# Leveraging customer knowledge to enhance process innovation

## Moderating effects from market dynamics

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### Abstract

**Purpose** – Nowadays, companies compete and win based on the capabilities they can leverage across their supply chains. With unpredictable and turbulent business environment, supply chains are seeking to customer knowledge as sources of competitive advantage. The purpose of this paper is to empirically test a conceptual framework to investigate the roles of customer leverage (CL) on process innovation and the relationships to performance.

**Design/methodology/approach** – Drawing upon the knowledge-based view, this study argues that CL is the sources of firms' process innovation. This study also posits that process innovation mediates the relationship between CL and performance based on transaction cost economics. This empirical study employed 650 manufacturers across different regions.

**Findings** – This study showed that strong association exists between a manufacturing firm's CL capability and its process innovation and performances. Process innovation play critical mediating roles in absorbing and transforming customer knowledge in supply chains. In a more dynamic market, CL strengthens the positive impacts on process innovation.

**Research limitations/implications** – This study further highlights the need to emphasize both strategic and CL capability in dynamic environments as these may be needed to enable the firm to seize market niches that may open up in such environments. Similarly, managers should emphasize CL capability and process changes in competitive environments as they are more difficult to imitate from competitors in regards of new product or services.

**Practical implications** – These results extend the limited existing research on global manufacturing context that the customer knowledge are effective sources for increasing innovative processes. The higher the market turbulence, the stronger the pressures for CL demanded by process innovation. The findings also confirm that process innovation plays a mediating role in absorbing and transforming customer knowledge in improving costs and financial measures. This is an important result that highlights the mechanism by which customer knowledge can influence a firm's bottom line.

**Originality/value** – This study examined the linkages between a marketing concept and operations and supply chain management.

**Keywords** Innovation, Customer knowledge, Knowledge management, Customer leverage

**Paper type** Research paper

## 1. Introduction

In the current business environment, intense competition, shortened product life cycles and rapidly changing customer needs have contributed to the need for more innovative and responsive supply chains. As a consequence, manufacturing companies are increasingly relying on better sources of knowledge that enhances their operational performances and consequently sustains their competitiveness (Al-Sa'di *et al.*, 2017; Wang *et al.*, 2015). Customer leverage (CL) reflects a firm's capability in obtaining and usage of their obtained

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knowledge from customers in developing new products and services (Thakur and Workman, 2016). Many firms aim to benefit from the knowledge, skills and resources of their customers by jointly creating new products (Lau *et al.*, 2010; Thakur and Workman, 2016), improving their supply chain processes for better costs and financial outcomes. Based on the social capital created between customers and manufacturers (Tsai *et al.*, 2013), an understanding of customer experiences, perception, demand, expectations and preferences (namely, customer knowledge) can be effectively leveraged by the innovation developers such as R&D teams or work groups eventually enhancing the teams' innovation performance (Rosell *et al.*, 2014). Recent literature re-emphasized the importance of process innovation, especially in combination with internal and external sources to yield superior results (Krishnan and Jha, 2011).

Although, customers have been regarded as the most important external source of knowledge for the innovation process (Hartley and Choi, 1996), research continued to debate on their impact on the types of innovation strategies (product or process), the stage of knowledge management (Liao and Barnes, 2015) and the influence on different aspects of performance. Research in innovation strategy has tended to examine mainly new product development rather than improvement in processes (Tsinopoulos, 2018; Fuchs and Schreier, 2011). The innovation–performance relationship has often been unclear, thus calling for the need to conduct further studies to investigate the linkage between different types of innovation and performance (Damanpour and Aravind, 2012). It has been stated that the effects of innovation types on the operational performance of manufacturing companies are under-investigated (Al-Sa'di *et al.*, 2017). Due to the same reason, product innovation has a prevailing exposure to research due to visibility and, more directly, to financial influences. However, process innovation equally requires attention in customer knowledge as in costs reduction and efficiency matters.

The concept of CL has been extensively examined for their acquisition, storage and transfer. Anne Jalkala (2010) use the concept of leveraging customer in marketing philosophy to enable loyal customers to become part of the sales and marketing team, however, there is scarce mention that the focal firm convert this knowledge into product design or process changes. Tsai *et al.* (2011) indicated that the extant literature may demonstrate bias because of the one-way communication used in addressing customers' knowledge acquisition. After reviewing 45 papers in the area of knowledge management and innovation, Costa and Monteiro (2016) concluded that knowledge acquisition and knowledge sharing are the most frequently studied processes. According to the knowledge-based view (KBV), the real value of both individual and organizational knowledge exists when knowledge is applied because of implicitness of knowledge (Hossain *et al.*, 2016). Thus, more research is needed to elaborate the usage and application of customer knowledge and the impact on processes and performance. Especially, managers need more guidance on how companies can effectively apply customer knowledge in response to the increasing turbulent business environment.

This current study addresses the above by defining the concept of CL below, and examining its relationship with process innovation and performance (financial and cost measures). This study investigates the following questions:

*RQ1.* To what extent does CL affect customer-firm innovation processes?

*RQ2.* How do these value dimensions of CL impact costs and financial outcomes?

*RQ3.* How is the relationship between CL and process innovation influenced by the dynamics of the markets?

It is intended that findings of this empirical study would provide better understanding on how customer knowledge contributes to process innovation and the effects on performance. For supply chain and operations management practitioners, the study demonstrates the

importance of linkages between marketing and operations management in enhancing process innovation in the whole supply chain. A deeper understanding of the performance outcomes associated with process innovation allows organizations, especially small manufacturing firms, to better decide when, how much, and where to invest resources to enhance performances. Furthermore, the current study contributes to the existing literature by investigating the proposed relationships in a more global context with 10 countries, representing different stages of economic development.

The paper is set out as follows. The first section provides theoretical background from process innovation and customer-buyer relationship literature. Next, the study provides the development of the research model and hypotheses. The study design section describes methods and findings. The last section offers interpretations, contributions and limitations.

## 2. Theoretical background and research hypotheses

In this section, the literature is reviewed to define CL, its relationship to process innovation and performance measures. The conceptual framework and hypotheses are then derived from this literature review, in particular, the theory of KBV and transaction cost economics (TCE).

### *2.1 Customer leverage (CL) and performance*

There exist three streams of research that examine customer knowledge. The first stream focuses on the importance of acquisition (Drechsler and Natter, 2012; West and Bogers, 2014). The second line of research into CL highlights the importance of in sharing knowledge (Peng Wong and Yew Wong, 2011; Wong *et al.*, 2013) and the third area of research offering opportunity for improvement (Wagner and Bode, 2014; Wang *et al.*, 2016). Liao and Barnes (2015) classified general knowledge into acquisition, sharing and application stages. A number of terminologies have been used in literature describing the process of customer knowledge management, customer relationship management (CRM) (Thakur and Workman, 2016), customer references (Anne Jalkala, 2010), customer co-creation (Thakur and Workman, 2016), external knowledge management (Revilla and Villena, 2012) and customer intimacy (Garvin, 1995). CRM is an important tool for creating a strong relationship between the company and its customers. It is where the firm's extended working relationship with its customers is important for the maintenance of a healthy business and the success of an organization. Co-creation with customers has recently been suggested to be a major source for firms' competitive advantage (Thakur and Workman, 2016). Gamal Aboelmaged (2012) reviewed customer knowledge articles involving customers in the innovation process, indicated that the company can obtain specific information about needs and desires, and translate these into concrete product specifications (Kaplan and Haenlein, 2006). Recent literature (Costa and Monteiro, 2016) concluded that knowledge acquisition and knowledge sharing are the most frequently studied knowledge processes.

Taking the tenets from three streams, this study defines a firm's customer leveraging capability as the extent of the focal firms' usage of their obtained knowledge from customers in developing new products and services, and in improving processes (Thakur and Workman, 2016). Whereas leverage in strategic business means enhancing the firm resources and capabilities to increase its competitive advantage. From a resource-based view (Barney, 1991), process innovation provides organizations with a "hidden" competitive advantage that cannot be easily imitated, as the blended internal-external knowledge on which this innovation is based is exclusive. Therefore, firms can combine customer knowledge and leverage process innovations as a strategic resource, thereby increasing entry barriers for competitors hence protecting the firms' market advantage (Smagalla, 2004).

Obtaining and acquisition of customer knowledge and knowhow enhances the firm's ability to respond to technical changes and market fluctuation. Sharing of customer knowledge could lead to reduced uncertainty and enrich the overall body of knowledge. Managing external knowledge is the process of capturing, developing, sharing and effectively making the best use of external knowledge (Hojnik and Ruzzier, 2016). However, companies are encouraged to move beyond just acquisition and sharing customer knowledge, towards integrating the knowledge learnt from customers into redesign and improvement of existing processes (Leonard-Barton, 1995). Changes in market demand occur rapidly, and it would be useful if firms use customer knowledge in their internal knowledge creation processes (Grant and Baden-Fuller, 2004). This requires knowledge integration across the boundaries of the firm. From a TCE perspective, CL can be regarded as a relationship-specific investment by exchange parties (Wagner and Bode, 2014) that can reduce uncertainty, potential conflicts and discourage efforts to seek a private advantage (Williamson, 1979). CL provides the firm's capability to respond faster to technological changes (Thakur and Workman, 2016) and to reduce risk and opportunistic behavior. Opportunism mitigation reduces transaction costs in negotiating, monitoring and safeguarding the involved parties' behavior. When opportunistic behavior can be restrained through an open sharing innovation, coordination cost and uncertainty between exchange parties are also reduced (Stump and Heide, 1996), resulting in improved manufacturers' performance. Therefore, learning and applying knowledge from customers in response to market changes and technological innovation can reduce uncertainty and opportunism in the ongoing partnerships with customers, thus lowering transaction costs. Thus, this study argues that:

*H1.* A manufacturer's customer leveraging capability exerts a direct positive effect on cost efficiency.

The usage of customer knowledge in both product and process innovation can help firms application of new knowledge and aspects that would otherwise have been lost. Customer knowledge, a special form of external knowledge, promotes engagement and collaboration in innovations (Chen and Huang, 2009). The benefits of this social capital from engagement and collaboration are multi-fold. Transactional cost economics suggests that firms are able to reduce production cost and reach greater economies of scale by pooling resources together (Williamson, 1979). CL knowledge acquisition gives companies the opportunity to improve their processes and to transform the existing or internal knowledge into new knowledge (Chen and Huang, 2009). Consequently, the new acquired knowledge contributes efficiently to maximize the available stocks of knowledge and minimize the uncertainty. Furthermore, customer knowledge could facilitate the process of sensing the new innovation as customers and also as end users. The latter would know the most about the market, thus enlarging market share and creating new engines for growth. This social capital can directly influence the performance such as market share and cost reduction. Collectively, these capabilities suggested that the new obtained customer knowledge provides opportunities for creating innovative processes resulting in operations efficiency and future market share. Accordingly, this study proposes that:

*H2.* A manufacturer's customer leveraging capability exerts a direct positive effect on financial performance.

### *2.2 Mediating roles of process innovation between CL and performance*

There are several linkages between customer knowledge and innovation processes. The role of customer knowledge in directly enhancing operational performance has been discussed in the above sections. Additionally, this study argues that the effect of customer knowledge on

performance will be greater in organizations involved in process innovations. This means that, in addition to the direct effect of customer knowledge on performance, an indirect effect exists through process improvement and process innovation. This indirect effect exists due to real exploitation of organizational resources, and knowledge capability provides organizations with the ability to design efficient (cheaper) and innovative processes that contribute to improving quality, flexibility and delivery and reducing cost (Chin-Yen and Tsung-Hsien, 2007).

First, CL exerts a positive impact on process innovation. Manufacturing firms have an incentive to build on the customers' innovation suggestions because they will likely guarantee eventual customer acceptance and market fit. In return, these customers can benefit from new or improved processes (i.e. resulting in better service or lower cost) or new or improved products (e.g. resulting in more innovative product offerings and higher sales) (Faems *et al.*, 2005). In sum, innovation suggestions that are pulled by customers will likely be beneficial for the manufacturing firms and lead to innovative product or process innovations. Theoretically, customer knowledge creates social capital between customers and innovation developers (Yang, 2014). Investments in these relationships enhance understanding of customer experiences, perception, demand, expectations, and preferences that can be effectively leveraged by the innovation developers, such as R&D teams (Rosell *et al.*, 2014). These investments are non-recoverable expenditures a firm makes to support a specific inter-organizational relationship with another firm (Wagner and Bode, 2014). Manufacturing firms that leverage customer knowledge are more likely to modify its own process innovations to the corresponding customers. After having deployed CL, a manufacturer seeks to earn the returns on its investment and is therefore interested in sustaining a long-term relationship with the corresponding customer firm. The process innovations could be a possible means to strengthen the relationship, because the buying firm benefits from process innovations such as quality improvements and cost reductions on the buying firm's side (Kim, 2000). Collectively, the above support the following hypothesis:

*H3.* CL has a positive relationship with process innovation.

Second, in the resource-based view, resources that are rare, valuable, difficult to substitute, and imperfectly imitable will contribute to sustainable performance and competitive advantage (Barney, 1991). Therefore, process innovations have an advantage over product innovations since they are often hidden internally within organizations which make them difficult to be imitated by competitors (Teece, 1986). Firms focusing on process innovations are able to compete in mature markets where the state of the art of the products is already well established, and the primary focus is to make and deliver products (which could be similar to competitors) to customers with higher values, such as faster, more flexible, or cheaper (Congden and Schroeder, 1996). In addition, Oke and Kach (2012) proved that process innovation effectively improves internal production operations resulting in decreased cost and improved manufacturing performance. When firms learn more about new processes before their competitors, they can save more resources in producing a similar product. Those manufacturers, who are first within the industry to apply these new processes, will be foremost in adding value, relative to their competitors. Most studies argue that customers possess unique knowledge about their preferences (Poetz and Schreier, 2012), and therefore, it is reasonable to expect their involvement increases success in terms of product–customer needs fit (Alam and Perry, 2002), consequently in financial measures such as profit (Lau *et al.*, 2010), or market share (Joshi and Sharma, 2004). Thus, this study proposes that (Figure 1):

*H4.* Process innovation strategy has a positive relationship with costs.

*H5.* Process innovation strategy has a positive relationship with financial performance.

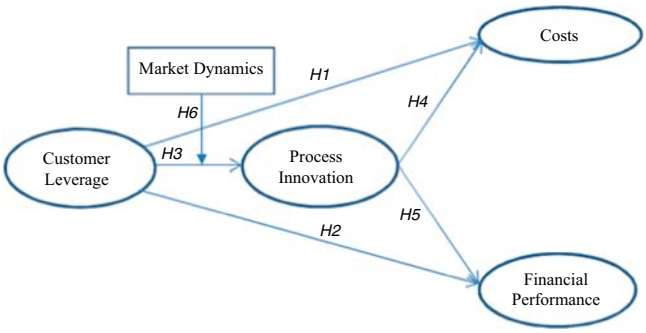


**Figure 1.**
Research model

On the other hand, although previous literature agrees that there is a positive impact of knowledge management capability on a firm's innovation performance (Tsai *et al.*, 2013), the mediating role played by innovation process in the relationship between knowledge management capability and operations performance has not yet been empirically revealed (Liao and Barnes, 2015). While firms may acquire, share, and apply knowledge to improve operations strategy, they may need to possess a higher level of process innovation to ensure effective outcomes of such integration. These joint activities are influenced, either directly or indirectly, by the choices and alignment efforts of members in the supply chain (Handfield and Nichols, 2002). Thus, the question is why are some firms successful at this leveraging whereas others are not? The next sections discuss contextual factors affecting the relationship between CL and process innovation.

### *2.3 Moderating roles of market dynamics*

While innovation studies have shown the effectiveness of innovation as a competitive strategy, they also suggest that such effectiveness is influenced by the environmental context in which the firm operates and competes (Tsai *et al.*, 2013). This is because the innovation strategies which are effective in improving performance in certain environments may not be as effective in other environments (Prajogo, 2016). Therefore, the primary objective of this section is to examine the moderating roles of market dynamics on the effectiveness of linkages between customer knowledge and process innovation in delivering cost and financial performance. This study focuses on market dynamics (Covin and Slevin, 1989), which are characterized by the constant rate of change in demand, inputs or technology. The reason for this selection is that in such business environments, firms tend to innovate to satisfy changing customer preferences and secure competitive advantage (Lumpkin and Dess, 2001).

The effect of CL on process innovation and firm performance is a multi-faceted issue which might require a contingency perspective (Sousa and Voss, 2008). Firms with more stable markets might deploy the process incremental or exploitative innovation (Wang *et al.*, 2015) whereas exploratory innovation is more speculative and focused on changing market dynamics. Economic theory lends empirical support that higher levels of market dynamics are associated with introducing new processes more frequently (Utterback and Abernathy, 1975). This allows a manufacturer to align operations with changing customer requirements, develop unique capabilities that can reduce costs and lead times associated with customization, and benefit from market dynamics (Liu *et al.*, 2012). In an aggressive technological environment, firms need to tap into external knowledge (e.g. customer knowledge) and draw deeply from partners along the supply chain. This allows them to increase performance in terms of the reduction of risks (Oliver *et al.*, 2010), costs and time

(Kolk and Punmann, 2008), as well as in the introduction of new or significantly improved products, services and processes (Ferreira *et al.*, 2015). Thus, this study hypothesizes that:

*H6.* Market dynamics strengthens the positive relationship between CL and process innovation.

## 3. Research design and associated analyses

### *3.1 Research design*

The data collection was done via e-mail using an interactive PDF questionnaire which targeted production and manufacturing managers as key respondents. This questionnaire was developed through the Global Manufacturing Research Group (GMRG) project conducted in 2014. The questionnaire distributed to the sample firms was developed in a rigorous process by key operations management scholars (Whybark *et al.*, 2009). The first section of the questionnaire pertains to general information of the business unit (i.e. company size, industry, production network configuration, competitive strategy and process innovation) within the context in which manufacturing takes place, whereas the other sections refer to the plant's most important product line, focusing on manufacturing strategies, practices and performance. The plant's most important product line refers to the product line that generates the most revenue for the plant. The plant is chosen as the unit of analysis in order to avoid problems related to business units with multiple plants operating in different ways. All research teams in the GMRG group follow a standard data collection protocol. The research team made telephone calls to potential plants and mailed or emailed questionnaires to those that agreed to participate in the survey. Follow-up telephone calls were made to improve the response rate.

Table I provides the company profiles in this study. The sample consists primarily of small and medium sized companies (74.6 percent) of the sample. Included in the survey are more than twenty manufacturing industries, which represent foods, garment and textile, chemical, furniture, metal products, semiconductor, electrical machinery, precision instrument, automotive and other transport industries. It can be seen that emerging industries in China, Korea and Taiwan have made significant investments in new processes compared to other developing and developed countries.

| Country | Frequency | Percent | Ave. GDP per capita | R&D budget (%) | Investment new process (%) | Training staff (%) |
|---|---|---|---|---|---|---|
| *Developed* | | | | | | |
| Australia | 10 | 1.53 | $65,600 | 0.51–0.75 | 5–8 | 1.1–1.5 |
| Korea | 72 | 11.1 | $45,091 | 0.76–1 | 9–12 | 1.6–2 |
| USA | 83 | 12.8 | $52,392 | 0.51–0.75 | 5–8 | 1.1–1.5 |
| *Emerging* | | | | | | |
| Hungary | 31 | 4.8 | $13,403 | 0.26–0.50 | 1–4 | 0.51–1 |
| India | 54 | 8.3 | $1,548 | 0.51–0.75 | 5–8 | 1.1–1.5 |
| China | 27 | 4.2 | $6,626 | 0.76–1 | 9–12 | 1.6–2 |
| Poland | 71 | 10.9 | $13,760 | 0.26–0.50 | 1–4 | 0.51–1 |
| Taiwan | 40 | 6.2 | $31,900 | 0.51–0.75 | 5–8 | 1.1–1.5 |
| *Developing* | | | | | | |
| Croatia | 111 | 17.1 | $13,490 | 0.26–0.50 | 1–4 | 0.51–1 |
| Vietnam | 151 | 23.2 | $1,868 | 0.51–0.75 | 5–8 | 1.1–1.5 |
| Total | 650 | 100.0 | | | | |

**Table I.** Respondent country profiles

*3.2 The research constructs and reliability, convergent validity and discriminant validity tests*

The section of the questionnaire related to this research study is displayed in Table II. A combination of perceptual and objective measures was used to capture the responses and to limit common method bias. The model includes process innovation construct, which focuses on firms' ability to learn more about new processes than their competitors; to be first within the industry in applying new processes; and to be updated with the latest processes (Malhotra *et al.*, 2007; Menor *et al.*, 2007). CL focuses on the manufacturer's extent in obtaining, acquiring and applying new customer knowledge (Choi *et al.*, 2002). Financial performance was measured objectively based on market share, revenue and profit increased relative to competitors (Choi *et al.*, 2002).

First, the internal consistency reliability test revealed that Cronbach's $\alpha$ ranged from 0.701 (process innovation) to 0.882 (financial performance), which exceeds 0.60, the threshold value (Hair *et al.*, 2010). Table II provides constructs' mean of measurement items, standard deviation, loading and *p*-values. Second, the confirmatory factor analysis (CFA)

| Research measurements | Estimate | Mean | SD |
|---|---|---|---|
| *Costs ($\alpha = 0.823$)* | | | |
| Total product unit costs | 0.71 | 4.39 | 1.20 |
| Raw material unit costs | 0.85 | 4.48 | 1.22 |
| Product performance | 0.69 | 4.46 | 1.14 |
| *Financial performance ($\alpha = 0.848$)* | | | |
| Total sales | 0.85 | 4.34 | 1.21 |
| Profitability | 0.88 | 4.28 | 1.02 |
| Market share | 0.71 | 4.32 | 1.13 |
| *Market competitive intensity ($\alpha = 0.738$)* | | | |
| There are many substitutes in the market for your products | 0.76 | 4.50 | 1.23 |
| Demand for your products is difficult to predict | 0.67 | 4.36 | 1.02 |
| Suppliers of critical inputs have significant bargaining power | 0.70 | 4.40 | 1.28 |
| Your industry is subject to rapid technological change | 0.68 | 4.20 | 1.31 |
| *Process innovation ($\alpha = 0.701$)* | | | |
| We are learning more about the newest processes than our competitors | 0.79 | 4.18 | 1.52 |
| We are the first within the industry to deploy new processes | 0.77 | 4.80 | 1.33 |
| We keep up with the latest process developments | 0.73 | 5.05 | 1.40 |
| Process innovation is important to this plant | 0.70 | 4.23 | 1.23 |
| We frequently introduce processes that are radically different from | 0.61 | 4.33 | 1.39 |
| We have no difficulty in introducing processes that are radically different from existing processes in the industry | 0.71 | 4.23 | 1.26 |
| *Customer leverage ($\alpha = 0.832$)* | | | |
| We are able to obtain a tremendous amount of technical knowhow from our customers | 0.65 | 4.43 | 1.14 |
| We rapidly respond to technological changes in our industry by applying what we know from our customer | 0.72 | 4.63 | 1.26 |
| As soon as we acquire new knowledge from our customer, we try to find applications for it | 0.65 | 4.36 | 1.21 |
| Our key customer's technological knowledge enriched the basic understanding of our innovation activities | 0.88 | 4.51 | 1.02 |
| Our key customer's technological knowledge reduced the uncertainty of our innovation activities | 0.85 | 4.52 | 1.06 |
| Our key customer's technological knowledge helps us to identify new aspects of innovation activities that would otherwise have gone | 0.81 | 4.26 | 1.23 |

**Table II.**
Constructs means and reliability measures

**Notes:** RMSEA, root mean square error of approximation; GFI, goodness of fit index; CFI, Comparative Fit Index. $\chi^2 = 205.8$; df = 111;, $\chi^2/df = 1.85$, CFI = 0.985; NFI = 0.973; RMSEA = 0.036. The scale format for each of these measures was 1 = strongly disagree to 7 = strongly agree

measurement models confirmed the presence of five unique constructs, and their CFA details are presented in Table III. The model fit indices were $\chi^2/df = 1.85$, which lies in the recommended range of 1–3. Further, the RMSEA value of 0.036 suggests a good model fit. The results in Table III showed that all of the average square root values (AVE) were higher than the correlations, again indicating acceptable discriminant validity. In addition, both max shared variance (MSV) and average shared variance (ASV) values are smaller than AVE (Hair *et al.*, 2010).

### 3.3 Hypothesis testing

A structural equation model was used to test the hypotheses. The fit indices indicate a good model fit as shown in Table IV. Table IV displays the directions and significance of the hypothesized relationships among the constructs. The results supported *H1–H5*, which confirmed the positive impacts of process innovation on both costs and financial measures; where CL strongly support costs (*H1*) but not financial performance (*H2*). The results supported *H1* confirming significant gains on process innovation from CL.

### 3.4 Moderating effects by market dynamics (H6)

*H6* suggested that process innovation will be pursued with different emphases based on the degree of market dynamics. A moderated regression analysis was run to test the hypothesis. This procedure also provides further refining results supporting the structural models (see Table IV). Table V confirms that CL strongly supports process innovation ($\beta = 0.47$ at $p < 0.001$). The moderating effects were tested by creating the product terms between these variables using their standardized scores. The dependent variable, process innovation, is jointly determined by the interaction of the predictors (Market dynamics × CL). The findings show that market dynamics strengthens the positive relationship between CL and process innovation ($\beta = 0.12$ at $p < 0.05$). Therefore, *H6* is supported. The results of the collinearity diagnostic test on the regression model show that the variance inflation factor

| Research constructs | CR | MSV | ASV | AVE | [1] | [2] | [3] | [4] | [5] |
|---|---|---|---|---|---|---|---|---|---|
| [1] Costs | 0.796 | 0.114 | 0.071 | 0.568 | *0.754* | | | | |
| [2] Process innovation | 0.837 | 0.200 | 0.101 | 0.508 | 0.263** | *0.713* | | | |
| [3] Customer leverage | 0.892 | 0.200 | 0.102 | 0.582 | 0.256** | 0.447** | *0.763* | | |
| [4] Market dynamics | 0.675 | 0.107 | 0.052 | 0.506 | 0.185* | 0.261** | 0.327** | *0.716* | |
| [5] Financial performance | 0.853 | 0.114 | 0.054 | 0.662 | 0.337** | 0.258** | 0.186** | 0.025 | *0.814* |

**Notes:** Diagonal elements (in italic) are the square root of the average variance extracted (AVE) between the constructs and their measures. Off-diagonal elements are correlations between constructs. For discriminate validity, AVE should be greater than off-diagonal elements. *,**Significant at 0.01 and 0.001

**Table III.**
Correlation matrix and construct validity measures

| Relationship of research constructs | Estimate | SE | CR | *p* | Hypotheses |
|---|---|---|---|---|---|
| Costs←Customer leverage | 0.150 | 0.040 | 2.717 | 0.007 | *H1*-Supported |
| Financial←customer leverage | 0.013 | 0.063 | 0.269 | 0.788 | *H2*-Rejected |
| Process Inno←customer leverage | 0.477 | 0.048 | 9.465 | *** | *H3*-Supported |
| Costs←process inno. | 0.294 | 0.046 | 4.932 | *** | *H4*-Supported |
| Financial←process inno. | 0.350 | 0.071 | 6.532 | *** | *H5*-Supported |

**Notes:** $\chi^2 = 300.251$; df = 158; $\chi^2/df = 1.900$; CFI = 0.986; NFI = 0.957; RFI = 0.941; RMSEA = 0.031. CR, composite reliability; ***$p = 0.001$

**Table IV.**
Results of the hypothesis testing

**Table V.**
Moderating effects from market dynamics

| | Process innovation | |
|---|---|---|
| | Model 1 | Model 2 |
| Size | 0.22*** | 0.22*** |
| Customer leverage | 0.46*** | 0.47*** |
| Market dynamics | | 0.30*** |
| Customer leverage × market dynamics | | 0.12* |
| $R$ | 0.541 | 0.654 |
| Adjusted $R^2$ | 0.290 | 0.420 |
| $F$ change | 88.97*** | 59.15*** |

**Notes:** *,***Significant at 0.1 and 0.001, respectively

values range between 1.06 and 1.45 (well below 10); thus, confirming the absence of multicollinearity problems in the data set. The interaction and the mixed impacts on process innovation are presented in Figure 2.

### *3.5 Mediating roles of process innovation*

In the proposed conceptual model, process innovation is mediating the effects of the CL on manufacturing performance (costs and financial performance). Structural equation models with boot strapping procedures (Mallinckrodt *et al.*, 2006) were used to test for such mediation effects. Table VI indicated the outcomes, which show the direct effects with and without mediator. The test of the indirect effects between CL → process innovation → costs and CL → process

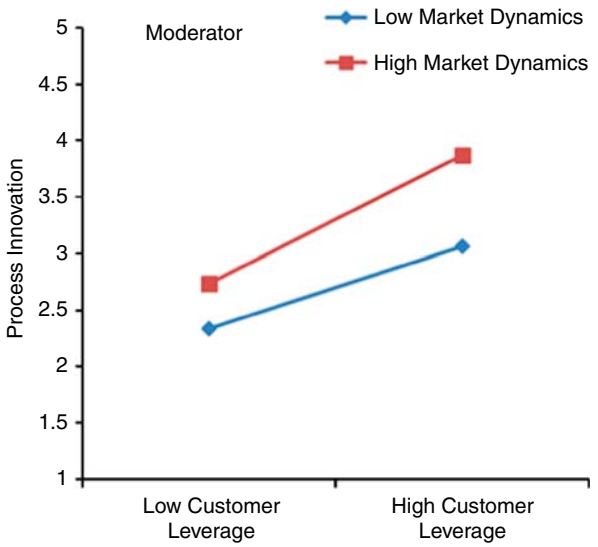


**Figure 2.**
Moderating effects from market dynamics on process innovation

| Mediator process innovation | Direct with mediator | Indirect | Mediation |
|---|---|---|---|
| Customer leverage to costs | 0.100 (0.096)* | 0.119 (0.005)** | Partial |
| Customer leverage to financial perf | 0.045 (0.398)n/s | 0.153 (0.009)** | Full |

**Notes:** $p$-value is in brackets. *,**Significant at 0.01 and 0.001, respectively

**Table VI.**
Results of the mediating effects

innovation → financial performance were all significant at 0.01 level. Interestingly, the direct effects (CL → financial performance) were not significant ($\beta = 0.045$, $p = 0.398$). Interestingly, the mediating effect of process innovation is fully on financial performance, but partially on costs. The next section provides more discussion on these findings.

## 4. Discussion and implication

This study examined the linkages between a marketing concept, CL and manufacturing performance via process innovation, which in turn affect cost efficiency and the firm's financial performance. Drawing upon the KBV, this study confirmed that CL has a strong influence on process innovation, where co-created knowledge between customers and manufacturers is able to reconfigure the existing processes to respond rapidly to the unpredictable and turbulent market. Where demand is unpredictable and customer and technological factors change frequently, the effect of perceived customer perception and its accumulative knowledge on process innovation can vary significantly. Process innovation, on the other hand, exerts a mediating effect between CL and performance, including both cost efficiency and financial measures, grounded in TCE. Collectively, the results shown above provide support to the argument of the importance of leveraging customer knowledge in enhancing process innovation and performance.

From a theoretical perspective, these results extend the limited existing research on global manufacturing context that customer knowledge forms an effective source for increasing innovative processes and enhancing the ability of manufacturing companies to adapt in new and different markets. These results are consistent with previous studies (Anne Jalkala, 2010; Liao and Barnes, 2015) that customer knowledge is a source for innovation strategies. This finding asserts that, in the manufacturing context, customer knowledge is an essential factor to enhance process innovation. This confirms previous literature that asserted the important role of customer knowledge to improve processes, reduce production costs (Mafabi, 2012), and improve quality of the products (Slavković and Babić, 2013), ultimately leading to sustainable competitive advantage (María Ruiz-Jiménez and del Mar Fuentes-Fuentes, 2013).

This study defines a firm's customer leveraging as the extent the focal firms depend on customers in developing new product, services and improving processes. The findings confirm that the speed and frequency of applying the acquired knowledge from customers will potentially decrease competitive uncertainty and thus lead to improved process innovation. In essence, CL plays a significant role as "business intelligence" in closing the gaps in traditional marketing and initiates process changes through organizational boundaries.

The higher the market turbulence, the stronger the pressures for CL demanded by process innovation. The results of moderating effects from market dynamics on the relationship between CL and process innovation (e.g. Table V and Figure 2) have shown that in dynamic markets (characterized by many substitutes, fluctuating demand and rapid technological change) investments through CL could help push process innovation to adapt to market changes. These findings enhance the understanding of the important role of knowledge management in supply chain management, especially when the market is fluctuating (Abrell, 2016; Revilla and Villena, 2012).

The results in Table VI confirmed that process innovation plays a mediating role in absorbing and transforming customer knowledge in improving costs and financial measures. This is an important result that highlights the mechanism by which customer knowledge can influence a firm's bottom line. Previous research has also found that CRM does not affect firm performance directly. Rather, the CRM–performance link is fully mediated by differentiation and cost leadership strategies (Reimann *et al.*, 2010). Interestingly, the results emphasized the essential role of CL in reducing costs (accepted *H1*), but not overall financial measures (rejected *H2*). This result is consistent with previous

studies that found a positive effect of CRM on some performance measures (Anne Jalkala, 2010; Lee and Kim, 2010) although not directly (Reimann *et al.*, 2010). The possible explanation for these counterintuitive findings is that firms in a mature market tend to look for improving the existing processes and more efficiency oriented matters, rather than growth and market share objectives (Bonanno and Haworth, 1998).

## 5. Managerial implications

The findings of this current study offer several implications for managers. Prior research has helped managers to understand the factors that enable them to successfully pull innovations from their customers (Al-Sa'di *et al.*, 2017; Wagner and Bode, 2014). This current study complements this view by demonstrating that it is also important for managers to understand how to integrate them into process innovation and which market conditions are expected to give rise to a greater manufacturing performance.

First, this study shows that managers in manufacturing companies should place more emphasis on customers, understanding their requirements and needs when considering process improvement. The knowledge acquired from external sources such as customers and other organizations is a valuable source of innovations (Liao and Barnes, 2015). Beyond that managers should reinforce leveraged external knowledge not just by acquiring and sharing, but also applying new ideas from customers as soon as possible. This study asserts that those with "first to market" attitude and continuous updating from customers will gain significant process improvement, eventually reducing costs and improving financial outcomes. Effective intra-organizational knowledge management depends on two factors: the timely and accurate communication of this knowledge to appropriate managers and the application of this knowledge for strategic decisions.

Second, these findings provide managerial suggestions on how to match the external business environment with innovation processes. The results from this study asserts that the higher the market turbulence, the stronger the pressures for CL demanded by process innovation. Thus, managers should be well prepared when observing markets with demand fluctuations, characterized with many substitutes; rapid technological change and high supplier power. Specifically, this is the best time to seek feedback from existing customers within the supply chain on technical knowhow and their understanding of the firm's processes. Parallel to that, this study recommends to quickly find applications from their learning from customers. Therefore, building and integrating both process innovation and CL would equip firms in facing the dynamics of the markets, and navigating through the changing conditions of business environments.

Finally, the findings also confirm that process innovation plays a mediating role in absorbing and transforming customer knowledge in improving costs and financial measures. This is an important result that suggests a mechanism by which managers can leverage customer knowledge to expect a greater performance. This research urges managers to try to be the first to apply customer knowledge into process changes. It supports previous research that purports by adopting advanced manufacturing and information technologies as well as developing new processes and/or frequently introducing new processes that are radically different, the flexibility and responsiveness of operations can substantially improve, thereby enhancing dynamic capability (Rungtusanatham and Salvador, 2008).

## 6. Limitations and future research

The results of this study are subject to several limitations. First, this study was conducted for manufacturing organizations across different industries, thereby potentially resulting in a greater source of variance, with the generalizability of this study's findings to other types of industry sectors other than manufacturing being quite limited. Hence, future researchers

may replicate and extend this study to sectors other than manufacturing. Second, the data points were collected from single sources (i.e. CEOs or supply chain managers). Although they were considered to be the more relevant informants, the most desirable data collection procedure would have used a design of multiple respondents.

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