Supplier and Customer Knowledge Leveraging and Financial Performance Nexus: Moderating Effects of the Internal Manufacturing Environment

Short Running Title: Knowledge Leveraging and Firm Performance

ABSTRACT

Exponentially growing knowledge and technology create dynamic but different expectations for customer and supplier leveraging practices in both knowledge exploitation and exploration. Although manufacturers equally adopt the imitable knowledge leveraging practices in both demand and supply side, they may generate varying financial performances subjecting to the internal conditions of the manufacturing environment such as dynamism, munificence and complexity. We invoke the Practice Based View and Knowledge Based View that grown out of Resource Based Theory to explore how the manufacturing environmental features moderate the associations between the supplier and customer knowledge leveraging practices and the financial performance. Empirical data from 513 plants across 9 countries and 21 industries validates that the positive association between supplier knowledge leveraging and financial performance increases at higher levels of environmental features. Also, the customer knowledge leveraging is positively associated with the financial performance and it lowers only at the higher levels of munificence.

Key words:

Supplier knowledge leveraging, customer knowledge leveraging, dynamism, munificence and complexity

INTRODUCTION

The manufacturing plant's ability to explore and exploit the explicit technical knowledge residing in the supply chain has become a key source of competitive advantage to withstand the obsolescence exacerbated by the heightened global competition (Grant, 2002; March, 1991; Weigelt, 2013). Particularly, supplier and customer knowledge leveraging are two major practices for creating the strategic fit between the supply chain knowledge acquisition and application (Lorenzoni and Lipparini, 1999; Ofek and Sarvary, 2001). Supplier knowledge leveraging aims at resource utilisation by synchronised control and coordinate of the supplier knowledge (Herrmann and Hodgson, 2001; Ofek and Sarvary, 2001; Weigelt, 2013). It increases the rate of innovation while reducing the contract governance costs. Customer knowledge leveraging seeks for fan based knowledge and application developments that ensure the return sales and growth in sales network by aptly approaching different money spinning scales of customers (Kim and Lee, 2007; Ofek and Sarvary, 2001; Peppard, 2000). While the existing literature that mostly concentrates on accessing relatively scarce knowledge and technology in the supplier base (Grant, 2002; Grant and Baden-Fuller, 2004; Kristal et al., 2010; Quinn, 1999; Weigelt, 2013) and customer base (Kim and Lee, 2007; Herrmann and Hodgson, 2001; Ofek and Sarvary, 2001) have their own merits, doubts remain in whether it received much attention in elaborating the significance of simultaneous leveraging in knowledge exploitation and exploration activities in both supplier and customer sides together. Also, a clear conceptualisation of supplier and customer knowledge leveraging as separate practices is lacking in the prior literature and how the manufacturing plants get varying performances by occupying these identical practices with the differences in internal environmental dimensions are yet to explore. Further, Choi and Lee (1997) underline the practical importance of knowledge leveraging practices with the proliferation of various interfirm relationships such as strategic alliances, joint ventures and dyadic relationships as determinants of business

performance. These practices are motivated by the technological change which has become a great equalizer over the years, eroding the competitive advantage of even well-rooted firms while propelling others to the forefront (Porter and Millar, 1985). For instance, Blackberry failed over Apple iPhones in 2007 due to its ignorance on customer and supplier knowledge leveraging for touchscreen based technology who had more than half of the United States market share.

The resource based theory (RBT) explains that the manufacturing plant gets more sustainable competitive advantages through its possession of a specific combination of resources that are valuable, rare and difficult to imitate (Barney, 1989; Barney, 1991; Hitt et al., 2016b; Peteraf, 1993). However, the existing literature that applied RBT on the operations management area mostly treats the dependent variable as the business performance, not the sustained competitive advantage (Bromiley and Rau, 2014). As such, Bromiley and Rau (2016) criticise that RBT does not align with the objectives and activities of operations management research and hence, they propose the practice based view (PBV) that illustrates the requirement of testing the impact of certain practices on the business performance in a theoretically correct manner. Further to this, knowledge based view (KBV) that largely extended RBT reasoning suggests that the plant's relatively scarce resources such as technology based knowledge are the primary resource underlying sustained competitive advantage (Barney, 1991; Felin and Hesterly, 2007; Grant, 1996). By invoking PBV, RBT and KBV with supply chain and business environment literature, this paper helps to make sense of whether the internal features of the manufacturing environment interact with customer and supplier knowledge leveraging practices as joint determinants of financial performance. Though the external environment is mostly characterised by the dynamism, munificence and complexity, the recent researches emerge to attribute the internal manufacturing environment mostly by the complexity (Bozarth et al., 2009; Flynn and Flynn ,1999; Wiengarten et al., 2017). Since the other constructs such as

dynamism and munificence developed based on the managerial perception predominantly epitomise the nature of the internal environment (Bourgeois, 1980; Pagell et al., 2007; Swamidass and Newell, 1987; Ward et al., 1995), and hence, we ascribe them as well to the internal environment. In light of all these theoretical underpinnings, this study aims to address the following questions:

1) How the supplier and customer knowledge leveraging practices are associated with plant's financial performance?
2) How the plant's internal features of the manufacturing environment such as dynamism, munificence and complexity moderate the relationship between the (a) supplier knowledge leveraging (b) customer knowledge leveraging and financial performance?

We analyse these direct and moderation relationships in our empirical setting: a global manufacturing data set from 513 plants across 9 countries and 21 industries.

This paper has useful contributions in many ways. We empirically validate the proposed constructs of supplier and customer knowledge leveraging and the internal environmental features of dynamism and munificence using exploratory factor analysis. We take a significant step toward recognising both the supplier and customer knowledge leveraging as separate practices that are imitable into different organisations in light of PBV. Though they could develop varying performances based on the contextual factors, it remains poorly understood in the prior literature. Hence, by shedding new light on RBT, KBV and recently emerged PBV, we propose a conceptual model to understand the association between the supplier and customer knowledge leveraging and financial performance and how these relationships vary under different levels of dynamic, munificent and complex features of the internal manufacturing environment. The empirically validated results confirm that the positive association between the customer knowledge leveraging and the financial performance is self-evident, but it lowers

in highly munificent manufacturing environments. The positive association between the supplier knowledge leveraging and the financial performance nexus increases at higher levels of internal dynamism, munificence and complexity of internal manufacturing environment but it does not exist in the absence of the internal pressures. Finally, we inform the managers how to make the strategic fit between the knowledge leveraging practices and the internal features of the manufacturing environment to enhance the financial benefits accompanied with industrial examples.

The remainder of this paper is split into seven main sections. Section 2 presents a brief literature review and the proposed conceptual model while section 3 dedicated for hypotheses development. Section 4 presents the research methods, data and operational definitions of the constructs. Sections 5 and 6 discuss the research findings based on the moderated regression analysis and both the theoretical and managerial contributions. The final section concludes the research with limitations.

LITERATURE REVIEW

RBT, PBV and KBV of the Firm

RBT has become popular due to its ability to deconstruct the sources of a firm's competitive advantage both internally and across the supply chain relationships (Hitt et al., 2016b). It suggests that firms are able to create and sustain competitive advantages through the collection and integration of rare, valuable, inimitable and non-substitutable resources (Barney, 1991; Sirmon et al., 2011). While RBT has its own merits, the recent development of PBV advises examining the effects of the imitable activities or practices that a variety of firms might execute on the firm performance (Bromiley and Rau, 2014). Though a dearth of RBT research in operations management was supposed to explore the inimitable things to achieve a competitive advantage, most of them actually examine the effects of imitable things and practices on the variations of firm performance (Bromiley and Rau, 2016). Further to this, the reality for the

manufacturing plants is that they barely possess inimitable resources rather they rely on relatively scarce resources such as technology and knowledge (Felin and Hesterly, 2007). Building on these insights, we can treat PBV as an alternative explanation for the researchers that examine the effects of a certain practice or relatively scarce resources on financial performance without violating the fundamental assumptions of RBT.

The relatively scarce resource, knowledge is in two forms such as tacit which is the intuitive and unarticulated knowledge that manifest only in the application and explicit which is the codified knowledge that can easily transmit across individuals and firms (Nonaka, 1991). Hence, the KBV that has grown out of RBT identifies the primary role of the firm as integrating the specialist knowledge that resides in individuals into goods and services (Felin and Hesterly, 2007; Grant, 1996). Substantive KBV literature that absorbed technology into the broader knowledge management field stresses that primary objective of forming strategic supply chain relationships and alliances should be explicit knowledge sharing (Dyer and Nobeoka, 2000; Grant and Baden-Fuller, 2004). To better understand the knowledge management, researchers recognise two conceptually distinctive dimensions such as ‘exploration’ which is the firm’s knowledge acquisition activity and ‘exploitation’ which is deploying or applying existing or acquired knowledge to create value (Kristal et al., 2010; March 1991). The manufacturing plants cannot escape from leveraging both the exploration and exploitation activities to enhance their sales, profitability and market share (Tamayo-Torres et al., 2017). Therefore, we recognise knowledge leveraging in customer and supplier relationships as two separate practices and hence apply PBV and KBV grown out of RBT to understand their effects on financial performance.

Supplier and Customer Knowledge Leveraging Practices

The role of knowledge in the supply chain relationships has definitely being stimulated by the acceleration of technological change especially the information and communication technologies (Grant, 2002). The inherent characteristics of knowledge are 'costly to produce but cheap to reproduce' and 'no specific knowledge contributes to a specific production' (Grant, 2002; Shapiro and Varian, 1999). Knowledge exploration requires specialisation while exploitation requires the diversity of knowledge wherein both cases knowledge that resides in supply chain relationships is equally important. In combining these practices, researchers have come up with the concept of ambidextrous supply chain or organisational strategy which is the complementary pursuit of exploration and exploitation counter to the trade-off view that makes the strategic fit between them to advance the business performance (Kristal et al., 2010; March, 1991; Tamayo-Torres et al., 2017). These remarkable researches explore the complementary effects of the knowledge exploration and exploitation activities on the manufacturing capabilities, yet they fail to recognise the customer and supplier knowledge leveraging practices separately which are driven by different motivations. For instance, supplier knowledge leveraging aims at significantly reducing the plant's variable costs by increasing efficiency (Grant, 2004; Weigelt, 2013) while customer knowledge leveraging aims at enhancing the quality of products and information offered by the plant (Kim and Lee, 2007; Ofek and Sarvary, 2001). Hence, of key interests in this study are to conceptualise the supplier and customer knowledge leveraging as two separate practices and to explore how those practices driven by the varying expectations are associated with the financial performance.

Grant (1996) identifies the main role of the firm as integrating the specialist knowledge resident in individuals into goods and services and hence, the management must establish the coordination mechanisms required for this knowledge integration. In light of RBT, Weigelt (2013) analyses how the buying firm benefit from the supplier information technology (IT) based knowledge capabilities where the IT capabilities are readily available to multiple

customers. Deploying customised IT capabilities at the client facility have complementary effects between the supplier IT and the client operational capabilities. Nonetheless, the clients with weaker operational capabilities benefit from outsourcing the respective activity to the supplier that can readily re-deployed to the competitors. From the network perspective, Lorenzoni and Lipparini (1999) study the process of vertical disintegration and the ability to integrate knowledge residing both inside and outside the firm's boundaries as a distinctive organisational capability. They recognise that the relational capability accelerates the lead firm's knowledge access and transfer that result in company growth and innovativeness, so the managers can develop a specialised supplier network and build a narrower and competitive set of core competencies over time. Dyer and Nobeoka (2000) investigate the Toyota production system to understand how it develops the bilateral and multi lateral knowledge sharing routines with suppliers that result in superior network learning. These scholarly efforts merely explain leveraging supplier capabilities and interfirm relationships but customer knowledge leveraging hitherto being largely neglected.

Another steam of research concentrates on customer leveraging. Kim and Lee (2007) suggest not to fire the unprofitable customers because of their strategic network value created by the network externalities through the operational and collaborative customer leveraging efforts. Since the current marketplace is characterised by a change in the economics of information but with enhanced IT solutions, firms can potentially convey a rich message to a wide base of customers with a number of different products as well as collecting information about the customer segments without paying attention to the so called trade-off between reach and richness (Peppard, 2000). In a competitive setting, knowledge management leads to quality improvements rather than cost reductions when the firms' ability to leverage their customer base is high but in a dynamic setting, higher ability to leverage the customer base may actually hurt profits and lead to industry shakeouts (Ofek and Sarvary, 2001).

Though both research streams are illuminating, they obscure the fact that how the concurrent but separate supplier and customer knowledge leveraging practices contribute to the plant's financial performance. Further, the recent debate between PBV and RBT emphasises that practices alone may not always add value to a firm. For instance, several firms or the plants across the same firm in an industry who try to implement similar practices such as total quality management (TQM) achieve varying levels of quality in the products due to their varying capabilities (Hitt et al., 2016a). Drawing upon capabilities perspective, the manufacturers usually rely on the contextual factors within their locus of control to sense the extent of knowledge leveraging to be practised. Thus, we recognise plant's internal environment as an important factor that interacts with plant's knowledge leveraging practices as joint determinants of financial performance. Therefore, this study brings about how the associations between the supplier and customer knowledge leveraging and financial performance vary with the different conditions of the internal business environment that are largely absent in the literature. Moreover, this helps to argue how these two practices bring counter results to the plant under the same environmental dimension.

Plant's Internal Environment

The business environment is a multidimensional construct, with the most commonly recognised dimensions being the munificence, dynamism, and complexity (Bourgeois, 1980; Dill, 1958; Miller, 1988; Swamidass and Newell, 1987). However, these concepts have been internalised to define the manufacturing complexity combining with the supply chain literature (Bozarth et al., 2009; Wiengarten et al., 2017). In line with the insights provided by Wiengarten et al.'s (2017) article, it illuminates the opportunities to define the plant's internal dynamism and munificence along with the longstanding business environment literature. Therefore, in this study, we conceptualise both internal dynamism and munificence apart from the existing

construct of internal complexity that proposed as moderators to the relationship between supplier and customer knowledge leveraging practices and financial performance.

Financial Performance

Through RBT perspective, plant's financial success is dependent on its possession of a specific combination of resources that are valuable, rare and difficult to imitate (Barney, 1991; Hitt et al., 2016b). In line with the RBT insights, the simultaneous application of PBV and KBV of the firm highlights the importance of knowledge leveraging practice to the supply chain as an antecedent of the firm performance (Bromiley and Rau, 2016; Grant and Baden-Fuller, 2004; Hitt et al., 2016b,). Hence, this study pursuits the strategic link between the supplier and customer leveraging practices and financial performance which in ways of sales, profitability and market share (Wiengarten et al., 2017). The conceptual model shown in figure 1 indicates the moderation effects of internal features of the manufacturing environment on the relationship between the knowledge leveraging practices and the financial performance. We hypothesise these relationships for empirical validation.

Insert Figure 1 about here

HYPOTHESES DEVELOPMENT

Knowledge Leveraging Practices and Financial Performance

Though most explicit knowledge and all most all the tacit knowledge remain with individuals, they create much of this knowledge within the organisation (Grant, 2002) as such the literature views organisation as a creator of knowledge (Choi and Lee, 1997). Since few firms possess these firm specific knowledges to keep up with the technology changes through internal efforts alone (Bettis and Hitt, 1995; Teece, 1986), a rich stream of scholarship extending the inward-looking perspective of RBT to the inter-firm level reveals that accessing supplier and customer capabilities is a decisive factor of firm's competitive advantages (Dyer and Singh; 1998,

Weigelt, 2013). However, merely accessing supplier or customer knowledge does not promise the performance rewards (Barney, 1989; Weigelt, 2013). Rather, it is the internal enforcement practices such as leveraging which is likely to result in performance variance among the firms that own or access similar knowledge and technical capabilities (Choi and Lee, 1997; Lorenzoni and Lipparini, 1999; Sirmon et al., 2007).

The expected role of knowledge leveraging is to make the relevant knowledge accessible and seek applications for the obtained new knowledge via the existing interfirm relationships under the norm of knowledge replication is cheaper than creation (Choi and Lee, 1997; Grant, 2002; Shapiro et al., 1999). Accordingly, leveraging practice is quite different from the ambidextrous supply chain strategy where seeking the fine balance between the knowledge exploration and exploitation that align with the firm's absorptive capacity (Kristal et al., 2010; Tamayo-Torres et al., 2017). Leveraging plays a critical role in deciding the knowledge appropriateness to the plant's activities and seeking applications through the supply chain relationships that enhance cost efficiencies and quality effectiveness than developing by the plant itself. The knowledge leveraging practices have different implications on both the supply and demand side of a manufacturing plant depending on their scope as resource utilisation and customer satisfaction consecutively (Herrmann and Hodgson, 2001; Ofek and Sarvary, 2001). Thus, the software based technologies treat supplier resource planning and customer relationship management separately to stay abreast with shrinking product lifecycles and steep price erosions (Herrmann and Hodgson, 2001).

The primary objectives of the supplier knowledge leveraging are to maximise the value of a manufacturer's supply base through substantial reductions in the true cost of materials, increased flexibility to dynamic situations and faster cycle times which can increase the market share (Herrmann and Hodgson, 2001; Lorenzoni and Lipparini, 1999; Weigelt, 2013).

Complying with the PBV, the performance benefits from the supplier knowledge that is available to multiple plants appear valuable but are not unique to any plant and therefore they are not the supplier knowledge based advantages (Barney, 1991; Weigelt, 2013). In this study, how the plant leverages supplier knowledge would give a clear indication of practice based performance benefits. The leveraging occurs when plant treat suppliers as knowledge generators while extensively relying on them at the early stages of the product developments (Lanier et al., 2010). This practice simultaneously controls and coordinates the supplier knowledge to reduce the contract governance cost and increase the rate of innovation while enhancing the financial performance (Wagner et al., 2012; Wagner and Bode, 2014).

Unlike the plant's tendency to create strategic alliances with the suppliers for knowledge leveraging that reduce the production costs (Grant and Baden-Fuller, 2004) the demand side leveraging must ensure that customers bring return sales to the plant (Kim and Lee, 2007; Ofek and Sarvary, 2001). Consequently, the conventional approach of the customer relationship management was to drop the unprofitable customers while strengthening bonds with more profitable customers (Kim and Lee, 2007, Ofek and Sarvary, 2001). Nonetheless, customer leveraging practice turns out to be important with the concept of network externalities that expedites the use of one-to-one relationships, customer-value analysis and mass customisation (Peppard, 2000). Kim and Lee (2007) posit that network externality is an interesting market characteristic that even makes seemingly financially unprofitable events strategically valuable to a firm if they result in growth in network size. With the advent of recent technological advancements, the trade-off between plant's reach (the number of customers connected with the plant and the range of products offering to them) and richness (knowledge sharing and accumulation from the customers) started to disappear by increasing financial benefits to the plant (Peppard, 2000). Hence, the plant creates wider opportunities to find knowledge and application even from an unprofitable customer who may be sometimes dealing with the plant's

competitors in the same product line. Customer leveraging plays a positive role in generating profits by sensing how to access and deploy the customer relationships than just dropping unprofitable customers from the list. As per the above discussion, we propose

Hypothesis 1: There is a positive association between the supplier knowledge leveraging and the financial performance.

Hypothesis 2: There is a positive association between the customer knowledge leveraging and the plant's financial performance.

Internal Environment: Moderating Effects of Dynamism, Munificence and Complexity

Although the manufacturers practice the supplier and customer leveraging identically in the same industry, it may bring varying results in firm performance due to the changes in inherent characteristics of the manufacturing environment (Hitt et al., 2016a). The nature of the internal environment differs by the modern industrial realities such as flexible manufacturing systems, modular products, computer aided designs and robotics that enable a wide variety of products (Boyer et al., 1997; Das and Narasimhan, 2001). However, the existing literature widely investigates the moderating effects of the external environment (Demeester et al., 2014; McArthur and Nystrom, 1991; Prescott, 1986) which mostly being characterised by the dynamism, munificence and complexity (Dess and Beard, 1984; Heeley et al., 2006; Keats and Hitt, 1988) on the association between manufacturing strategies and performance and paid less attention to the role of manufacturing environment for performance variations implied by the supply chain practices. Therefore, this study internalises these environmental characteristics to the manufacturing environment and proposes how they interact with the knowledge leveraging practices to jointly determine the financial performance.

External dynamism contributes to the fluctuations in innovations, customer preferences (Ward et al., 1995) and organisational decision making (Bourgeois, 1980; Heeley et al., 2006) and internal dynamism also share the same attributes of the manufacturing environment. For instance, the survey based items that used to measure the external dynamism are the plant's product obsolescence and innovation rate, process innovation rate and customer tastes and preferences in the industry (Pagell et al., 2007; Tamayo-Torres et al., 2017; Ward et al., 1995). While these items have their own merits, first three items that actually represents the plant's internal operations used as proxies of external dynamism and therefore they convey the importance of exploring how the knowledge leveraging and financial performance nexus varies at different dynamic levels at the plant.

The early developments of RBT recognise that plant's environmental dependence is governed by the importance of a resource to the plant based on the number of available sources and competitors and their relative power (Dess and Beard, 1984; Pfeffer and Salancik, 2003). Hence, the plant cannot escape from being decidedly dependent on numerous external sources to acquire a unique resource such as knowledge. However, this dependency varies across the industries and markets implied by various dominant requirements such as customer service, product quality, innovation and technology developments (Ofek and Sarvary, 2001; Prescott, 1986). Further, exponentially growing knowledge and technology persuade managers to make quick updates in operational decisions adopting the environmental uncertainties (Demeester et al., 2014; Lawrence and Lorsch, 1967). Per se, the concept of internal dynamism should reflect from where and how frequently the innovations and knowledge transfer to the plant and the nature of operational decision-making.

Consequently, the managers expose to discontinuous decision making (Aldrich, 2008; Dill, 1958) in dynamic operations to quickly match contemporary needs and mostly solve the short-

term issues (Demeester et al., 2014; Swamidass and Newell, 1987) that attached to the unpredictable change in demand, technology and competitors (Ward et al., 1995). The motivation behind the supplier knowledge leveraging is to achieve the time compressions in product and process developments and the search for new technologies and innovation opportunities that execute the market uncertainties (Lorenzoni and Lipparini, 1999). When the demand uncertainties are higher, the manufacturers excessively rely on the supplier relationships moving away from the internal absorption strategies within corporate boundaries and increasing the sales and market share (Lorenzoni and Lipparini, 1999; Podolny, 1994). Highly dynamic manufacturing environment supports for the upsurge of the positive association between supplier knowledge leveraging and financial performance.

In contrast, Ofek and Sarvary (2001) posit that the firms who excessively practising customer knowledge leveraging to improve the product quality and the customer base may actually hurt profits and lead to industry shakeouts in a dynamic setting. Though customers use their potential power to claim benefits from the manufacturers, they cannot use the power in a corresponding way at the risk of customers shifting to their rivalry (Kim and Wemmerlöv, 2015). Accordingly, plants can influence only the extent to which customer expectations play a role in their demand (Ofek and Sarvary, 2001). When the dynamic level of operations is increasing, it diminishes the positive slope between the customer knowledge leveraging that deals with demand uncertainties and financial outcomes. Therefore, we propose

Hypothesis 3: Higher dynamism within the plant leads to a stronger positive relationship between the supplier knowledge leveraging and the financial performance.

Hypothesis 4: Higher dynamism within the plant leads to a weaker positive relationship between the customer knowledge leveraging and the financial performance.

Literature defines munificence as the resource generosity which can support the sustained growth of a manufacturing plant in a certain industry (Heely et al., 2006; Ward et al., 1995) and we define the internal munificence as the plant's resource generosity that may attenuate the resource slack. Developing resource efficiency is argued to have a stable and predictable plant performance (Shah and Ward, 2003). Likewise, maintaining a resource slack would experiment product and process innovations without compromising plant performance and consequently attenuating negative financial reactions from the market (Modi and Mishra, 2011). Ward et al., (1995) included three scales to represent the environmental munificence such as business costs, labour availability and competitive hostility (Pagell et al., 2007) but we select only the items that represent the manufacturing environment. For instance, they use company's shortage of technicians and skilled workers under labour availability scale. In this line, we use the proxies such as workforce technological skills and superior technical know-how in the plant to define the construct of internal munificence. The other two proxies that we used such as plant's having state of the art and unique manufacturing processes contribute to producing with the required quality standards (Pagell et al., 2007; Ward et al., 1995) and increasing plant's survival chances (Demeester et al., 2014) that represent the external munificence in prior research. In light of RBT, the plants endowed with unique and competitive assets such as labour, manufacturing processes and technologies are able to produce more economically and better satisfy customer desires (Peteraf, 1993).

Though competitive advantage is rooted inside a plant, in assets that are valuable and inimitable (Russo and Fouts, 1997), plant's supplier knowledge leveraging practice somewhat marshal these assets to determines the superior financial performance. For instance, the plant mostly enjoys the pull model of innovation where the plant is the active party that initiate to receive a higher output of supplier innovation in new product and process development efforts (Wagner and Bode, 2014). Highly munificent manufacturing setting would stimulate inducing

the plant's control over knowledge and technology flow from the suppliers and innovation selection (Grant and Baden-Fuller, 2004) to match with the available resources. Therefore, we can expect positively steeper slopes for the supplier knowledge leveraging and financial performance nexus by limiting the unnecessary wastages in time, cost and resources.

Plants outperform the competitors by leveraging intangible resources such as technology and knowledge at the customer interface (Zahra et al., 2003). Having a larger number of customers is always beneficial to the plant whether they are profitable or not but plant must impose boundaries for the richness of knowledge that reveals and relies for each customer segment and characteristic separately (Peppard, 2000). The product-specific sales fluctuations encourage plants to learn, develop and innovate diverse product and process offerings to win customers' hearts. Hence, they practice customer knowledge leveraging by blending and bundling the customer knowledge to comply with the plant's resource requirements (Zahra et al., 2003). When the plant is internally capable of having higher levels of skilled labour, unique product and process technologies comparative to rivals (Barney, 1991; Ward et al., 1995), unreasonably leveraging customer knowledge might bring negative financial reactions from the demand side (Modi and Mishra, 2011). It is questionable whether the investments made on customer knowledge leveraging bring marginal sales and profits to the plant by increasing market share when the plant possess unique technical knowledge and labour (Grant, 2002; Hitt et al., 2016; Kim and Lee, 2007). For instance, Apple which has unique technology based resources imposes more restrictions on application development for iPhones but still make more profits than Android which support for open source developments even with higher application downloads than Apple. Though in a vastly munificent manufacturing setting, customer leveraging causes for diminishing the positive slopes of customer knowledge leveraging and financial performance nexus, the positive effect of customer knowledge leveraging will continue to remain. Therefore, we propose

Hypothesis 5: Higher munificence within the plant leads to a stronger positive relationship between the supplier knowledge leveraging and the financial performance.

Hypothesis 6: Higher munificence within the plant leads to a weaker positive relationship between the customer knowledge leveraging and the financial performance.

Bozarth et al. (2009) define the internal manufacturing complexity as the level of detail and dynamic complexity found within the manufacturing facility's products, processes, and planning and control systems (Child, 1972). The product and parts range determine the detail complexity while dynamic complexity involves the situations where cause and effect are subtle (Bozarth et al., 2009). As such, the changes to master schedule quantities can have unpredictable, nonlinear impacts on the individual material plans due to the differences in planning lead times, lot-sizing rules and inventory levels for lower level components (Bozarth et al., 2009). Wiengarten et al. (2017) interpret the internal manufacturing complexity through the aspects of a plant's bill of material and product changes and we will use the same items in this study complying with the measures proposed by Flynn and Flynn (1999) such as the types and number of products and processes and the changes in manufacturing schedules.

Increasing manufacturing complexity does not necessarily fulfil the market or customer requirements (Flynn and Flynn, 1999) and mostly has negative reactions to competitive operational performances while limiting the financial gains (Bozarth et al., 2009; Modi and Mishra, 2011). For instance, the literature suggests using strategies such as commonality, shared product platforms and modularization as much as possible (Meyer and Lehnerd, 1997) over product proliferation as it contributes to negative manufacturing performances (Salvador et al., 2002). Plants tend to increase the manufacturing complexity only if they continue to grow in profits, sales and market share by expanding its product offerings even though their operational performances might diminish (Salvador et al., 2014). Consequently, the literature

infers that the internationally expanded businesses have succeeded through leveraging both tangible and intangible resources which marked significant percentages of profits from international sales (Zahra et al., 2000). To enhance the product configuration effectiveness in a complex setting, the conflicting goals of knowledge exploration and exploitation should be complemented with the supplier and customer knowledge leveraging practices supporting product and process innovations (Salvador et al., 2014).

The supplier and customer knowledge leveraging practices are interwoven in increasingly complex manufacturing environments as the supply side knowledge and technology related applications must make a match with demand side goal diversity that focuses on product variety, volume and markets (Flynn and Flynn, 1999, Galbraith, 1973). In a complex setting, supplier knowledge leveraging simultaneously operates on the content side and the application side of relational sets to secure significant results (Lorenzoni and Lipparini, 1999). It simplifies the manufacturing processes resolving the conflict and competition among products and processes, technologies, quality standards and market segments raised by proliferation (Meyer and Lehnerd, 1997). This practice lowers the supply side opportunistic behaviour that enhances their reliability, lead time and supply base management (Bozarth et al., 2009). For instance, manufacturing plant sets strategies such as the pull model of innovation (Wagner and Bode, 2014) and coopetition (Pathak et al., 2014) that leverages the suppliers' knowledge sufficiently to shape both the cooperative and competitive behaviours capturing value from the relationships (Kim and Wemmerlöv, 2015).

Similarly, plants use customer leveraging strategies such as 'efficient consumer response' and 'collaborative planning, forecasting and replenishment' to control product proliferation by maintaining an optimum selection of products and avoiding unnecessary new product introductions (Bozarth et al., 2009). However, the multiplicity of products with shorter life

cycles (Azadegan et al., 2013) offer limited opportunities for customer knowledge leveraging specially in a very fragmented customer base. For instance, customers' dependence on multiple manufacturers for products such as smart phones devalues the leveraged knowledge and applications about the expected quality improvements, delivery performance and enhanced sales forecasting (Cousins and Menguc, 2006). Therefore, higher manufacturing complexity that deals with a wider range of products, suppliers and customers degrade the positive relationship between customer knowledge leveraging practice and financial performance while increasing the positive association of supplier knowledge leveraging and financial performance nexus and hence we propose,

Hypothesis 7: Higher manufacturing complexity leads to a stronger positive relationship between the supplier knowledge leveraging and the financial performance.

Hypothesis 8: Higher manufacturing complexity leads to a weaker positive relationship between the customer knowledge leveraging and the financial performance.

RESEARCH METHODOLOGY

Data and Operational Definitions

The database used in this study is the fifth edition of Global Manufacturing Research Group (GMRG) survey that designed for the improvement of manufacturing supply chains worldwide and it includes the questions related to the business performance, supply chain management, innovation and sustainability. It collected data from directors of operations/ manufacturing and the sample consists of 968 manufacturing facilities in 21 industrial classifications and 18 countries. We use data from 513 manufacturing facilities in 9 countries such as Australia, Croatia, USA, Vietnam, Poland, Ireland, Hungary, China and Taiwan for the analysis after eliminating the missing values. The unit of analysis is the manufacturing plant. We control for the country effects on the basis of United Nation's list of developed and developing countries

(United Nations, 2014) and industry effects divided into two categories such as products and industries and commodities using dummy variables. Also, we control for the plant size which is a proxy for economies of scale and measure as the natural logarithmic transformation of the number of employees (Wagner et al., 2012).

Validity and Reliability

Since we propose new items and variables complying with the existing literature except for the financial performance and the internal complexity, we conduct an exploratory principal component factor analysis with Promax rotation and Kaizer normalisation of 0.750 (at p=0.000) that converged in exactly 6 iterations. The table 1 shows the underline structure of the variables used for the analysis and ensures the discriminant validity. Further, the table 2 in the appendix summarises the items used in developing the respective variables and supported literature with their factor loadings of principal components factor analysis with the varimax rotation that verifies the convergent validity. In both tests, the average factor loading of each variable is greater than 0.70. Reliability is the degree of internal consistency of a construct (Boyer et al., 1997). We use Cronbach's alpha to assess the reliability of the proposed scales and the threshold for acceptable reliability for existing measures is alpha values of 0.70 and 0.60 for new measures (Hair et al., 2006). In this study, all the constructs exceed the 0.70 threshold as indicated in table 2. We did linear transformations for some composite variables to meet the expectations of normal distributions such as squared terms of supplier and customer knowledge leveraging and logarithmic transformation of internal complexity. Table 3 indicates the mean, standard deviation and correlations between the scale variables. The correlations between the internal environmental features are due to its simultaneous occurrences. Though the customer and supplier knowledge leveraging are independent constructs, they are interwoven when matching the customer expectations with supplier innovations as such, they are correlated.

Insert Table 1 and Table 3 about here

Endogeneity

The number of survey respondents varying from 1 to 11 persons answered the questionnaire together from a plant and collected from 18 countries in 21 industrial classifications. The survey that consists of five separate sections employee different measurement scales. Although the survey group took the mentioned precautions to reduce the common method bias it is still likely to occur in the results. Therefore, we performed endogeneity tests to check whether some explanatory variables are not independent of the residuals. We performed the Two-Stage Least Squares (2SLS) regression analysis using the instrumental variable procedure to check the endogeneity for the dependent variable of financial performance. We use the instrumental variables of 'rapid technological change in the industry' for the dynamism, 'difficult to predict the demand' for the munificence, 'too much stability is seen as bad and not progressive' for the complexity, 'the extent of using the plant recommended vendor list by the first tire supplier to select second and third tier suppliers' for the supplier knowledge leveraging and 'competitive intensity in the industry' for the customer knowledge leveraging variables. Since the robust endogeneity test statistics are not significant (at $p<0.05$), the endogeneity does not exist in the proposed variables.

RESULTS

We use the moderated regression analysis as shown in table 4 to test how the different levels of manufacturing environmental variables change the association between the independent variables of supplier and customer knowledge leveraging with financial performance. It helps to compare the regression models with and without the interaction terms of interest that include the product of each of the knowledge leveraging variables with each of the mean cantered internal manufacturing environmental variables. The first model that controls for the firm size,

country and industry effects accounts for a variance of 3% in financial performance. The second and the base model that includes the knowledge leveraging variables provide an incremental variance of 1.6% in financial performance while the inclusion of moderators in the third model account for 2.3 % increase in the model variance. The overall effect of the fourth model explains 10.4% variance in the financial performance after adding the interactions with an incremental variance of 3.5%. All the associated F tests are significant at $p<0.01$.

We further carried out a couple of tests to check the normality conditions of the proposed models. First, the multicollinearity tests confirm that the variance inflation factor does not exceed 2 for all four models tested in the analysis and it is below than the critical level of 10 (O'brien, 2007). Second, we check for the heteroskedasticity using both Breusch-Pagan / Cook-Weisberg test ($p=0.2139$) and Cameron and Trivedi's decomposition test ($p=0.1275$) as the final model includes the interaction terms and both tests confirmed that there is no heteroscedasticity of the tested model. Third, there are no omitted variables in the proposed model as Ramsey Reset test result is not significant (at $p= 0.281$). Finally, Link test confirmed that there are no model specification errors with a nonsignificant hat square (at $p=0.611$). Hence, the proposed model is well defined.

Insert Table 4 about here

The results support five hypotheses. Though the results do not support the direct association between the supplier knowledge leveraging and financial performance, all the three environmental factors significantly moderate the positive association between supplier knowledge leveraging and financial performance supporting 3rd, 5th and 7th hypotheses. In a dynamic setting, plant relies more on supplier knowledge and innovations at early stages of product developments to challenge the demand uncertainties (Herrmann and Hodgson, 2001). Munificent internal environment motivates the plant to leverage supplier knowledge to mitigate

the losses from the excess and scrap inventory and nonvalue adding tasks (Herrmann and Hodgson, 2001). Further to this, complex manufacturing operations also urge the importance of flexible and simple process developments and part commonalities in product development (Meyer and Lehnerd, 1997) and excessively leveraging supply knowledge related applications using strategies such as coopetition and alliances (Grant and Baden-Fuller, 2004; Pathak et al., 2014). Thus, supplier knowledge leveraging and financial performance nexus becomes evident in the guise of internal pressures of the manufacturing environment than presenting alone.

The findings confirm that one additional unit of the squared term of the customer knowledge leveraging increases the financial performance by 25.7% supporting the 2nd hypothesis. However, only the internal munificence acts as a significant moderator that lowers the positive association between the customer knowledge leveraging and the financial performance relationship supporting the 6th hypothesis. Surprisingly, the results reveal that both the internal dynamism and percentage increase of internal complexity are not dominant factors that can change the slope of the customer knowledge leveraging and the financial performance relationship. This might be the reason that the plant's role as a supplier in relationships with customers does not capture the value by leveraging rather cooperative behaviours and customer initiation increases the profits (Kim and Wemmerlöv, 2015). Therefore, plants may not pressure the customer base even under highly dynamic or complex manufacturing settings rather focus on supplier base for cost reductions and innovations that address the demand uncertainties (Lorenzoni and Lipparini, 1999). Yet, the plant may perceive a powerful position by possessing unique technical skills and processes in a munificent manufacturing environment that lead to lower the positive association between the customer knowledge leveraging and the financial performance nexus.

The moderation graphs (Hayes, 2013) shown in figure 2 in the appendix graphically affirm the above arguments. We have indicated only the moderation results which are significant

below 0.05 probability levels. The graph shows how the relationship between the independent variable and the dependent variable varies at three levels of the moderator such as mean minus 1 standard deviation, mean and mean plus 1 standard deviation. The straight lines indicate the significant relationships. The supplier knowledge leveraging and the financial performance relationship is evident at the higher level of internal dynamism while both the mean and high levels in the percentage of internal complexity manifest the relationship. As proposed by the 6th hypothesis, the customer knowledge leveraging and the financial performance nexus is only evident at the mean and low levels of internal munificence with a diminishing positive slope.

DISCUSSION

The primary objective of this study is to understand how the relationship between the knowledge leveraging practices and the financial performance varies at different levels of the manufacturing environmental dimensions. The results supported for moderation capability of all the internal features such as dynamism, munificence and complexity that significantly increases the positive slope of the supplier knowledge leveraging and the financial performance nexus at higher levels of the moderators. Only the internal munificence lowers the positive association of the customer knowledge leveraging and the financial performance relationship while the other two internal features remain silent. However, the customer knowledge leveraging and the financial performance relationship is dominant by itself to improve the financial performance without subjecting to any internal pressure while the results based on this sample affirms the nonexistence of the supplier knowledge leveraging and the financial performance association in the absence of internal environmental pressures.

Theoretical Contributions

The KBV that has grown out of RBT provides insights into the management of strategic supply chain relationships and researchers later distinguish between the knowledge exploitation and

exploration (Grant and Baden-Fuller, 2004; March, 1991). Also, the recent papers argue that a simultaneous approach of knowledge exploitation and exploration creates better performances for an ambidextrous firm than the long-stood trade off concept between these two activities (Tamayo-Torres et al., 2017). Hence, this study recognises the importance of leveraging practice in both knowledge exploitation and exploration which may have been misguided leveraging as creating the strategic fit between these two in prior literature. Therefore, we provide a clear conceptualisation of both the supplier and customer knowledge leveraging indicating the leveraging activity in both exploitation and exploration. The underlying basis of these constructs are the prior KBV literature that emphasises knowledge replication is much profitable than accumulation and developing by the plant itself (Grant, 2002; Nonaka, 1991).

In light of PBV arisen from the RBT literature (Bromiley and Rau, 2014), we recognise knowledge leveraging as a distinctive practice imitable by the other firms to increase the performance apart from the knowledge's relative importance as a scarce resource (Grant, 1996). To a larger extent, supplier and customer knowledge leveraging literature evolve independently to explain the business performances. For instance, the anecdotal evidence of literature mostly examines the concept of supplier knowledge leveraging in interfirm alliances (Grant and Baden-Fuller, 2004)) and knowledge accumulation at the product level frim networks (Lorenzoni and Lipparini, 1999). Also, the customer knowledge leveraging literature mostly deals with the trade-off between the information richness and customer reach in handling customer relationships (Peppard, 2000). As such, this cross-sectional study explores the association between both the plant level supplier and customer knowledge leveraging efforts and financial performance at the relationship level without treating them as strategic alliances.

The external environmental features such as dynamism, munificence and complexity generally apply to moderate the strategy and performance relationship (Demeester et al., 2014;

McArthur and Nystrom, 1991; Pagell et al., 2007,). Nevertheless, empirically grounded studies propose internal manufacturing complexity as an antecedent of operational performance (Bozarth et al., 2009; Wiengarten et al., 2017). In addition to its potential for moderating the context specific strategies, the other two features also have important implications for the leveraging and performance nexus. Thus, we conceptualise and propose the items for the internal dynamism and munificence in the guise of business environment literature that used survey based items. This paper further extends the knowledge leveraging literature by theoretically proposing and empirically validating the internal features of the manufacturing environment as moderators of the positive associations between the supplier and customer knowledge leveraging and financial performance. Most importantly, underlying theoretical framework combines three perspectives of KBV, PBV and RBT with manufacturing environment literature to empirically validate how the financial gains of the knowledge leveraging practices vary at different levels of the internal manufacturing environmental dimensions.

Managerial Implications

In light of PBV, this study is more relevant to the practitioners that increase the legitimate potential explanations for financial performance than using RBT alone (Bromiley and Rau, 2016). Though previous studies elucidate larger positive effects of knowledge exploitation and exploration on the performance (Tamayo-Torres et al., 2017), this study examines the additional benefits of leveraging practice in both the exploited and explored knowledge along supplier and customer relationships and how these relationships vary under internal environmental conditions. Manufacturing plants mostly increase their competencies by possessing the relatively scarce knowledge and unique product and process technologies that encourage the supplier involvement in early stages of product development (Grant, 1996; Weigelt, 2013). The knowledge leveraging practice becomes highly imperative in simplifying the complex

manufacturing processes, increasing commonality to reduce proliferation, promoting coopetition among suppliers and optimum demand forecasting and replenishment. Hence, this practice contributes to every single bit of manufacturing by gaining cost efficiencies through knowledge replication and finding proper applications along the supply chain relationships.

Customer knowledge leveraging practice enhances the financial performance by controlling product wastages and satisfying the customers with quality efficient and optimum product range. For instance, Dell continues to grow in profits through customised computer sales while passing the innovation risks and inventory to the supplier base. However, this positive association significantly lowers only in highly munificent internal environments. The recent acquisition of Compaq by HP was mainly due to Compaq's ignorance on key customer concerns who even pioneered in customer knowledge leveraging for application development in a munificent environment supported by talented employees. The positive association of supplier knowledge leveraging and financial performance continues to increase at the higher levels of dynamism, munificence and complexity than becoming self-evident. The suppliers' involvement at early product development stage with the costing details helps Honda to fulfil the regional demand even at dynamic facets. Apple whose armed with abundant inhouse IT knowledge still bonds with a comparatively larger number of suppliers to get a very small portion of its supplies to keep them as a latent capacity. Further, Zara's vertically integrated supply network is very popular to get the best use of its suppliers to thrive in complex customer markets. These industrial examples approach the managers with all the controllable factors, as such, they can align their internal features of the manufacturing environment with supplier and customer knowledge leveraging practices to enhance the financial performances.

These interactions are effective strategic means of transferring and seeking the knowledge and applications of supply chain innovations and technologies that ensure the plant's financial

performance. They provide an ideal platform for the managers to develop more effective business models by facilitating the supply chain partner enabled vision for the performance. It will result in competitive advantage for the plants to stay economically sustainable in their target markets and to approach new markets. Having a proper awareness of the moderation effects can avoid unexpected disruptions to the supplier and customer relationships and mitigate the negative impact on the financial performance. We develop the table 5 to further elaborate the aforementioned industrial examples that empirically supported the hypotheses.

Table 5: Managerial implications with industrial examples

Hypothesis	Industrial examples
H2: Customer Knowledge Leveraging	Dell that follows the make to order strategy deliberately relies on customer knowledge leveraging to meet custom made requirements at a reasonable price (Quinn, 1999). As such, it concentrates only on unique value-added activities transferring the huge inventory, facilities and innovation risks to its supplier base. Customer knowledge leveraging is at the heart of Dell's strategy with dedicated knowledge managers for each major customer and an entire staff to track these customers' changing needs and system configurations (Quinn, 1999). Dell continues to grow in profits by capturing crucial market information through customer knowledge leveraging.
H3: Internal Dynamism * Supplier Knowledge Leveraging	Supplier knowledge leveraging helps to stay abreast with new technologies tapping into the external suppliers' capabilities to compensate the plant's weaknesses (Weigelt, 2013) in forms of technical skills and manufacturing technologies. Although knowledge and technology are readily available at suppliers, it is how the plant recognises, transforms and delivers them profitably in a highly dynamic manufacturing setting. Honda works with the strategic suppliers from an early stage of product developments with open book arrangements to continuously improve the quality, delivery and costing. It outsources nearly 75% while suppliers provide 90% of the costing details. The plant optimises the available knowledge related resources and supplier diversity to fulfil the regional demand with direct contacts of around 600 suppliers in North America.
H5: Internal Munificence * Supplier Knowledge Leveraging	Apple increasingly leverages supplier knowledge to recognise the technological knowhow and applications that reduce the uncertainty of innovations but it ensures they comply with its highly munificent internal environment that owns unique knowledge and technology. It is best at inventory handling with unrivalled 5 days' turnover by handling entire operation with one assembly plant in China and one central warehouse in the United States of America. Its supply bases accounts for around 200 suppliers for 97% of the supplies while around 600 suppliers for the rest. Apple that entirely driven by design and innovation leverages supplier knowledge for pricing, volume and strategic raw material that increase the financial performance remaining as the world's number one supply chain since 2010 and growing in revenue during the recent recession.
H6: Internal Munificence * Customer Knowledge Leveraging	Merely possessing the customer knowledge and technology (Weigelt, 2013) does not increase the financial performance, rather the plant must ensure the return business and profits by focusing only on opportunities that enhance the reliability of boundary spanning processes. Compaq, the world's largest PC supplier during 1990s won an enormous credibility and a technological lead unmatched by its competitors supported by its munificent manufacturing environment including skilled employees and astute marketers. Although Compaq pioneered with customer knowledge leveraging that empower users to share applications for

	products, they failed to pick up on key customers' concerns about their new corporate strategy such as merging with HP. Finally, HP acquired Compaq and discontinued brand by 2013.
H7: Internal Complexity * Supplier Knowledge Leveraging	Zara is reckoned for introducing new designs and launching new products of limited quantity within a short time duration. Hence, it manages this complex but centralised manufacturing strategy with 11 plants and one warehouse dedicated to supplying. Zara has full control over the different phases of garments production with vertically integrated supply network to increasingly leverage supplier knowledge at early stages of new garment designs.

CONCLUSION

The primary purpose of this study is to recognise both the supplier and customer knowledge leveraging as separate practices that promote the plant performance in light of recently emerged PBV literature (Bromiley and Rau, 2014). These practices can also apply to both the knowledge exploitation and exploration tasks irrespective of plants trying to simultaneously approach them or make a trade-off between them to enhance the operational performances (Kristal et al., 2010). Hence, this study provides a clear conceptualisation of these two constructs illuminating the KBV and RBT as replication is cheaper than creating alone for a relatively scarce resource such as knowledge (Nonaka, 1991). We then propose the plant's internal environmental features as the moderators that can change the positive associations of leveraging practices and the plant's financial performance deviating from the conventional approach of considering external environmental features as moderators into the strategy-performance relationship. Accordingly, we develop new items for the constructs of internal dynamism and munificence which are lacking in the prior literature. By doing so, we develop a conceptual framework within the manufacturer's span of control by integrating PBV, KBV and RBT with business environment literature.

The empirical results validate that the positive association of the supplier knowledge leveraging and the financial performance increases when the internal dynamism, munificence and complexity levels increase. However, the positive slope of the customer leveraging and the

financial performance lowers in highly munificent manufacturing environments while other two features are not significant as moderators for this relationship. Most importantly, only the customer knowledge leveraging is self-evident in improving the plant's financial performance in the absence of internal pressures. This study offers a more rigorous and scientific analysis to the managers elucidating how to foster the PBV, KBV and RBT together in developing customer and supplier knowledge leveraging strategies to enhance the financial performance subjecting to the internal environmental conditions.

Study Limitations

The use of cross sectional data may limit the discussion of the causality in which the longitudinal researches replicating this study would increase our understanding. Also, this approach relies on survey respondents to provide opinions which may have a demand characteristic rather than using externally reported information (York and Miree, 2004) but it seems to be the better approach as this study mostly deals with the plant's internal features and strategies. The use of the existing databases sometimes affects the operationalization of constructs (Narasimhan and Jayaram 1998) as some of the relevant items in GMRG questionnaire fail in this study due to the reliability and validity issues.

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TABLES AND FIGURES

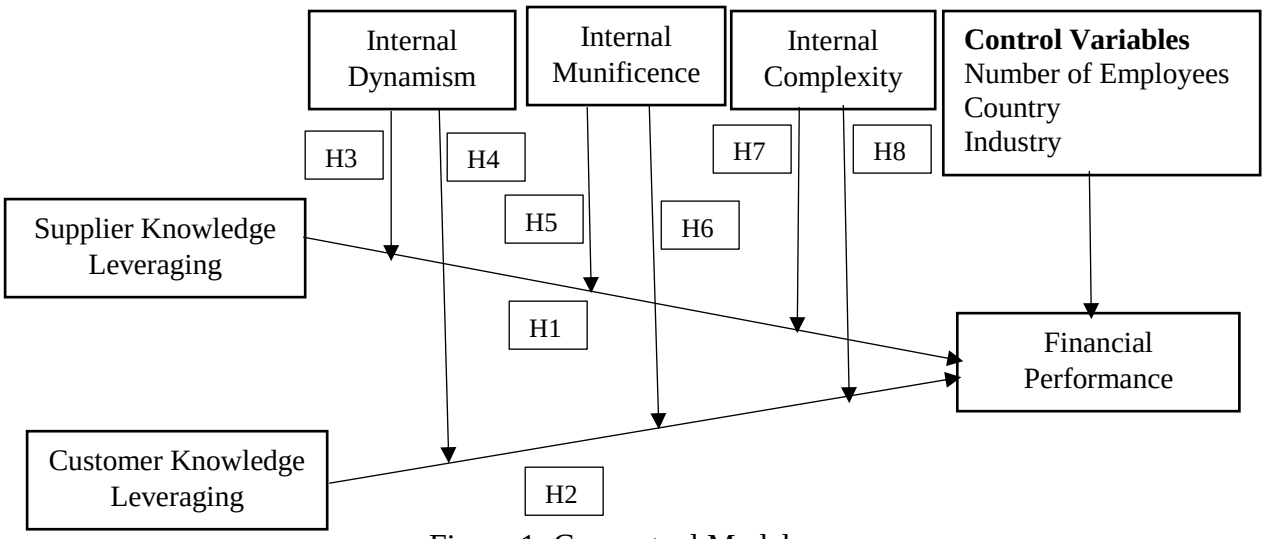

Figure 1: Conceptual Model

Table 1: Exploratory factor analysis

Item	Component					
	1	2	3	4	5	6
IM4	.873					
IM1	.811					
IM2	.810					
IM3	.759					
IC3		.868				
IC1		.831				
IC4		.771				
IC2		.762				
CKL2			.916			
CKL1			.881			
CKL3			.843			
FP1				.921		

FP2				.913		
FP3				.835		
SKL1					.895	
SKL2					.889	
SKL3					.828	
ID4						.778
ID3						.775
ID2						.738
ID1						.661

SKL- Supplier knowledge leveraging, CKL- Customer knowledge leveraging, ID- Internal dynamism, IM- Internal munificence, IC – Internal complexity and FP- Financial performance

Table 3: Descriptive and correlations between scale variables

Variable	Mean	S.D.	$(SKL)^2$	$(CKL)^2$	ID	IM	Ln(IC)	FP
$(SKL)^2$	21.989	10.578	1.000					
$(CKL)^2$	25.581	11.170	0.434***	1.000				
ID	4.481	1.049	0.217***	0.278***	1.000			
IM	4.743	1.092	0.321***	0.266***	0.142***	1.000		
Ln (IC)	0.782	0.532	0.117***	-0.015	0.116***	0.105**	1.000	
FP	4.143	1.198	0.093**	0.134***	0.092**	0.187***	0.022	1.000

*** p<0.01, ** p<0.05, * p<0.1 S.D.- Standard deviation

Table 4: Moderated regression for financial performance

Variables	Model 1	Model 2	Model 3	Model 4	Hypothesis
No. of employees	0.0851**	0.0832**	0.0820**	0.0621*	
Country	0.161	0.148	0.126	0.0936	
Industry	0.257**	0.245**	0.257**	0.247**	
$(SKL)^2$		0.00345	-0.00104	-0.00487	H1: No
$(CKL)^2$		0.0122**	0.00842*	0.00959*	H2: Yes
ID			0.0432	0.019	
IM			0.172***	0.192***	
Ln(IC)			-0.0636	-0.0436	
$(SKL)^2$ * ID				0.0104**	H3: Yes
$(CKL)^2$ * ID				0.00342	H4: No
$(SKL)^2$ * IM				0.00865*	H5: Yes
$(CKL)^2$ * IM				-0.0130***	H6: Yes
$(SKL)^2$ * Ln(IC)				0.0212**	H7: Yes
$(CKL)^2$ * Ln(IC)				-0.0093	H8: No
Constant	3.654***	3.281***	2.528***	2.641***	
Observations	513	513	513	513	
R-squared	0.03	0.046	0.069	0.104	
R-squared change	0.03	0.016	0.023	0.035	
F test	5.17*	4.42*	4.35*	3.96*	

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX

Table 2: Construct development and supported literature

Independent Variables	Factor loading	Measurement scale							Supported literature
		Strongly disagree		Neutral			Strongly agree		
Supplier knowledge leveraging (SKL) Cronbach's Alpha = 0.860									(Choi and Lee, 1997; Grant, 2002; Grant and Baden-Fuller, 2004; Kristal et al., 2010; Lorenzoni and Lipparini, 1999; Tamayo-Torres et al., 2017; Weigelt, 2013)
SKL1: We are able to obtain a tremendous amount of technical know-how from our suppliers	.851	1	2	3	4	5	6	7	
SKL2: We rapidly respond to technological changes in our industry by applying what we know from our supplier	.869	1	2	3	4	5	6	7	
SKL3: As soon as we acquire new knowledge from our supplier, we try to find applications for it	.814	1	2	3	4	5	6	7	
Customer knowledge leveraging (CKL) Cronbach's Alpha = 0.871									(Kim and Lee, 2007; Kristal et al., 2010; Ofek and Sarvary, 2001; Peppard, 2000 Sirmon et al., 2007; Tamayo-Torres et al., 2017; Wang and Lo, 2003)
CKL1: We are able to obtain a tremendous amount of technical know-how from our customers	.842	1	2	3	4	5	6	7	
CKL2: We rapidly respond to technological changes in our industry by applying what we know from our customer	.883	1	2	3	4	5	6	7	
CKL3: As soon as we acquire new knowledge from our customer, we try to find applications for it	.826	1	2	3	4	5	6	7	
Moderators									
Internal dynamism (ID) Cronbach's Alpha = 0.733		Not at all		Some extent			Great extent		(Bourgeois, 1980; Dess and Beard, 1984; Demeester et al., 2014; Swamidass and Newell, 1987 Tamayo-Torres et al., 2017; Ward et al., 1995)
ID1: Most innovations come from monitoring competitors and/or using suppliers	.666	1	2	3	4	5	6	7	
ID2: We are constantly looking outside our facility for useful ideas	.753	1	2	3	4	5	6	7	
ID3: Operational decisions are always set to quickly match current needs	.751	1	2	3	4	5	6	7	

ID4: We devote most of our time solving immediate, short term issues	.748	1	2	3	4	5	6	7	
Internal munificence (IM) Cronbach's Alpha = 0.829									(Demeester et al., 2014; Dess and Beard, 1984; Heely et al., 2006; Keats and Hitt, 1988; Pagell et al., 2007; Ward et al., 1995)
IM1: Plant has state of the art manufacturing processes	.790	1	2	3	4	5	6	7	
IM2: Workforce has superior technological skills	.799	1	2	3	4	5	6	7	
IM3: Plant has unique manufacturing process capabilities	.746	1	2	3	4	5	6	7	
IM4: Plant has superior technological know-how	.850	1	2	3	4	5	6	7	
Internal complexity (IC) Cronbach's Alpha = 0.826									(Bozarth et al., 2009; Flynn and Flynn, 1999; Child, 1972; Wiengarten et al., 2017)
Considering your plant's <u>most important product line</u>, please answer the next questions: IC1: Approximately, how many part numbers are on a typical end-item BOM for this product line?	.833	<10	10-29	30-49	50-99	100-249	250-1000	more than 1000	
IC2: approximately how many permanent changes are made on a typical end-item BOM for this product line annually?	.762	0	1-5	6-19	20-39	40-69	70-100	more than 100	
Considering your plant's highest value product line, please answer the next questions: IC3: How many items are listed on your bill of materials (BOM) for this highest-value product line?	.867	<50	50-100	100-200	200-300	300-400	400-500	>500	
IC4: How many of these items are produced in your plant	.761	<50	50-100	100-200	200-300	300-400	400-500	>500	
Dependant variable									
Financial Performance (FP) Cronbach's Alpha = 0.871		Reduced more	Reduced 15%-25%	Reduced 5%-15%	Remained same	Increased 5%-15%	Increased 15%-25%	Increased more than	(Lanier et al., 2010; Modi and Mishra, 2011; Wiengarten et al., 2017; York and Miree, 2004)

How did the following financial measures? change in the last fiscal year (check one box for each item)?		than 25%			-5% - +5%			25%	
FP1: Total sales of goods and services	.912								
FP2: Profitability	.905								
FP3: Market share	.839