Customer involvement in the new process innovation: antecedents, mediation and performance

Yuan-Chieh Chang
Institute of Technology Management, National Tsing Hua University, Hsinchu, Taiwan

Wen-Hong Chiu
Department of Business Administration, Asia University, Taichung, Taiwan

Jian-Hang Wang
Department of Risk Management and Insurance, Feng Chia University, Taichung, Taiwan, and
Min-Jun Teng
China Jiliang University, Hangzhou, China

Abstract
Purpose – The paper proposes customer involvement can be considered an organization-level construct of knowledge creation in the new process development. Specifically, the paper evaluates three distinct organizational practices as knowledge antecedents – competitor orientation, social network and internal coordination – that can facilitate the adoption of customer involvement in the process innovation development.

Design/methodology/approach – The paper empirically tests this theory for 2,000 firms that are stratification sampled from a population of 33,844 Taiwanese firms, and a data set of 170 valid questionnaires is collected. The questionnaire was mainly modified from a Kim and Kim (2010) measure which was designed based on the 3rd edition of the Oslo Manual OECD/Eurostat 2005. The concept of customer involvement in new service development proposed by Alam (2002) was also applied to the questionnaire.

Findings – (1) The antecedents of customer involvement, which include competitor orientation, external social networks and internal coordination, function as a determinant to nourish customer involvement. (2) Customer involvement significantly positively mediates the relationship between knowledge antecedents and new process performance. (3) Customer involvement is a crucial knowledge creation for improving the new process innovation performance in manufacturing firms.

Originality/value – Two basic tenets of theory building serve as the foundation of the model in this paper. First, research on customer involvement is augmented by showing that customer involvement can emerge as a shared perception among organizational members that is distinct from individual-level involvement. Moreover, customer involvement in process innovation can help firms manage their knowledge and further enhance firm performance. Second, the knowledge management model provides a key lens through which researchers can take a process-oriented view that focuses on customer involvement as a unique capability that firms can develop in process innovation.

Keywords Customer involvement, Process innovation, Antecedents, Manufacturing firms

Paper type Research paper

1. Introduction
In term of process innovation, firms have developed specific process instruments and equipment to satisfy their in-house needs (Larger, 2010). Collaborating with and involving...
customers in process innovation have led to win-win situations in which firms have acquired
knowledge which they have then used to increase profitability, to respond quickly to the
market and to gain more flexibility in pursuing their R&D endeavors (Chaochotechuang et al.,
2019; Chesbrough and Schwartz, 2007). Firms interacting with customers not only provide
after-sales support but also enhance customer knowledge in order to better serve their target
markets (Anderson and Narus, 1995). Therefore, working with customers in process
innovation has the potential to create value for firms by satisfying customer needs, reducing
refunds and generating higher profits (Cui and Wu, 2017; Niehaves, 2010). In addition, from
the perspective of demand-led innovation strategy, customers desire an increasing range and
abundance of low-cost or efficient products, which can stimulate the development of process
innovation that relies on close customer involvement in manufacturing (Cox and Rigby, 2013;
Franke and Shah, 2003; Morrison et al., 2000; Urban and von Hippel, 1988). Therefore,
cooperating with customers in order to understand a given market is an important means to
incentivize R&D activities.

However, there are both practical and scholarly interests in investigating customer
involvement (Alajoutsijärvi et al., 2012; Cheung and To, 2011; Feng et al., 2010). Although it
has been recognized as a key success factor in new product development (von Hippel, 2005),
little research has been conducted on process innovation (Dey et al., 2019; Sjödin et al., 2020).
Furthermore, research focusing on the antecedents of customer involvement in relation to
process innovation has also received little attention (Antonelli and Fassio, 2016; Cui and Wu,
2017; Lager, 2010; Nguyen and Harrison, 2019). Previous studies on the determinants of
customer involvement tend to employ an end-user perspective in their analysis, such as that
of a buyer or consumer (Edvardsson et al., 2012; Henkel and Von Hippel, 2004; Nguyen and
Harrison, 2019; Rapp et al., 2012). This knowledge gap is understandable, given that the
concept of customer involvement remains relatively new in the field of management literature
(Cantù et al., 2015; Rich et al., 2010). More specifically, almost all previous research studies on
customer involvement have been conducted on new product or service development, in
addition to product innovation (Thakur and Workman, 2016). Practitioners have asserted
that customer involvement as co-creation of knowledge may be a method for firms to enhance
their process innovation in manufacturing (Al-Saidi et al., 2017; Nguyen and Harrison, 2019).
In other words, customer involvement has, up to now, been regarded as a crucial external
source of knowledge creation for process innovation, yet organizational knowledge contexts,
both internal and external, which facilitate customer knowledge co-creation and the firm’s
benefits derived from customer co-created knowledge, still remain unknown (Sedighi et al.,
2018). Therefore, with this in mind, this paper aims to bridge these gaps in research.

To extend the understanding of the role that customer involvement plays in process
innovation, this paper aims to integrate the concept of customer involvement with the
knowledge management model (Grant, 1996; Nonaka, 1994). Two basic tenets of the
knowledge management model are applied in this paper. First, customer involvement can
emerge as a shared perception among organizational members that is distinct from
individual-level involvement. Moreover, customer involvement in process innovation can
help firms manage their knowledge bases and further enhance firm performance. Second, the
knowledge management model provides a process-oriented view that focuses on customer
involvement as a unique capability during which time firms develop their process innovation.

To develop contributions, this paper uses the insights gained by examining how firms can
collectively share the perception that customers of an entire organization are involved as a
unified whole. Thus, this paper presents a model of customer involvement that mediates the
relationship between organizational knowledge antecedents and performance, while
proposing four research hypotheses. The paper empirically tests these hypotheses via
analysis carried out regarding 2,000 firms that were stratification sampled from a population
of 33,844 Taiwanese firms. A data set of 170 valid questionnaires was also collected. The
paper suggests that scholars and practitioners alike should recognize collective customer involvement as an important means of knowledge creation that has the potential to influence the results of the process innovation for manufacturing firms.

The structure of this paper is as follows. Section 2 reviews the relevant literature covering a range of topics from the antecedents to customer involvement and the effects of process innovation. Five research hypotheses are then proposed. Section 3 illustrates the questionnaire, the data collection and the data analysis deployed in the paper. Section 4 describes the results and hypothesis testing, and Section 5 offers discussions. Finally, conclusions and implications are provided in Section 6.

2. Theoretical model

2.1 Knowledge management model

The knowledge management model perspective posits that effectively managing knowledge is a key success factor in the value advantages of a given firm because the firm can be considered as a set of heterogeneous knowledge items that can be further enlarged, enriched and applied through the tacit and explicit knowledge held by individuals, groups and firms (Nonaka, 1994; Nonaka and Nishihara, 2018). Knowledge management is viewed as a process of building the coordination necessary for knowledge integration and creation (Grant, 1996; Vila et al., 2015), innovativeness and responsiveness (Adams and Graham, 2017). Firms can establish their knowledge base by identifying existing knowledge, finding it and leveraging it from external and internal environments. Firms can further involve or integrate existing knowledge to create and develop new content or to replace existing content with the aim of leveraging and creating enhanced value for themselves and their customers (Abubakar et al., 2019; Gebert et al., 2003). To optimize the value created in this process of establishing knowledge, coordination is a key managerial task which should successfully fortify the link between these knowledge bases and the firm’s activities.

Researchers have largely considered that individuals or groups forming collaborative, social and cognitive units can help create, share, amplify, enlarge and justify knowledge in an organization (Alavi and Leidner, 2001; Grant, 1996; Huarng and Mas-Tur, 2016; Nonaka, 1994). Despite being an appealing concept, the application of knowledge-based theory to customer relationship management (CRM) has also led to criticism (Garrido-Moreno and Padilla-Meléndez, 2011). Key criticism in this regard is the absence of an adequate understanding of how firms can manage successful knowledge resources to create value with customers (Garrido-Moreno and Padilla-Meléndez, 2011; Gebert et al., 2003). This paper seeks to address this criticism by proposing that one unique customer relationship-focused capability available to firms is cultivating an internal workforce that views itself as fulfilling the principle of collective involvement.

Furthermore, knowledge-based management recognizes that a firm’s behavior with respect to exploiting external and internal knowledge plays a critical role in generating valuable capabilities for the firm and its customers (Abubakar et al., 2019; Grigoriou and Rothaermel, 2017). Therefore, it is likely that the firm’s behavior and activities concerning the strategy contingently affect collective customer involvement on the basis of how effectively the firm’s knowledge and resources are orchestrated. To understand these managerial practices more clearly, this paper examines how directing progress toward the firm’s strategic goals augments the effects of organizational knowledge in creating collective customer involvement capabilities.

2.2 Customer involvement

Previous studies describe customer involvement at specific stages of a new service development process and then conceptually or empirically link such involvement to specific
innovation outcomes (Anning-Dorson, 2018; Brodie et al., 2011; Carbonell et al., 2009; Cui and Wu, 2017; Hollebeek et al., 2019; La Rocca et al., 2016; Menguc et al., 2014). The original research on customer involvement in the various stages of new service and product development has been conducted by Alam (2002), who investigated several aspects of user involvement in each of the ten sequential stages of a new service process. Alam (2002) did not explicitly link customer involvement at specific stages to any particular set of outcomes, but the Alam (2002) paper did report how frequently and intensely service firms involved customers at each process innovation stage. From the perspective of manager respondents, user involvement was especially important in terms of idea generation, service/process system design and service testing/pilot stages.

Alam (2002) provided valuable insights on how customers are involved in process innovation, in addition to creating the basis for hypothesizing how customer involvement at specific developmental stages influences innovation outcomes. Magnusson (2003) placed emphasis on the idea generation stage in an experiment that demonstrates how customers’ new service ideas can be more valuable than the ideas produced by professional service designers. The experiment showed that customers can generate innovation ideas that are potentially as (or more) beneficial to a firm as (or than) those of in-house professional developers, and the potential profitability of those ideas snowballs when customers are provided with the right amount of training and consultation regarding what is and what is not technically feasible. In terms of firm owners, the paper found that less closed innovation or innovation with customers is each more likely to recognize the importance of competitive intelligence and knowledge management by means of introducing process innovation with customers. This is consistent with the finding made by Guimaraes et al. (2019) which revealed that the firms with knowledge management and competitive intelligence with inputs from customers had more positive effect on innovation performance.

Customer-driven innovation refers to the process of collecting a certain category of information about users; customer-driven innovation addresses insights at both observable and more latent levels that are quite difficult to grasp (Anning-Dorson, 2018; Cui and Wu, 2017; Matthing et al., 2004). Magnusson (2003) found that customer involvement has led to ideas for new innovative and useful services and that it is heavily dependent upon how that involvement is managed. To facilitate proactive learning about customers, several findings stress the value of customer involvement in the development process and observations of customers in real-world action (Matthing et al., 2004). Kristensson et al. (2008) further proposed a conceptual framework involving the key strategies required to successfully involve customers in the co-creation of new technology-based services. Furthermore, user involvement not only provides useful information about users’ needs, but also increases the understanding of users’ values (Kujala, 2008). With this understanding, the value of customer involvement leads users in the early stages of the innovation process and increases when users bring their need and know-how into the innovation (von Hippel, 1976, 1977), which leads to products that provide value for customers (Cornelius and von Hippel, 1992). For example, in the case of customer involvement into the innovation process of the healthcare industry, nurse participation has implemented the process innovation of healthcare management system by understanding the design solution of a system that better serves the needs of the intended product users (Guimaraes et al., 2020).

As a result of such literature, this paper highlights the beneficial results associated with customer involvement in the idea generation and market testing stages of innovation development. Customer involvement can emerge as the firm’s knowledge and resources, and firms need to be able to differentiate between their collective customer involvement and ways of customer connections (Anning-Dorson, 2018; Kristensson et al., 2008). Despite the conceptual link between customer involvement and the pursuit of customer connections, prior studies on outcomes of customer involvement (e.g. Anning-Dorson, 2018; Carbonell
et al., 2009) have not fully considered the level of analysis issues relevant to developing a
higher-level construct for process innovation, or have not fully considered applying measures
that coordinate the theoretical definition of involvement with knowledge management model.
Moreover, a growing body of such literature emphasizes how customers can be involved to
such an extent in innovation development as to voice their opinions (Brodie et al., 2011;
Cui and Wu, 2017; Hollebeek et al., 2019; Lau, 2011; Menguc et al., 2014). Two types of
customers who expect to profit from using and experiencing a participating firm’s systems,
products or services are involved in this paper: firms and individuals. Thus, high-achieving
business customers and users are the main targets, and the customer involvement
perspective is considered a co-creation of process innovation.

In addition, the measurement of customer involvement clearly and precisely matches the
theoretical definition of the construct. Some scales used to measure group-level involvement
have been criticized as using items that contradict the idea of involvement with its antecedent
conditions, or that are not aligned with the conceptual definition of the involvement with
customers (Carbonell et al., 2009). This paper suggests that Alam’s (2002) conceptualization of
involvement is a more comprehensive description of firm’s objective, stages, intensity and
modes with users/ customers, and, in so doing, represents a more holistic view of the
construct of firm’s self as compared to other conceptualizations of involvement, or other
narrower evaluations of firm’s connection with customer’s role. Therefore, based on the
currently ongoing arguments, this paper builds upon Alam’s (2002) conceptualization of
involvement and defines customer involvement as the shared perceptions of a firm’s
customers that the customers of the firm are on a higher strata of the scale, using several
different modes of involvement. Therefore, customer involvement can be characterized as
possessing the purpose of generating ideas to be used for innovation or new services.

2.3 Competitor orientation as a key to discovering the needs for customers
A focus on customer involvement might play a key part in the strategy to create superior
customer value, but an effective strategy requires more than simply customer-centered
methods (O’Dwyer and Gilmore, 2019; Svendsen et al., 2011). Complete reliance on customer
orientation can lead to business strategies which are incomplete and that leave an
organization prone to a reactive posture – as opposed to a proactive disposition – when in a
situation of coping with competitors’ strategies (Day and Wensley, 1988; Han et al., 1998).
Peled and Dvir (2012) also argued that external competition and system complexity of
coordination in the project would encourage customer involvement to create more benefits for
performance. However, a disproportionate focus on a firm’s competitors is not desirable either
because exclusive attention paid to competition can lead to the neglect of customers’
exigencies (Deshpandé et al., 1993; Kristensson et al., 2008; Nakos et al., 2019). Therefore, Day
and Wensley (1988) propose that a balanced mix of customer and competitor orientation
should be a requirement for maintaining a firm’s competitive advantage in the marketplace,
an assertion which is consistent with Narver and Slater’s (1990) equal weighting of market
orientation’s core components.

Besides this point, it is well documented that there is a positive understanding regarding
customer involvement between the perceived level of technology novelty and the development
process (Cui and Wu, 2017; Gales and Mansour-Cole, 1995; Lin and Germain, 2004; Song and
Monotoya-Weiss, 2001). When the technological novelty of competitor orientation is high, firms
will attempt to understand development and its application from the perspective of potential
customers. Competitor orientation essentially centers on the following questions: (1) Who are
the competitors? (2) What technologies do they offer? (3) Do they represent an attractive
alternative from the perspective of target customers (Slater and Narver, 1994)? In general,
competitor orientation entails gathering intelligence concerning these three questions. The core
methodology typically consists of measuring a company directly against its target competitors (Day and Wensley, 1988; Kristensson et al., 2008). Competitor-oriented firms seek to identify their own strengths and weaknesses by integrating their operations with customers (Nakos et al., 2019). Such an approach often leads to helpful insights into their relative standing in the marketplace because a competitor orientation spurs a company to discover, understand and satisfy the expressed needs of customers, which can also lead to discovering, understanding and satisfying the latent needs of customers (Narver et al., 2004; Kristensson et al., 2008).

A business should practice forms of competitor orientation if it seeks to attract and retain customers. Thus, the challenge for businesses lies in identifying and satisfying the latent needs of customers. Competitor orientation requires that a company is able to formulate a number of intelligent questions and/or to carefully observe customer behavior that will later enable it to tailor a product or service that has value for the customer. The customer typically plays a largely passive role in such a process, merely answering questions or allowing observations. Proactive competitor orientation means that the customer participates as a collaborative partner, jointly co-creating value with the company. Although customers may collaborate with the company over time, opportunities are likely to occur in which they can share their experiences. The implication of this is that a competitor-oriented culture should facilitate customer involvement and innovation based on competitor-centered methods that are used to keep pace with or remain ahead of the rest of the field (Kristensson et al., 2008). The above discussion therefore suggests the following hypothesis.

H1. The competitor orientation of a firm is positively correlated with customer involvement.

2.4 External social network as a key to touching the heart of customers

Customer involvement in external social networks is important because customers achieve credibility in the eyes of their peers through their particular social networks, which means that their views have a significant influence on creating, shaping and disseminating innovation ideas through these same social networks. Moreover, these concepts are closely connected to trust because trust is defined as individual beliefs about peer reliability, competence and dependability (McAllister, 1995). Thus, trust occurs due to the effectiveness of external social networks, CRM and membership (Agostini et al., 2019; Kyriazis et al., 2012). Furthermore, external social networks function as efficiency consultation centers between the corporation and consumers (Houghton et al., 2009; Shareef et al., 2019), as well as promoting the social learning of adaptive responses (Hollebeek et al., 2019; Kraatz, 1998). Thus, when both parties trust one another, they will become more actively involved in intensive consultations on an array of topics, and equally, each can benefit from the diverse knowledge and potential news of the other (Carlson et al., 2018; Daft and Weick, 1984; Smith and Lohrake, 2008; Houghton et al., 2009; Wernerfelt, 1984). Therefore, the increasing popularity of external social networks confirms that customer involvement enables customers to share and understand the context in which products are used, which, in turn, triggers cognitions that help firms generate and further enhance ideas for innovation. Thus, the participants in external social networks have a positive influence on a variety of customers, while sharing their diverse roles fosters new ideas (Sigala, 2012).

Process innovation is performed in a project when all customers are presented. The concept of external social networks is useful for identifying, accessing and involving customers in innovation development (Pitta and Fowler, 2005; Sigala, 2012). Social tools might further accelerate customer involvement in innovation development based on the features of external social networks (Helfat, 2006; Hoyer et al., 2010; Kohler et al., 2009). Moreover, a different level of co-production with external customers involved in process innovation might provide a clearer profile for performance (Cheung and To, 2011). Close
social network interaction with external customers has resulted in more information gathered by firms engaging in customer involvement. These firms have not only gained an advantage in responding to challenges and opportunities but have also reduced the amount of time used during the R&D cycle (Cooper, 2011; Slater and Narver, 1995; Souder et al., 1998). Empirical studies also reveal that customers participate in some communities to contribute knowledge about existing products, to exchange experiences regarding the use of certain products or to communicate needs and preferences concerning products (Belz and Baumbach, 2010; Frasquet-Deltoro et and Lorenzo-Romero, 2019; Fuller et al., 2007). On this basis, the above discussion leads to the following hypotheses.

**H2.** The external social network of a firm is positively correlated with customer involvement.

### 2.5 Internal coordination as a key factor in listening to the feedback of customers

The paper proposes that certain internal coordination practices represent one of the organizational resources that may be used to create collective customer involvement. Taking a knowledge management view of firm-customer relationships, internal coordination of a firm can be considered in accordance with two dimensions: (1) those practices that focus on the socialization, externalization, combination and internalization of interaction and conversion of tacit knowledge and explicit knowledge which contribute to the emergence of new knowledge to meet the customers' expected outcomes (Nonaka and Nishihara, 2018), and (2) those that enhance the interaction of firms which are not passive parties that simply utilize existing knowledge in order to provide solutions to the customers, and that organizations and environments simultaneously influence knowledge creation (Nonaka and Nishihara, 2018). When both expectation-enhancing practices and internal coordination are high, the firm—customer relationship shifts away from a short-term view of knowledge-based exchange of customer as co-creator contributions and product values as rewards toward a long-term, open-ended relationship in which both firm and customers commit to, and invest in, one another's future growth and development (Vargo and Lusch, 2004). More specifically, internal coordination comprises of knowledge acquisition and assimilation as it reflects its absorptive capacity to its innovation performance (Chen and Chang, 2019; Guimaraes et al., 2017). In this balanced, mutual investment relationship, the internal coordination of a firm is expected to consider unit or organizational interests to be as important as the firm's core value for knowledge management and to fulfill whatever roles or assignments that are needed by the customer.

Throughout the process of innovation development of manufacturing firms, whether it is at the stage of prototyping, launching, testing or various business functions, firms must coordinate their efforts with one another on various tasks (Krishnan and Ulrich, 2001; Peterson et al., 2005). Internal coordination is thus an essential ability that transmits knowledge and skills among corporate organizations (Cohen and Levinthal, 1990; Grant, 1996; Teece et al., 1997). In practical terms, a corporation has a bundle of obstacles and challenges to overcome in the process of innovation (Luo et al., 2010). Thus, it is important that those firms have this ability as well as further accumulate mutual understanding across organizations to obtain a higher standard of performance (Larson and Gobeli, 1988; Parker, 2003; Calantone et al., 2002). Otherwise, insufficiently developed internal coordination will lead to less integration of knowledge and information gathered from the various business organizations (Dougherty, 1992; Henke et al., 1993; Hershock et al., 1994).

The concept of internal coordination involves coordinating and leveraging all available resources across departmental boundaries to create superior customer value (Narver and Slater, 1990; Silva et al., 2019). Internal coordination has become important in the sales and performance context because changing customer demands have led to all departments
becoming more involved in customer relationships (Flint and Mentzer, 2000; Zhao et al., 2020). Thus, the greater the integration among departments, the better the firm’s ability to adapt to current customer needs. Internal coordination allows for faster communication between departments and fewer chances for communication between departments (Inglis, 2008; Silva et al., 2019). When cross-functional employees work toward a common goal, problem-solving capabilities and reaction times are highly likely to be improved (Rapp et al., 2012). Besides, the current literature realizes that organizational factors of internal coordination are crucial in influencing the progress of innovation development, which comprises of the knowledge sharing, organization’s absorptive capacity and organization culture (Guimarães et al., 2017).

Furthermore, previous empirical studies reported a positive relationship between a firm’s development process and the degree of customer participation (Carlson et al., 2018; Martin and Horne, 1993). It has been argued that customer involvement is positively related to internal coordination and has a positive effect on the degree of innovation success. Working in physical proximity to internal employees allows informal networks and interactions to arise and become organized (Gajendran and Harrison, 2007). By increasing the spatial distance from their colleagues, outside employees might create an environment in which they are inadvertently ostracized from these same colleagues (Rapp et al., 2012). The less frequently the colleagues engage in face-to-face interactions with one another, the poorer the communication between telecommuters and other organization members will be. As a result of evolving technologies, many customers also expect immediate responses from their sales representatives. This type of constant and immediate correspondence may also prohibit employees from developing relationships with organizational colleagues. This paper summarizes the above argument with the following hypothesis:

\[ H3. \] The internal coordination of a firm is positively correlated with customer involvement.

2.6 Customer involvement and performance

One competitive advantage that had proved successful is empowering customers to share experiences with a firm (Hollebeek et al., 2019; Prahalad and Ramaswamy, 2004; Ramani and Kumar, 2008). From the perspective of transaction cost theory, consumer involvement in the design and R&D stage could reinforce the integration of the supply chain by building highly self-disciplined relationships and informal contractual relationships (Rosenzweig et al., 2003). Furthermore, firms can engage in customer involvement to reduce idea costs, to reduce time engaged in innovation, to decrease uncertainties in the environment and to meet user demands for co-operation (Dong and Sivakumar, 2017; Gales and Mansour-Cole, 1995; Leonard-Barton, 1995). Resource-based theory indicates that customer involvement can provide opportunities for customer-experience service patterns and further indicates suggestions to help ensure that customers are highly satisfied with the goods or services they receive (Lengnick-Hall et al., 2000). In addition, customer involvement can be considered an important operational resource and a form of investment that facilitates new product/service development (Kumar et al., 2019; Lengnick-Hall, 1996; Vargo and Lusch, 2004).

Moreover, prior empirical research suggests that firms invite customers to participate in the early and late stages of process innovation to ensure that service and product ideas are correct in the initial development phase and to evaluate the complete product and service delivery offering before the full rollout (Alam, 2002; Cui and Wu, 2017; Gales and Mansour-Cole, 1995; Kumar et al., 2019; Millson and Wilemon, 2002). Magnusson (2003) demonstrated that customer-generated new ideas have higher user value than those generated solely by internal product development staff. Customer involvement in idea generation improves product and service marketability by helping the firm to better anticipate and respond to both expressed and latent customer needs (Lau, 2011; Tan and Tracey, 2007). Bowers (1989) also argued that customer involvement is helpful for better understanding of how to satisfy
customer needs at the design stage and for creating the most effective promotional messages at the development stage. Besides, knowledge gained due to customer involvement will indicate an awareness of external threats and new changes in customers’ needs and so will be more innovative in business process reengineering and will perform better (Guimaraes and Brandon, 2016; Taherparvar et al., 2014). This is consistent with Guimaraes and Brandon’s (2016) finding that the banking sector has introduced customer involvement to understand customer demand for the purpose of improving business process reengineering and innovation development. Similarly, Edvarsson and Olsson (1996) found that customer involvement in concept and process development leads to value-added service offers which involve “customer-friendly” service processes. Clearly, customer contributions to the development of content and delivery mechanisms for a new service help differentiate a firm’s products, make the offer sufficiently simple to be readily understood by the target market and contribute to a product’s innovativeness and product and service delivery quality (Cui and Wu, 2017; Edvardsson et al., 2012). Therefore, the following hypothesis is proposed:

**H4.** Customer involvement is positively correlated with process innovation performance.

This paper argues that customer involvement mediates the relationship between the three antecedents (competitor orientation, the external social network and internal coordination) and subsequent innovation performance. Three antecedents influence innovation performance through customer involvement. Prior research has argued that the mediating effect of contextual customer involvement occurs because the features of the antecedents themselves can create and amplify internal tensions if they do not contribute to the simultaneous capabilities for customer decisions (Cheung and To, 2011). A greater amount of implementations of the use of knowledge interfaces with customers can help firms have a greater opportunity to exploit knowledge about competitors, markets as well as experiences of business innovation (Garcia-Murillo and Annabi, 2002; Guimaraes and Brandon, 2016; Taherparvar et al., 2014). Therefore, how to collect information from customer involvement to facilitate business process reengineering and innovation development is one of the most important goals for firms. In other words, customer involvement mediates the relationship between antecedents – captured by the interaction of competitor orientation, external social network and internal coordination – and performance. This paper depicted the research framework and the corresponding hypotheses in Figure 1.

### 3. Methods

**3.1 Questionnaire development**

The questionnaire was mainly modified from a Kim and Kim’s (2010) measurement, which was designed based on the design of the 3rd edition of the Oslo Manual (OECD/Eurostat, 2005). The concept of customer involvement in new service development proposed by [Add relevant content here]

**Figure 1.** Antecedents, customer involvement and performance in the process innovation.
Alam (2002) was also applied to the questionnaire. The questionnaire was centered on five constructs, which included three items of competitor orientation, six items of external social network, three items of internal coordination, two items of customer involvement and four items of performance. Table 1 shows all the conceptions and measurements for the dimension of customer involvement in process innovation. The five constructs are measured by a six-point Likert scale (1 = strongly disagree; 6 = strongly agree). Appendix also shows the questionnaire for all the variables and items.

### 3.2 Data collection and response rates

The paper utilized questionnaire development to achieve a holistic understanding of firms’ behavior with customers when engaging in process innovation. Against this backdrop, this paper has three objectives: (1) to investigate the effects of customer involvement on performance, (2) to examine the effects of the antecedents on customer involvement and (3) to explore the mediating effects of the stage of the development process on the relationships among competitor orientation, external social networks, internal coordination customer research constructs.

<table>
<thead>
<tr>
<th>Research constructs</th>
<th>Items</th>
<th>References</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitor orientation (CO)</td>
<td>(1) Competitive advantages of the firm</td>
<td>Day and Wensley (1988), Han et al. (1998)</td>
<td>Six-point Likert scale</td>
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<td></td>
<td>(2) Innovation capabilities of the firm</td>
<td>Kristensson et al. (2008)</td>
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<td></td>
<td>(3) Competitive advantages of the projects</td>
<td>Slater and Narver (1994)</td>
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<tr>
<td>External social network (ESN)</td>
<td>(1) Relationships with competitors</td>
<td>Daft and Weick (1984), Houghton et al. (2009), Kim and Kim (2010)</td>
<td>Six-point Likert scale</td>
</tr>
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<td></td>
<td>(2) Relationships with suppliers</td>
<td>Houghton et al. (2009), Kim and Kim (2010), Smith and Lohrake (2008)</td>
<td></td>
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<td></td>
<td>(4) Relationships with different industry partners</td>
<td>Houghton et al. (2009), Kim and Kim (2010), Smith and Lohrake (2008)</td>
<td></td>
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<td></td>
<td>(6) Relationships with government or international institute or research institute</td>
<td>Kim and Kim (2010)</td>
<td></td>
</tr>
<tr>
<td>Internal coordination (IC)</td>
<td>(1) Feedback from colleagues</td>
<td>Rapp et al. (2012)</td>
<td>Six-point Likert scale</td>
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<tr>
<td></td>
<td>(2) Sharing partner</td>
<td>Kim and Kim (2010)</td>
<td></td>
</tr>
<tr>
<td>Customer involvement (CI)</td>
<td>(1) Assistance from clients or customers</td>
<td>Alam (2002), Magnusson (2003), Matthing et al. (2004)</td>
<td>Six-point Likert scale</td>
</tr>
<tr>
<td></td>
<td>(2) Technical support from clients or customers</td>
<td>Alam (2002), Magnusson (2003), Matthing et al. (2004)</td>
<td></td>
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<td></td>
<td>(2) Cost reduction</td>
<td>Tan and Tracey (2007)</td>
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</table>

Table 1. The variables of customer involvement in process innovation.
involvement and performance. To achieve these objectives, the paper developed four steps to collect the data. First, the questionnaire was mailed to the 2,000 sampled firms using the contact information provided by the Department of Commerce of the Ministry of Economic Affairs of Taiwan to ask who introduced innovations during the period 2008–2010. Second, 455 firms responded that they had introduced innovation(s) during this three-year period. Third, this paper mailed the questionnaire regarding innovation development to those 445 firms and obtained 202 questionnaires during a series of phone calls and mailed reminders. Finally, after screening the questionnaires, there were 170 valid questionnaires, but only 108 firms produced process innovations over the 2008–2010 period; hence, the effective response rate was 24%.

3.3 Data analysis
Since all the scales in this paper were self-reported and measured with Likert scales, this paper utilizes certain remedies suggested in previous literature (Podsakoff et al., 2003). First, this paper adapted dyad questionnaires, which obtain measurements of variables from different resources. The scores related to external social networks, internal coordination and customer involvement were gathered from subordinates, whereas information regarding competitor orientation and performance indicators was taken from superiors. Second, on the front page of each questionnaire, this paper informs subjects that there are no right or wrong answers and asks them to answer as honestly as possible. In addition, there is a note attached to the covers of the questionnaires that asks respondents to seal the questionnaires with the adhesive on the back of the questionnaires after they have finished answering. This procedure was intended to reduce respondents’ “evaluation apprehension and make them less likely to edit the responses to the more socially desirable” (Chang et al., 2010). Third, during editing preparation process, each name in the construction is hidden (Peng et al., 2006). Because two of the variables in this research are related to process innovation performance, this procedure could have lowered respondents’ fear, inflation and sense-making. Fourth, this paper applies different scales in each construct to reduce methodological biases caused by commonalities in scale endpoints and anchor effects (Chang et al., 2010). Finally, reversed items and careful construction of items are utilized. The task of keeping items simple, precise and focused was followed during the translation process.

After the data were obtained and stored, a factor analysis of the variables of all the dimensions was conducted. To realize whether the data were appropriate to conduct a factor analysis, the paper examined and assessed the data using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The KMO measure of sampling adequacy was 0.763. According to Kaiser (1974), the variable is appropriate for the effectiveness of conducting factor analysis. The paper examined variables drawn from five constructs using the factor analysis method. Then following this, an analysis of internal consistency was conducted to obtain the reliability coefficient (Cronbach’s $\alpha$) for each extracted factor. Eighteen items were investigated and were processed in the factor analysis.

Factor 1 is condensed from three items related to competitor orientation in industry. Because the items included in the factor match the theoretical dimension of competitive advantage, it denominates the “competitor orientation” factor. The explanatory variance of the factor reached 58%, while the Cronbach’s alpha of this factor was 0.71, which meets the minimum standard of 0.5 suggested by Nunnally (1978). Factor 2 includes six items related to the external social network in process innovation. The observable items are mostly derived from the concept of cooperation with customers; therefore, it denominates the “external social network supports” factor. Moreover, the cumulative percentage of explanatory variance reached 64%. The Cronbach’s alpha of this factor was 0.90, which exceeds the standard suggested by Nunnally (1978). Factor 3 identified three items, including coordination with internal departments and business units in companies when they are conducting process innovation. The seven observable items are consistent with the theoretical dimension of internal coordination; thus,
the factor denominates the “internal coordination” factor. The cumulative percentage of explanatory variance reached 75%. Additionally, the Cronbach’s alpha of this factor was 0.73, which exceeds the standard suggested by Nunnally (1978).

Factor 4 was derived from the theoretical dimension of customer involvement in innovation. From an empirical data set perspective, customer involvement orientation includes two items, namely customer characteristics and customer capabilities, which are therefore represented by the “customer involvement” factor. The cumulative percentage of explanatory variance reached 90%. Additionally, the Cronbach’s alpha of this factor was 0.9. Ultimately, Factor 5 identified four items, which include the performance of application frequency, decreased costs, increased technological abilities and increased competitive advantage. Because the four observable variables were a more obvious motivation for process innovation, they were represented by a “performance in process innovation” factor. Moreover, the cumulative percentage of explanatory variance reached 75%. Additionally, the Cronbach’s alpha of this factor was 0.74, which exceeds the minimum standard of 0.5 suggested by Nunnally (1978).

4. Results
4.1 Demographics of the respondents
A total of 170 effective questionnaires were received. Through the analysis of descriptive statistics, the characteristics of these 170 firms are summarized in Table 2. Electrical machine and metal industry had the highest rate (27.6%) among the samples, while most of the sample firms

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Classification</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>Electronics and information technology</td>
<td>27</td>
<td>15.9</td>
</tr>
<tr>
<td></td>
<td>Electrical machine and metal</td>
<td>47</td>
<td>27.6</td>
</tr>
<tr>
<td></td>
<td>Chemistry and consumer</td>
<td>40</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>Biotechnology and medicine</td>
<td>7</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>49</td>
<td>28.8</td>
</tr>
<tr>
<td>Ownership</td>
<td>Independent</td>
<td>125</td>
<td>73.5</td>
</tr>
<tr>
<td></td>
<td>Domestic</td>
<td>35</td>
<td>20.6</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>10</td>
<td>5.9</td>
</tr>
<tr>
<td>Employment</td>
<td>Below 50</td>
<td>73</td>
<td>42.9</td>
</tr>
<tr>
<td></td>
<td>51–100</td>
<td>25</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td>101–300</td>
<td>22</td>
<td>12.9</td>
</tr>
<tr>
<td></td>
<td>301–500</td>
<td>12</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Above 501</td>
<td>38</td>
<td>22.4</td>
</tr>
<tr>
<td>R&amp;D intensity</td>
<td>Below 1%</td>
<td>37</td>
<td>21.8</td>
</tr>
<tr>
<td></td>
<td>2–3%</td>
<td>47</td>
<td>27.6</td>
</tr>
<tr>
<td></td>
<td>4–5%</td>
<td>40</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>6–10%</td>
<td>23</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>Above 11%</td>
<td>23</td>
<td>13.5</td>
</tr>
<tr>
<td>Export ratio</td>
<td>Below 10%</td>
<td>74</td>
<td>43.5</td>
</tr>
<tr>
<td></td>
<td>11–30%</td>
<td>26</td>
<td>15.3</td>
</tr>
<tr>
<td></td>
<td>31–50%</td>
<td>15</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>51–70%</td>
<td>10</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Above 71%</td>
<td>45</td>
<td>26.5</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>Below 10%</td>
<td>72</td>
<td>42.4</td>
</tr>
<tr>
<td></td>
<td>10–20%</td>
<td>32</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>20–30%</td>
<td>23</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>30–40%</td>
<td>9</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>Above 40%</td>
<td>34</td>
<td>20.0</td>
</tr>
</tbody>
</table>

**Table 2.**  
Characteristics of the samples (N = 170)
were independently owned (73.5%). Nearly 60% of the firms had fewer than 100 employees. Moreover, 27% of the firms had an R&D intensity (total R&D expenditure over total sales) of over 5%. Nearly 60% of the firms had export ratios below 30%. Finally, 25.3% of the firms had more than 30% innovativeness, calculated as total sales of innovation output in the last five years over total sales in this year. Among these 170 firms, 108 were engaged in at least one innovation project. In addition, descriptive statistics (means, standard deviations and correlations) for all the constructs are presented in Table 3. Competition orientation, external social network and internal coordination were positively correlated in a significantly positive manner with customer involvement. Furthermore, performance had a strong and positive correlation with competition orientation, external social network, internal coordination and customer involvement, showing that those four constructs can indeed lead to performance. More importantly, the findings indicated that the antecedents of competition orientation, external social network and their internal coordination are positively related to customer involvement; moreover, customer involvement is positively related to performance. The subsequent analysis in the subsection verified the complexity of this relationship mediated by customer involvement.

4.2 Tests of hypotheses
This paper tested the hypotheses using ordinary least square (OLS) regression. Hypothesis 1 predicted that competition orientation would be positively related to customer involvement. As depicted in Table 4, the coefficient for competition orientation in Model 2 is significantly

Table 3. Means, standard deviations and correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Competitor orientation</th>
<th>(2) External social network</th>
<th>(3) Internal coordination</th>
<th>(4) Customer involvement</th>
<th>(5) Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(1) Competitor orientation</td>
<td>10.82</td>
<td>2.70</td>
<td>0.197*</td>
<td>0.160</td>
<td>0.693**</td>
</tr>
<tr>
<td>(2) External social network</td>
<td>16.31</td>
<td>7.84</td>
<td>0.301**</td>
<td>0.446**</td>
<td>0.441**</td>
</tr>
<tr>
<td>(3) Internal coordination</td>
<td>13.06</td>
<td>7.29</td>
<td>0.283**</td>
<td>0.427**</td>
<td>0.454**</td>
</tr>
<tr>
<td>(4) Customer involvement</td>
<td>10.54</td>
<td>9.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Performance</td>
<td>12.18</td>
<td>4.57</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note(s): $N = 108$; $^* p < 0.05$; $^{**} p < 0.01$

Table 4. Results of regression analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1 customer involvement</th>
<th>Model 2 customer involvement</th>
<th>Model 3 performance</th>
<th>Model 4 performance</th>
<th>Model 5 performance</th>
<th>Model 6 performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>$-0.166^+$</td>
<td>$-0.131$</td>
<td>$-0.004$</td>
<td>$-0.004$</td>
<td>$-0.005$</td>
<td>$-0.004$</td>
</tr>
<tr>
<td>Ownership</td>
<td>$-0.093$</td>
<td>$-0.063$</td>
<td>$-0.007$</td>
<td>$-0.009$</td>
<td>$-0.005$</td>
<td>$-0.005$</td>
</tr>
<tr>
<td>Employee</td>
<td>$0.243^*$</td>
<td>$0.091$</td>
<td>$0.036$</td>
<td>$0.035$</td>
<td>$0.028$</td>
<td>$0.024$</td>
</tr>
<tr>
<td>Competitor orientation</td>
<td></td>
<td>$0.202^*$</td>
<td></td>
<td></td>
<td>$0.021$</td>
<td></td>
</tr>
<tr>
<td>External social network</td>
<td></td>
<td></td>
<td>$0.216^+$</td>
<td></td>
<td></td>
<td>$0.043$</td>
</tr>
<tr>
<td>Internal coordination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0.084$</td>
</tr>
<tr>
<td>Customer involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>$0.228^*$</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Ownership</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Employee</td>
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<td></td>
</tr>
<tr>
<td>Competitor orientation</td>
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<td></td>
<td></td>
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<tr>
<td>External social network</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Internal coordination</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta R^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Adjusted $R^2$</td>
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</tr>
<tr>
<td>ANOVA $F$</td>
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<td></td>
</tr>
</tbody>
</table>

Note(s): For all models, $N = 108$; $^+ p \leq 0.10$; $^{*} p \leq 0.05$; $^{**} p \leq 0.001$
positive ($\beta = 0.202, p < 0.05$), thus supporting Hypothesis 1. Moreover, Hypothesis 2 predicted that external social networks would be positively correlated with customer involvement. As shown in Model 2, this prediction is also partially supported ($\beta = 0.216, p < 0.1$). Hypothesis 3 predicted that internal coordination would be positively correlated with customer involvement. As depicted in Table 4, the coefficient for internal coordination in Model 2 was significantly positive ($\beta = 0.228, p < 0.05$), thus supporting Hypothesis 3.

Furthermore, Hypothesis 4 predicted that customer involvement would be positively related to performance. Table 4 shows that the coefficient for customer involvement in Model 3 was significantly positive ($\beta = 0.860, p < 0.001$), thus supporting Hypothesis 4. Besides, this paper predicted that customer involvement would mediate the relationship between customer involvement antecedents and performance. A mediator variable represents an intervening variable or, to state the term differently, a mechanism through which an independent variable is able to influence a dependent variable (Baron and Kenny, 1986). Analyzing the mediation involved three steps (Baron and Kenny, 1986; MacKinnon and Dwyer, 1993). The first step was to establish that the independent variable (customer involvement antecedents) influences the mediator (customer involvement). This step was supported in Model 2 shown above and demonstrated in Hypotheses 1–3. The second step was to establish that the mediator (customer involvement) influences the dependent variable (performance). This step was supported in Model 3 and demonstrated in Hypothesis 4. Finally, it is crucial to show that the mediating variable (customer involvement) influences the dependent variable, with the independent variable (customer involvement antecedents) controlled. In this final step, if the effect of the antecedents on performance is no longer significant when the mediator is factored into the model, full mediation is indicated (Aldwin, 1994; Baron and Kenny, 1986). As shown in Models 4, 5 and 6 of Table 4, the coefficients for customer involvement are correlated in a significantly positive manner with performance, indicating a main effect of customer involvement on performance ($\beta = 0.864, p < 0.001; \beta = 0.584, p < 0.001; \beta = 0.826, p < 0.001$), thus supporting the full mediation that proposed that customer involvement would mediate the relationship between customer involvement antecedents and performance.

Furthermore, none of the above models were significantly influenced by any of the following firm characteristics: industry, ownership or employee. To verify our findings further, this paper discusses these findings in the next section.

5. Discussions
This paper advances the understanding of how process innovation in manufacturing firms is implemented by developing the antecedents-customer involvement-performance construct. In so doing, this paper integrates the concepts of involvement and the knowledge management model to explain why and how these novel constructs create value for a firm. As summarized in the framework of Figure 1, a key contributor is a detailed conceptual model that illustrates how the firm can create and enhance customer involvement to ultimately raise the performance of a firm. Furthermore, this paper reveals that when a firm (1) is more competitor-oriented, (2) further extends its social network in the external environment and (3) implements high internal coordination, it maximizes its collective customer involvement, which leads to the firm’s improved performance.

In process innovation regarding manufacturing firms, one important component of both innovation and innovation-related activities of a firm is found largely in helping customers to use its products in a better manner and to further assist them in the improvement of their own products or processes (Lager, 2010; Nguyen and Harrison, 2019). Therefore, cooperation with customers and customer involvement in process innovation has long since identified this area of development as one of great industrial importance in manufacturing. Indeed, this paper has conducted an integrated approach to understanding customer-involvement antecedents
in process innovation in manufacturing and their effects on performance success. We verified the significant influence that customer involvement exerts on the relationship between the features of the customer involvement antecedents that encourage their performance, and those findings raised important theoretical and practical issues for discussion.

First, the findings suggest that the antecedents of customer involvement, which include competitor orientation, external social networks and internal coordination, function as a determinant in nourishing customer involvement. This paper provides insights into how competitor orientation is positively correlated with consumer involvement when firms are faced with operational challenges. Nonaka and Nishihara (2018) explicitly described a firm’s knowledge and capabilities as combined assets that may include its management skills, organizational process and leadership. Applying this definition, the concept of competitor orientation includes the evaluation of the weaknesses and strengths of the competition by a firm and the leader who embraces the process of analyzing competitor information. Thus, when a firm broadly implements these competition characteristics to enhance its value of experienced meaningfulness of organizational knowledge, the firm collectively senses that its work has an obligation to value customer needs, actions of competitors and the change of technology in markets, which generates a shared perception of psychological meaningfulness among the involved customers and collectively fulfills their expectations and provides their interactions. When a firm and their leader perceive that their roles and others’ roles in the market provide them with competition, opportunities to utilize a variety of capabilities and management to find, locate, gather and place appropriate internal and external stakeholders in a timely evaluation arise. In this sense, they are more likely to connect and relate customers and employees as a shared and involvement context, thus promoting the creation of new knowledge (Nonaka and Nishihara, 2018).

Moreover, one of the antecedents, competitor orientation, positively impacted on customer involvement. This finding supports the notion that competitor orientation involves a company understanding and satisfying the expressed needs of customers and that it involves discovering, understanding and satisfying the latent needs of customers (O’Dwyer and Gilmore, 2019; Kristensson et al., 2008). This finding is also consistent with the argument made by Svendsen et al. (2011), who argued that competitor orientation positively affects customer involvement. Moreover, Svendsen et al. (2011) also suggested that competitor orientation was conducive to facilitating both technical and administrative innovations when the level of technological turbulence in the business environment is relatively high. This paper suggests that the customer involvement antecedents are those that provide a clearly defined approach for process innovations to enhance the profile of customer involvement.

Second, the social concept of external social networks is one of the antecedents that persuade customer involvement to engage simultaneously in performance activities. The results of employing external social networks and internal coordination, which affect customer involvement, were frequently mentioned in previous studies (e.g. Bhimani et al., 2019; Pitta and Fowler, 2005; Rapp et al., 2012; Roberts et al., 2016, Sigala, 2012). This paper proposes that social tools include virtual tools that allow manufacturers to become involved with customers of their choice. One particularly relevant example is that IT integration appeared to improve the ability of sample manufacturers to request their customers to provide useful information on product design. Moreover, due to the continued social relationships and deeper understanding of a company’s performance, customers might have a greater ability to suggest relevant information which could be incorporated into the design of new or existing products (Athaide et al., 2019; Cui and Wu, 2016; da Silveira, 2011; Palacios-Marqués et al., 2015). In addition, similar explanations are illustrated in the following quote:

... We generalized the customer-invited idea of different shapes for different modes into a new line of add-on technologies to its processing machines, to better adapt to the special modes of the wide
range of input materials processed by its customers. Under a solid tacit agreement with our customers, our corporation had produced a machine that the consumers had modified, and allowed customers to be involved in their process innovation. Besides, our top manager empowered and encouraged the staff to participate in the process innovation project (Corporation A, Manager of Sales Division, Mr. Chiang).

...We had long-term partners to play the critical roles in transferring potential commercial ideas and suggestions to the industrial sector. ...we’ve known each other for more than 11 years. To integrate the application with current plastic products for vehicle engineering, we also recruited or consulted with external programmers from customers that have a wide selection of products and a high standard of quality control (Corporation B, President, Mr. Huang).

Third, the internal coordination is aided by antecedents that persuade customer involvement to engage simultaneously in performance activities. The paper suggests that the use of resource practices of a firm characterize a balanced, mutual investment firm–customer relationship that encourages collective customer involvement by fostering benefits, safety of value co-creation as well as the other conditions necessary for involvement. Therefore, while firms are encouraged to manage internal coordination and to further involve customers to co-create, they should also ensure that these activities are beneficial for the customers that perform them. More specifically, formal performance appraisals and merit-based compensation provide clarity and increase consistency regarding performance expectations firms have for its customers (Frasquet-Deltoro and Lorenzo-Romero, 2019).

Fourth, customer involvement positively influences innovation performance in manufacturing. Successful process innovation in manufacturing can be aligned and efficient in response to customer involvement, while simultaneously being adaptive to commercial performance. The same concept has been discussed in user innovation studies, which contributes to extending the existing model of innovation to a more dynamic setting (Gambardella et al., 2017; Raasch et al., 2010). In this paper, process innovation in manufacturing can generate a context of customer involvement, integrating external and internal information to make resources further shape performance in innovations. More importantly, our results indicate that achieving customer involvement in process innovation stimulates significant performance. This view supports the notion that developing a customer involvement context such as concurrent functionality in a social- and environment-based strategy is critical to creating co-worker synergies and improved performance with regards to innovations (Cui and Wu, 2016; Edvardsson and Enquist, 2008; Sigala, 2012). Alternatively, this paper argues that customer involvement creates a co-worker strategy in process innovation that complements new service/product development and further benefits performance level in terms of manufacturing. In addition, several authentic cases also support this result, as is shown in the following:

...Those process innovations were adopted by consumers and suppliers since they were expected to possibly enhance the economic feasibility of organization structure in order to lead outcomes to be commercially applicable. ...we had increased efficiency by about 40% and had decreased 80% of financial costs already (Corporation C, Manager of R&D division, Mr. Lin).

Finally, customer involvement antecedents are important in enhancing customer involvement. However, these antecedents are only necessary conditions to a firm’s performance, but customer involvement is sufficient factor to improve firm performance. This finding is in line with da Silveira (2011), who contended that customer involvement mediates the relationship between organizational context and a firm’s performance. Moreover, there are numerous objective measurements available to evaluate performance in process innovation. Indeed, Edvardsson et al. (2006) claim that customer involvement yields long-term payouts rather than short-term maximization of profits. Svendsen et al. (2011) also contend that customer involvement studies should consider multiple performance
dimensions by considering that process innovations can be scattered across a variety of
disciplinary fields and thus difficult to regulate under the same performance criteria.

6. Conclusion
This paper integrates the currents in the literature of this field from the perspective of
customer involvement and knowledge-based management. On the one hand, this paper
contributes to an understanding of the customer involvement perspective in three ways, each
involving theoretical contributions. First, the paper extends involvement to the firm level and
addresses key conceptual practices in investigating customer involvement. Second, this
paper establishes three knowledge-based management models representing the firm-level
antecedents affecting collective customer involvement in manufacturing firms. Third, this
paper highlights customer involvement as a key mechanism by which a critical firm
knowledge resource (competitor oriented, extant social networks and internal coordination)
influences firm performance.

On the other hand, this paper also contributes to the deepening of a knowledge-based
management perspective in two ways, each with theoretical contributions. First, this paper
develops customer involvement as a core capability that is fostered by the knowledge
management model and generates firm value, as indicated by the improvement of firm
performance. Second, the three antecedents represent the components of a firm’s unique
knowledge-based portfolio.

The results reveal that the method by which customer involvement can enhance firm
performance in process innovation is by creating knowledge-based management of a wide
interaction with the external social networks, internal coordination and competitor
orientation of the firm. This finding highlights the need for manufacturing in process
innovation to manage knowledge resources by means of interactions with the external
environment, the internal environment and competitor-oriented capabilities in order to
enhance customer involvement and improve performance. By proposing a knowledge-based
management perspective in relation firm activities, this paper considers the fact that
competitor-oriented interaction with external social networks and internal coordination is not
something that occurs automatically without enforcement and management; instead,
deliberate management of these knowledge resources must emerge to enhance customer
involvement.

Besides, in terms of practical implications, the paper reveals that one way in which firm
managers can enhance the performance of their firms is by creating a widely shared
perception that organizational members and customers are both involved in one unified
whole. This finding highlights the need for firms to manage the development of their internal
capabilities in order to enhance customer involvement at the firm level with the aim of gaining
a competitive advantage. Customer involvement is inherently multifaceted. As such,
managers of firms must utilize multiple endeavors at the firm level rather than relying on a
single practice in order to maximize both their collective level of customer involvement and
their performance benefits in process innovation. First, tasks and tools held by the internal
coordination of firm may be redesigned to provide organizations with more feedback and
greater autonomy, identity, variety and significance regarding their tasks. Second, various
levels of involvement may be encouraged to invite customers to co-create, whilst firms design
a user-friendly co-creation platform for coordinating the formal performance appraisals of all
members of a firm with compensation, along with other similar evaluations such as high
performers reward to those for outstanding effort and feedback regarding areas for
improvement for lower performers. Third, top managers play an important role in the
execution of their firm’s strategies and should couple the creation of an inspiring strategy
with steps that ensure activities pursued by the workforce with customers are focused on
achieving the objectives they have set forth. By combining these organizational knowledge
resources with a focus on strategic objectives critical to it, a firm should assist leaders to maximize collective employee engagement, which, in turn, increases the firm’s potential for growth and survival in an increasingly competitive environment.

The findings of this research offer insights into relationships between various parties in particular types of involvement, such as external partners and internal employees. From the point of view of managerial recommendations, this paper can guide R&D managers and marketing executives in their search for process innovation. First, customer involvement is not an equally appropriate approach for everyone. For example, if the firm’s behavior regarding competitor orientation is built on developing new products, services or innovation projects from new process based on deep customer insights, a customer involvement approach should be considered. In order to succeed, a truly proactive competitor orientation organization is required. Second, customer involvement potentially offers various important benefits regarding external social network. Managers should decide carefully as to what objectives they seek, and work accordingly. Third, the techniques are the means by which customer information and knowledge are created. To achieve the previously stated objectives, the working methods used should be designed to facilitate customer knowledge development. Finally, a customer involvement approach integrates market research and R&D. Consequently, different knowledge and skills are needed to collect, interpret and learn from customer knowledge. R&D operation should be developed to a multi-functional site including marketers, engineers, behaviorists and other relevant parties.

Regarding policies implications, this paper empirically contributes to the understanding of the types of external social networks and internal coordination that are needed to increase the level of customer involvement. Moreover, managers who plan to adopt customer involvement should consider the type of competitor orientation they are seeking. Second, the strategic focus of a firm should not be on standardized ways of involvement with customers or different ways of customer involvement offerings, but on how the firm can create maximum value as well as knowledge for its customers from its resources. Based on a knowledge-based approach, open interaction and exchange of information between collaborating customers and firms are critical factors for success in the process innovation such as mass customization and business-to-business marketing.

This paper verifies that the contextual customer involvement in process innovation is influenced by features of competitor orientation, external social networks and internal coordination; we would not be so prescriptive as to expect the effects to be significant across the industries in a nationwide context. More specifically, the effect of contextual ambidexterity might be distinguished by the national characteristics and differences between industries. There is, however, little evidence regarding this point, and it would be useful for future research to verify whether there are industrial characteristics or boundary conditions regarding the concept of customer involvement in process innovation.

While this paper provides several contributions to this field of research, we note that it is not without limitations. One limitation is that much of the research design is cross-sectional in nature, and thus any inferences regarding causality in our model rely largely on a theoretical rather than an empirical foundation. Future research using longitudinal designs would enable a more thorough test of these causal relationships. This paper is unsure whether customer involvement is subject to similar dynamism, and recognizes that the question could also be addressed using a longitudinal approach focused at the firm level of analysis. Besides, a second limitation of this paper is that we focus on relationships at only one level of analysis. While such an approach is not uncommon for a paper that introduces a new construct to the literature, future research should examine customer involvement from a more multilevel perspective. A third limitation of this paper relates to the generalizability of the relationship between the constructs of framework, while equally the underlying theoretical connections between them justifies the use of measures collected from the same individual, as no person
other than the manager is in a better position to make these judgments. The theoretical connection between these constructs is founded upon the firms’ collective perception of each organizational resource and how those resources jointly influence the level of customer involvement. Finally, the use of objective measures of firm performance also alleviates some concerns associated with common-source bias. Further empirical research is needed to investigate the critical success factors of proves innovation with customer involvement. Besides this, the issues of how to organize customer involvement in process innovation needs to be further explored.

References


von Hippel, E. (2005), *Democratizing Innovation*, MIT, Cambridge, MA.


**Further reading**

### Appendix

<table>
<thead>
<tr>
<th>Research conceptions</th>
<th>Measurements</th>
</tr>
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</table>
| Competitor orientation (CO) | (1) Competitive advantages of the firm  
Your company has a competitive advantage in product or service performance  
(2) Innovation capabilities of the firm  
Your company has a competitive advantage in innovation capabilities  
(3) Competitive advantages of the projects  
The innovation projects developed by your company have a competitive advantage compared with those developed by other companies or competitors |
| External social network (ESN) | (4) Relationships with competitors  
Your company has a strong relationship with the competitors  
(5) Relationships with suppliers  
Your company has a strong relationship with the suppliers  
(6) Relationships with customers  
Your company has a strong relationship with the customers  
(7) Relationships with different industry partners  
Your company has a strong relationship with different industry partners  
(8) Relationships with universities or research institutes  
Your company has a strong relationship with universities or research institutes  
(9) Relationships with government or international institutes  
Your company has a strong relationship with the government or international institutes |
| Internal coordination (IC) | (10) Feedback from colleagues  
Your company encourages mutual feedback among employees  
(11) Sharing partner  
Your company encourages knowledge sharing among employees  
(12) Technical assistance  
Your company encourages mutual technical assistance among employees |
| Customer involvement (CI) | (13) Assistance from clients or customers  
The innovation projects developed by your company received assistance from the clients or customers  
(14) Technical support from clients or customers  
The innovation projects developed by your company received technical support from the clients or customers |
| Performance (PER) | (15) Innovation  
The application frequency of the innovation projects developed by your company is high  
(16) Cost reduction  
The innovation projects developed by your company reduce costs  
(17) Skills of technological abilities  
The innovation projects developed by your company enhance the technology skills of the employees  
(18) Competitive advantage  
The innovation projects developed by your company enhance the company’s competitive advantage |

**Table A1.** Items of questionnaire for the competitor orientation, external social network, internal coordination, customer involvement and performance

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**Corresponding author**

Jian-Hang Wang can be contacted at: dearjianhang@gmail.com; jianhwang@fcu.edu.tw

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