr>
<td>Model 5</td>
<td>Two factors: CP, KI, Process, and Product were combined</td>
<td>493.913</td>
<td>188</td>
<td>2.627</td>
<td>23.945**</td>
<td>0.816</td>
<td>0.798</td>
<td>0.771</td>
<td>0.795</td>
<td>0.082</td>
<td>0.074</td>
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</table>

Note: **, $p < 0.01$; CP = customer participation, PC = project complexity, KI = knowledge integration, DF = degree of freedom, GFI = goodness-of-fit index, IFI = incremental fit index, TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual

Table 1: The comparison of measurement models.
correlated with knowledge integration ($r = 0.486$, $p < 0.01$), process performance ($r = 0.388$, $p < 0.01$), and product performance ($r = 0.403$, $p < 0.01$). Moreover, knowledge integration was correlated with process performance ($r = 0.511$, $p < 0.01$) and product performance ($r = 0.483$, $p < 0.01$). These results are consistent with our theoretical expectation and provide the initial support for our hypotheses.

**Hypothesis Test**

We conducted a hierarchical multiple regression analysis to test all the hypotheses, except for Hypothesis 6. As shown in Table 3, customer participation was positively related to process performance ($\beta = 0.367$, $p < 0.01$, Model 4) and product performance ($\beta = 0.342$, $p < 0.01$, Model 7) after entering control variables; thus, Hypothesis 1a and Hypothesis 1b were supported. Additionally, customer participation was positively related to knowledge integration ($\beta = 0.471$, $p < 0.01$, Model 1), and knowledge integration was positively related to process performance ($\beta = 0.472$, $p < 0.01$, Model 5) and product performance ($\beta = 0.435$, $p < 0.01$, Model 8). Thus, Hypothesis 2 and Hypothesis 3 (Hypothesis 3a and Hypothesis 3b) were supported.

Hypothesis 4 proposed that knowledge integration mediates the relationship between customer participation and project performance. When customer participation and knowledge integration were entered simultaneously, the positive correlations between customer participation and process performance, product performance, decreased from 0.367 ($p < 0.01$, Model 4) and 0.342 ($p < 0.01$, Model 4) to 0.180 ($p < 0.01$, Model 6) and 0.171

<table>
<thead>
<tr>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Cost</td>
<td>3.637</td>
<td>0.860</td>
<td>−0.075</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Time</td>
<td>5.428</td>
<td>1.249</td>
<td>−0.028</td>
<td>−0.048</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Scale</td>
<td>3.351</td>
<td>0.598</td>
<td>−0.057</td>
<td>0.018</td>
<td>0.159*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 CP</td>
<td>3.542</td>
<td>0.581</td>
<td>−0.006</td>
<td>0.156</td>
<td>−0.032</td>
<td>0.386**</td>
<td>(0.727)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 PC</td>
<td>3.541</td>
<td>0.730</td>
<td>−0.047</td>
<td>−0.006</td>
<td>−0.002</td>
<td>0.256**</td>
<td>0.398**</td>
<td>(0.641)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 KI</td>
<td>3.962</td>
<td>0.595</td>
<td>0.075</td>
<td>0.178**</td>
<td>−0.076</td>
<td>0.163*</td>
<td>0.468**</td>
<td>0.336**</td>
<td>(0.630)</td>
<td></td>
</tr>
<tr>
<td>8 PcP</td>
<td>3.938</td>
<td>0.571</td>
<td>−0.001</td>
<td>0.314**</td>
<td>−0.007</td>
<td>0.101</td>
<td>0.386**</td>
<td>0.375**</td>
<td>0.511**</td>
<td>(0.821)</td>
</tr>
<tr>
<td>9 PdP</td>
<td>4.153</td>
<td>0.457</td>
<td>0.066</td>
<td>0.228**</td>
<td>0.057</td>
<td>0.229**</td>
<td>0.403**</td>
<td>0.350**</td>
<td>0.485**</td>
<td>0.626**</td>
</tr>
</tbody>
</table>

Note: *$p < 0.05$; **$p < 0.01$; CP = customer participation, PC = project complexity, KI = knowledge integration, PcP = process performance, PdP = product performance. Values set in boldface on the diagonal are the Cronbach’s alpha value of each variable.

**Table 2:** Descriptive statistics and correlations.

<table>
<thead>
<tr>
<th>Knowledge Integration</th>
<th>Process Performance</th>
<th>Product Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
</tr>
<tr>
<td>Type</td>
<td>0.084</td>
<td>0.092*</td>
</tr>
<tr>
<td>Cost</td>
<td>0.109*</td>
<td>0.122*</td>
</tr>
<tr>
<td>Time</td>
<td>−0.052</td>
<td>−0.049</td>
</tr>
<tr>
<td>Scale</td>
<td>−0.007</td>
<td>−0.030</td>
</tr>
<tr>
<td>CP</td>
<td>0.471**</td>
<td>0.402**</td>
</tr>
<tr>
<td>PC</td>
<td>0.188**</td>
<td>0.175**</td>
</tr>
<tr>
<td>CP*PC</td>
<td>0.257**</td>
<td>0.286**</td>
</tr>
</tbody>
</table>

Note: *$p < 0.1$; *$p < 0.05$; **$p < 0.01$; CP = customer participation, PC = project complexity, KI = knowledge integration

**Table 3:** Regression analysis.
Customer Participation and Project Performance

(p < 0.05, Model 9), respectively, whereas knowledge integration was still found to be positively related to process performance (β = 0.398, p < 0.01, Model 6) and process performance (β = 0.363, p < 0.01, Model 9). Hence, Hypothesis 4 was preliminary supported according to the steps proposed by Baron and Kenny (1986). We tested the indirect effects of customer participation on project performance via knowledge integration using bias-corrected confidence intervals derived from bootstrap estimates, which provides further evidence of the mediating effect of knowledge integration. We constructed bias-corrected confidence intervals by drawing 1,000 random samples with replacements from the full sample. An indirect effect is significant when the 95% confidence interval excludes zero (Edwards & Lambert, 2007). In our data, the size of the indirect effect of customer participation on process performance via knowledge integration from the full sample was 0.183, of which 95% was the confidence interval (0.115, 0.258), and the indirect effect of customer participation on product performance via knowledge integration from the full sample was 0.135, of which 95% was the confidence interval (0.081, 0.195). The 95% confidence interval from the bootstrap analysis both excluded zero (see Table 4); thus, Hypothesis 4 was supported.

Hypothesis 5 proposed that project complexity moderates the relationship between customer participation and knowledge integration. As shown in Table 4, the interaction between customer participation and project complexity was positively related to knowledge integration (β = 0.129, p < 0.05, Model 3). We plotted the interaction effects using Stone and Hollenbeck’s (1989) procedure. Figure 2 shows that customer participation is more positively related to knowledge integration when project complexity is high; hence Hypothesis 5 was supported.

Hypothesis 6 predicts that project complexity moderates the customer participation–knowledge integration–project performance mediating linkage. To examine this hypothesis, we conducted Edwards and Lambert’s (2007) general path analytic framework. The results, summarized in Table 5, show that the size of the difference in the indirect effect of customer participation on process performance was 0.008, with the 99% confidence interval computed using

<table>
<thead>
<tr>
<th>Path</th>
<th>Indirect Effect</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP→KI→Process Performance</td>
<td>0.183</td>
<td>(0.115, 0.258)</td>
</tr>
<tr>
<td>CP→KI→Product Performance</td>
<td>0.135</td>
<td>(0.081, 0.195)</td>
</tr>
</tbody>
</table>

Note: CP = customer participation, KI = knowledge integration

Table 4: Indirect effect between customer participation and project performance via knowledge integration.

Figure 2: The moderating effect of project complexity on the relationship between customer participation and knowledge integration.
bootstrap estimation, excluding zero; product performance was 0.003, with the 99% confidence interval computed using bootstrap estimation, including zero. Specifically, the indirect effect of knowledge integration on the relationship between customer participation and process performance was significantly stronger at a high level of project complexity, but the effect of project complexity on the mediating relationship between customer participation and product performance via knowledge integration was insignificant. Thus, Hypothesis 6a was supported but Hypothesis 6b wasn’t supported.

**General Discussion**

**Theoretical Implications**

One strength of this research model of customer participation is that it explains knowledge integration as a mediator that transmits the effects of customer participation to project performance. Although previous studies have observed and examined that customer participation is linked with high coordination effectiveness (Fang et al., 2008), information sharing (Fang et al., 2008), and service quality (Ngo & O’Cass, 2013), Chang and Taylor’s (2016) conceptual model and Joshi and Sharma’s (2004) research on customer knowledge development have implied that the linkages between customer participation and project performance might occur via knowledge integration. For example, the research conclusions of Martín-de Castro and colleagues have revealed that knowledge integration is a predictor and key potential mechanism of new project performance (Martín-de Castro, López-Sáez, Delgado-Verde, & Koch, 2011). Although existing studies have revealed that customer participation should positively affect project performance (Chan et al., 2010), it is unclear how and why customer participation in a project can promote project performance. Customer participation can promote project performance and follows an increase in access to knowledge and information, which contribute to success of a new project. The customer has been conceptualized as a key knowledge and information source associated with project team competence in which the customer provides his or her diversified useful knowledge and information to improve project performance. Although this implies the linkage between customer participation and project performance via knowledge integration, Chang and Taylor (2016) argued that the conclusions on the mediating effects of knowledge-related processes on the relationship between customer participation and new project performance were mixed. Although resource-based models facilitate shedding light on how customer participation enhances project performance, the existing research avoids testing the mediating role played by knowledge integration in the association between customer participation and project performance, which leaves open the issue of whether such resources explain the effects of customer participation on project performance. Therefore, this research empirically examined Chang and Taylor’s (2016) conceptual model, using knowledge integration to explain how and why this critical resource affects project performance.

Second, this article’s findings confirmed that the effect of customer participation on outcomes depends on the level of project complexity. Previous research has revealed that project complexity can strengthen the positive effects

### Table 5: Results of the moderated path analysis.

<table>
<thead>
<tr>
<th>Customers Participation (X) → Knowledge Integration (M) → Process Performance (Y1)</th>
<th>Stage</th>
<th>Effect</th>
<th>Direct effect</th>
<th>Indirect effect</th>
<th>Total effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X→M</td>
<td>M→Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMX</td>
<td>PY1M</td>
<td>PY1X</td>
<td>PMX*PY1M</td>
<td>PY1X + (PMX*PY1M)</td>
<td></td>
</tr>
<tr>
<td>Low level of PC (−1 SD)</td>
<td>0.375**</td>
<td>0.318**</td>
<td>0.102</td>
<td>0.119**</td>
<td>0.221**</td>
</tr>
<tr>
<td>High level of PC (1 SD)</td>
<td>0.391**</td>
<td>0.326**</td>
<td>0.118</td>
<td>0.128**</td>
<td>0.246**</td>
</tr>
<tr>
<td>Difference</td>
<td>0.016**</td>
<td>0.008**</td>
<td>0.016*</td>
<td>0.008**</td>
<td>0.025**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customers Participation (X) → Knowledge Integration (M) → Product Performance (Y2)</th>
<th>Stage</th>
<th>Effect</th>
<th>Direct effect</th>
<th>Indirect effect</th>
<th>Total effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X→M</td>
<td>M→Y2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMX</td>
<td>PY2M</td>
<td>PY2X</td>
<td>PMX*PY2M</td>
<td>PY2X + (PMX*PY2M)</td>
<td></td>
</tr>
<tr>
<td>Low level of PC (−1 SD)</td>
<td>0.375**</td>
<td>0.241**</td>
<td>0.083</td>
<td>0.090**</td>
<td>0.173**</td>
</tr>
<tr>
<td>High level of PC (1 SD)</td>
<td>0.391**</td>
<td>0.237**</td>
<td>0.095</td>
<td>0.093**</td>
<td>0.183**</td>
</tr>
<tr>
<td>Difference</td>
<td>0.016**</td>
<td>−0.004</td>
<td>0.012</td>
<td>0.003</td>
<td>0.015*</td>
</tr>
</tbody>
</table>
Customer Participation and Project Performance

of customer participation on new product innovativeness (Fang, 2008) and the positive effects of technological learning on new product development outcomes (Ignatius et al., 2012). Although these findings are plentiful, there are few studies exploring the benefit of project complexity from a knowledge management perspective. This article’s findings about the moderating role of project complexity in strengthening the positive effects of customer participation on knowledge integration bridge a gap between project complexity and knowledge integration from a knowledge management perspective. Previous studies have revealed that customer participation brings many benefits to a new project team (Chang & Taylor, 2016), yet no studies have uncovered the positive association with knowledge-related processes. Finding a way to strengthen the beneficial effects of customer participation in a project has become a fast-growing topic in project management. The project management literature, however, reveals little about project-level strengthening characteristics, despite the argument that a project’s features can effectively increase the beneficial effects of customer participation (Fang, 2008). In light of the fact that project complexity requires the inclusion of multiple sources in a new project (Fang, 2008), and that the lead project member should play more attention to project-related knowledge and information (which is likely to act as a critical project feature that will strengthen access to various types of knowledge and information that promote knowledge integration and project performance). Therefore, the finding of this article provides an ideal foundation for future research testing the strengthening effects of project complexity on the impacts of other forms of knowledge and information sources. We expect that our examination into the project feature area will inspire further project complexity research in various contexts, which can help us capture a synthetic picture of project complexity in increasing the positive effects of multiple knowledge and information sources.

Finally, examination of project complexity reveals the limited conditions of knowledge integration’s mediating role in customer participation and project performance. The findings of this article indicate that knowledge integration’s mediating effects are stronger when project complexity is higher, but become weaker when project complexity is lower. These findings extend the existing studies that deal with customer characteristics only as influencing factors of new product development outcomes, thereby ignoring the joint effects of mediator (e.g., knowledge integration) and moderator (e.g., project complexity). The findings of this article guide us to challenge the approach adopted in previous studies and we propose that the mediating impacts of knowledge integration are moderated by project complexity. These moderating effects are not at all surprising as project complexity needs more inclusion, which creates more chances for interaction and benefits the exposure of novel linkage during co-creation processes (Milliken & Martins, 1996). Therefore, project characteristics should be considered as a critical moderator that offers limited conditions for the mediating effect of knowledge integration in the linkage between knowledge and information sources and project performance. Accordingly, the results of this research imply that future studies focusing on knowledge-related processes of project performance should adopt more precise ways to test the joint effects of knowledge source and project characteristics.

Managerial Implications

The findings of this article confirm that customer participation can promote knowledge integration, which in turn positively correlates with project performance. When developing a new project, the project leader should establish the procedure or mechanism to facilitate the customer involved in the project. During the process of solving problems, both sides can cultivate mutual behavioral norms and common symbols, which can promote the integration of knowledge and project performance. Simultaneously, firms should establish co-determination and feedback mechanisms to facilitate more knowledge and information lacking in the project team, which in turn promotes project performance. Furthermore, the enterprise should alert project teams to realizing the fact that encouraging customers to participate in the process of projects can catch customers’ needs, which can potentially benefit the project team and firm. This can improve customers’ acceptance and satisfaction with the project.

Additionally, this article found that project complexity moderates the relationship between customer participation and knowledge integration, along with the mediating role of knowledge integration on the relationship between customer participation and project performance. Specifically, when the level of project complexity is higher, the positive relationship between customer participation and knowledge integration, as well as the positive indirect effect of customer participation on project performance via knowledge integration, is stronger. When firms conduct a new project they should, in terms of the characteristics of the project, guide the customer to participate in the development of a new project. For example, firms should emphasize the importance of sharing knowledge to promote integration of knowledge under conditions of high-level project complexity.

Limitations

Our research also has some limitations, which future studies could address. First, we collected data from a single source, which may lead to common method variance, despite our efforts to ensure the quality of the questionnaire. In future studies, we should collect data from multiple sources or multi-wave sources to control the potential influence created by the common method variance.

Second, our research only considered knowledge integration as a mediator to interpreting the mediating effects of customer participation on project performance.
mechanism, but there may be other mediators between customer participation and project performance. For example, technological learning has been posited to be positively related to project performance (Ignatius et al., 2012) and the customer as important information and knowledge sources, which can encourage project members to adopt the learning behavior required to get more information and knowledge from customers (Chan et al., 2010). Therefore, we can conduct empirical research on considering other mediators to explain the mechanisms between customer and project performance.

References


Customer Participation and Project Performance


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