EXTERNAL KNOWLEDGE SEARCH STRATEGIES TOWARD PRODUCT INNOVATION PERFORMANCE IN MALAYSIAN MANUFACTURING FIRMS

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ABSTRACT

It is commonly accepted that External Knowledge Search (EKS) strategies are important for firms' Product Innovation Performance (PIP). However, there are two questions that are still not clear. First, what dimensions of firms' EKS strategies that are crucial in determining their product innovation success? Second, how firms are exploiting the external knowledge from their external knowledge search activities? This study intends to open the "black box" between different dimensions of EKS strategies and PIP by proposing Absorptive Capacity (AC) as the mediating variable. Employing path analysis through Partial-Least Squares- Structural Equation Modelling (PLS-SEM) among a sample of 137 Malaysian manufacturing firms, this study demonstrates that collaboration depth, information search breadth and information search depth are directly related to AC, and indirectly related to PIP. These results suggest that AC mediates the relationship between these three types of EKS strategies and PIP. Interestingly, this study found that AC partially mediates the relationship between collaboration depth and PIP, but fully mediates the relationship between information search breadth and PIP. Although partially mediates, the relationship recorded significant mediation effect between information search depth and PIP. In this way, it provides insights that information search breadth and depth are essential in contributing to firms' AC development, whereas collaboration depth, albeit contributes to developing firms' AC, and yet, this strategy could also contribute directly to PIP. This study advances the extant literature by explaining the way of a firm in attaining superior PIP from EKS strategies and AC. Besides that, this study provides insight for managers in developing suitable strategies to gain and sustain competitive advantages. As firms improve in their PIP, it could move up the value chain of a country and encourage a better economic development for the nation.

Keywords: manufacturing firms, managers, product innovation performance (PIP), external knowledge search (EKS) strategies, absorptive capacity (AC).

ABSTRAK

Firma umumnya menerima bahawa strategi Pencarian Pengetahuan Luaran (EKS) adalah penting untuk Prestasi Inovasi Produk (PIP) mereka. Walau bagaimanapun, terdapat dua persoalan yang masih kurang jelas. Pertama, apakah dimensi strategi EKS yang penting dalam menentukan kejayaan inovasi produk bagi sesebuah firma? Kedua, bagaimanakah firma menggunakan pengetahuan luaran hasil daripada aktiviti pencarian pengetahuan luaran firma? Oleh itu, tujuan kajian ini dilaksanakan adalah untuk membuka "kotak hitam" antara dimensi yang berbeza dalam strategi EKS yang digunakan, dan PIP pula mencadangkan kapasiti penyerapan atau *Absorptive Capacity* (AC) sebagai pemboleh ubah pengantara. Kajian ini menggunakan kaedah *path analysis* melalui *Partial-Least Squares- Structural Equation Modeling* (PLS-SEM), di kalangan 137 buah firma perkilangan di Malaysia. Hasil kajian menunjukkan bahawa kedalaman kerjasama, keluasan pencarian maklumat dan kedalaman pencarian maklumat mempunyai kaitan secara langsung dengan AC, dan hubungan secara tidak langsung dengan PIP. Keputusan kajian menunjukkan bahawa AC berperanan sebagai pengantara dalam hubungan antara ketiga-tiga jenis strategi EKS dan PIP. Kajian ini juga mendapati bahawa AC hanya menjadi pengantara separa dalam hubungan antara kedalaman kerjasama dan PIP, tetapi menjadi pengantara penuh dalam hubungan antara keluasan pencarian maklumat dan PIP. Selain itu, AC juga menjadi pengantara separa dan signifikan dalam hubungan antara kedalaman pencarian maklumat dan PIP. Keluasan pencarian maklumat dan kedalaman pencarian maklumat pada dasarnya menyumbang dalam membangunkan AC sesebuah firma. Manakala kedalaman kerjasama bukan sahaja menyumbang kepada pembangunan AC firma, malah turut menyumbang secara langsung kepada PIP. Oleh itu, kajian ini mengembangkan lagi ilmu dengan menjelaskan cara-cara yang boleh dilakukan oleh sesebuah firma untuk meningkatkan PIP hasil daripada strategi EKS dan AC. Kajian ini juga menyumbang dalam meningkatkan pemahaman dalam kalangan pengurus bagi membangunkan strategi yang sesuai untuk mendapatkan serta mengekalkan kelebihan daya saing. Apabila firma-firma meningkatkan PIP, maka firma-firma ini boleh bergerak ke atas nilai dasar sesebuah negara dan sekaligus menggalakkan pembangunan ekonomi yang lebih baik.

Kata Kunci: firma perkilangan, pengurus, prestasi inovasi produk (PIP), strategi pencarian pengetahuan luaran (EKS), *absorptive capacity* (AC).

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LIST OF ABBREVIATIONS

AC	Absorptive Capacity
AVE	Average Variance Extracted
CIS	Community Innovation Survey
E&E	Electrical and Electronic Industry
EPU	Economic Planning Unit
EKS	External Knowledge Sourcing
FDI	Foreign Direct Investment
FMM	Federation of Malaysian Manufacturing
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GNI	Gross National Income
IMP	Industrial Master Plan
KBV	Knowledge- Based View
MASTIC	Malaysian Science and Technology Information Centre
MPC	Malaysia Productivity Corporation
MITI	Malaysia of Trade and Industry
MOSTI	Ministry of Science Technology and Innovation
NEAC	National Economic Advisory Council
NEM	National Economy Model
NPD	New Product Development
OBM	Original Brand Manufacturer
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer
OECD	Organisation for Economic Co-Operation and Development
PACAP	Potential Absorptive Capacity
PIP	Product Innovation Performance
RACAP	Realised Absorptive Capacity
RBV	Resource- Based View
RCA	Revealed Comparative Advantages
R&D	Research and Development
SMEs	Small and Medium Enterprises
TFP	Total Factor Productivity
UN	United Nations
U.S.	United States

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

After independence in 1957, Malaysia relied on the development of the agricultural and commodity sector, such as rubber, timber, palm oil, and cocoa. Although the agricultural and commodity sector promoted growth in the Malaysia economy, the government realised that investment in agro-based activities did not bring high value for the country's economic performance, typically for export earnings and trade profit. This is compared to industrialised products that have greater value and higher selling profit. Hence, Malaysia transitioned from an economy dependent on primary commodities to an industrialised economy that focuses in the manufacturing sector.

The first transition step taken by the Malaysian government was introducing the First Industrial Master Plan (IMP 1) from 1986 to 1995 to encourage the inflow of Foreign Direct Investment (FDI) in accelerating growth in the manufacturing sector (Asid, 2010). During this period, export growth, the share of manufacturing in GDP growth, and the growth of value-added in manufacturing had reported obtaining superior results and Malaysia became one of the leading economy growths in Southeast Asia (OECD, 2013). Following the success of IMP 1, IMP 2 continued to attract FDI and encourage export in the manufacturing sector.

Today, Malaysia no longer is the best place for FDI due to the rise of labour wages and competition from emerging countries, such as China, India, and Vietnam. As a result, export in the Malaysian manufacturing sector is declining. Reliance on FDI without creating competing entities through the transfer of foreign skills and knowledge to local industries causes Malaysia to lose its competitive advantage following the outward migration of some key products in manufacturing. Malaysia is at an economic crossroad right now. The country's competitiveness will be threatened if Malaysia continues to depend on its 'low-cost production strategy'.

As Malaysia transitioned into an upper-middle-income country, the increase of wages led to the increase of investment costs to foreign investors and caused the outflow of foreign businesses to other countries with lower wages. Malaysia's government realised this issue, and formulated a new direction for the manufacturing sector to shift their strategy from 'low-cost production' to 'quality and performance-based production'. However, the transition from a manufacturing sector to a performance-based production has been extremely slow due to low productivity, lack of competitiveness and pervasiveness of low value-added labour-intensive industries based on reports from Economic Planning Unit (EPU, 2015).

Foreign dominated supply chains in Malaysia rarely gear up towards supporting the local technological and business process innovation in the manufacturing sector (OECD, 2013). Malaysia's challenge is to develop homegrown products and improve domestic manufacturing innovation capabilities (The World Bank, 2010). That is to say, the manufacturing sector in Malaysia should focus on original brand manufacturing (OBM) and original design manufacturing (ODM) rather than focus on original equipment manufacturing (OEM). Product innovation is the key here for Malaysia's manufacturing sector to advance to OBM and ODM by improving the productivity and creating more sophisticated products that can sell under its brand or create their patents.

Product innovation is crucial for firms' survival in the current dynamic and competitive environment. Product innovation is a "process that includes the technical design, research and development (R&D), manufacturing, management and commercial activities involved in the marketing of a new (or improved) product" (Alegre & Chiva, 2008, p. 317). The success of product innovation allows firms to maintain and expand market share (Baker & Sinkula, 2009), contribute to firms' output, increase investment returns and production efficiency (Reguia, 2014), as well as contribute to long-term sustainability of the organisations in the market (Troy, Szymanski, & Varadarajan, 2001). Ultimately, the improvement in product innovation performance increase firms' productivity profit and efficiency, and this leads to improved economic growth and social well being (increase income per capita gives better lifestyle) (OECD, 2013).

Product innovation is defined as the introduction of a new product that is making changes or improvement on an existing product, which is differentiating it from existing products' features and functions (OECD, 1997). In other words, product innovation is value added activity. A product's added value should "shorten the product life spans, diversify the product portfolios, technical and aesthetic changes to the products as well as increase or sustain the product market shares" (OECD, 2005, p. 107). In a business context, firms look towards product innovation to offer differentiated goods in order to improve business profit and competitive advantage or survival, and success of business in the market (Dewangan & Godse, 2014). In this regard, the core for firms to introduce product innovation is to generate desired outcomes, such as business profit and return, and other intangible outcomes (Hannachi, 2015). In order to ensure the effectiveness of firms' investment in product innovation, there is the need for firms to measure the performance of product innovation in achieving the desired business outcomes - both tangible and intangible.

Product innovation performance (PIP) is the outcome of product innovation (Alegre, Lapiedra, & Chiva, 2006). It refers to the assessment of the impact of product innovation on firms' competitive advantage or survival and success of businesses (Atuahene-Gima & Wei, 2011). From knowledge- based perspectives, performance differs between firms due to the differences in firm's stock of knowledge (Kogut & Zander, 1992), firm's capability in integration of knowledge, and firm's capability in using and developing knowledge (Grant, 1996). In this regard, knowledge is viewed as a core element in explaining PIP. Knowledge sources can be divided into internal and external sources (Svetina & Prodan, 2008). Traditional closed innovation paradigms indicate that firms use internal knowledge (particularly own research and development activities) to generate product innovation (Chesbrough, 2003). However, reliance on internal innovation or close innovation only may increase the time to introduce a new product to the market, as well as causing the firms to miss the right time to enter the market (Laursen & Salter, 2006).

In recent years, practitioners and academicians gradually agreed that open search for new knowledge could improve firm's product innovation. The interest for open innovations has grown substantively as witnessed by various scholarly research. Firm committed to search for external sources of knowledge to compensate for the lack of existing market and technological knowledge. This help to overcome the problem of "Not Invented Here" syndrome. This perspective is somehow different from conventional 'innovation management' thoughts that "fear of losing their competitive advantage when they made their internal innovation activities accessible to the external environment" (Herzog, 2011, p. 22). Fundamental to this new paradigm, the search for external knowledge is important for product innovation for two reasons. Firstly, is to close internal knowledge gaps and external competitive gaps, and this benefits firm in catching up on product technological changes (Zack, 2002). Secondly, the use of external knowledge helps to reduce over-reliance on internal knowledge thus avoiding learning traps (Purcell & McGrath, 2013).

Knowledge- based views (KBV) suggests that firms engaged in 'external knowledge search' lead to the accumulation of knowledge (Eisenhardt & Santos, 2000) and generate more entrepreneurial opportunities. Indeed, this can result in greater PIP in firms that could generate competitive advantage for the firms (Foss, Lyngsie, & Zahra, 2013). External knowledge search is the firm's systematic scanning of the external environment for useful knowledge using mechanisms ranging from formal collaboration with external actors (Chen, Chen, & Vanhaverbeke, 2011), informal network with external actors, conferences, trade fairs, and more (Maskell, Bathelt, & Malmberg, 2006). Past studies indicate that external knowledge search can be depicted in many facets because it can be distinguished by the search directions (breadth and depth by Laursen & Salter, 2006), search sources (external actors such as customers or suppliers) and search parts (formal and informal search mechanisms by Purcell & McGrath, 2013).

Different search strategies provided different opportunities for firms to obtain the required knowledge for product innovation (Laursen & Salter, 2006; Sofka & Grimpe, 2010; Ebersberger & Herstad, 2011). In this regard, insight of the search strategies for external knowledge in enhancing innovation performance is critical for the management of innovation processes (Sofka & Grimpe, 2010; Ebersberger & Herstad, 2011). There are copious numbers of studies conducted to investigate the effect of external knowledge search strategies on PIP. However, it presents mixed results, such as curvilinear, positive, and even negative relationships between external knowledge search strategies on PIP (Katila & Ahuja, 2002; Chiang & Hung, 2010; Hwang & Lee, 2010; Leiponen & Helfat, 2010; Esbersberger & Herstad, 2011; Martini, Aloini, & Neirotti, 2012; Wu, Wang, & Li, 2014; Xu, 2014; Wang, 2015). These heterogeneous findings call for further investigation in exploring the inter-firm differences in external knowledge search benefits.

Prior literature found that different search strategies, by focusing on 'where to search', contribute differently on PIP (Patel & Van der Have, 2011; Ferreras-Mendez, Newell, Fernandez-Mesa, & Alegre, 2015; Wang, 2015). This study takes a step further to open the "black box; not only investigating the effect of different external search strategies on PIP, but also digging in-depth of how the firms benefit from external knowledge search through their internal mechanisms - absorptive capacity, thus improving their PIP. Indeed, to understand how absorptive capacity (AC) could explain inter-firm differences in benefiting from external knowledge search, KBV provides fundamental justifications on it.

Fundamentally, KBV perspectives advocate knowledge that has the characteristics that are tacit, specific, complex and difficult to imitate by others. These are firms' strategic assets that could translate into competitive advantage (Grant, 1997). In this regard, AC plays a role in combining externally acquired knowledge with existing knowledge (recombination of knowledge) and creates new knowledge (Curado, 2006). At the same time, the new 'application of knowledge' enlarges firms' existing knowledge base, and this enables firms to continuously learn for greater use of external knowledge (Gratton & Ghoshal, 2003). This process is path dependent in nature because it is cumulative and it has to depend on experience and prior knowledge accumulation in order for it to facilitate the use of new knowledge (Cohen & Levinthal, 1990). The path dependent characteristic of knowledge, it is indeed a tacit, specific and complex knowledge that is difficult to imitate by others (Lichtenthaler, 2016). In this case, firms involved in external search, required AC to translate it into competitive advantage in product innovation, since the combination of externally acquired knowledge with existing knowledge is specific to a firm and are hardly imitated by others.

AC has seen much application in many areas of organisational studies (Lewin, Massini, & Peeters, 2011). Much of the empirical studies are mainly operationalised AC with research and development related factors (Murovec & Prodan, 2009; Li, 2011; Yu, 2013; Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011; Lin, Wu, Chang, Wang, & Lee, 2012). However, the use of research and development related factors have been criticised of having validity challenges, such as overlooks on the dynamic nature of AC (Lane, Koka, & Pathak, 2006) and overestimating or underestimating the real representations in firms (Volberda, Foss, & Lyles, 2010). Such criticism urged for better measurement of AC to overcome the stated weakness.

Based on KBV, AC is tacit, specific and complex. It is deeply embedded in an organisation. Zahra & George (2002) refined the concept of AC as a set of organisational capabilities. This gives a better understanding of the tacit nature of AC, and it reveals the manner that AC functions to translate external knowledge into PIP. Lewin et al. (2011) stated that direct measurement of capabilities better explain the role of AC in firms' competitive advantage. That's why it offers a better understanding of Behavioural Theory of the Firm.

In essence, the ability of firms to search for external knowledge sources is essential for product innovation because it is unlikely that all knowledge needed for product innovation resides within firm boundaries. However, the search for external knowledge sources does not imply that firms could straightaway benefit from it. Drawing on insights from KBV, the ability of firms' sources and combined knowledge from external environments are at the core for firms to benefit from external knowledge search. Despite these, a current study attempted to link both external knowledge search and AC to explain the PIP. This study contributes in understanding the way firms search for external knowledge, as well as helps to explain inter-firm differences of firms in benefiting from external knowledge search.

1.2 Problem Statement

In Malaysia, the manufacturing sector plays an important role in economic growth, because it contributed 81.8% of total exports and recorded a 23% Growth Domestic Product (GDP) from the sectors' total GDP in 2015 (EPU, 2015). Since the manufacturing sector is the growth engine for the country, typically of its benefit in export; Dato' Sri Idris Jala stated that Malaysia needs to focus on the manufacturing sector in order to improve the products' exports and to make the country's growth more sustainable (Business Circle, 2014). However, according to the Tenth Malaysia Plan (from the year 2011 to the year 2015) report, the manufacturing sector in Malaysia has not evolved to respond to changing global demands (EPU, 2015). Indeed, this report indicates that Malaysia's manufacturing sector is involved in an 'imitation strategy', whereby the firms are producing products that are also manufactured by many other countries. As a result, this caused the declining in the numbers of exports that have Revealed Comparative Advantages greater than 1 (RCA> 1). Subsequently, in the Eleventh Malaysia Plan (from the year 2016 to the year 2020), the strategies outline a new direction for the manufacturing sector, that is, emphasis on product innovation in manufacturing firms to produce high-value, diverse and more sophisticated products. This called for interest in the study of product innovation in Malaysia's manufacturing sector.

Product innovation serves as a key factor for successful market entries (according to Schumpeter growth model-creative destruction) thus, creating a competitive advantage for firms to penetrate in the competitive export market with their differentiated products (Tavassoli, 2013). In addition, product innovation is attractive to manufacturers due to its short-term benefits, such as financial return, and long-term benefits such as sustainability of the firms in the market (Johne & Snelson, 1988) - if the managers are more astute at "selecting new product winners, and at effectively managing the new product process from product idea through to launch" (Cooper & Kleinschmidt, 1987, p. 215).

Product innovation is a complex activity, thus it is not an easy task for the firms. Indeed, product innovation is always associated with high uncertainty and high failure rate (Cooper & Kleinschmidt, 1987; Griffin, 1997; Evanschitzky, Eisend, Calantone, & Jiang, 2012). According to Cooper & Edgett (2009), it is on average 44% of product development projects fail to achieve their financial target, and almost half of new product launches are late to the market. Therefore, a firm that introduces a new product to the market does not neccessarily obtain the desired outcomes. Consequently, studies on product innovation should indicate the outcome of product innovation, so that firms can perceive the impact of this innovation on their firm's performance. PIP is to measure impact of product innovation. However, PIP is loosely defined and therefore, the measurements of PIP are heterogeneous across the literatures (Alegre et al., 2006; Hannachi, 2015). Thus, it raises a question of what is PIP in the manufacturing sector. For this reason, this study attempted to investigate the component of PIP based on prior research to allow firms to obtain a better picture of actions and effects within the firms.

The success of product innovation is a key for the manufacturing sector to sustain its profit and competitiveness in the market (Gracia-Muina, Pelechano-Barahona, & Navas-Lopez, 2009). In recent years, external knowledge searching is viewed as the important factor to promote PIP of the firms (Lu, 2013). However, external knowledge manifests itself in various types and contents, and it is also provided by different carriers of external sources such as customers, the internet, patents, and universities (Kruse, 2012). Intensively, the varying contexts of external knowledge lead to a lack of a generalised view on the role of external knowledge and its impact on PIP. Therefore, it raises a question regarding the effects of external knowledge search on the manufacturing sector's PIP. Hence, this study explores the effect of types of external knowledge search on PIP to close the literature gaps.

The presence of valuable external sources of knowledge does not imply that the inflow of information and new knowledge from external sources are an automatic and easy process (Clausen, 2013). Firms can only use the external knowledge for product innovation, when firms develop the routines to recognise, assimilate, integrate and exploit the external knowledge in its knowledge base (Vanhaverbeke, Cloodt, & Van de Vrande, 2008). In the same manner, Lewin et al. (2011) mentioned that external search is not worth much if the firms are unable to transfer knowledge back to the organisation. In this regard, AC serves as a key in explaining how firms can gain advantages from external knowledge, and thus, improve PIP (Moilanen, Ostbye, & Woll, 2014).

Although prior studies provide the theoretical models to explicate the nature, antecedent, and consequences of AC (Zahra & George, 2002; Lane et al., 2006; Lichtenthaler, 2009), there are a few studies that examine in specificities of the link between AC with its antecedent and consequences (Jansen, Van Den Bosch, & Volberda, 2005). In this regard, the evidence is scarce in explaining the role of openness of firms in its external knowledge search in improving firms' AC (Vanhaverbeke et al., 2008), and more importantly, the role of AC that translates these searches into realized benefits or competitive advantage (Zahra & George, 2002). This raises a question about the role of AC in explicating the benefits of external knowledge search on firms' PIP.

Another reason the investigation between AC with its antecedent and consequences is insufficient is due to the ambiguity of its definition and lack of clarity about the empirical operationalisation of the constructs (Ferreras-Mendez, Newell, Fernandez-Mesa, & Alegre, 2015). This raises a question on what is AC and how it mediates between its antecedents (external knowledge search) and consequences (PIP). Given these points, this study aims to address the mentioned gaps with extends the literature gaps by assigning AC the role of mediator in the relationship between external knowledge search and PIP, and also clarify the concept of AC to allow a better picture of the link between AC with its antecedents and the outcome. The following subsections will further discuss the literature gaps from previous studies.

1.2.1 Loose Definition on the Concept of Product Innovation Performance

The success of product innovation contributes to firm's outputs, such as financial benefits (sales and profits), improving product quality and differentiation, and realising continuance of customer's fidelity that could create value for customers in return (Reguia, 2014). In this respect, the core of product innovation lies at the core of its ability to create value for the firm in return, rather than merely introduce new products in the market. Hence, the assessment of product innovation is essential to determine what the firms have achieved. Particularly, relating to competitive advantage aspects [to create persistent above-normal returns and superior resource value to the firms] (Alegre et al., 2006;

Paladino, 2007). Consequently, this leads to distinguishing between the concept of product innovation and PIP. Product innovation involves a series of activities for new product creation (i.e. number of new products introduced in the market), whereas, PIP reflects the level of success (value creation for the firms) of the new products that have been introduced to the market (Alegre et al., 2006).

PIP is a broad concept. It measures the success of product innovation, through performance indicators (Cooper & Kleinschmidt, 1987), and this provides information on how well the firms are doing, or whether they are improving or declining in their PIP (Griffin, 1997). By doing so, it provides benchmarking for the firms to find effective practices and processes that contribute to the success of a product innovation (Robert, 1989). The success of a new product is not simple or unidimensional, but it is multidimensional and includes several performance indicators (Cooper & Kleinschmidt, 1987). The performance indicators for PIP are presented in many points of view in prior studies. However, there is no consensus on its indicators used to measure PIP (Cooper & Kleinschmidt, 1987; Johne & Snelson, 1988; Alegre et al., 2006; Hannachi, 2015). This study attempts to define and operationalise the concept of PIP in Malaysia's manufacturing sector thus providing insight for practitioners regarding their strengths and weaknesses of their product innovation. On top of that, this provides insight for academicians in mapping effective practices or processes that can contribute to the success of product innovation.

1.2.2 Lack of a Generalised View on the Role of External Knowledge Search in the Manufacturing Sector

In Malaysia’s manufacturing sector, Chandran, Rasiah, and Wad (2009) stated that Malaysia is not innovating at the frontier. So far, we have learned to use new imported technology and equipment from more advanced countries, which indicates that we largely rely on low value added activities rather than design and develop new products that have higher value added content. Likewise, the World Bank Report (2010) also indicated that the domestic value added of Malaysia’s manufacturing sector is the lowest in the region compared to Japan, China, Indonesia, Korea and Singapore. This implies that our manufacturers remain highly reliant on low and semi-skilled intensive assembly-type manufacturing.

Openness to external knowledge sources is essential for firms' product innovation as to upgrade Malaysia from an assembly stage to new product designs and development (The World Bank, 2010; MOSTI & MASTIC, 2012). Firms committed to search for external sources of knowledge do that to compensate for the lack of existing technology and market knowledge, and this helps firms to overcome the problem of “Not Invented Here” syndrome (Lu, 2013). In this respect, it enables firms to achieve better PIP (Ferreras-Mendez et al., 2015). The search for external knowledge sources could be varied according to the type of source provider, strategies of search, and the methods of search (Kruse, 2012). Therefore, the empirical evidence for the link between external knowledge search and PIP are varied across the literature.

In general, external knowledge can be sourced from many places, but, not all types of sources can contribute equality to competitiveness and innovativeness (Kruse, 2012). Thus, some studies emphasise on the effects of some types of external sources through a specific sourcing method on PIP (Faria, Lima, & Santos, 2010; Annique, Cuervo-Cazurra, & Asakawa, 2010). In hopes that the access to the effects of each type of external sources on PIP, the external sources covered in their research are limited to certain common sources, such as customers and suppliers. In this regard, Laursen and Salter (2006) proposed two external knowledge search strategies, namely, search breadth and search depth, as to capture the degree of openness of firms in their external knowledge search activities. Indeed, their proposed strategies shift the concept of search from the degree of interaction with each external source, to the focus on the types and number of pathways of exchanges between a firm and its environment. In doing so, the proposed strategies can take into account the variety of channels used by firms in its external search activities.

According to KBV, firms act as semi-permeable membrane that allows external knowledge and information pass at different rates and different degrees flow into the firms (Kogut & Zander, 1992). The knowledge flow or knowledge transfer between the firms depend on both types of knowledge sources (types of external sources, i.e., customer, supplier), and nature of relationships between the firms. The nature of the relationship between the firms is determined by strategic choice (Fey & Birkinshaw, 2005). The strategic choice, in other words, means external knowledge search methods, which refer to the firm’s strategic choice for assessing knowledge from external sources, for instance, collaboration and external information search. Different strategic choice involved different level of interaction, cost involve and the transfer of knowledge type (refer to Chapter 2, Table 2.4). Therefore external knowledge search methods have different implications for the ability of the firm to achieve superior performance, hence, explain the differences of innovation performance across the firms (Ebersberger & Herstad, 2011). As a result, it is important to integrate into explaining the role of external knowledge search on PIP.

Current empirical studies that emphasise the role of both external knowledge search strategies (search breadth and depth), external knowledge search methods (collaboration and information search) are limited. Thus, in order to expand current literature, this study integrates both search strategies (search breadth and depth) and sourcing methods (collaboration and information search) to explain the role of external knowledge on PIP in Malaysia's manufacturing sector.

1.2.3 Ambiguity of Absorptive Capacity's Operational Definitions

The literature regarding AC indicates that the concepts of AC manifests in different disciplines (i.e., accounting, strategic management, organisational learning) and context (i.e. individual level, firm level), hence, resulted measurements of AC are heterogeneous across the literature. Specifically, some of the literature measures AC using a proxy, such as internal research and development (Cohen & Levinthal, 1990; Murovec & Prodan, 2009), whereas others measure AC based on dynamic capabilities (Zahra & George, 2002) and organisational routines (Lewin et al., 2011).

Using proxy in measuring AC has its limitation in its validity that covers an implicit aspect of AC (Schmidt, 2010). For instance, Kostopoulos et al. (2011) in their study has indicated a limitation in using a proxy in measuring AC, and they have suggested future research to use direct measures in measuring AC, as to capture a greater implicit aspect of AC at firm level context. Thus, this study operationalised the concept of AC based on the multidimensional definition in Malaysia's manufacturing context.

1.2.4 Role of Absorptive Capacity in the Relationship between External Knowledge Search and Product Innovation Performance

Leveraging external knowledge sources is necessary to improve firms' PIP. In Malaysia, the policy was designed to facilitate the collaboration of domestic firms with external actors, especially with multinational companies, universities, intermediaries and industry associations, and yet, this does not result in greater innovation in the manufacturing sector. The Malaysia Economic Monitor report showed that weak innovation position of Malaysia when to compare internationally (The World Bank, 2010). In this regard, AC serves as a key to explain how a firm could learn and upgrade from external linkages and external sources in a systematic and collective way, which may result in greater innovations in return.

Scholars in the literature on AC and KBV suggest that exposure or access to external knowledge does not imply successful application (Zahra & George, 2002; Foss et al., 2013). External knowledge can only derive innovative benefits when firms have recognised, assimilated and applied it in innovation processes (Moilanen et al., 2014). Vanhaverbeke et al. (2008) stated that absorptive capacity plays dual roles in improving

PIP. First, the firms increase its internal knowledge base by bringing in external knowledge and use it to generate a new product. Second, the expansion of internal knowledge base also increases firms' abilities in identifying the value of other external information, to transmit, assimilate, and subsequently lead to further exploitation of this new knowledge for new products which may lead to greater PIP.

In sum, AC demonstrates the bridging role in generating value out from external knowledge search practices, rather than as an amplifier (Kostopoulos et al., 2011). While many studies assume a moderating role of AC in between external knowledge search and PIP (Murovec & Prodan, 2009), there are only few studies that identify the mediating role of AC between external knowledge search and PIP (Kostopoulos et al., 2011; Moilanen et al., 2014). The current study assigns AC as a mediator in the relationship between external knowledge search and PIP as to comprehend the understanding of how a firm can use external knowledge to enhance their PIP.

1.3 Research Questions

This study attempts to answer the following research questions:

1. Do external knowledge search strategies have an effect on product innovation performance in Malaysian manufacturing firms?
2. Do external knowledge search strategies have an effect on absorptive capacity in Malaysian manufacturing firms?
3. Does absorptive capacity has an effect on product innovation performance in Malaysian manufacturing firms?
4. Does absorptive capacity mediate between the external knowledge search strategies and product innovation performance in Malaysian manufacturing firms?

1.4 Research Objectives

In order to answer the research questions, the following objectives need to be achieved:

1. To determine the effect of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) on product innovation performance in Malaysian manufacturing firms.
2. To determine the effect of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) on absorptive capacity in Malaysian manufacturing firms.
3. To determine the effect of absorptive capacity on product innovation performance in Malaysian manufacturing firms.
4. To examine the mediating effect of absorptive capacity on the relationship between each type of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) and product innovation performance in Malaysian manufacturing firms.

1.5 Significance of the Study

In this study, the impact of firms' external knowledge search on their PIP contributes to the current literature in two ways. First, the study contributes to define PIP in Malaysia's manufacturing sector. This helps firms to access the performance of their product innovation and also helps to provide insight for academicians in mapping effective practices or processes that can contribute to the success of product innovation.

Secondly, researcher extent the analysis of external knowledge search strategies by incorporating different types of sourcing modes, which are, external collaboration and external information search. In fact, external collaborations and external information searches are diverging due to the cost involved, interaction levels and the transfer of knowledge type (refer to Chapter 2, Table 2.4). Also, Ebersberger and Herstad (2011) found that external collaborations and external information searches are distinct dimensions through factor analysis and have to avoid treating these merely as a binary characteristic of the firms. In this respect, this study has contributed in investigating external collaboration and external information search sourcing mode effects on PIP. By doing this, the researcher can capture the effects of each sourcing mode on PIP, and it allows the researcher to take into account the more holistic picture of firms' external knowledge search behaviours.

Thirdly, researcher combines the search strategies, namely, search breadth and search depth with sourcing mode in this study to investigate the impact of firms' in external knowledge search on their PIP. Indeed, Laursen and Salter (2006) mentioned that the search strategies (breadth and depth) reveal the way of the firm in organising search for new ideas that have commercial potential for the firm. The combination of search strategies and external knowledge search mode enable the researcher to capture the effect on each of the organising way in particular sourcing mode, thus, leading to more comprehensive understanding of the distinct way firms organise external sourcing, and the impact of different external knowledge search on firms' PIP.

This study also contributes to a better understanding of inter-firm discrepancies in benefiting from external knowledge for their PIP. This study made two contributions in explaining inter-firm discrepancies in benefiting from external knowledge. Firstly, this researcher proposed AC mediate between external knowledge search and PIP. In this regard, AC serves as the key in explaining inter-firm discrepancies in benefiting from external knowledge for their PIP.

Secondly, despite the rising role of AC in explaining firms' internal mechanisms in acquiring, assimilating, transforming, and exploiting the external knowledge in firms' commercial applications, the researcher proposed a multidimensional ACs to serve as intermediate mechanisms in capturing firms' internal processes (acquisition, assimilation, transformation, exploitation) in managing the external knowledge sources and how they utilise it in commercial applications. In fact, this study contributes in capturing richer means of AC, hence, opening the "black box" of the firms through revealing how they use their internal mechanisms to utilise external knowledge for their commercial applications.

Apart from the contribution to literature, this study also contributes in a practical manner. Fundamentally, practitioners and managers always face difficulty in selecting the external knowledge search strategies that suit their context, due to uncertainties about the potential commercial values that could be obtained (West & Bogers, 2014). In this regard, the study contributes in comprehending the practitioners' understanding of the effects of external of knowledge sourcing strategies on PIP through AC. Indeed, these help practitioners and managers to identify the opportunities to gain competitive advantage through aligning external knowledge search strategies and the generation of AC (Ferreras-Mendez et al., 2015).

In addition, this study also contributes by developing a new approach in integrating the external knowledge search breadth and depth with the strategic choice (information search, collaboration) in measuring the search behaviour of firms. On the other hand, this study also contributes to policy formulation in facilitating product innovation of the manufacturing sector, through identifying the suitable external knowledge search strategy that contributes to product innovation. Moreover, this study also reveals the role of inner firm's processes AC in utilising the external knowledge sources and applying it in a commercial application. Therefore, this provides insight for policy makers in designing suitable policies and programmes to facilitate product innovation in the manufacturing sector through improving firms' AC.

1.6 Scope of the Study

This study aimed at investigating the relevant deployment of external knowledge sources and AC to achieve better PIP in Malaysian manufacturing firms. The unit of analysis of this study is firm level. The firm-level analysis allows the researcher to identify relevant attributes that contribute to firm's PIP. On the other hand, the target respondents of this study are factory/product managers or any equivalent managers that complement product innovation projects or activities.

The undeniable importance of product innovation in the manufacturing sector in Malaysia justifies the interest of this study to investigate determinants of PIP of Malaysian manufacturing firms, hence this study took place in Malaysia's manufacturing sector. In order to determine the population frame of this study, researcher employed the Federation of Malaysian Manufacturing (FMM) Directory 2015 as the population frame.

Based on this Directory, there were 2544 manufacturing firms that manufacture the physical products themselves while the other 268 firms are service-based which includes accountancy, financing, consultancy, forwarding and distribution, all of which are excluded from this study. Likewise, out of 2544 manufacturing firms, there are 174 subsidiaries owned by other members of FMM (e.g. same postal address/ contact persons), and 10 non-members of FMM (as stated in the directory) that are also omitted to avoid bias (Ahmed, 2011). Consequently, there were 2360 valid manufacturing firms in the sample frame.

Finally, current study focused on the completed product innovation projects that are manufactured by the firms themselves within previous three years, which is a reasonable period to observe the PIP (as suggested in OSLO Manual 2005) and the effects of external knowledge search and AC on PIP.

1.7 Limitations of the Study

There are several limitations of this study. Current study employed the Federation of Malaysian Manufacturing (FMM) Directory 2015 as the population frame. As a result, the Malaysian manufacturing firms that are not registered with FMM will be excluded from this study. Hence, findings cannot be extrapolated to all Malaysian manufacturing firms that are not listed in the FMM Directory 2015.

Furthermore, the choice of variables for the study depicted as limitation in this study. Although open sources innovation variables are an important factor that affects the PIP, this does not mean that other organisational and individual factors are not important determinants of PIP. However, due to time and other constraints, it is necessary to delineate the scope of the study. The fact that some important factors may have been excluded provides another limitation of the study.

Current study employed cross-sectional method in data collection process. Indeed, cross-sectional data has limitation due to its restriction in inference of causality that may exist among the variables (Sekaran & Bougie, 2013). At a minimum, a longitudinal design is required to "infer any causality that may exist among the variables" (Bryman & Bell, 2011, p. 57). On the other hand, respondents that reluctance to participate in the survey, respondents do not answer the questionnaire seriously, and firm policy does not allow respondent to participate in the survey are likely depicted as limitation of this study.

In addition, self-completion questionnaire self-completion questionnaire poses potential bias and disadvantages such as, greater risk to reach some kinds of inappropriate respondents and lower responses rate that may affect the research's validity and reliability (Bryman & Bell, 2011). Likewise, Hong, Oxley, and McCann (2012) also stated that self-completion questionnaires in innovation studies might be subject to human error or bias and with potentially low response rates as there may be limited representativeness. In this study, the researcher attempted to reduce the potential self-completion questionnaire's limitations, and the details of the ways to reduce these potential limitations are discussed in Chapter Four.

Moreover, time and cost constraint depicted as limitations for current study. Although the larger the sample size, the greater the precision (Bryman & Bell, 2011), due to time and cost constraints, the selection of population for this research is based on the FMM directory list rather than the whole manufacturing firms in Malaysia. Finally, the administration of questionnaires by researcher is subjected to external limitations. Questionnaires that are received by respondents but lost and need to be resent, questionnaires that do not reach respondents' addresses, and follow up of respondents involves firm's bureaucracy are external limitations in this study because this changes factors are out of the researcher's control.

1.8 Definition of Key Terms

The following sub-section discusses the key terms and definition of the independent, dependent, and mediator used in this study. The operational definitions for each dimension of the variables are discussed in Chapter Four.

1.8.1 Product Innovation Performance

PIP refers to the firm's level of success in terms of the new product ideas exploitation and the realisation of these ideas into the market (Griffin, 1997; Hannachi, 2015). The performance for the improved or new products can be categorised into financial and non-financial performance in the period of the last three years. In this study, product innovation financial performance is defined as firms' performance based on accounting measures and product innovation non-financial performance is coined as firms' performance based on non-accounting measures that potentially contributes to firms' subsequent PIP.

1.8.2 Absorptive Capacity

AC is explained as the level of firms' capacity to absorb knowledge based on a set of firms' dynamic capabilities (Zahra & George, 2002). Firms' dynamic capabilities include acquisition capability, assimilation capability, transformation capability and exploitation capability. Acquisition capability refers to firms' capability to recognise and make sense of the potential external knowledge sources (Cohen & Levinthal, 1990). While assimilation capability are firms' capability in resolving the inconsistency between newly acquired knowledge from external sources and existing knowledge bases of the firm

(Zahra & George, 2002). Firms' capability in transforming the knowledge by maintaining and reactivating the knowledge is termed as firms' transformation capability (Lichtenthaler, 2009). Lastly, exploitation capability is the firms' capability in using and implementing the acquired knowledge into the commercial application (Lichtenthaler, 2009).

1.8.3 External Knowledge Search

Generally, external knowledge search refers to the method use in flowing the external knowledge across organisations that contribute to the accumulation of knowledge (Eisenhardt & Santos, 2001) such as external collaboration, contracting and acquisition, and also external information search (Fey & Birkinshaw, 2005). External collaboration refers to the joining of knowledge development efforts by firms through the relationship with external partners. Next, contracting and acquisition is coined as firms' acquisitions of knowledge on a market basis. External information search is defined as firms' access to knowledge for free or with limited marginal fees from external sources (OECD, 2005). This study only discusses external collaboration and external information search because studies regarding contracting and acquisition concerns more on firms' knowledge output rather than the process of developing the knowledge (Fey & Birkinshaw, 2005) compared to external collaboration and external information search.

It is assumed that a commercial product requires various combinations of knowledge in a codified, tacit and specific set of technology. Hence, firms diversify their search strategies, namely search breadth and search depth, to lead to a greater connection of disparate external knowledge sources with the internal knowledge that result in greater product innovation (Grant & Baden-Fuller, 1995; Laursen & Salter, 2006; Leiponen & Helfat, 2011). The search breadth and search depth of both external collaborations and external information searches are discussed in the following paragraph.

As for external collaboration, the external collaboration depth refers to firms' intensity in searching for knowledge from different collaborating partners (Ferreras-Mendez, 2015) and external collaboration breadth is defined as firms' number of collaboration with different types of external partners that are bound with formal agreements (Laursen & Salter, 2006).

As for external information search, the information search depth is coined as the firm's intensity in searching for knowledge from different external information sources (Cruz-Gonzalez, Lopez-Saez, Navas-Lopez, & Delgrado-Verde, 2015) and information search breadth refers to the firm's number of external information sources which provide information to the firm to be used in its innovation activities (Laursen & Salter, 2006).

1.9 Organisation of the Thesis

Chapter one provides a brief discussion on the background of the study, problem statement, research questions, research objectives, significance of the study, scope of the study, limitations of the study, and definition of key terms.

Chapter two offers a review of the literature concerning the theoretical review of KBV and theoretical review of AC. Instead of that, the review of PIP is presented. Next, overview of knowledge search for innovation and reviews on external knowledge search for innovation and PIP that includes external collaboration breadth and depth and information search breadth and depth are discussed. Then, a review of external knowledge search strategies and AC and review of AC and PIP are presented.

Chapter three discusses the methodology of the study. This chapter focuses on the following topics: (1) theoretical framework, (2) hypotheses development, (3) research design, (4) operational definition, (5) measurement of items and scales, (6) sampling procedures, (7) survey administration, (8) pilot study, and (9) data preparation, analysis, and interpretation.

Chapter four reports and discusses the data analysis results of the study. The preliminary data analysis involving the response rate, assessment of potential bias (non-response bias and common method bias) and missing data treatment are discussed. Next, this chapter focuses on the profile of respondents, multivariate assumptions (outliers and normality), descriptive statistics, and followed by exploratory factor analysis. The specifying path model in PLS-SEM (measurement models and structural model), evaluation of the measurement model (internal consistency reliability and indicator reliability), and evaluation of the structural model are reported. This chapter concludes with a summary of hypotheses testing result.

Chapter five recapitulated the study and summarised the findings. The focus of the discussion is towards the research findings and justification based on previous research. Next, this chapter elaborates on the key findings - summarised according to the research objectives, the theoretical reviews, methods, practical and policy implications. Also, this chapter discusses the limitations and recommendation for future studies and the concluding remark for the thesis.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the innovation in management discipline that includes the concept of organisational learning, resource- based view (RBV) and KBV. This study discusses the KBV exhaustively due to its implication as the underpinning theory. Instead of that, the AC is also being reviewed as it is an important model to explain the relationship between external knowledge search and PIP. Then the discussion on the product innovation and PIP follows. Next, this chapter includes the reviews on external knowledge search and PIP by capturing the types of external knowledge search methods, namely external collaboration and external information search. Both sources are explained using the breadth and depth strategy and its impact towards PIP. Then, review on external knowledge search and AC, and also review on AC and PIP follows. Lastly, the chapter concludes with a summary. Based on the research questions proposed in Chapter One, this chapter attempts to discuss the related topic in depth.

2.2 Theoretical Review of Knowledge- Based View

The KBV has begun to receive greater attention recently from scholars since the word "knowledge" emerged. The proponents of KBV suggested that a generic resource that contributes to firms' competitive advantage is knowledge (Grant, 1996a, 1996b). Fundamentally, the KBV has its root in the RBV and organisational learning theory. The RBV had made assumptions that tangible and intangible resources draw a distinction in firms' performances. Knowledge is regarded as a kind of intangible resources that contribute to firms' performances. However, the knowledge- based proponents have argued that RBV "does not go far enough" (Grant, 1996b; Kaplan, Schenkel, Krogh, & Weber, 2001, p. 8).

The proponents of KBV suggested that knowledge plays a significant role in explaining firms' heterogeneous performances and contributing to firms' competitive advantage (Grant, 1997; Nonaka & Takeuchi, 1995; Kogut & Zander, 1992). In this point of view, the interpretation of knowledge is still bounded by the firm resources, but the interest of the study is to focus on exploring knowledge resources. For this reason, Curado (2006) mentioned that there is a theoretical connection between RBV and KBV, and thus KBV can be considered as the extension from RBV (Eisenhardt & Santos, 2000; Rahmeyer, 2006; Curado, 2006).

Even though KBV is treated as the extension to the RBV, however, the perspectives of KBV present some extended points compared to RBV. In fact, proponents of KBV claimed that knowledge has its unique characteristics compared to other types of resources and hence treated knowledge as strategic resources of firms. Fundamentally, Eisenhardt and Santos (2000) have stated that knowledge, unlike traditional resources because traditional resources can be used up and it needs to restock after use (Kaplan et al., 2001). However, knowledge can be replicated and transferred without losing its value due to its unique character (Eisenhardt & Santos, 2000; Kaplan et al., 2001).

Knowledge can be transferred from one party to another party. Due to this characteristic, knowledge assets are subject to the risk of knowledge leak-outs from a firm. In this regard, a firm, although at a time, owned good knowledge assets, their knowledge assets are subject to the risk of erosion at the same time. As a result, a firm will lose its competitive advantage. In this respect, innovation plays an essential role in sustaining a firm's valuable knowledge assets. Typically, innovation of a firm is a result of a combination of knowledge flows (inter-firms or intra-firms) and knowledge stocks of a firm that served as the renewal role in renewing the strategic knowledge assets in a firm, to enable a firm to achieve competitive advantage. In conclusion, the following subsections further elaborate the concept of KBV by discussing the evolution of KBV from RBV, development path of KBV, the used of KBV in innovation study and the application of KBV in the context of this study.

2.2.1 Evolution of Knowledge- Based View from Resource- Based View

In the past decade, the strategic management field used RBV as the popular framework for examining the economic success of firms through competitive advantage. Fundamentally, competitive advantage is defined in the value-price-cost framework that indicates the relative differences between the willingness of the consumers to pay to a firm, observed price and cost paid by a firm, and its suppliers' reservation prices compare to the rivals (Ghemawat, 1991; Hoopes, Madsen, & Walker, 2003). In this respect, if a firm earns greater economic value compare to its rivals, competitive advantage can be achieved (Peteraf & Barney, 2003). It is leading us to understand that competitive advantage is referring to the relative value captured by a firm to its rival parties. Complementary to this definition, Walker (2004, p. 19) stated "competitive advantage encounters two aspects, that is, superior economic value capture and sustainable market position" or in other words enjoy greater market shares.

RBV suggests four conditions, namely heterogeneity, imperfect mobility, *ex-ante* limits to competition and *ex-post* limits to competition in elucidating the competitive advantage. These underlined the logical conditions that allow firms to capture the value or attain sustainable market positions. Indeed, the logic of these conditions is also relevant in the context of KBV. Fundamentally, RBV interpreted heterogeneity as Ricardian's rents, which indicate rents generate from superior resources that are scarce in supply. Knowledge possessed some of the public goods characteristics due to its special character. In this case, knowledge can be a superior resource not because of the limited supply of its quantity, but due to its potent barriers to diffusion (Ziesemer, 2013).

Intensively, the nature of knowledge (cumulativeness, tacitness, specificity) presents strong barriers to diffusion and eventually can be regarded as superior resources that generate rents for a firm. Also, knowledge is idiosyncratic and high context dependency in firm-level context (Grant, 1996b). Therefore, this suggests the immobility condition that is the result of imperfect mobility. The basic premise of imperfect mobility condition in the knowledge context refers to the speciality condition that causes causal ambiguity or loss of the value of knowledge when deployed outside a firm's context (Reed & DeFillippi, 1990; Som, 2012). More precisely, knowledge in a firm's context is collective in nature. Integration knowledge from individuals led to the integration of different knowledge modules, and hence indicates a composite form of knowledge properties that make it highly context dependent (Antonelli, 2006).

The *ex-ante* limits to competition condition refer to the condition whereby the rents do not offset costs. In this case, the firm has foresight or luck to acquire the superior resources in the absence of competition (Peteraf, 1993). Typically, in the KBV context, uncertainty on the 'knowledge actual economic value' and its particular context give rise to difficulty in anticipating the outcome of the research process (Antonelli, 2006). Moreover, uncertainty about the knowledge- based activities returns also depends on the degree of innovativeness, demand structure, and knowledge cumulativeness process that cause difficulty in identifying potential knowledge resources for the creation of profits (Ziesemer, 2013). In this respect, Foss and Foss (2000) mentioned that knowledge- based perspective is distinct compared to the resource- based perspective that assumes the firm earns rents that stem from either luck or superior insight into resources' true value. Indeed, they asserted that a firm can create and improve the resources through learning, and hence indicates that a firm can earn rents from developed superior capabilities rather than simply luck or being better informed than suppliers of inputs.

Finally, *ex-post* limits to competitions mentioned about sustainable competitive advantage which limits the competition for those rents that are achieved by superior firm performance (Som, 2012). The RBV underlined that when *ex-ante* cost is lower than *ex-post* value, a firm earns economic value. In such synthesis, if the firm has foresight or luck to acquire superior resources in the absence of competition, the *ex-ante* cost may be low or offset in this case. Conversely, "when the strategic factor market is perfectly competitive, the *ex-ante* cost is equal to the *ex-post* value, hence, bring no economic rents for a firm" (Barney & Arikan, 2001, p. 135). To capture the differences between *ex-ante* and *ex-post* cost within the knowledge- based context, the potent barriers and external imitations by competitors are essential in sustaining the economic rents of a firm.

Nevertheless, these barriers are subject to erosion as competitors learn and absorb the knowledge as well as apply it to its respective knowledge (Ziesemer, 2013). Implicitly, firms have to develop continuously and advance their knowledge to endanger its potential adopters. However, a knowledge- based perspective implies that innovation is the source of sustainable competitive advantage, which limit the competition for those rents that are achieved by superior firm performance. More precisely, innovation is understood as a process of creating novelty knowledge that develops and advances the existing knowledge base of a firm. Incessant development of knowledge limits the potential adopters in their catching up process, hence, creating sustainable competitive advantage for firms (Zack, 2002).

The cornerstone of sustainable competitive advantage in KBV emphasises on the task of discovering or creating novel knowledge through innovation. In this case, innovation conceives as the origin of the continuous creation of idiosyncratic (imperfect mobility) firm-level knowledge properties as well as serving as heterogeneity resources that enable the firm to earn economic rents from limited potential imitators in their catching up process (to achieve sustainable competitive advantage). In essence, KBV is the extent beyond RBV in emphasising knowledge rather than other types of resources in explaining the performance differences between firms.

2.2.2 Knowledge Properties

In this section, the researcher attempts to elucidate the properties of knowledge to understand how knowledge depicts as key for firms' innovations. Knowledge inherently is intangible and is traditionally characterised as 'non-excludability' and 'non-rivalry goods'. In this sense, knowledge shares the fundamental properties of public goods. Non-excludability refers to impossibility to exclude the access or use by one party from another party who do not pay anything in exchange for the goods, whereas, non-rival goods mean that others can use the goods without detracting its value or affect its availability to other users (Fischer, 2006; Ziesemer, 2013).

Kraaijenbrink, Spender, and Groen (2010) mentioned that knowledge is different compared to other types of intangible resources because knowledge possesses non-rivalrous characteristic. In this case, knowledge use or deployment is subject to economic of scale rather than depletion after being used by one party. Thus, the increase in deployment of knowledge resources will lead to greater knowledge expansion and development. This suggests that cooperation or co-development of knowledge could be one of the effective ways of obtaining significant knowledge for firms. Also, non-excludable characteristics make knowledge not kept in secret, and diffuse or make the knowledge external to the market (Ziesemer, 2013).

Wolfe (2006) found that not all knowledge is non-rival and non-excludability. Indeed, he indicates that knowledge cannot equate to pure public goods. In this sense, evolutionary theory underlined that firms have no direct or costless way in accessing technological knowledge because this type of knowledge is often seen as specifically idiosyncratic and accumulate over time through a specific learning process (Dosi, Nelson, & Winter, 2000). Intensively, knowledge possesses some tacit characteristic (embedded in the human mind which requires human articulation) and cumulative features (Dosi et al., 2000; Fischer, 2006; Ziesemer, 2013). Cumulative features of knowledge imply that once a particular piece of knowledge is created, it may serve as a fundamental for further advancement (Ziesemer, 2013). In this context, accumulation of knowledge serve as the foundation for any advancement in the future, these include modifying and extending the existing knowledge through new inventions, recombination of knowledge in a new way, and discovery of novel knowledge.

According to Coff (1999), knowledge is viewed as a special resource that is subjected to economic of scale (increase use or deployment of knowledge, the greater knowledge expand) and exhibit externalities effect (sometimes all can benefit from others' application of that knowledge). On the other hand, knowledge exhibits a source of competitive advantage by hindering the knowledge transfer and imitation. In this case, knowledge is a tough task in strategic management fields regarding the explanation on the transferability of it and how it can emerge as a strategic resource for the firms. Fundamentally, RBV identified resources that are valuable, rare, and inimitable and non-substitutability (VRIN) as firms' strategic assets. However, knowledge is not a scarce resource but exhibits some extent of public goods' characteristics, and thus is not sufficient to be considered as "rare" resources (Kraaijenbrink et al., 2010). Thus, treatment of knowledge in the analysis of sustainable resources is different compared to other tangible or intangible resources stated in the RBV perspective.

The basic premise for recognising knowledge as a strategic resource is indeed centred on knowledge transfer mechanisms (Grant, 1997). From a strategic management point of view, it suggests that uniqueness and difficulties to imitate asset will create competitive advantage (Ziesemer, 2013). In this sense, the degree of knowledge' tacitness and knowledge cumulativeness are important in determining the transferability of knowledge (Wernerfelt, 1984; Grant, 1997). Knowledge transfer depends on the degree of tacitness (Winter, 1987). The degree of tacitness refers to the extent of knowledge that resides in a human's head and the level of ability in articulating the knowledge to make it available for others. In this case, the higher the degree of knowledge tacitness, the harder to codify the knowledge, and eventually lead to difficulty in transferring and imitating the knowledge (Dyer & Singh, 1998). Likewise, Som (2012) also indicates that tacit knowledge tends to be significantly costly to replicate or to make it codify.

On the other hand, Ziesemer (2013) underlined the role of cumulativeness property of knowledge in knowledge transfer mechanism. The cumulativeness of the knowledge indicates that yesterday's knowledge binds today's knowledge. Traditionally, the theory of production suggests that knowledge accumulation generates learning curves that may result in cost reduction in the production process (Arrow, 1962). The evolutionary theory goes beyond this and suggests that knowledge is embedded in organisation routines, capturing experiential lessons of history, and thus, serves as an organisational memory that is continuously accumulated and maintained over the time-path dependence (Levitt & March, 1988).

The path dependence feature of the firm creates causal ambiguity (inability of competitors in understanding the cause of superior performance of another firm) that creates a barrier to limit the firm's ability and making it very difficult for other firms to copy due to its unique historical evolutionary part that is highly tacit (embedded in organisation and hard to articulate) and also specific in context (Nelson, 1991). Furthermore, Winter and Szulanski (2001) indicated that replication of organisational routine is tough and costly because replication of organisational capabilities can only be done through continuous execution.

Apart from tacitness and cumulative characteristics, 'knowledge carrier' is seen as a necessary characteristic that determines the knowledge transferability (Som, 2012). KBV postulates that collective knowledge serves as a guiding frame for interactive learning among members within firms or members of external parties. Interestingly, Becker and Huselid (2006) claimed that tacit knowledge is not sufficient to be described as a sustained resource. Indeed, collective knowledge presents strong idiosyncratic characters since it is the knowledge typically shared and integrated within a whole organisation.

Needless to say, collective knowledge is intrinsically bound to a firm's context due to the synergetic integration among members within a firm, hence resulting in specificity of knowledge for a firm. Therefore, the higher the specificity of knowledge for a firm, the higher of difficulty in transferring or imitating the knowledge.

Based on the underlying properties of knowledge regarding tacitness, cumulativeness and specificity, knowledge is indeed characterised by a quasi-public character. The transfer mechanism of knowledge is not a free process. In other words, knowledge is not freely available to a firm unless firms can identify the value of the knowledge, acquire the knowledge and recombine the newly acquired knowledge into firms' existing knowledge through continuous replication of organisational routine.

2.2.3 Knowledge- Based View in the Context of this Study

In a dynamic environment, firms' knowledge are not proprietary to firms because the value of the knowledge erodes quickly due to the nature of knowledge (partially non-excludable and non-rivalry in nature) that would, at any rate, leak out to the market. Innovation is the way for the firm to sustain competitive advantage by being continuously involved in innovation generation, make competitors difficult to replicate the knowledge assets owned by a firm, and the manner in which a firm deploys the knowledge assets (Teece, Pisano, & Shuen 1997). Innovation, in KBV context, is necessary when firms' knowledge stock becomes obsolete due to changes in the external environment (Som, 2012).

Based on the KBV perspective, firms' performances are determined by the heterogeneity of knowledge possessed by a firm and the ability to create, recombine, and utilise the knowledge in productive activities that is unique and not readily replicated by another firm (Grant, 1996a, 1996b, 1997). The logic of KBV can be applied for PIP because product innovation requires a wide range of knowledge sources (Leiponen & Helfat, 2010), as well as integrating and extending different pieces of knowledge emerging from various sources for new productive activities (Barrutia, Echebarria, Apaolaza-Ibanez, & Hartmann, 2014).

Central to this argument, knowledge is a key resource for product innovation. Typically, knowledge can be sourced both internally (through internal R&D generation) or externally (such as collaboration with external actors for innovation, or knowledge spill-over from informal linkages with external actors). Internal R&D is recognised as a source of new knowledge creation. However, in a dynamic industrial environment, knowledge in this industry is highly distributed across firms and new knowledge is constantly emerging (Barrutia et al., 2014). Consequently, new knowledge that often emerges outside the boundary of firms is thus an imperative for firms to source new knowledge from external sources to gain and sustain competitive advantage.

Knowledge is subjected to the economics of scale. Therefore, the greater the increase of use or deployment of knowledge, the greater the level of knowledge expansion it would be. Indeed, the search for knowledge should be wide and deep across a variety of search channels (Laursen & Salter, 2006; Wang, 2015). Knowledge provides firms with new ideas, information, and knowledge that could help them gain and exploit innovative opportunities (Foss et al., 2013). Although access to a variety of knowledge is expandable, use or deployment of knowledge, however, knowledge has quasi-public character (partially non-excludable and non-rivalry), that indicates the knowledge is not freely available for the firm, but necessitates (costly) efforts is required to gain access and make use of it (Buchmann & Pyka, 2015). Implicitly, this argument is rooted in the logic of bounded rationality (Simon, 1991). Firms have limited information and knowledge, thus, the excessive external search can be ineffective and even detrimental to a firm's innovation performance (Laursen & Salter, 2006), and because the search can be costly and simply inconclusive in increasing a firm's actual knowledge stock (Martini, Neirotti, & Appio, 2017).

Based on the discussion above, the exposure to the same amount of external knowledge does not necessarily derive equal benefits to the firms' PIP (Martín-de Castro, 2015). Indeed, the key that differentiates them depends on a firm's ability to capitalise and apply the externally acquired knowledge in the innovation process that can produce the desired product performance (Martini et al., 2017). This ability is always associated with the internal integration mechanism that allows knowledge articulation of newly acquired knowledge, and then translates and shares it with the experiential knowledge in a firm which is developed from passing through external search routines (Zollo & Winter, 2002). The combination of external searches and internal integration mechanisms are therefore determining the PIP of a firm. Figure 2.1 illustrates the summary of KBV for this study.

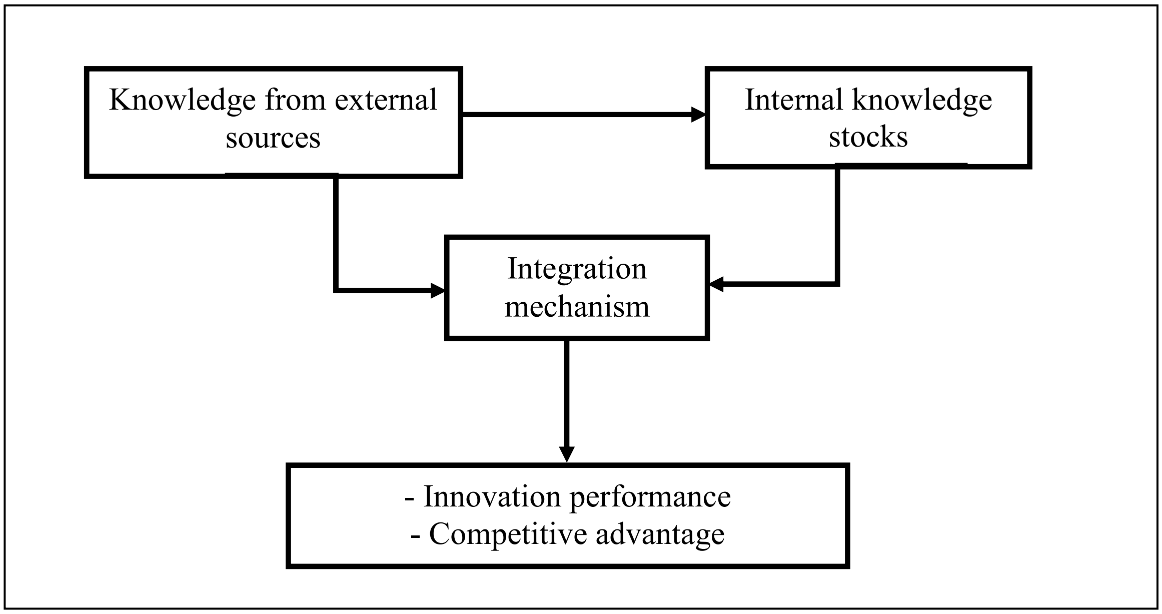


Figure 2.1
Summary of Knowledge- Based View
Source: Eisenhardt and Santos (2000) and Som (2012, p. 207).

2.3 Theoretical Review of Absorptive Capacity

During the last two decades, AC emerged as the popular concept that has seen proliferation in the citation of literature in many areas of organisational science research, such as strategic management, organisational learning and innovation studies (Volberda et al., 2010). Since Cohen and Levinthal (1989, 1990, 1994), and published works on AC. The concept has been widely applied in many fields of research due to its flexible setting. Despite this wide application, AC received various modifications on its dimensions, and most importantly, on its definitions and operationalisation of constructs (Murovec & Prodan, 2009; Schmidt, 2010; Volberda et al., 2010).

In this study, the researcher attempts to discuss AC in firms' innovation contexts. Since the AC is a broad concept, it is necessary for the researcher to review the concept thoroughly to make clear of the notion as to better fit it into the current study field. So as to comprehend our understanding regarding AC and innovation of a firm, the following sub-sections further discuss the AC in different contexts, development of the AC model (in an innovation context), and AC dimensions, typically in a firm-level context.

2.3.1 Prior's Conceptualised Models of Absorptive Capacity in Innovation Context

Based on the knowledge- based point of view, knowledge is a firm's most strategic resource. A firm's combined and integrated knowledge from various specialists to generate innovation outcomes. Grant (1996) stated that the mechanism of knowledge integration involves both internal and external integrations. Internalisation of knowledge occurs within a firm, whereas external integration involves market contract and relational contracts. Grant (1996) contended that a firm's internalisation of knowledge within itself enables it to transfer effectively knowledge gained from embodied product purchases (through market contract) and benefits from utilisation of specialise knowledge through inter-firm collaborations (relational contract).

Grant's (1996) notion of internalisation of knowledge is analogies with the notion of AC. It is now well accepted that development of AC does help a firm to exploit or utilise external knowledge to generate innovation effectively (Fabrizio, 2009). The fundamental concept proposed by Cohen and Levinthal (1990) emphasise that the role of AC in the search of external knowledge can be applied to innovation commercial ends. Indeed, from their perspective, AC is suggested as the critical component for innovation performance. Figure 2.2 illustrates the model of AC proposed by Cohen and Levinthal (1990).

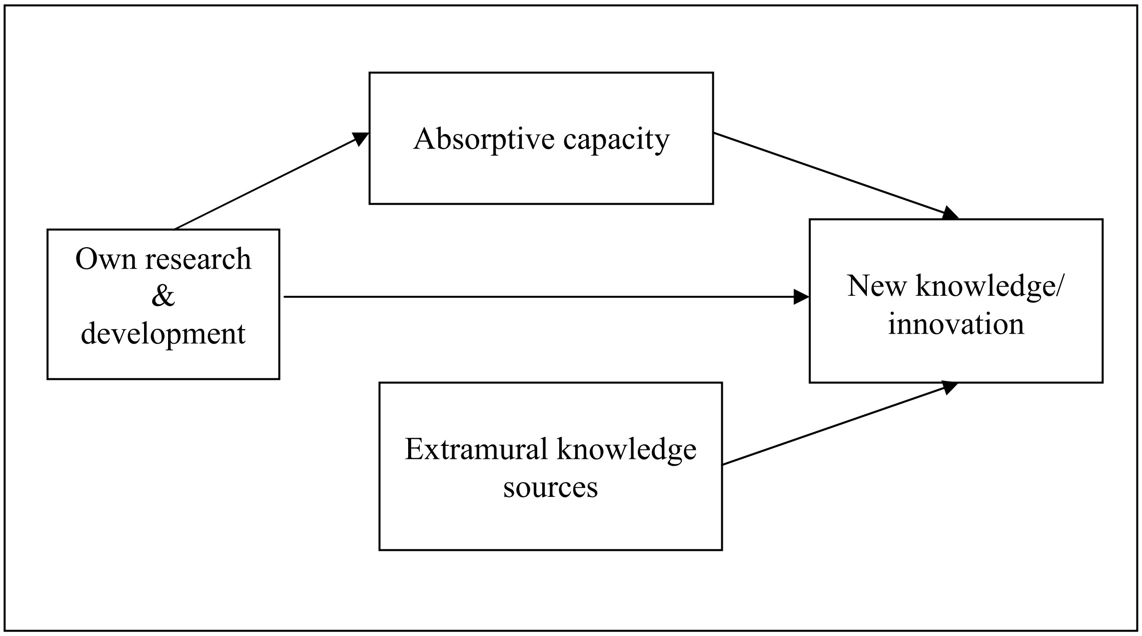


Figure 2.2
Absorptive Capacity Model
Source: Cohen and Levinthal (1990).

Cohen and Levinthal (1989, 1990) found a firm's ability to learn from its external environment largely depends on its prior related knowledge. Prior related knowledge in the firm refers to knowledge accumulation in one period of time that will permit more efficient knowledge accumulation in the next period. In this respect, they suggested that a firm's investment in R&D serves as the origin of prior related knowledge; and in turn, contribute to a firm's AC. Their studies highlight two important roles of R&D investment in an innovation context. Firstly, R&D aims at generating innovations. Secondly, R&D function as a by-product that expands a firm's capabilities and knowledge base (function as firm-level AC).

The findings from Cohen and Levinthal (1990) open up a new page for innovation studies by integrating the concept of AC into a firm's learning capabilities in a competitive environment. In their latter work in the year 1994, they depicted AC as a set of capabilities that allow the firm to understand better about external knowledge and to predict more accurately the nature and commercial potential of technological advances. Indeed, the ability to capture technological opportunities contribute to a firm's success in innovation (commercialising of a new product or a new process in the market), eventually, generating sustainable competitive advantage for a firm.

In innovation studies, the AC concept introduced by Cohen and Levinthal (1990) offered an explanation in heterogeneous innovation performance across the firms due to the different rate of AC through firm's investment in R&D (Lane et al., 2006). However, investment in R&D is stated as potentially reflecting bias towards science and technology knowledge rather than technical knowledge, that is through learning by doing (Oliver, Garrigos, & Baixauli, 2012), and are conceivably treated as proxies for prior knowledge bases rather than direct meaning for AC (Volberda et al., 2010). Despite such interest, Zahra and George (2002) seek to capture the capability view of AC, which includes a set of organisational routines in explaining the knowledge content directly rather than capturing a firm's investment in R&D.

Zahra and George (2002) re-conceptualize AC into two components, namely realised absorptive capacity (RACAP) and potential absorptive capacity (PACAP). The PACAP plays an important role in renewing a firm's knowledge base and skills as well as re-configure a firm's resource base to compete in changing markets. The PACAP brings in external knowledge and assimilates the external knowledge into a firm's knowledge base that is ready for any transformation processes. The RACAP has an explicit impact on a firm's innovation. The RACAP involves both knowledge transformation and knowledge exploitation capability. Transformative capabilities help firms to develop new perceptual schema or changes to existing processes, whereas exploitative capabilities convert the transformed knowledge into new products or processes. Figure 2.3 illustrates the absorptive model proposed by Zahra and George (2002).

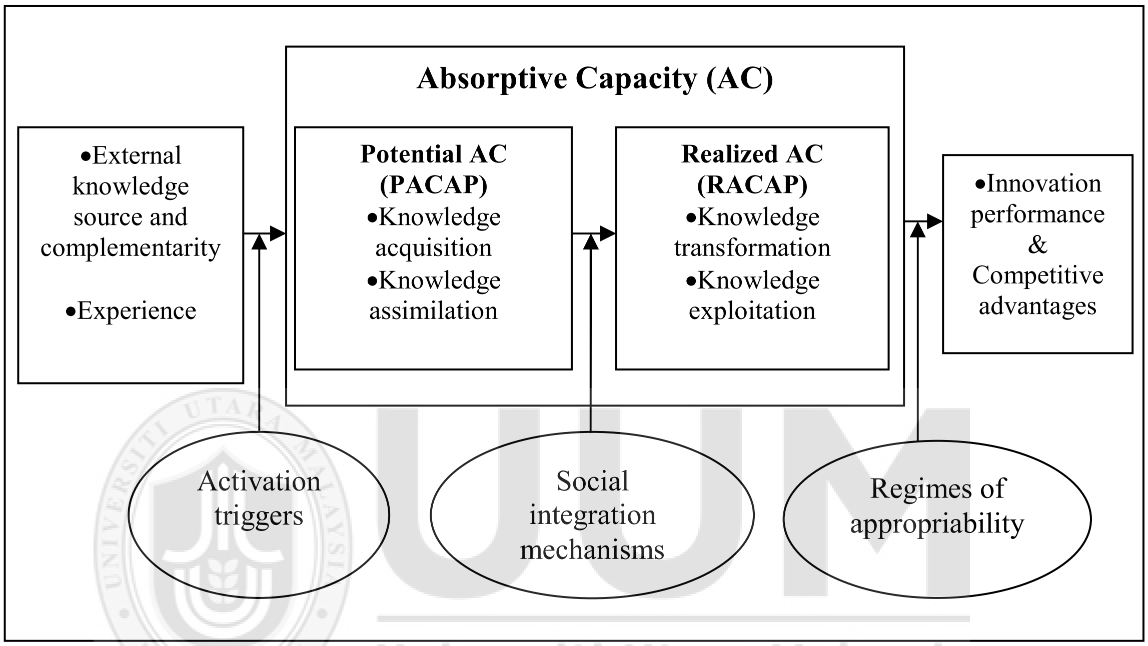


Figure 2.3
AC Model I
Source: Zahra and George (2002, p. 192).

The proposed model by Zahra and George (2002) laid on the foundation from KBV perspectives through underlining organisational knowledge base capabilities of AC in explaining the variations of a firm's achievement on innovation performance. AC is characterised as a slow accumulation of knowledge from time to time and is path dependence in nature. Differences in costs, efforts, and timing are associated with the AC development paths of firms causing performance differences across firms. In essence, Zahra and George (2002) also stated that firms with well-developed PACAP is likely to sustain a competitive advantage through offering greater flexibility and reconfiguration of a firm's knowledge base, as well as effectively time capability deployments at lower costs than its competitors. On the other hand, a firm with greater RACAP allow greater innovation creations (value creation) and eventually lead to the achievement of competitive advantage than those with less developed capabilities.

Derived from the model proposed by Cohen and Levinthal (1989, 1990, 1994), Zahra and George (2002) incorporated both external and internal factors in explaining to what extent these factors (activation triggers, social integration mechanisms, appropriability) influence a firm's AC. Fundamentally, activation triggers refer to both internal and external stimuli for linkages between AC and its antecedent (external knowledge sources and experiences). Internal stimuli refer to a firm's important events that trigger a firm's efforts to search externally for new knowledge, whereas external stimuli refer to external environmental change, such as technological shifts, that will induce a firm's efforts to seek external knowledge in improving a firm's internal capabilities base AC. On the other hand, social integration mechanisms are important in triggering knowledge sharing and knowledge exploitation of a firm, and reduce the gap between PACAP and RACAP. Also, Zahra and George's (2002) model of AC also highlighted the effect of appropriability conditions that affect a firm's ability to protect the advantages of new products or processes.

Todorova and Durisin (2007) reviewed the conceptual model proposed by Zahra and George (2002) and stated that the ambiguous view of the model is proposed with two components, namely PACAP and RACAP. They contended that transformation and assimilation are not subsequent dimensions, but rather they are alternative dimensions.

They evoked the cognitive science concept in the proposed dimensions and suggested that a firm's decision in assimilating and transforming the knowledge hinges on a firm's existing cognitive structure. In a case where new ideas fit into an existing cognitive structure, a firm assimilates the newly acquired knowledge, whereas when the new ideas cannot fit with the existing cognitive structure, a firm will transform the newly acquired knowledge.

Despite that assimilations and transformations are not sequential dimensions, Todorova and Durisin (2007) proposed to view AC in four dimensions, which are acquisition, assimilation, transformation and exploitation. The empirical study by Jansen et al. (2003) showed that the four dimensions of AC exhibited linear relationships with each other. In other words, they are not in the sequential model. They found that the dimensions of independent construct exhibit high validity in their hypotheses testing.

Lane et al. (2006) conducted a detailed analysis of 289 AC papers from fourteen journals to assess the concept of AC from the year 1991 to the year 2002. They proposed AC as a three-dimensional learning concept that contributes to innovation outcomes. Figure 2.4 illustrates the model of AC proposed by Lane et al. (2006).

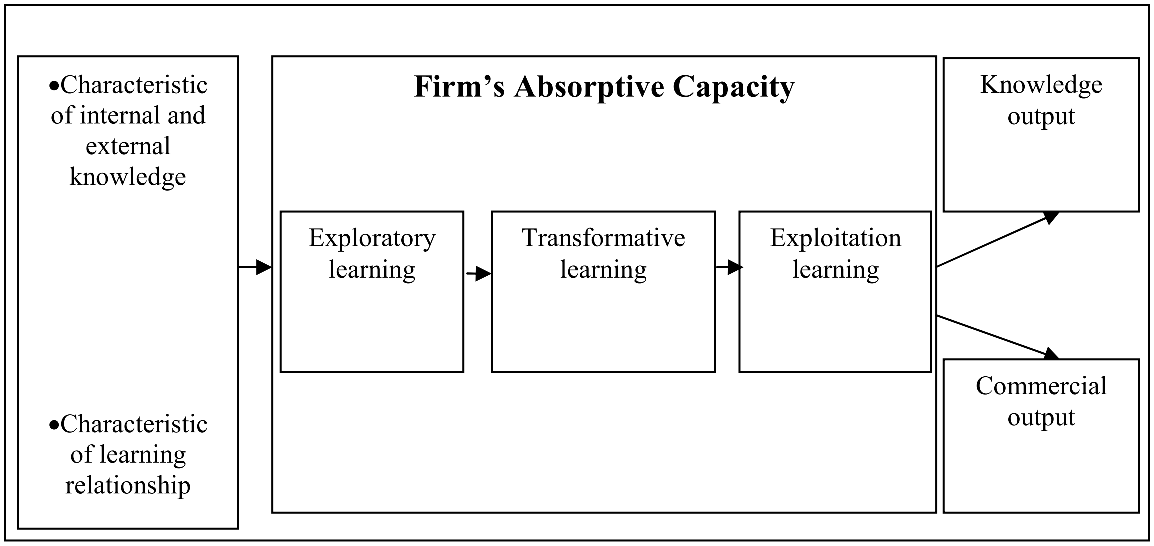


Figure 2.4
AC Model II
Source: Lane et al. (2006).

Fundamentally, Lane et al. (2006) proposed that AC is a firm's ability to utilise externally held knowledge through sequential learning process from exploratory learning, transformative learning, and exploitation learning. In contrast with Zahra and George (2002), Lane et al. (2006) stated that the three learning processes have distinct functions in utilising the external knowledge and acts complementary between one another. The synergies from these three learning processes are likely to form a whole knowledge that is greater than the sum of each of the three processes.

In this regard, Lichtenthaler (2009) defines exploratory learning as a firm's ability in recognising and understanding newly acquired external knowledge, whereas transformative learning refers to a firm's ability in retaining assimilated knowledge and reactivating this knowledge when it is needed. Exploitative learning is the process of transmuting the assimilated knowledge and applying this knowledge. In his findings, he found that only exploitative learning has direct positive and significant effects on innovation performance (perpetual performance of new product development successfulness). Also, independent analyses of single learning processes produce inconsistent results. Thus, he concluded that the complementary effect between these three learning processes on profiting from external knowledge through innovation, and suggested a single learning process is not beneficial to the firm.

In conclusion, AC provides a fundamental explanation on how a firm gains leverage from external knowledge through its learning process or knowledge- based capabilities, and ultimately leads to commercial output for a firm. Cohen and Levinthal (1990) have provided a broad concept of AC, and thus allow ample development for AC in different contexts and dimensions. Lewin et al. (2008) found that this vast development leads to validity challenges in AC concept operations. Thus, to further comprehend our knowledge on the AC concept operations, the following subsection explores the operational definitions for AC concepts based on the extant literature.

2.3.2 Application of the Absorptive Capacity Concept in Innovation Contexts

The concept of AC is always fuzzy and complex (Abreu, Grinevich, Kitson, & Savona, 2008), relatively difficult to define (Schmidt, 2010), and the many aspects of learning processes that are defined in prior studies are largely not utilised and operationalised by the empirical researcher (Volberda et al*.,* 2010). Thus, the dimensions of AC are discussed critically to capture the whole or part of AC in its operational level.

Cohen and Levinthal (1990) stated that AC is intangible and its advantages towards a firm are indirect. Thus, they proposed R&D in investment proxies as both determinants of innovation and AC. The R&D in investments serves as dual roles in explaining a firm's internal learning and new knowledge generation processes. In essence, the work of Cohen and Levinthal have drawn a prior work in operationalising the concept of AC, and thus, revealing the black box of the AC and how it works in firms.

There is a similar proxy indicator that includes not only the existence of R&D, but it also involves the R&D of human capital in better capturing the firm's internal R&D activities (Oltra & Flor, 2003). The example of R&D in human capital includes R&D of employees divided by total employees (Gao, Xu, & Yang, 2008), investment in staff training (Nieto & Quevedo, 2005), R&D in skills (Escribano et al., 2009), percentage of R&D personnel with high education qualifications (Veugelers, 1997) and total sales to personnel training (Frenz & Oughton, 2004). Furthermore, the literature also emphasises the patents and publications as the indicators for AC. For example, Mancusi (2008) employed self-citations on patents as an indicator of AC. Self-citation is the citation on previous patents applied for by the same applicant of the citing patent.

Despite growing interest in AC studies, Van den Bosch and Volberda (2003) stated that R&D measurement appears to be problematic. Lane and Lubatkin (1998) on the other hand found the weak explanatory power of R&D spending in measuring AC compared to their newly established AC measurement. Their proposed measurement includes the investigation of the dyad relationship between "student" and "teacher" firms when establishing knowledge of absorption activities. Indeed, the more similarities in social contexts, knowledge and research among "teacher" and "'student" firms, the greater the ability of the firm in learning.

Implicitly, the result showed by Lane and Lubatkin (1998) has proved that Cohen and Levinthal's (1990) argument on other proxies in R&D can be employed in capturing the AC in a firm. Likewise, Lane et al. (2006) reviewed 180 papers citing the shortage on determinants of AC which examine only the R&D determinant. Specifically, they stated that the proxies of R&D as the determinant of AC is unable to treat AC as a process or capability, but rather as static forms of resource (Lane et al., 2006).

In addition to the argument, assuming R&D information as the proxies for AC, it tends to overestimate or underestimate the real representations in firms (Volberda et al., 2010). The inaccurate estimation by R&D information is most probably caused by this unidimensional measure of AC that cannot meet the complexity of the constructs as stated by the Cohen and Levinthal (Flatten, Engelen, Zahra, & Brettel, 2011) and not efficiently dealing with different knowledge forms that exist from different industries (Schmidt, 2010).

Despite the growing literature that argue the efficiency in using R&D as the proxy for R&D, there are some authors who proposed that using others determinants beyond the idea of using R&D as the proxy for AC. Bogers and Lhuillery (2011) proposed proxies of functional areas of R&D, manufacturing and marketing to illustrate the AC in organisations. Indeed, they found that each proxy functions in absorbing different kind of knowledge. In particular, R&D functions as an absorber for scientific knowledge, especially in manufacturing which is important for absorbing supplier and competitor's knowledge, and in marketing by helping to absorb customer's knowledge.

Even though the functional perspective proposed by Bogers and Lhuillery (2011) capture further about the explication on AC, however, the proposed indicators still exist as the proxies for AC. In this context, Veugelers (1997) mentioned that there is a need for the researcher to elicit the multidimensional role of AC in a more direct way to overcome the limitations of the proxy indicators. The approach employed to elicit multidimensional AC is captured through the perceptive instruments, or in other words, involved a set of survey questionnaires in capturing the perspectives of firms regarding their AC capabilities. The past empirical research have proved that the dimensions of AC are valid in representing a firm's AC (Jimenez-Barrionuevo, Garcı´a-Morales, & Molina, 2011; Camison & Fores, 2010; Flatten et al., 2011; Jansen et al., 2005). In conclusion, the AC measurements employed by the prior researchers are shown in the following Table 2.1.

Table 2.1
Measurement of Absorptive Capacity

Classification	Measurement	Examples
Proxy Indicator	Output oriented indicators	Internal R&D expenses, staff in R&D department, R&D personnel training, ratio of scientists and researchers (Escribano et al., 2009). Internal R&D, extramural R&D, training of personnel related to innovation project (Murovec & Prodan, 2009). In-house R&D investment and patenting (Li, 2011). Percentage of R&D investment [R&D expense/net sales *100] (Yu, 2013). Total R&D expenditures, number of employees with bachelor degree, R&D activities (development of new technological application, prototypes of new designs, submission of patents or copyright), R&D personnel training (Kostopoulos et al., 2011). R&D intensity [R&D expenditure/total assets] (Lin et al., 2012). R&D employees divided by total employees (Gao et al., 2008). R&D activities (continuous versus occasional), R&D intensity (R&D expenditure in total turnover), employees with higher education degrees as a share of total employees (Schmidt, 2010). Self-citation (Mancusi, 2008). Total sales to personnel training (Frenz & Oughton, 2004).
	Non-R&D/ Others	Functional perspective of AC includes manufacturing and marketing as the AC aspects (Bogers & Lhuillery, 2011). Employee motivation and employees ability (Liao, Fei, & Chen, 2007).
Perceptive instruments	Multidimensional	Four dimensions: acquire, assimilate, transform, and exploit (Jimenez-Barrionuevo, Garcia-Morales, & Molina, 2011; Camison & Fores, 2010; Flatten et al., 2011; Jansen et al., 2005). Three dimensions included, which are acquisition, assimilation and transformation (Chen, Lin, & Chang, 2009).
	Single component	RACAP [transformation and exploitation] (Navarro, Eldridge, & Wensley, 2013). PACAP [Acquisition*amount of external information available in the environment, assimilation] (Fosfuri & Tribo, 2008).
	One or two dimensional	Acquisition and exploitation. Both dimensions are divided into scientific and industrial types of external knowledge acquisition and exploitation (Jurado, Gracia, & de Lucio, 2009).

In essence, the concept of AC lacks consensus in their dimensions (Jimenez-Barrionuevo et al., 2011). The origin of AC dimensions proposed by Cohen and Levinthal (1990) involves the acquisition, assimilation and commercialisation of new external knowledge. Lane and Lubatkin (1998) then examine this concept in relational context. Later, there are a few studies which have re-conceptualized the concept of AC dimensions and these involved Zahra and George (2002), Lane et al. (2006), Todorova and Durisin (2007), Lichtenthaler (2009) and Gebauer, Worch, & Truffer (2012). However, the operationalised concept of AC in R&D for investment has its limitation in providing the information about the resultant change in capabilities (Mowery, Oxley, & Silverman, 1996).

Zahra and George (2002) viewed AC as a set of organisational routines and proposed four dimensions of AC, which are acquisition, assimilation, transformation, and exploitation capability. Their proposed dimensions extend the original concept by incorporating the concept of transformation in their proposed concept. In their model, they have explicitly separated assimilation and transformation dimensions through dividing the AC into two components, namely potential AC (acquisition and assimilation) and realised AC (transformation and exploitation). In particular, assimilation capability refers to a firm's capability to analyse, process, interpret and understand newly acquired external knowledge sources, whereas, transformational capability refers to a firm's capability to develop and refine newly assimilated knowledge.

Extensively, the transformation dimension is stated by Zahra and George (2002) whereby it coexists with the assimilation dimension. In other words, they mentioned that potential

AC (PACAP) coexist with realised AC (RACAP). They stated that firms might not transform and exploit knowledge (RACAP) without firstly acquiring and assimilating knowledge (PACAP). On the other hand, a firm does not necessarily enhance their performance with the acquired and assimilated knowledge (PACAP) because firms are not able to transform it for commercial use without transforming and exploiting (RACAP) the knowledge.

Moreover, Jimenez-Barrionuevo et al. (2011) found that the independent dimension shows high validity on the constructs. The difference of their findings compared to others is that they have extended their investigation on both PACAP and RACAP components. Surprisingly, they found that both components of AC showed high validity of the constructs that have been examined. The result indicates that the components proposed by Zahra and George (2002) are valid in the empirical test. Likewise, Camison and Fores (2010) also obtained high validity results on the proposed scales of instruments using PACAP and RACAP components. They treated the four dimensions (acquisition, assimilation, transformation and exploitation) as the second order latent factors and links them to the PACAP and RACAP components and prove that acquisition and assimilation are accepted in PACAP components, whereas transformation and exploitation are accepted in RACAP components.

In essence, the results showed by Jimenez-Barrionuevo et al. (2011) and Camison and Fores (2010) both indicate that PACAP and RACAP components are related to the dimensions that have been proposed by Zahra and George (2002). However, they did not further examine whether RACAP is the subsequent learning process from PACAP. Also, their model did not include the empirical test on the complementary role-play by the four dimensions suggested.

Lichtenthaler (2009) had closed the gap by studying the complementary role in AC aspect. It is suggested that AC is made up of three distinct learning dimensions that contribute to innovation and performance. These dimensions are exploratory, transformative and exploitative learning and found to have complementary effects on innovation and performance. Concerning the dynamic nature of a firm's learning, Lichtenthaler (2009) stated that firms do not have a uniformed level of all learning processes. For example, some firms are excessively concerned on searching and acquiring external knowledge sources but put little effort in transforming and exploiting the newly acquired external knowledge. The distinction of the AC dimensions is to understand the inter-firm discrepancies in profiting from external knowledge.

Extensively, in Lichtenthaler's (2009) proposed model, both acquisition and assimilation are combined as one dimension called exploratory learning. In addition, the transformation is viewed as a separate dimension from the exploitative dimension. The transformation is functioning as the link between exploratory and the exploitative learning process. Indeed, transformation learning plays an important role in both maintaining and reactivating the knowledge. The knowledge that has been assimilated is not necessary to be applied instantly. Indeed, this assimilated knowledge need longer time to be applied to new products, and thus maintaining and reactivating knowledge is essential at this stage.

Moreover, Lichtenthaler (2009) claimed that even though exploitative dimension is separated from transformation learning, they are complementary in generating innovation performance. The complement between exploitative and transformation learning are more likely in a turbulent environment, where firms strongly rely on external knowledge. The rapid changes in the environment require knowledge to be activated and transformed from technological knowledge into new products or processes and at the same time, maintain a large knowledge base that may later be applied in exploitative learning.

The debates over AC are captured in many facets; through discussions of the arrangement and the roles of the dimensions in the extent. The arrangement of AC dimensions is mentioned about either if it is sequences or distinct dimensions, whereas the discussion on roles of AC encompass whether the dimensions of the AC is complementary to each other. Thus, the disparities of the proposed dimensions by the prior researcher urged to further clarify on each of the dimensions of AC. Table 2.2 illustrates each dimension of AC.

Table 2.2
Absorptive Capacity Multidimensional

Dimension	Definition	Authors that contribute in defining the dimensions
Acquisition	Firm's ability in scanning, recognising, valuing, and acquiring external knowledge. Includes seeing and understanding the potential external knowledge.	Cohen & Levinthal (1990); Zahra & George (2002); Todorova & Durisin (2007); Camison & Fores (2010); Jimenez-Barrionuevo et al. (2011).
Assimilation	Firm routine and process that allow it to analyse process, interpret, understand, internalise, and classify the external knowledge sources. Shared languages and symbols are important to disseminate new knowledge throughout the firm.	Zahra & George (2002); Camison & Fores (2010); Gebauer et al. (2012).
Transformation	Involved maintaining and reactivating the knowledge, adding or deleting the knowledge, interpreting and combining the knowledge, and integrating the new knowledge with the existing knowledge base.	Cohen & Levinthal (1990); Zahra & George (2002); Todorova & Durisin (2007); Lichtenthaler (2009); Lane et al. (2006); Camison & Fores (2010); Jimenez-Barrionuevo et al. (2011); Gebauer et al. (2012).
Exploitation	Involved transmute knowledge into commercial processes, such as introduce new products and processes, firm routine to refine, extend, and leverage existing competence or create the new ones through incorporating and transforming the knowledge into operation.	Cohen & Levinthal (1990); Zahra & George (2002); Todorova & Durisin (2007); Gebauer et al. (2012).

In this study, we defined AC as a set of organisational routines that involved acquiring external knowledge, assimilating it, transforming it and exploiting it to commercial ends. Table 2.2 indicates that acquisition, assimilation, transformation and exploitation play different roles in processing the incoming knowledge into valuable knowledge for product innovation. Therefore, in this study, we viewed that each of the dimensions of AC determined how the knowledge turns into useful knowledge for product innovation, and each dimension should be included in define the means of AC in innovation studies.

On the other hand, with regards to different point of views in treating AC dimensions (acquisition, assimilation, transformation, exploitation) as continuous, a process, or complementary between the dimensions, we are convinced with the latter standpoint. Based on the idea of interactive innovation (Swan & Scarbrough, 2005), innovation is a continuous performative accomplishment. That is, innovation does not go step by step starting from acquisition, assimilation, transformation, and exploitation, rather it is a continuous back and forth process between acquisition, assimilation, transformation and exploitation, and it exists as a messy unfolding of innovation in practice (Dougherty & Dunne, 2012).

Due to the stated reason, in our model, we propose AC as a big concept that consists of these four organisational routines - acquisition, assimilation, transformation, and exploitation. These four dimensions are interactive and complementary between each and others. Therefore, it can be viewed to represent AC as a whole without access it in according to the sequences as suggested by prior studies (Zahra & George, 2002).

2.4 Product Innovation Performance

Product innovation is defined as value added to products which results in technical and aesthetic changes in significance or improvement rates (OECD, 1997), as well as, result in market and technological discontinuity (Garcia & Calantone, 2002). With the intention to operate product innovation in a firm or business context, product innovation could have as objectives or effects, loyalty improvement of existing customers, improvement of market share (Blindenbach-Driessen, Van Dalen, & Van den Ende, 2010). KBV indicates that innovation contributes in generating economic rent and sustainable competitive advantage. In this regard, product innovation is defined as the "value added of a product to fulfil the objectives of product innovation, such as shortening the product lifespans, diversifying the product portfolios, technically and aesthetically changing products as well as increasing or sustaining product market shares" (OECD, 2005, p. 107).

PIP refers to the assessment of the impact of product innovation on a firms' competitive advantage; or survival; or success of businesses (Wei & Atuahene-Gima, 2009; Atuahene-Gima & Wei, 2011). Current studies indicate that PIP is a multidimensional concept rather than a unidimensional concept because product innovation is a better measure in a multidimensional context, since it can enhance the ability to access reliability, capture broader, new product performance domains and ensure a common reference for decision-making (Henard & Szymanski, 2001). Also, PIP can be defined in different ways due to the different perspectives and classification of the level of its impact on a firm (Marsh & Stock, 2003; Paladino, 2007; Millson, 2015). The impact can be market rewards for new products - in terms of objective financial outcomes or subjective financial and non-financial outcomes (Evanschitzky et al., 2012; Zhang, Benedetto, & Hoening, 2009).

Basically, the objective financial outcome measures the degree of market rewards for a new product (in numbers), such as new products' sales or profit, new products' return on investment and new products' market shares (Kohler, Sofka, & Grimpe, 2012; Tsai, 2009). This type of measurement is essential to capture the outcome of product innovation. However, it also suffers the limitation in accessing the confidential financial data of companies (Henard & Szymanski, 2001; Lily Julienti Abu Bakar & Hartini

Ahmad, 2010). Also, obtaining only financial information in accessing PIP may perhaps overlook on other aspects related to impact of product innovation on firms (Henard & Szymanski, 2001). Moreover, Chang, Chen, and Lin (2014) stated that objective measures for PIP, particularly financial data, are often inaccurate, unavailable and less useful when companies access the various subjective strategic implications such as customer satisfaction.

The shortcoming of this approach leads to the introduction of subjective product innovation measurement. The subjective measure is a self-assessment method that captures the PIP of the firm through the information provided, expert or representative in survey studies (Becheikh, Landry, & Amara, 2006). Although self-assessment methods tend to be subjected to human error or bias, as well as low response rates, this approach is popular due to widely covered subjective constructs that are likely to reveal significant and reliable perceptions from practitioners regarding product performance in the firm (Zhang, Wu, & Cui, 2015). The subjective measure covers a wide range of product innovation success in a firm about its stated objective or comparative with the competitors. In essence, Table 2.3 shows PIP measurement from prior studies that are based on a set of subjective measures.

Table 2.3
Product Innovation Performance Measurements

Authors	Scope	Dimension	Measurement Scales
Griffin (1997)	New product development (PDMA)	Financial performance	Better profitability compared to firm's other product. Better market share compared to firm's other product. Better sales or revenue compared to firm's other product.
		Technical performance	Enhance competitive advantage. Better product quality.
		Customer performance	Improved customer loyalty. Customer satisfaction.
Garcia & Calantone (2002)	Literature review on 21 empirical studies	Level of Innovativeness	Newness to the customer. Newness to industry (market know-how, technology know-how). Newness to firm (Market know-how, technology know-how).
Alegre et al. (2006)	Develop PIP scale with 132 usable responses for French biotechnology firms	Product innovation efficacy (compare with competitors)	Replacement product being phase out. Extension of product range within main product or outside main product field. Development of environment-friendly products. Market share evolution. Opening new markets (domestic and abroad).
		Product innovation efficiency (compare with other competitors)	Average innovation project development time and working hours. Average cost per innovation project. Global satisfaction degree with innovation. Project efficiency.
Maravelakis, Bilalis, Antoniadis, Jones, & Moustakis (2006)	100 usable responses for SMEs	Innovation measuring and benchmarking in SMEs	Market need. Value for money. Delivers functional needs. Good aesthetic definition.
De-Luca & Atuahene-Gima (2007)	Firm-level survey with 363 usable responses for China high technology firms	PIP	Market share and sales relative to firm's stated objectives. Profitability, return on assets and investment relative to firm's stated objectives.

Table 2.3 (Continued)

Authors	Scope	Dimension	Measurement Scales
Stone, Rose, Lal, & Shipp (2008)	Australian National Innovation Survey	Qualitative output	Effects of innovation on productivity and performance. Degree of novelty of product innovation (firm, country, region, and world). Effect of innovation (productivity, proficiency, profitability, and market position).
Brettel & Cleven (2011)	Technology based and knowledge intensive German companies with 254 usable responses	New products innovation	Market success of new products. Degree of novelty of new products. New products' sales volume.
Tsai, Hsu, & Fang (2012)	106 manufacturing firms in Taiwan	PIP	Financial (sales goals, revenue goals, sales growth, market share goals, profitability) relatively to stated objectives. Open new market opportunity. Development cost, time to time market, launch on time, and break-even time relative to the stated objectives.
Tavani, Sharifi, & Ismail (2014)	233 usable responses from UK manufacturing firms with sample drawn from FAME database	General product performance Agile product performance	New products goals (sales growth, market share, return on investment, customer acceptance and satisfaction, development cost). Level of novelty, speed of new product development, time to market, and number of products introduced to the market, number of new products that is first to the market.
Lin, Tu, Chen, & Huang (2013)	196 NPD projects of Taiwanese high technology firms	New product development outcome	Development speed (time efficient and meet target objectives). Development costs (meet target objectives and cost efficient). Product quality (better quality compare than competitors, better quality compare than firm's other products, met target functionality objectives, and unique benefits for customers).
Hannachi (2015)	PIP measurement, 100 usable response from biotechnology industry	Financial	Profits and return on investment achieved target objectives. Profit of new product greater than other products in the firm.

Table 2.3 (Continued)

Authors	Scope	Dimension	Measurement Scales
Zhang et al. (2015)	Product Development and Management Association (PDMA) with 341 usable responses for firms in U. S.	Market	New product sales, market share, and penetration of new market achieved target objectives. New product sales and market share relatively greater than other products in the firm.
		Technical	Better product quality. New product launches effectiveness (within deadlines and budget). Develop environmental friendly product.
		Customers	New product in customer's perspectives (improves satisfaction, loyalty and reduces complaints).
		Strategic	New product to achieve particular goal, improves reputation, and provide competitive advantage.
		New product innovativeness	New to industry. Creative & interesting. Platform to introduce further new products.
		New product development speed	New product development speed relative to its stated objective, industry norm, and firm's standard product development time.
		New product financial performance	Return on investment, sales, profit margin, and market share relative to its stated objectives.

PIP involves successful exploitation of new product ideas and realisation of these ideas into the market. Measuring product innovations' outcomes is a thorny task, since the multiplicity of meanings of product innovation measurement is associated with the scope of defining and the roles that performance measurement plays (Hannachi, 2015). Based on the summary shown in Table 2.3, PIP is endeavoured to achieve greater product quality, market share, profit, as well as, shorten product development time or period.

Interestingly, to capture the value of “greater”, product innovation measurement suggested by past researchers allow a firm to compare its performances with their stated objectives, as well as, to benchmark with other firms. Implicitly, this leads to better understanding of a firm’s achievement, corresponding to the extent of the strengths and weaknesses of a given product innovation (Hannachi, 2015).

According to KBV, the firm innovates to gain greater economic rent and sustainable competitive advantage. In this regard, product innovation is essential for the firm not only of its economic or financial prospect but also include market success, ability to provide valuable and unique product in terms of greater functionality value and greater novelty product value for a firm to achieve sustainable competitive advantage. In essence, refer to Table 2.3 - comparing the scales of PIP, regardless of differences of the dimensions and measurement scale of PIP, the measurement scale indeed consists some common characteristics. In this study, based on prior studies of measurement scales in Table 2.3, there are two levels of a new product’s success, namely internal and external successes. Specifically, financial dimension and market dimension refer to external success, whereas, technical dimension refers to the internal success of a product.

The technical performance of products should be measured in the context of how well the new product achieved the functionality desired and produce greater quality in comparing with external competitors or a firm’s existing products (Lin et al., 2013). Therefore, based on Table 2.3, the technical dimension includes the improvement in product quality, good aesthetic definition, better quality compared to competitors, better quality compared to a firm's other products, and met target functionality objectives (Griffin, 1997; Alegre et al., 2006; Maravelakis et al., 2006; Lin et al., 2013; Hannachi, 2015).

In the strategic management field, KBV underlined the impact of innovation on a firm's competitive advantage. In this regard, product innovation, if necessary, needs to lead to financial and market value. Financial dimensions in product innovation measures the degree of which an organisation reaches its new product development goals (Zhang et al., 2015). Likewise, McNally, Cavusgil, and Calantone (2010) contended that a successful product innovation has to lead to financial improvement for a firm. In Table 2.3, most of the authors include financial measurements except Alegre et al. (2006) that omitted the financial aspects. The measurement scales in financial dimensions include new product sales, a product's return on investment and profit margins about its stated objectives or to other range of products.

Successful product innovation is essential to enhance the opportunity to new market, and improve market positions (Hannachi, 2015). The measurement scales in market dimensions include product's market shares and penetration of the new market, and market position for the product as compared to the other firms or the set target objectives. Regarding this dimension, researchers stated, the evaluation of successful product innovation in market dimension is "distinguished from the marketing innovation" (OECD, 2005, p. 49). In this regard, the introduction of a new product is viewed as a direct impact in improving market position and enhancing opportunities to new market, rather than to introduce new marketing methods to address better market opportunities and market positions.

Some authors include customers' perceived value on a product (customer satisfaction, complaint and loyalty) to evaluate the success of products in the market (Griffin, 1997; Hannachi, 2015). This dimension is essentially contributed in evaluating the sustainability of new products in the market. Apart from the stated dimensions, some authors have proposed an evaluation of PIP based on the level of novelty (Brettel & Cleven, 2011; Tavani, Sharifi, Soleimanof, & Najmi, 2013). Indeed, a measure of novelty levels reflect the level of extent of a new product achieved at firm-level, market-level as well as at industry-level.

In conclusion, PIP reveals the success of new products introduced by the firms. Unlike product innovation, PIP constitutes the very end of the innovation process. Commercialisation of a new product does not indicate the direct success of a firm in innovation studies. Thus, to capture the commercial impact of product innovation, implementation of the new product should be access in its' impact on firm' performance based on both financial and non-financial performance. In this study, the researcher proposed to combine both financial and non-financial dimensions for PIP measures. Further details of PIP measures are discussed in Chapter Four of this thesis.

2.5 Overview of Knowledge Search for Innovation

Innovation is view as a new combination of existing components (Schumpeter, 1939; Kogut & Zander, 1992). Firms seek new combination across multiple and different channels to gain relevant knowledge that required for firms' product innovation process (Falkenberg, Woiceshyn, & Karagianis, 2003; Ebersberge & Herstad, 2011). Typically, firms acquired knowledge from the search within organisation boundary or search beyond organisation boundary (Savino, Messeni-Petruzzelli, & Albino, 2017). Search within organisation takes place within the firm when the firm's members generate and distribute the knowledge in-house (Falkenberg et al., 2003). Internal social capital is a key here by which firms can access knowledge (Inkpen & Tsang, 2005). The interaction between the firm's members across different subunits allows the firm to enhance knowledge stocks through the integration of individual's knowledge (Fleming, 2002). Interactions of members help to increase firm's knowledge stocks, create greater recombinant potential, and eventually are more likely to create a new product (Carnabuci & Operti, 2013).

Based on KBV, firms are viewed as generator, repositories, and integrator of knowledge (Ranft & Lord, 2002). Therefore, the search within the firms is tied to firms' ability to develop new internal activities that will enhance its internal capacity to innovate (Doloreux, 2015). All these activities rely in part of firms' prior knowledge that is previously accumulated in an organisation (Tang & Murphy, 2012). Prior knowledge in regards to internal organisation refers to idiosyncratic information about the operation, knowledge or skill of firms' members that are accumulated through their work experience (Cooper, Gimeno, & Woo, 1994). Indeed, with prior knowledge, it provides the foundation for mutual understanding on firms' operations and enhanced socialization initiatives among their members that eventually foster integration of multiple knowledge elements, which is required for innovation (Savino et al., 2017).

In general, search within organisation that mostly related to innovation is internal R&D related investment (Doloreux, 2015). Reliance on internal R&D for product innovation received great debates among the scholars. The most prominent work regarding this issue raised by Chesbrough (2003) notion of "open innovation paradigm". From his perspectives, reliance on internal R&D is indeed a "closed model paradigm" that stressed on the new technology which should be discovered and developed by the firm itself. He argued that no company could stay competitive in the market if it remains as a technology island. Firms are not isolated from the business environment. Firms should use external ideas to advance their technology (Chesbrough, 2003). The use of external ideas helps to reduce the costs, shorten the time in introducing new product to the market, increase differentiation in the market, and create new revenue streams for the company (Chesbrough, 2003).

On the other hand, employing knowledge beyond organisation boundary is essential for firms to innovate. In fact, searching knowledge externally increases the likelihood to generates innovation (Neito & Santamaria, 2007; Chiang & Hung, 2010; Sofka & Grimpe, 2010; Wu, 2014). Innovation requires combination from various knowledge sources and external knowledge search enables firms' to access to various knowledge that needed in innovation process (Kang & Kang, 2009). In particular, exploring external knowledge can be in various ways (Martini et al., 2017). Building from the prior works, external search involved the choice of external actors (Fabrizio, 2009; Sofka & Grimpe, 2010), choice of search strategies breadth and depth (Laursen & Salter, 2006), and choice of methods that involve different levels of commitments (Van de Vrande, Lemmens, & Vanhaverbeke, 2006).

External knowledge search alone can be ineffective without the internal involvement of the companies (Martini et al., 2015). In fact, external knowledge is necessary in integrating with firms' existing knowledge base in order to allow knowledge articulation, sharing of the experiential knowledge for research, and implementing the external source ideas (Grant, 1996). The KBV logic clarified that firms' capacity in deploying both internal and external knowledge sources is the key to explain the innovation performance (Falkenberg et al., 2003). However, external knowledge search helps firms to access varieties of knowledge but this knowledge is not yet ready to convert into final products (Foss et al., 2013). Therefore, firms need to acquire, assimilate, transform, and exploit the external knowledge to convert it to commercial end (Cohen & Levinthal, 1990; Zahra & George, 2002; Costa & Monteiro, 2016).

Over the course of time, the process of translating the raw knowledge gained from external search into actionable knowledge creates an isolating mechanism that raises the barriers for competitors (Martini et al., 2015). As the span of knowledge is integrated into firms' routines, the knowledge owned by firms are specific, sophisticated, and not easy to trade or redeployed outside the firms, thus, make it more difficult for potent rivals to accomplish replications (Dierickx & Cool, 1989; Costa & Monteiro, 2016). Despite the consensus on the importance of external knowledge search and internal mechanism in integrating external knowledge to the internal knowledge base, it is worthwhile to explore further in following sections.

2.6 Review of External Knowledge Search for Innovation

External knowledge is indispensable for a firm's innovation. KBV suggested that external knowledge which flows across organisations contribute to the accumulation of knowledge (Eisenhardt & Santos, 2000), as well as more entrepreneurial opportunities; that could lead to more innovation for firms (Foss et al., 2013). In order to comprehend the understanding of the huge body of literature in the context of search and knowledge sourcing for innovation, this section illustrates the sources of external search, methods of external search and external search strategies in following subsections. Indeed, this help to clarify the external knowledge search literature through identifying where to search (from whom) and how to source for external knowledge sources from external sources (methods and strategies used).

2.6.1 Types of External Sources

KBV perspectives highlight the bounded rationality of firms' (with limited knowledge, limited information and limited resources) characters, hence, firms can only master and excel in a limited range of products' competence (Simon, 1957). Consequently, firms are always searching for the knowledge needed from external sources (Smith, 2000). Firms' access to different external sources in searching different types of knowledge is needed for product innovation (Fu, Diez, & Schiller, 2013). External knowledge can be accessed through a broad range of different knowledge channels (Tether & Tajar, 2008; Brunswicker & Vanhaverbeke, 2015; Antonelli & Fassio, 2015; Chen, Vanhaverbeke, & Du, 2015).

Fundamentally, prior literature distinguished the external sources into two major types, namely, science-based and market-based knowledge providers (Danneels, 2002; Du, Leten, & Vanhaverbeke, 2014). Typically, science-based knowledge can be sourced from specialist knowledge providers, such as universities and research institutes (Tether & Tajar, 2008; Ankrah & Al-Tabbaa, 2015), whereas, market-based knowledge can be sourced from customers or suppliers (Lau, Tang, & Yam, 2010). Also, firms can source the scientific knowledge from other types of external sources, such as innomediaries (Sawhney, Verona, & Prandelli, 2005), technology agencies, intellectual property organisations and venture capital enterprises (Chen et al., 2015).

Sources from competitors are a special case (Ghosh & Morita, 2012). The scope of search from competitors tend to be limited (Gaubinger, Rabl, Swan, & Werani, 2015) since the competitors tend to associate to anti-trust implications where they tend not to disclose their knowledge to protect their self-interests (Ghosh & Morita, 2012). Although knowledge search from competitors are limited, literature has recognised the role of competitors in contributing to the spurring of knowledge recombination and creative imitations which may lead to cross-industry innovations (Chen et al., 2015). A widely used method to access the competitors' knowledge is 'reverse engineering' which diassembles the competitors' products to identify the underlying functional and manufacturing principles (Gaubinger et al., 2015). Moreover, collaboration with a competitor is another way for a firm to access a competitors' knowledge through a formal agreement between the parties **(**Ghosh & Morita, 2012)**.**

In addition to the stated external sources, firms can source the codified knowledge from external sources to help a firm explore innovation opportunities (Cho, Park, & Choi, 2011). Codified knowledge refers to the knowledge of articulating in messages and generic algorithms which can easily transmit and be deployed in other contexts (Brusoni, Marsili, & Salter, 2005). David and Foray (1995) highlights three types of external sources that contribute to codified knowledge, and this includes computer-based informational networks, publications, patent disclosures, fairs and conferences. Computer-based informational networks refer to knowledge product space that is fully codifiable and fully disclosed via internet or intranet in an organisation (Brusoni et al., 2005). These types of sources enable a firm to keep their information updated (search codified information globally) and build an arms-length market relationship to share the information with external actors (Fu et al., 2013).

On the other hand, publications provide general and abstract knowledge in codified forms (Brusoni et al., 2005). Indeed, it includes a broad range of information such as technical or trade press, branch works of literature and journals (Li & Xiang, 2011). Publication is easily accessible, but the use is limited to the description and requires further interpretation and knowledge recombination to contribute in generating new product (Gaubinger et al., 2015). On the other hand, the patent disclosure provides the insight of new products that has been introduced in the market (Brusoni et al., 2005). This type of external source allow the firm to exploit its explicit and codified knowledge into the new product through creative recombination process (recombine the patent knowledge and other sources of knowledge to form a new product) (Cardinal, Alessandri, & Turner, 2001).

2.6.2 Types of External Knowledge Search Methods

Generally, external knowledge search can be distinguished according to its methods. External knowledge can be access through various methods that includes external collaborations, and external information searches. External collaborations refer to the joining of knowledge development efforts through relationships with specific external partners (Fey & Birkinshaw, 2005). For instance, external collaborations that include joint ventures and alliances (Mowery et al., 1996; Tsai, Hsieh, & Hultink, 2011), collaboration in innovation efforts with competitors, customers, suppliers (Petroni & Panciroli, 2002; Tomlinson & Fai, 2013; Von Hippel, 1988), universities, research institutes and knowledge intensive business firms, including consultants, (Vivas & Barge-Gil, 2014) and joint R&D programs (Azadegan, Napshin, & Oke, 2013).

The focus in external collaboration studies can be differentiated according to the types of actors, the strength of relationships, types of knowledge sourcing, as well as the geography of sourcing. Likewise, OECD (2005) also indicates linkages vary by whom or what the link is with and level of interaction as well as the geography whereby the linkages have formed. It is important to consider the type of knowledge in external collaboration research because a firm's learning mechanism or nature of knowledge absorption is varied according to the types of knowledge absorption (Granero & Jurado, 2012). Implicitly, knowledge content, in particular, the external collaboration mechanism is highly bonded to the external actors accessed; for instances, customers and suppliers, and the universities and research centres (Stanko & Calantone, 2011; Tomlinson & Fai, 2013). Tomlinson and Fai (2013) found that cooperation with customers enable firms to access the market demand and ideas in new products' development whereas cooperation with suppliers enable firms to access the experts' knowledge, as well as, experience and skills. Furthermore, Stanko and Calantone (2011) indicated that different types of linkages with different actors would cause firms to get different types of knowledge.

External information search is the second method in external knowledge search. According to OECD (2005), external information search provides access to knowledge for free or with limited marginal fees. Brusoni et al. (2005) suggested that codified information sources from the government-supported information network, scientific papers, pattern disclosure, publication and computer-based information networks contribute significantly to a firm's novelty generation. Likewise, Foss et al. (2013) found that external information search in conferences, trade fairs, or exhibitions, or scientific journals or trade or technical publications, or industries associations and/or online communities contribute to a firm's recognition and exploitation of opportunities for new products, processes, systems, as well as business models. Also, West and Bogers (2014) stated that innovation can be sourced via direct and costless processes, such as technology scouts, broadcast systems, and the internet.

Informal information exchanges with customers and suppliers provide interaction and synergies to design innovative products (Kang & Kang, 2009). Likewise, Von Hippel's (2010) study on open user innovation suggests that information from users and producers are important in contributing to a firm's innovation. In this case, asymmetrical information from users and producers enable firms to know different knowledge. For instance, information from users enable firms to know the need and context of information use (specific demand from users), whereas generic solution information enables firms to know particular types of solutions regarding the process, product, and system. Information can also be transferred from universities, private research institutes and consultants. Tether and Tajar (2008) found that information from specialist knowledge providers are likely to provide open approaches to innovation and are complementing rather than substituting for one another. Table 2.4 summarises the characteristics of knowledge search methods.

Table 2.4
Summary of the External Knowledge Search Methods

	External Collaboration	**External Information Search**
Cost involved	Involved cost in acquiring knowledge. Collaborating with specialists such as consultant is usually costly.	Involved low cost to access to the information.
Level of interactions	Firms actively joint or collaborate in innovation development. This method involves a high level of interaction between the parties that involved actively in the work.	Most of the external information search does not involve any interactions with the information providers, except exhibitions, trades and fairs, and conferences that provide limited or no interactions with information providers.
Knowledge type	External collaboration enables firms to access to tacit knowledge.	Mostly allow the access to codified knowledge. Provide limited access to tacit knowledge such as exhibitions.
Example	External collaboration within the supply chain (customers or suppliers), competitors, university, consultants, and private and public research institutions.	Informal information exchange with customers, suppliers, and from specialist knowledge providers. Codified knowledge sources such as patents, scientific papers, and publications.

2.6.3 Types of Search Strategies

The search for external knowledge is essential for a firm's innovative activities. Fundamentally, prior studies distinguish the search strategies based on the choice of knowledge proximities, knowledge boundaries, knowledge domains and search breadth and depth (Aloini, Bessant, Martini, & von Stamm, 2013; Martini et al., 2017; Wang, 2015). For knowledge proximities, Lopez-Vega, Tell, & Vanhaverbeke (2016) envisaged local and distant searches as a relative distance from a firm's current knowledge base-knowledge proximity. Typically, a local search refers to a search approximate to a firm's current knowledge whereas distant search refers to a search that is farther away from a firm's current knowledge.

On the other hand, a search strategy that emphasises the search for knowledge based on knowledge boundaries focuses on the choice of the search based on geography (Wang, 2015). In this context, firms can search for knowledge either locally or internationally. Next, the search based on the knowledge domain refers to the search strategy that emphasises on the agents with particular knowledge needed for innovation. Within this type of choice, a firms' concern on two types of knowledge i.e. market knowledge and technology or science-based knowledge (Aloini et al., 2013). Firms that search for market knowledge usually emphasise on search practices that are concerned on value chain actors - suppliers, customers (Ylimaki, 2014) and industry actor-competitors (Cruz-Gonzalez et al., 2015). Instead of that, a firm's search for technology knowledge usually emphasises on search practices that are concerned on science-based actors - university and research institutions (Veugelers & Cassiman, 2005).

Finally, search practices that emphasise on the openness to external knowledge sources are the search depth and search breadth (Wang, 2015). Search breadth refers to the knowledge search strategies that is based on the range of different external sources whereas search depth refers to intensively accessing knowledge from a range of external sources (Laursen & Salter, 2006). Indeed, the search practices are based on the KBV logic that suggested knowledge is subject to the economy of scale. Therefore, under this logic, firms should be open to using different external sources to enable firms to access to different types of knowledge. The external search breadth and depth enriched the in-sourcing firm's knowledge pool by adding in new knowledge, offering a wide range of problem-solving choices and it offers the combinatory search that can enhance firms' innovations (Monteiro, Mol, & Birkinshaw, 2016).

In this study, the researcher emphasises on search breadth and search depth. These approaches focus on the type and number of pathways of exchanges between a firm and its environment. In doing so, the attention of the study focuses on the variety of channels used in its external search activities rather than access to each of the search channels separately on innovation. Following sections further discuss the effect of search breadth and depth on PIP.

2.7 Review of External Knowledge Search and Product Innovation Performance

According to the KBV perspective, the firm is the integrator of knowledge (Grant, 1997), which not only integrates the knowledge within a firm's boundary but also beyond a firm's boundary (Grant & Baden-Fuller, 1995). This leads to the conceptualisation of the organisational boundary of the firm as a semi-permeable membrane that allows for knowledge passes at different rates and degrees (Fey & Birkinshaw, 2005). Knowledge is a productive resource for a firm, and it is subject to increasing returns (Grant, 1997). In other words, the more knowledge is used, the more valuable it becomes, and this includes renewal of organisational capabilities and generates more entrepreneurial opportunities for new products or processes to be introduced (Kirsimarja & Aino, 2006; Foss et al., 2013).

This section has included the discussion regarding the contribution of two external search methods (collaboration networks and information search) on PIP separately. Indeed, the discussion of collaborative networks and external information search revealed that the relationship of each channel used to source external knowledge sources (i.e., customer, supplier) have a significant impact towards PIP. Hence, the discussion enhances our understanding of the type of external sources associated with each of the search methods and its search impact on PIP.

In capturing the intensity and scope of external knowledge sources, Laursen and Salter (2006) proposed the strategy of search breadth and search depth. Thus, this study attempts to study the effect of both the sourcing method (collaboration and external information search) associated with two search strategies - search breadth and depth toward PIP. The following sub-section further elaborates the relationship between search strategies (with the typical type of search method) and PIP.

2.7.1 Collaborative Networks and Product Innovation Performance

Utilisation of external partners in innovation studies has been an area of interest for industry practitioners, academics and policymakers. The increased complexity of knowledge processes, intense competitive environment, and shorter products and technological life cycles have forced firms to widen their technology base through greater external collaborations to expedite a new product development process, improve new product market success, and spread the risk and cost with potential partners (Faria et al., 2010). Indeed, collaborations with external parties have gained an important role in product innovation due to its efficient means for intensive knowledge exchange and interactive learning between firms and their collaborating partners.

In this respect, the KBV suggested fundamental logic of a firm's external collaborations. Also, the KBV acknowledged that humans are subjected to bounded rationality, thus, no agent can command the full variety of knowledge (Antonelli, 2006). Therefore, firms are facing a gap between competencies of a firm and difficulties in mastering all the knowledge and information that flows into the market (Pyka, 2002). Due to the constraint in mastering all the knowledge internally, firms tend to search valuable knowledge and information beyond a firm's boundaries to balance their internal competencies with the external environment (Grant & Baden-Fuller, 1995).

Antonelli (2006) stated that knowledge in the context of coordinated transactions is viewed as both heterogeneous and endogenous activities due to its tacitness (highly sticky and embedded in organisations, not easily transmitted or communicated to third parties), indivisibility (composite, results of synthesis of many different knowledge modules), and complementarily (inter-dependency of a myriad of learning agents). This suggests that knowledge is not freely available in the market (Bougrain & Haudeville, 2002). Firms need to absorb, create and exchange knowledge interdependently. In this regard, network relationships "create greater opportunities for learning and assist firms to find information and knowledge that cannot be generated internally" (Fischer, 2006, p. 99).

Network relationships consume longer time to develop and "tend to create a high degree of interdependence" (Fischer, 2006, p. 102). External collaboration for innovation refers to "the partnership between innovating firms built on mutual dependency basic that enable the firms to interact with other institutions, firms, and community for acquiring knowledge needed for their activities such as developing and commercialising new products or processes" (Fischer, 2006, p. 102; Bonte & Keilbach, 2005). According to OECD (2005), external innovation collaboration refers to firms' activities such as participating actively in joint innovation projects with other organisations. Pure contracting out of work is not regarded as external innovation collaboration. Indeed, external innovation collaboration varied, based on the "type of partners, sector or industry, and regional or national environment" (Fischer, 2006, p. 102). Typically, various types of partners in external innovation collaboration provide different types of knowledge (Beers & Zand, 2014).

In a product development context, external innovation collaboration plays an essential role in contributing knowledge that is needed for a new product development to take place. Intensively, product innovation requires a broad knowledge base because the development of a new product involves multi-disciplined knowledge (Annique et al., 2010). Likewise, Grant and Baden-Fuller (1995) stated that the scope of knowledge required by an individual product is very broad. Inter-firm collaboration has to exist to provide the information access, the need to integrate knowledge provided by other firms which can be more efficient, and the necessity for supplement to knowledge which is only partially deployed within a firm. In this respect, collaborating with different partners will offer different types of knowledge that are vital for product innovation in firms (Beers & Zand, 2014; Kohler et al., 2012; Nieto & Santamaria, 2007).

Firstly, collaboration with customers in product innovation is important in developing the innovativeness of products. Fundamentally, customers provide complementary knowledge to users' technical know-how and market demands, as well as users' behaviour for the purpose of new product development (Tether, 2002). Likewise, customers participation in product innovation contribute in terms of highlighting a product's use and design preferences which may supplement to the knowledge of in-house expertise (Greer & Lei, 2012), contribute to joint problem solving (Bonner, 2010), as well as reduce likelihood of poor designs in early new product development processes (Tsai, 2009).

Customers' knowledge is often tacit because customers may not always explicitly express their needs and perceptions towards a product (Tether, 2002; Annique et al., 2010; Greer & Lei, 2012). Due to that, firms are facing difficulties in articulating the customer's knowledge. Consequently, firms are unable to understand the causal relationship between their actions and outcome, and thus result in firms failing to capture potential market opportunities (De-Luca & Atuahene-Gima, 2007; Cui & Wu, 2015). Cui and Wu (2015) stated that the collaboration with customers in product innovation processes enable firms to understand comprehensively the heterogeneous customers' needs and preferences which manifest their tacit needs in the application, and to some extent express the potential product solutions for new product developments.

In the same manner, De-Luca and Atuahene-Gima (2007) stated that collaboration with customers would increase the firm's ability to make connections among dissimilarity between customers' ideas and concept and understanding the diverse needs of its customers segments as well as enable firms to execute the complex tasks in product innovation processes. Similarly, Lin et al. (2013) stated that customers' collaboration in product innovation minimises the need for re-work, clarifies the definitions of product requirement, and illuminates new market opportunities. In essence, external collaboration with customers offer great benefits for a firm's product innovation.

There are some studies, which conducted research to examine the customers' innovation collaboration in new product development processes. These past studies found that customers' collaboration may lead to greater new product development successes (Brettel & Cleven, 2011; Cui & Wu, 2015; Sawhney et al., 2005), higher degree of novelty (Lau et al., 2010), increase in new products sales (Beers & Zand, 2014), improve abilities to introduce new or improved products (Annique et al., 2010), higher PIP (De-Luca & Atuahene-Gima, 2007), and also better product designs and product market performance (Lai, Chen, Chiu, & Pai, 2011).

Secondly, collaboration with suppliers play an important role in the product innovation context. Suppliers' involvements allow firms to access technical knowledge and identify potential technical problems (Tsai, 2009). Likewise, Lawson, Tyler and Potter (2014) found that suppliers with greater technical capabilities lead to greater creativity in problem-solving tasks and produce an impact on new product advantages, whereas Cousins, Lawson, Petersen, and Handfield (2011) asserted that suppliers' knowledge is significant for subsequent product developments. Also, greater collaborative activities with suppliers help the firms to share the cost and risk, reduce lead times of product developments, improve product quality and market adaptability, as well as to enhance the flexibility of new product developments (Chung & Kim, 2003).

Nieto and Santamaria (2007) found that collaboration with suppliers has a positive impact on the achievement of product innovation with more or less degree of novelty. Indeed, they stated that collaboration with suppliers improve quality and productivity, reduces lead times, and bring new products to the market quickly. Likewise, Annique et al. (2010) stated that collaboration with suppliers offer a specialised set of skills for focal firms, reduce the time to market out new products, and reduce development cost and risk sharing due to the combination of complementary capabilities and common goals between firms and suppliers.

Thirdly, collaboration with competitors is often motivated by the need to pursuit synergetic effects through resource- pooling and cost- sharing between competitors and firms (Miotti & Sachwald, 2003). Intensively, a competitor has relatively a similar knowledge base with focal firms (Annique et al., 2010). This similarity enables firms to benchmark their strengths and weaknesses with their competitors, and thus further identifies the complementary parts from the competitors (Tether, 2002). Furthermore, collaboration with competitors can assists firms in overcoming fierce competition from third party competitors, as well as creates a market-standard to guide a product's pricing strategy (Ghosh & Morita, 2012; Perks & Easton, 2000). Several findings recorded the positive impact of collaboration on PIP, and these include Tsai (2009) findings in 1346 Taiwan manufacturing firms and Annique et al. (2010) results in 781 Spain manufacturing firms.

Tether (2002) stated that collaboration with competitors is dubious due to the potential anti-competitive behaviour and complexity of the managing process. Tomlinson and Fai (2013) found that collaboration with competitors does not lead to significant impact on PIP in the SMEs context. Brettel and Cleven (2011) also found an insignificant link between the collaboration of competitors and new product development performance. They stated that the intention of firms to safeguard the knowledge and avoid unintended appropriation and imitation make firms to unlikely engage in this type of collaboration. Moreover, Zhang, Shu, Jiang, and Malter (2010) found that excessive collaboration with competitors may cause a negative impact on innovation since the partnering firm may pursuit their own interests rather than focusing on achieving common objectives.

In contrast to this point of view, Wu (2014) stated that with strong technological capabilities in assimilating, transforming and exploiting the knowledge from competitors, firms may have greater chances to utilise such knowledge in product innovation processes. Besides that, the risk involved in collaborating with competitors may be mitigated through the capabilities in selecting trustable and capable partners; who not only provide the access to their knowledge but also avoid from imitating behaviour (Gnyawali & Park, 2009). On the other hand, Nieto and Santamaria (2007) stated that collaboration with various partners will favour innovation novelty than a single type of collaboration due to the complement between the different linkages with different partners. In this regard, the negative side in competitor collaboration is suggested to be mitigated through the collaboration with different partners and internal capabilities.

Finally, collaboration with universities, private research institutions and government research institutions in connection with product innovation is increasingly seen as supportive activities that are required for carrying out commercially successful product innovation. Typically, collaboration with knowledge institutions provides firms with access to the scientific knowledge (Grimpe & Sofka, 2008; Tether, 2002). This scientific knowledge offers an opportunity for firms to access diverse knowledge modules that are required for new product developments that include both academic knowledge specific and technical specialisation knowledge for new product developments (Brettel & Cleven, 2011). Moreover, Ankrah and Al-Tabbaa (2015) highlighted that collaboration with knowledge institutions provide the access to complementary expertise, the state of the art of equipment and facilities, and access to funding of research. Instead of that, it allows the firm to grab on to better business opportunities as well as provide new ideas or solutions to the firm for their product development.

Tether (2002) stated that collaboration with universities increase the chances for a firm to introduce innovative products that are new to the market. Likewise, Brettel and Cleven (2011) and Kohler et al. (2012) found the positive and significant impacts of collaboration with universities on new product successes and sales. Annique et al. (2010) found that collaboration with universities has a long-lasting influence on product innovation due to the relatively easy knowledge access that is best suited for a firm's long-term strategic sourcing. In contrast, Tsai (2009) found that collaboration with research organisations is negatively and insignificantly related to innovation performance, but at a higher level of AC, this type of collaboration implies a positive relationship with incremental changes of new products. Indeed, they stated that knowledge from research institutions usually go beyond the scope and experience of the firms (rather than new technology trajectory), hence requiring more effort from the firm in building the internal capacities to absorb better knowledge and apply it in a firm's new product development. This result is also similar to the discussion of Chandran, Sundram, and Santhidran (2014) studies in the Malaysian context as well as Veugelers and Cassiman's (2005) study in Belgian manufacturing firms.

2.7.2 Search Strategies- Collaboration Breadth and Depth and Product Innovation Performance

KBV acknowledged that the role of the firm in integrating various knowledge resources both internally and externally to create a competitive advantage for a firm (Grant & Baden-Fuller, 1995). A commercial product requires various combinations of pieces of knowledge in codified, tacit and specific technology sets. Based on this logic, a firm diversifies their search strategy to lead to a greater connection with disparate external knowledge resources with internal knowledge which results in greater product innovation (Grant & Baden-Fuller, 1995; Laursen & Salter, 2006; Leiponen & Helfat, 2011). Chesbrough's (2003) prominent work of "Open Innovation" has underlined that the external sources of knowledge are distributed widely in the market thus a firm needs to search openly in the market (see pp. 50-53).

Knowledge is far more widely distributed today. Firms often need to access openly to the external sources of knowledge beyond its boundaries (West & Bogers, 2014). Fundamentally, Chesbrough (2003) stated that the traditional paradigm (internal R&D) is insufficient to enable firms to innovate successfully or commercialise new products. This model suggests that open access to external knowledge expose opportunities for firms. Making external links with external partners enable firms to fill up knowledge gaps by understanding their weaknesses as well as expedite the innovation process. He employed different case studies to illustrate the benefits in deploying external knowledge ideas or knowledge sources towards commercialising new knowledge to the market. For instance, Xerox collaborates vertically with PARC in exploiting the potential of the technologies created, and thus provide insights for Xerox in realising the value of its innovation investments.

Nieto and Santamaria (2007) found that collaboration with diversity of partners favour innovation novelty more than a single type of partners does. Likewise, Tsai (2009) annotated that different collaboration partners may serve different purposes in product innovation through contributing different types of knowledge needed in new product creations. The variety of knowledge inputs provide an opportunity for firms to imagine, experiment and recombine the existing technology with new knowledge, which enables firms to venture down new technological paths (Metcalfe, 1994; Ebersberger, Bloch, Hestad, & Velde, 2010). This suggests that when collaboration breadth-search is done widely across different channels, it is likely to obtain a higher level of PIP (Clausen, 2014).

Love, Roper, and Vahter (2014) investigated the impact of openness regarding external linkages on firm's PIP by using panel data from Irish manufacturing firms and found that the breadth of collaboration linkages are effective in delivering innovation performance. Typically, they also found that firms with higher prior experience engagements in innovation collaborations with external partners enhanced the positive effects on the relationship between current linkage breadth and PIP. In other words, their results support the learning from prior experiences in collaborating with external partners increase a firm's benefits in current linkages and therefore result in higher PIP. Likewise, Beers and Zand (2014) recorded a significant positive impact of collaboration partner diversity on firms' innovation performances in Dutch innovating firms from various industries by using a large scale of data information from the Dutch Community Innovation Survey from the year 1994 to 2006. Indeed, their result indicated that a variety of knowledge intake produces synergetic effects in new products' development and commercialisation processes.

The extent of using external knowledge refers to the search depth strategy (Laursen & Salter, 2006). Collaboration depth refers to the extent of a firm that can draw intensively from a collaborating partners' knowledge (Laursen & Salter, 2014). Before the firms draw intensively from its collaborative partner's knowledge, firms with deep search may facilitate greater trust, communication and understanding with an external source, and thus lead to greater knowledge transfers between the parties (Terjesen & Patel, 2015). Typically, collaboration breadth is always alongside with collaboration depth in emphasising the openness of firms in its efforts to source the external knowledge from different sources' channels.

In this regard, Laursen and Salter (2006) developed the concept of breadth and depth in accessing firms' openness search strategies and links these concepts with firms' PIP. In Laursen and Salter's (2006) perspective, a firm that engages in formal innovation collaboration links with different external sources indicates that firm is engaging in external search depth. In other words, their result indicates that collaboration with diverse external partners contributes to greater PIP. In this regard, Monteiro et al. (2016) found the positive and direct relationship between openness to external knowledge on the ability of a firm in introducing new products and the revenues coming from such new products.

Chen et al. (2011) employed 209 responses from China manufacturing firms operating in all industry sectors in investigating the impact of external collaboration breadth, depth and collaboration orientation on PIP measures in the context of new product sales, speed of new product development, and new product success ratio relative to their vis-a-vis competitors. The capture of collaboration breadth and depth in this study is indeed different from Laursen and Salter (2006). Typically, in their study, they focus only on the collaboration networks which emphasis on the strength of collaboration in "depth" and diversity in collaboration in "breadth". Interestingly, they found the support of greater breadth and depth of collaborative networks indicating a positive impact on PIP, but the greater breadth of collaborative networks only improve a firm's innovative performance up to a certain optimum point. This result indicates that intensive collaboration breadth does not necessarily benefit a firm's PIP. Indeed, the search breadth is accompanied by intensive or strong ties with partners that will bring greater positive impact on PIP.

Ferreras-Mendez et al. (2015) investigate the impact of external linkages depth and breadth on product innovation by using 102 biotechnology firms in Spanish. Interestingly, they found that collaboration breadth did not significantly influence PIP, whereas collaboration depth only had indirect linkages with PIP through a mediator, namely, AC. This result is different from the previous studies and suggested that the potential risks and high costs in collaboration may impede a firm to engage in diverse and depth collaboration with external partners. The result also suggested that the breadth of collaboration is not the focus for science-based industry-biotechnology firms. This is because the acquisition and application of complex scientific knowledge in biotechnology industry require a rather deep relationship with the firm in order for a firm to gain more specific knowledge from its collaborating partners.

Kang and Kang (2009) on the other hand, combined both depth and breadth in examining the relationship between the extents of using R&D collaboration with diverse partners on technology innovation performance (mainly product innovation). Typically, they found that inverse-U relationship exists between the extents of using R&D collaboration and technological innovation performance. This suggested that excessive collaboration does not result in a positive impact on a firm's innovation performance. In contrast, Bengtsson, Lakemond, Lazzarotti, Manzini, Pellegrini, and Tell (2015) found that collaboration breadth has a negative impact on innovation outcomes, whereas, collaboration depth contribute does significantly impact innovation outcomes (novelty and efficiency - a decrease of development cost, time to market, innovation risks). This result suggested that collaboration with a few partners is more beneficial than having numerous partners, and firms need to draw intensively from the limited range of partners to obtain better innovation outcomes. Table 2.5 illustrates the summary of collaboration breadth and depth on PIP.

Table 2.5
Summary of Collaboration Breadth and Depth on Product Innovation Performance

Authors	Measurement	Sector	Findings
Laursen & Salter (2006)	Sum of search diversity across different search channel and level of importance of the partners' knowledge.	U. K. manufacturing firms	Inverted-U relationship (breadth and depth) on new product introduction and turnover of new product.
Nieto & Santamaria (2007)	Count on each search channel.	Spanish manufacturing firms	+Breadth on product novelty.
Kang & Kang (2009)	Extent of used (combined breadth and depth).	Korean manufacturing firms	Inverted-U relationship on number of new products, number of patents, and turnover relating to innovative products.
Chen et al. (2011)	Sum of search diversity across different search channel and average score of the level of importance of the partners' knowledge.	China innovative firms	+Depth, breadth inverted U relationship on number of new products, sales and speed of new products, and success rate of products (patents and industry standard).
Ebersberger & Herstad (2011)	Sum of search diversity across different search channel.	Norwegian innovative firms	+Breadth on novelty and sales of new products.
Love et al. (2014)	Sum of search diversity across different search channel.	Ireland manufacturing firms	+Breadth on share of sales on new and improved products.
Beers & Zand (2014)	Count on each search channel.	Dutch innovative firms	+Breadth stronger on radical rather than incremental innovation.
Ferreras-Mendez et al. (2015)	Sum of search diversity across different search channel and average score of the level of importance of the partners' knowledge.	Spanish biotechnology industry	Depth inverted U relationship, breadth insignificant on new product introduction, profitability and compatibility of new product.
Bengtsson et al. (2015)	Sum of search diversity across different search channel and 7 points Likert scale to measure importance of the partners' knowledge.	Italian, Finnish, and Swedish firms	-Breadth, + depth on efficiency and novelty of new products.
Monteiro et al. (2016)	Sum of search diversity across different search channel and four level of intensity, not used, low importance, medium importance, and high importance.	U.K. innovative firms	+Openness to external knowledge (breadth and depth) on novelty and sales of new products.

Notes: + refer to a significant positive relationship; - refer to a significant negative relationship.

In essence, the external search breadth enables the firms to access diverse knowledge, skills, and experiences that can result in greater PIP. All prior studies stated in Table 2.5 showed positive impacts of breadth collaboration networks on PIP except findings from Ferreras-Mendez et al. (2015) and Bentsson et al. (2015). This result supports that each type of partner provides different types of knowledge that are required for a firm in product innovation, and thus the broader collaborations associated with the likelihood of new product introduction. As for the success of new products, collaboration with diverse partners provided a holistic view of the external environment (Ebersberger et al., 2012) and enriched the knowledge pool available for firms (Katila & Ahuja, 2002).

However, several findings from prior studies indicated a negative impact of over-search on innovation performance (Chen et al., 2011; Laursen & Salter, 2006; Ferreras-Mendez et al., 2015; Kang & Kang, 2009). The over-search in the context of collaboration may have a negative influence on innovation performance based on three reasons as proposed by Koput (1997). These are problems in managing and selecting the ideas, wrong timing to fully exploit the ideas, and attention allocation problems (Laursen & Salter, 2006). Indeed, some researchers stated that AC plays an essential role in determining the positive impact of collaboration breadth on innovation performance. In this regard, it serves as the knowledge base that enables a firm in managing and selecting ideas, maintaining the acquired knowledge over time, as well as transforming and exploiting knowledge that could lead to success of new products (Cohen & Levinthal, 1990; Dyer & Singh, 1998).

On the other hand, search depth usually recognises the reuse of knowledge (Katila & Ahuja, 2002), level of involvement of partners in collaborative networks (Brettel & Cleven, 2011), and intensity of the draw of knowledge in a collaborative network with a particular actor (Laursen & Salter, 2006; Chen et al., 2011; Ferreras-Mendez et al., 2015). Collaboration depth enables the firm to facilitate the transfer of knowledge, greater access to experiences, skills, and tacit knowledge of a partner's firm (Cruz-Gonzalez et al., 2015), as well as leading to more understanding of knowledge that has been acquired. Typically, all prior studies stated in Table 2.5 showed positive impacts and inverted U relationship between depth collaboration networks on PIP, except Ferreras-Mendez et al. (2015) which proposed that the positive impacts of depth collaboration networks on PIP must go through an intermediate variable called AC.

Some studies indicated that over-emphasis on the depth of collaboration network with many external sources would exhibit lower innovative performance (Chen et al., 2011; Kang & Kang, 2009; Laursen & Salter, 2006). This negative impact is caused by the constraint of resources in deeply drawn knowledge from external partners (Laursen & Salter, 2006) and increases the chances of knowledge leakages (Chen et al., 2011). However, Cruz-Gonzalez et al. (2015) stated that the search depth is indeed leading to more exploration of new knowledge in distant fields. In other words, a firm's engagement in deeper interaction with external actors is to build upon distant technology that resides outside of a firm. In this regard, external collaboration depth provides an opportunity to establish a technology outside the firm's technology domain. Implicitly, the thick information exchanges and tacit knowledge sharing allow firms to improve their knowledge base that is different from their technology domain and eventually lead to improvement of PIP.

2.7.3 External Information Search and Product Innovation Performance

Traditionally, knowledge is characterised as a public good, which is non-excludable and non-rivalry in nature. This leads to the assumption that knowledge is freely available in the market and the economic agents are freely retrieving the knowledge as well as using the knowledge in their business operation. In this stream of literature, it is acknowledged that the transfer and dissemination of knowledge and ideas between agents are usually free hence, generating positive externalities in business economics context (Feldman, 1994). According to Lambooy (2005), transferring knowledge is not always in conscious mode, which means the non-use of acquired knowledge could be flowing into a firm without compensation.

This public notion of knowledge characteristic received great debates from scholars since knowledge to some extent, is excludable. In this respect, Fischer (2006) stated that “even a completely codified piece of knowledge cannot be utilised at zero costs by everyone” (p. 119). This suggests knowledge is not purely a public good. KBV suggested that knowledge is partially excludable (knowledge producers are unable to prevent other firms from utilising their knowledge, but this utilisations are not without compensation) and a non-rivalry good (knowledge can be utilised many times and in many circumstances). In this respect, Fischer (2006) stated that “firms have to learn the code before being able to retrieve and imitate” and “realised the economic value of the given pieces of knowledge” (p. 119).

In this regard, external information or knowledge can flow into a firm, but with the effort of a firm in searching, building or acquiring through an informal relationship with economic actors and codified sources for complementing a firm’s internal knowledge (West & Bogers, 2014). According to OECD (2005), external information search provides access to knowledge without cost or with only marginal fees for access. Furthermore, OECD stated that this type of information search does not provide the rights to use the patent knowledge, other forms of intellectual property, as well as the knowledge, which are embodied in equipment or machinery. Typically, external information search can be in the form of information spill-over that are diffused through the layers of personal ties, such as customer or supplier’s informal ties, as well as codified knowledge sources, such as publications or databases (Ebersberger & Herstad, 2011).

Information, which transfers from informal networks, does not require formal agreements or contracts as what formal collaboration requires, and it does not require the firm to develop a deep organisational interaction between focal firms and external actors (Kang & Kang, 2009). Informal network refers to the social networks that are weakly connecting between firms and external actors (Kang & Kang, 2009) that enable the knowledge or information exchange between the parties (Bellantuono, Pontradolfo, & Scozzi, 2013). This type of sourcing is convenient and cost efficient which means that the sourcing is at a very low cost or costless (Dahlander & Gann, 2010), as well as to provide fast access to external information that enables the firm to react faster than the dynamic change of environment (Kang & Kang, 2009). Information or knowledge can be transferred from the informal networks with external parties, such as customers, suppliers, competitors, commercial labs, consultants, public and private universities, professional associations, and public and private research institutions.

Informal exchanges of information or technical knowledge between external parties provide firms with vital information that is needed for product innovation processes. For example, informal networks with customers provide information regarding insights of technological opportunities (Lukas & Ferrell, 2000) and information about preferences and future market (Von Hippel, 1988). Besides, the OECD (2005) stated that feedback from customers and suppliers may be easy to use compared to information from knowledge institutions because it may be difficult, complex, and require higher AC to absorb, assimilate, transform, and exploit the acquired knowledge and then convert it into commercially successful products.

Fu et al. (2013) investigated the role of informal networks in product innovation processes based on 359 responses from electronic firms in Pearl River Delta, China, and found that informal networks are essential in contributing to product innovation process. In this study, informal networks are recognised as informal "guanxi", which describes a basic dynamic network of influence, or connections, or informal interpersonal relationship with business partners, friends, or relatives as to exchange for favours. Typically, informal "guanxi" in a business context consists of obligation and loyalty that is in reciprocal form (give and take). This mutual interaction between firms and others enable firms to expand the existing network, and improve their level of reputation. Indeed, they stated that through informal "guanxi", the firm search goes beyond the scope of their business environment, and this permits more information and knowledge access to firms within the "guanxi" network. Intensively, they found that informal "guanxi" triggers new ideas resulting in greater chances of obtaining equipment and technical know-how which contributes to product innovation processes and also in improving a firm's internal knowledge base.

Bonte and Keilbach (2005) found that both informal network and formal networks contributes positively to innovation performance in German innovating firms. He found that large firms tended to engage in formal networks, whereas small firms tend to engage in informal networks. Implicitly, they stated that small firms favour engagements in an informal network because this type of sourcing requires low or even no cost of maintenance than formal networks. In addition, they stated that informal exchanges of knowledge or information allow for flexible transfers of specific and commercially sensitive information, which is not in writing, and enforcing contracts. For example, information about new product designs, production methods or market developments.

Apart from informal networks of various partners, firms often actively search for codified knowledge or information as well as participating in trade fairs, exhibitions and conferences. Codified knowledge refers to knowledge in written forms or explicitly expresses using the knowledge in a formal and systematic ways to make it easier to transfer between persons, institutions, as well as stored in firm's repositories (Brusoni et al., 2005). Examples of codified sources are technical reports, scientific publications, use of patent databases, and use of the internet. Basically, technical reports, patents, and scientific publications such as journals reflect useful information regarding basic or applied scientific knowledge, invention information, and technological development trends (Caloghirou, Kastelli, & Tsakanikas, 2004). The use of the internet as the platform for information is a direct and costless process in enabling the firm to retrieve all types of useful information for the use in innovation processes (West & Bogers, 2014).

Brusoni et al. (2005) explore the use of codified sources of information for innovation at a firm and sector levels based on Community Innovation Survey (II) for manufacturing sectors in the year 2011, which covers 11 industries. They found that codified and disclosed information (patent disclosure, computer-based information networks, conference, journals, fair, and exhibitions) are positively and significantly influencing the innovation performance of firms. This results in significant inter-industry differences and thus, they concluded that codified sources are more important in low and medium technology industries rather than science-based industries. Furthermore, they found that the extent of a firm to access codified sources strongly is influenced by a firm's AC.

Fundamentally, Brusoni et al. (2005) stated that conferences, fairs, and exhibitions are codified sources of information. However, OECD (2005) stated that conferences, fairs, and exhibitions to some extent give firms access to tacit knowledge via interaction with other participants in conferences, fairs and exhibitions. Likewise, Rinallo, Borghini, & Golfetto (2010) stated that participants in trade shows possess embodied experiences and greatly appreciate the informal interactions with other participants. Implicitly, the events permitted the knowledge and information exchanges and interactions between participants. Indeed, these types of external sources are used in fashionable sectors, such as furniture and textile sectors due to the easy access and aim to collect knowledge and ideas that will benefits for the company (Dawood & Chong, 2013; Rinallo et al., 2010).

In essence, several studies' findings indicated that the external information search plays a positive role in a firm's innovation (Caloghirou et al., 2004; Ebersberger & Herstad, 2011; Escribano et al., 2009). Typically, Caloghirou et al. (2004) employed datasets from seven European countries with a total of 558 samples and found that open sources of technical reports, use of patent databases, attendance at conferences, scientific publications, reverse engineering and the use of internal knowledge are significant and positively related to a firm's innovation performance. Escribano et al. (2009) drew from the data from the Community Innovation Survey (CIS) during the year 2000 to the year 2002 which cover firms in all sectors in Spain found that the external knowledge flow, that includes suppliers, clients, competitors, universities, other research institutions, and specialised journals and meetings are significantly contributing to PIP. Likewise, Ebersberger and Herstad (2011) found that searching information from suppliers, clients, competitors, research institutes, universities, consultants, journals, and professional associations are significantly contributing to PIP.

2.7.4 Search Strategies- Information Search Breadth and Depth and Product Innovation Performance

Information search is different compared to collaboration methods (refer to subsection 2.5.2). Information search is a systematic scanning of external environments, using search mechanisms ranging from codified sources, participation in conferences and trade fairs (Ebersberger et al., 2012) and information searches from informal networks with external actors (Kang & Kang, 2009). The contributions of information searches to product innovation are notable in the product innovation literature because product innovation requires various information since it consists of problem-solving activities, which involves the creation and recombination of technological ideas (Ahuja & Katila, 2001; Baldwin & Hanel, 2003).

Following KBV logic, complementary knowledge synergy from different learning agents and indivisibility or interdependence between knowledge modules is diverse (Antonelli, 2006). This brings about the support of firms' efforts to diversify their external information searching to create more potential knowledge synergies from different learning agents, as well as opportunities for new combinations of knowledge. Cruz-Gonzalez et al. (2015) contended that search breadth and depth as two distinct open search strategies, and yet an interrelated concept that jointly represents the openness of a firm's external search process. Intensively, the information search should be viewed as combined with both of the search strategies (search depth and search breadth).

Katila and Ahuja (2002) captured the breadth and depth of external knowledge by using patent data in a longitudinal setting, with a set of samples of Robotic industrial firms in

Europe, Japan and North America. The external linkages depth refers to a firm's reuse of existing knowledge, whereas external breadth search scope refers to the extent of a firm widely searching from external knowledge sources. They found that external search breadth contributes positively (linearly) to innovation performance, whereas external search depth contributes positively to innovation performance in a curve-linear relationship. On the other hand, Wu et al. (2014) used patent citation data of the Medical Device Industry in the United States, and they found the only marginal effect of search depth is the rate of new products' introductions. Moreover, Xu (2014) using the same operational concept like Katila and Ahuja (2002), found an inverted-U relationship between information search breadth with radical innovation and the inverted-U relationship between information search depth with incremental innovations.

Capturing information search through patent information is indeed suffering from several limitations, such as propensity of patenting data which varies across firms (Katila & Ahuja, 2002), not all inventions are patented, and there are limited opportunities to identify distinct types of knowledge search in terms of partners' type (Kohler et al., 2012). Indeed, the use of patent data may be inappropriate because patent data mentions little about the importance of different sources of information. In addition, the use of patent data may only represent one type of source rather than include all types of information sources (Cruz-Gonzalez et al., 2015). Therefore, the inclusion of all types of information sources is essential to capture the information search strategy to capture different knowledge domains within each channel (Laursen & Salter, 2006). Due to the stated limitations, the search of breadth and depth is suggested to focus on all search channels to obtain information sources for the innovation process. Table 2.6 illustrates the summary of information in search breadth and depth on product innovation.

Table 2.6
Summary of Information Search Breadth and Depth on Product Innovation Performance

Author	Measurement	Sector	Findings
Katila & Ahuja (2002)	Patent citation to measure the extent of breadth (search scope) and depth of knowledge search.	Industrial robotic companies in Europe, Japan, & North America	Linear effect of search scope on new product innovation and linear curves effect of search depth on new product innovation.
Chiang & Hung (2010)	Sum of 16 types of information sources (search breadth) and dummy variable indicating the level of importance for information sources used (search depth).	Taiwanese electronic product manufacturers	Search breadth is positively related to incremental innovation performance, whereas, search depth is positively related to radical innovation performance.
Hwang & Lee (2010)	Sum of 13 types of information sources (search breadth) and dummy variable indicating the level of importance for information sources used (search depth).	Korean ICT industry	Search breadth has an inverted-U relationship with incremental innovation.
Leiponen & Helfat (2010)	Use binary value based on 4 points: Very important, important, somewhat important, and not important.	Finnish innovative firms	Greater breadth associated with greater innovation success (sales of new products and number of new products introduced).
Esbersberger & Herstad (2011)	Sum of 9 types of information sources (search breadth) and 4-level scale points to measure the level of importance for information sources used (search depth).	Norwegian innovative firms	Search breadth and depth affect innovation performance positively.

Table 2.6 (Continued)

Author	Measurement	Sector	Findings
Martini et al. (2012)	A sum of diversity of external information input (search breadth) and search usage level (search depth).	Italian medium and high-tech firms	Search depth has an inverted-U relationship with radical product innovation. Search breadth does not have a relationship with both radical and incremental product innovation.
Wu et al. (2014)	Patent citation to measure the extent of depth of knowledge search.	Medical device industry in U. S.	Marginal effect of search depth on product innovation (number of new product introduced).
Xu (2014)	Patent citation to measure the extent of breadth and depth of knowledge search.	Public pharmaceutical firms in U. S.	Inverted-U relationship between knowledge breadth and radical innovation and inverted-U relationship between knowledge depth and incremental innovation.
Martini et al. (2017)	Information search scope measured by the sum of the use of knowledge range from market, technical providers, and intermediates.	Italian medium and high-tech firms	Inverted-U relationship between information search and innovation performance (innovative knowledge creation and revenue from the sales of product innovation). However, with the included of internal integration mechanism, it allows to unveiling this effect.
Wang (2015)	Combine search breadth and search depth with geographic proximity (local versus non-local search).	Clustering firms in Zhejiang, China	Local search breadth and search depth have a positive relationship with product innovation in technologically leading firms. Local search breadth and non-local search breadth has a positive relationship with product innovation in technologically lagging firms, whereas, non-local search depth is negatively related to product innovation in technologically lagging firms.

Table 2.6 shows that majority of researchers found positive relationship of search breadth and PIP (Katila & Ahuja, 2002; Chiang & Hung, 2010; Leiponen & Helfat, 2010; Esbersberger & Herstad, 2011; Wang, 2015). In the case of external information search, it required less monetary payment compared to collaboration and acquisition, and the transfer of knowledge and information method. Baldwin and Hanel (2003) annotated that this method "consists of what are closer to un-priced spill-over" (p. 75). Likewise, Laursen and Salter (2014) stated that an external search is a form of soft openness, whereby a firm is drawing knowledge from external parties or externally codified sources without entering legally into a binding agreement. In this respect, Esbersberger and Herstad (2011) stated that the diversity in external information search is a complement to the internal knowledge base, as well as contributing to a firm's ability to identify the potential opportunities.

Implicitly, Esbersberger and Herstad (2011) indicated that external information search may not necessarily follow a specific technology trajectory. Indeed, the greater the diversity in information search, the greater it will open up more opportunities to innovate, with no restrictions on specific technological trajectories. Moreover, following the KBV assumption on knowledge characteristics, knowledge is complementary and indivisible, and thus, diversity in information search will benefit a firm to enlarge their knowledge base. Hence, it will lead to new knowledge or recombination of new knowledge and existing knowledge that eventually results in greater innovation outcomes. Additionally, external information search is indeed different from other open search strategies that require more interactions and cost. Thus, firms involving in greater external information searches will not necessarily harm firms' innovations.

Although external search breadth does contribute positively to product innovation, however, Table 2.6 showed the inverted-U relationship between information search breadth and PIP (Katila & Ahuja, 2002; Hwang & Lee, 2010, Xu, 2014; Martini et al., 2017). The inverse-U relationship denoted that search breadth has a positive impact on innovation performance, but up to an optimal point whereby the openness is counterproductive. Intensively, the negative side of excessive external searches entail significant managerial challenges, financial burdens, as well as cognitive costs (Chen et al., 2011). Typically, managerial challenges refer to the challenges faced in the internal knowledge base (or coined as AC) in understanding externally on developing innovation. On the other hand, financial burden refers to the cost involved in searching, while cognitive cost refers to the limits that restrict on the amount of information an individual can process. Chen et al. (2011) indicated that these three factors may detriment the positive impact of external search breadth on innovation performance.

On the other hand, information search depth refers to the number of different search channels that a firm draws upon deeply and intensively (Cruz-Gonzalez et al., 2015). Indeed, search depth enables firms to deepen into the knowledge of external agents, as well as understand the distant knowledge that could not be acquired through superficial searches (Hsieh & Tidd, 2012). Furthermore, search depth is likely to reduce the uncertainty that is inherent in product innovation processes, facilitating comprehensive information for new product development process, and speed up the problem-solving process (Patel & Van der Have, 2010). Several findings indicate positive impacts of information search depth on innovation performance (Chiang & Hung, 2010; Esbersberger & Herstad, 2011; Martini et al., 2012; Wu et al., 2014; Xu, 2014).

Search depth has potential benefits for product innovation. These include improved firms' product improvements and line extensions that are aimed at satisfying the needs of existing customers and help to improve product quality (Chiang & Hung, 2010). However, some studies indicate that search depth may lead to the detriment of innovation (Laursen & Salter, 2006), due to the tendency to repeatedly exploit its core competence in a narrowly defined area (Xu, 2014). Indeed, the costs associated with information search depth is the core argument of prior researchers regarding the over-search depth issues (Laursen & Salter, 2006; Martini et al., 2012; Xu, 2014; Cruz-Gonzalez et al., 2015).

Kang and Kang (2009) has mentioned that the fast growth of IT and communication technology allowed firms to handle external information with lesser costs and efforts, thus, enable firms to use the external information efficiently. Their argument seems to provide the alleviation of over-search depth issues, and indicates that information search depth contributes to improved innovation performance. On the other hand, Wu et al. (2014) contended that although deep search may lead to core rigidities but knowledge search depth helped to broaden knowledge scope of a firm. Enhancement in knowledge scope enables a firm to exploit the knowledge and help firms maintain a high performance.

2.8 Review of External Knowledge Search Strategies and Absorptive Capacity

KBV suggests that external knowledge is not freely available to a firm. Fischer (2006) indicated that firms need to realise the economic value of a given piece of knowledge before they can utilise it. Cohen and Levinthal (1990) proposed that the concept of AC is a firm's ability in recognising the value of external information, assimilate 'external knowledge' for 'internalisation of the external knowledge' into a firm's 'existing knowledge base', and finally, exploit external knowledge for the commercialising of a new product and process.

A firm engaged in collaborative networks and external search allow greater external knowledge inflow into firms. Vanhaverbeke et al. (2008) indicated that a firm engaged in external sourcing is indeed an effort to make the firm open to these valuable external sources, and yet, does not imply that inflow of new ideas or knowledge into a firm is an automatic or easy process. External knowledge search allows a firm to access valuable external knowledge sources, and the firm needs to develop organisational routines and structure to tap into external knowledge. However, if a firm is not involved in external knowledge search, then, a firm is not necessarily developing AC. Thus, external knowledge search and a firm's AC are inter-connected.

Following subsections discuss about the relationship of two types of external knowledge search methods (collaborative networks and external information search) by using breadth and depth strategies with a firm's AC.

2.8.1 Absorptive Capacity: Systematic Acquisition and Absorption of External Knowledge

Knowledge is the strategic resource for a firm, in a broad sense, as the main factor for business and economic growth. Firms can source knowledge either internally or externally. The traditional model for increasing or speeding up knowledge accumulation of a firm is ascribed to a firm's R&D activities. Nowadays, with the rapid growth of information technology and intense competitiveness arise from the industries around the world; firms that rely on their internal R&D investments in generating new knowledge are having trouble catching up to the dynamic environment (Chesbrough, 2003). Thus, firms are required to engage actively in external sourcing activities to facilitate the flexibility in production to cope with the changing environment.

West and Bogers (2014) stated that for firms to profit from external sources of innovation, the innovations must be fully integrated into a firm's R&D activities. AC is the key here. A firm with AC in their process of acquiring knowledge externally will overcome the tendencies of "not invented here" barriers (Trott, 2008, p. 331). Studies of external sourcing always link with the AC of explaining the impact on a firm's innovation performance. West and Bogers (2014) found that there are more than 80 articles from 151 articles citing the effect of AC as the ability of firms in utilising the external knowledge sources. Although there are an abundance of studies in studying the effect of AC in utilising external knowledge sources, the operational concept of AC are varied. Even some scholars used the term of AC without defining it (Murovec & Prodan, 2009). AC is an umbrella concept due to the wide definition proposed by prior researchers (Lewin et al., 2011). In this respect, it operationalises the concept of AC as a thorny task for researchers, especially in the context of external knowledge search.

In general, the literature on AC differentiates in several types of constructs such as using a proxy in measuring AC either in one-dimensional or multidimensional and using a dynamic capacity or an organisational routine in capturing the AC concept either one-dimensionally, dual-dimensionally, or in multidimensional perspectives. Most of the studies of AC and external collaborations use a single proxy, which is internal R&D in capturing a firm's AC level. This measure aligns with the operational concept proposed by Cohen and Levinthal (1990), whereby they indicate that a firm's internal R&D expenditures have a dual effect, which simultaneously stimulates a firm's innovation and as a by-product - AC.

Poldahl (2012) employed data from Statistic Sweden and examined the dual effects of AC on Swedish manufacturing firms' innovations and their effects on transmissions of new knowledge through external linkages. Indeed, the study constructed R&D activities as the proxy for AC and found that a firm's R&D efforts do matter for absorbing new external knowledge from domestic inter-sector linkages as well as international sources of R&D spill-over. Likewise, Fabrizio (2009) constructs a firm's research intensity and basic research as the proxies of AC and found that firms with greater AC contribute to more efficient searches for inventions in biotechnology and the pharmaceutical industry.

In the same manner, Lin et al. (2012) used panel data on alliances and patenting activities in the biotechnology industry and they found that AC, typically, similarity of knowledge between the alliances parties could lead to greater firm-learning and exploiting knowledge from their alliances portfolios (number of R&D agreements). On the other hand, based on the two indicators of AC (R&D investment in identifying technological opportunities and exploring the environment for technological development), Egbetokun and Savin (2014) found that AC is essentially closing up the gap of the technological distance (knowledge dissimilarity) between firms and its partners, and this eventually resulted in firms benefitting from innovation cooperation with external actors. Likewise, Xia and Roper (2008) found that the AC, with the proxy of R&D intensity, continuous R&D activity, and employee skills are significant in determining a firm's links to universities or academic institutions.

Operational AC by using R&D related measures received great debate from prior scholars regarding its tendency to be insufficient to capture the richness of AC concepts (Camison & Fores, 2010; Flatten et al., 2011; Lane & Lubatkin, 1998; Van den Bosch & Volberda, 2003; Volberda et al., 2010). Likewise, Clausen (2013) annotated that investments in internal R&D is not the most important to contribute to firms' AC. There are other indicators that are proposed by Cohen and Levinthal (1989, 1990) regarding firms' AC. These includes prior related knowledge, training, individual skills, organisational structure and human resource management practices.

In this regard, Schmidt (2010) proposed various determinants of AC in capturing the various level of analysis. Typically, they proposed three groups of measures that could be used in operationalising the concept of AC that includes R&D activities related to prior knowledge and individual skills, organisational structure, and human resources management practices. The three approaches suggested by Schmidt (2010) in capturing

R&D related activities, includes, first, R&D expenditure, intensity, and investments; second, continuous R&D activities; and third, existence of an R&D lab. On the other hand, he suggested that related prior knowledge and individual skills could be captured through training and human capital count in firms. As for capturing AC in human resource management practice, he proposed the sum of employees' abilities and knowledge similarity between two cooperating firms as the measures' factors, while for the organisational structure, he proposed that the cross-functional communication and organisational cultures as the measures in facilitating the flow of knowledge within the firm. Fundamentally, he found all determinants of AC are influence firm's ability in exploit external knowledge.

On the other hand, findings from Bougrain and Haudeville (2002) showed that a firm's R&D intensity does not influence the success of innovations through conducting empirical analysis on French's SMEs. Indeed, they found that hiring technically qualified manpower and designed offices are significant and positively influence a firm's ability to cooperate with external actors and carry innovation projects successfully. Implicitly, this result provides us with an insight that R&D is not the only source of innovation, as well as a source to increase a firm's capability in utilising external knowledge sources. Indeed, in SMEs, formal R&D departments may not necessarily exist. Thus, R&D related activities are not a good proxy to capture firm's AC, seeing that R&D is not the only way for a firm to increase their internal capabilities for exploiting external knowledge sources.

The studies above focused on the indirect measures of AC. Indeed, these indicators of AC fail theoretically and empirically to distinguish the different aspects of AC (Srivastava, Gnywali, & Hatfield, 2015). Likewise, Lewin et al. (2011) indicated that using indirect measures could lead to validity challenges, whereby these proxy types of measures have a tendency to underestimate or overestimate the AC. In this regard, they stated that a firm needs to employ a direct measure in constructing the AC concept. In their perspective, AC is indeed covering the internal routine and external routine in absorbing external knowledge originating from the external environment.

Typically, Zahra and George (2002) suggested four dimensions; acquisition, assimilation, transformation and exploitation as the measure of AC, and each of these dimensions operate differently as organisation routines. The operation of AC as a set of organisation routines provide a good synthesis of the argument that the knowledge comes from external sources which require a recipient's ability to diffuse the knowledge within the organisation so that it can be assimilated, transformed and utilised (Easterby-Smith, Thorpe, Jackson, & Lowe, 2008). Despite the importance of these routines in the innovation process, the empirical research which links the external knowledge search with the direct measure of AC remain in the black box (Cruz-Gonzalez et al., 2015). This leaves room to connect a more rigorous AC means with external knowledge searches to open the black box (organisational processes and routines) with a better explanation on how a firm can improve their innovation successes through building external knowledge searches with external actors.

2.8.2 Search Strategy- Collaboration Breadth and Depth and Absorptive Capacity

Collaboration is the form of interaction taken by a firm with external organisations or institutions with formal agreements to offer a firm a way of ensuring a high degree of flexibility in their operations through the transfer of important technical knowledge between parties (Fischer, 2006). However, the transfer of this specific tacit technical knowledge is not an automatic process. Firms involved in innovation collaboration can increase their strategic gains and learn from their cooperative partners. In this regard, engaging in innovation collaboration contributes to a firm's ability to evolve with the changing environment such as staying in touch with latest technology developments (Vanhaverbeke, 2006) as well as increasing a firm's internal knowledge or technological capabilities (Gambardella & Giarratana, 2006). Although innovation collaboration contributes to a firm's learning, not all firms are equal in capturing or creating similar value from its external sourcing activities.

Vanhaverbeke et al. (2008) posited a link between open innovation and AC in discussing the role of AC in open innovation. Typically, open innovation is a paradigm which assumes that a firm can and should use purposive inflows and outflows of knowledge in advancing their technology or accelerating internal innovations or expanding the markets for external use of innovations (Chesbrough, 2003; Chesbrough et al., 2006). This paradigm focused mainly on a firm's external sourcing strategies rather than explaining how firm could internalise the external knowledge from external sourcing strategies.

The AC, typically in Zahra and George (2002), modelled as a set of dynamic capabilities mainly explained the internal mechanisms of a firm in internalising the external knowledge sources. In this regard, a combination of AC with open innovations tends to explain a more implicit means of external knowledge towards a firm's innovation performance. Extensively, innovation collaboration breadth and depth are external knowledge search strategies of a firm that are purposively taken by the firm to enhance its innovation activities as well as to increase its internal knowledge base (Datta, 2011; Laursen & Salter, 2006).

In this respect, AC is not merely the by-product of R&D activities, but AC is a firm's dynamic capabilities in taking small learning steps over time in integrating external knowledge into a firm's knowledge base (Zahra & George, 2002). Vanhaverbeke et al. (2008) indicated that purposive external sourcing allows the firm to scan a broad range of interesting ideas and knowledge, and this eventually leads to better learning opportunities for a firm to learn about new technologies. Implicitly, this argument leads to the assumption that the more engagement of a firm in external knowledge search mechanisms, the greater it contributes in firm's learning AC.

Collaborations with external partners are salient to AC. Collaborations with more diverse partners enable firms to access different sources of knowledge from different actors. Likewise, Fosfuri and Tribo (2008) also stated that the greater the interaction with external knowledge sources (diverse sources of external knowledge), the larger the experiential learning that could accumulate by a firm. Increase in experiential learning contributes to reducing the risk and uncertainty in innovation processes (Lasagni, 2012). Also, Foss et al. (2013) indicated that firms' connections with outside parties will help them in recognition of new opportunities and contributes to firms' problem-solving processes, which in turn increases firms' exploration and exploitation learning.

Fosfuri and Tribo (2008) use data from a sample of 2,464 innovative Spanish Firms and found that R&D collaborations, external knowledge acquisition and experience in knowledge search are the key antecedent for potential AC (knowledge identification and knowledge assimilation capability). Implicitly, this means a firm's engagement in external linkages is important in facilitating the accumulation of potential AC. Their findings also indicated that heterogeneity in the level of potential AC tends to persist across time. This makes potential AC having strong explanatory power in elucidating the persistence innovation performance differences across the firms.

Likewise, Enkel and Heil (2014) also stated that a firm's ability in recognition and assimilation of external knowledge sources require permeable boundaries as well as broad external sources of change through environmental scanning and boundary spanning activities. For instance, their result cited from the Senior Manager Innovation and Intellectual property, Industrial Petrochemicals, BASF has indicated that interactions with scientists and industrial partners across fields and industries have widened their awareness for new knowledge values. In the same manner, Murovec and Prodan (2009) indicated that broader collaboration networks strengthen organisation's awareness of others capabilities and knowledge. Moreover, Ferreras-Mendez et al. (2015) stated that broader external collaborations with external agents contributed to the overall level of AC.

On the other hand, Liao, Wu, Hu, and Tsui (2010) argued that access to knowledge sources do not equal to the acquisition of external knowledge. Tacit knowledge is deeply embedded in a firm's context and it is idiosyncratic in nature. Innovation collaboration enables a firm to access to this knowledge. However, the idiosyncratic and specific nature of this knowledge does not automatically transfer between the parties. Foss (1996) stated that the transfer of the idiosyncratic knowledge between firms contributed to the increase of firms' internal knowledge base, and hence resulted in a successful exploitation of the external knowledge that eventually led to the successful commercialisation of new products.

Vinding (2006) indicated that firms with a deep relationship with external partners tend to increase the potential effects of transferring information, more importantly, tacit knowledge across a firm. In this sense, increase collaboration depth (measure with the extent of the depth of a relationship with external partners), is essential to facilitate the transfer and combination of the tacit knowledge with the existing knowledge base (Chen et al., 2011). Also, Murphy, Perrot, and Rivera-Santos (2012) stated that closer ties of a firm and its collaboration partner enables a firm to bridge the knowledge gaps between firms, and this also enhances the AC of a firm.

Ferreras-Mendez et al. (2015) found that the depth of external knowledge search is significantly and positively associated with AC. Typically, they indicated that a firm establishes a deep relationship with external partners in innovation collaboration contributed to the truth necessarily to transfer of the knowledge. Deep relationship between the partners (proximity in innovation collaborations) in collaboration tends to contribute in common skills, shared languages as well as cognitive structures (greater collective minds), and this enables a firm to identify relevant external knowledge, as well as tacit knowledge (Grant & Baden-Fuller, 1995). Furthermore, Ferreras-Mendez et al. (2015) also stated that strong relations with collaborative partners enable firms to have greater sharing routines. A greater sharing routine enables a firm to understand better the external sources of knowledge and hence assist a firm in assimilating, transforming and exploiting externally acquired knowledge into a competitive advantage.

2.8.3 Search Strategy- Information Search Breadth and Depth and Absorptive Capacity

Innovation is a complex activity, which is drawn on a wide range of external ideas and knowledge sources. External information search is purposive search activities conducted by a firm to source the knowledge or information beyond a firm's boundaries (Ebersberger & Herstad, 2011). Laursen and Salter (2014) stated that external searches that do not involve formal agreements among firms can be seen as a form of soft openness. This type of sourcing is more flexible, low or even at no costs (OECD, 2005), as well as fewer governance problems (Ebersberger & Herstad, 2011).

External information search is essential for a firm's AC. Fundamentally, the AC model proposed by previous researchers posits that the link of external knowledge inflow, which includes all types of external knowledge search, has an impact on AC (Cohen & Levinthal, 1990; Zahra & George, 2002). Zahra and George (2002) stated that exposure to knowledge or information in isolation does not guarantee higher levels of AC. In this sense, they suggested that diversity-exposure for different forms of knowledge sources or information lead to greater opportunities for a firm to develop its potential AC. Likewise, Kostopoulos et al. (2011) indicated as follows:

> *"When a firm has access to complementary knowledge inflows from various external sources it is more likely to engage in knowledge acquisition, assimilation, and exploitation because of the value and growth opportunities that these inflows could create; hence stimulation the level of AC* (p. 1336)."

Kostopoulos et al. (2011) indicated that AC is essential to produce tangible benefits from a firm's external searching activities. They are using path analysis in a sample of 461 Greek enterprises in the third Community Innovation Survey found that external knowledge inflows are directly related to AC, and path analysis showed a full mediation effect of AC in the relationship between diversity of external knowledge sources and both a firm's innovations and financial performance.

Findings from Kostopoulos et al. (2011) provide insight for the explanation of firms' differences in identifying and translating external knowledge sources into tangible benefits. Typically, AC is the key to translating external knowledge sources into firms' innovation performance and financial performance. They adopt multiple indicators for AC, and this includes internal R&D related indicators, training, R&D, and employees' education levels as the proxy to measure firm-level AC. Based on this inclusion of multiple indicators of AC, they found that firms having access to diverse external knowledge inputs allow firms to take advantage of two learning opportunities. Firstly, it improves a firm's ability to access to a diverse array of novel knowledge and skills. Secondly, it develops abilities to interpret and apply diverse inputs via identifying similarities and overlaps with existing knowledge bases.

In the same manner, Moilanen et al. (2014) conducted a survey based on 431 SMEs located in North Norway and found that diversity of external searches has a direct positive relationship with a firm's AC, and a firm's AC has a direct relationship with a firm's innovation performance. This result indicates that firm-engagement in the diversity of external searches does not necessarily result in higher innovation performance. Indeed, innovation performance depends on a firm's ability in acquiring, assimilating, transforming and exploiting the related external knowledge sources of AC into a competitive advantage. In other words, a firm engaged in active external searches increases the chances for new knowledge creation. This can be encounter with internal mechanisms of a firm in identifying the relevant external sources from a broad range of external knowledge and information in order for it to be translate into innovative products or processes.

Moilanen et al. (2014) on the other hand differentiated the effects of external search diversity, AC, and product innovation between R&D intensive firms and non-R&D intensive firms. In order to capture AC for non-R&D intensive firms, they have included employees' education levels, learning activities and knowledge management as the dimensions that reflect firms' levels of AC. They found that non-R&D intensive SMEs have much stronger direct effects between external searches and innovation performance, and leave a weak mediating effect of AC, while for all firms, the mediating effects of AC are nearly full mediation. This result suggested that the measure of AC is still an incomplete picture. Thus, Moilanen et al. (2014) suggested future studies to include more relevant measures that can capture a better picture of the AC concept in non-R&D SMEs contexts.

Apart from discussing the impact of 'external search diversity' on a firm's AC, external search depth reinforces the use of external knowledge and this reduces the distance of the external information and knowledge and a firm's extant knowledge, thus, enhance a firm's ability in identifying, assimilating, transforming and exploiting the relevant external information (Patel & Van der Have, 2010). Furthermore, greater access (high frequency) on the external information will facilitate comprehensive information, and this might complement to a firm's AC. For instance, Ebersberger and Herstad (2011) found that greater external information generates strong internal competence of firms in access to other external sourcing types, such as innovation collaborations. Implicitly, this result indicates that external search depth contributes to facilitates firm's AC.

External knowledge search contributes in developing a firm's AC. Collaboration breadth and information search breadth help firms to scan the environment and provide opportunities for a firm to access different types of knowledge. Indeed, this helps firms to accumulate knowledge, helps firms to mix and match the acquired knowledge and information needed for facilitating new knowledge creation processes. On the other hand, collaboration depth and information search depth enable a firm to gain tacit knowledge, skills and experiences, as well as accessing thoroughly on the information as to improve a firm's understanding of the acquired knowledge and information as well as contributing to enhance a firm's exploitation of external knowledge sources.

2.9 Review of Absorptive Capacity and Product Innovation Performance

Product innovation refers to the significance or improvement of a product that is introduced by a firm, which can result in market and technological discontinuities (level of novelty). The capabilities to develop innovative new products require various sources of ideas and knowledge sources externally and internally (Purcell & McGrath, 2013; Santamaria, Nieto, & Barge-Gil, 2009). In this regard, external knowledge sources are essential for a firm in discovering new product opportunities. For instance, Trott (2008) stated that assembly of knowledge from various external knowledge sources with a firm's internal knowledge base generates business opportunities for a firm that will later turn into new product concepts. AC plays an essential role in assembling external knowledge into a firm's internal knowledge base.

External sources of knowledge are often critical to a firm's innovation outcome. However, Clausen (2013) indicated that the presence of valuable external sources of knowledge does not imply that the firm directly benefited from external knowledge. Cohen and Levinthal (1990) stated that the ability to evaluate and utilise external knowledge is a critical component of innovative capabilities that can generate competitive advantage for a firm. Thus, AC is a key determinant for a firm to identify, assimilate, transform and exploit these external sources and later translate it into innovation outputs (Zahra & George, 2002).

Prior studies in the AC field posit a direct link between AC and innovation performance (Cohen & Levinthal, 1990; Lane et al., 2006; Lichtenthaler, 2009; Volberda et al., 2010; Zahra & George, 2002). In this respect, AC is seen as an explanation of a firm's heterogeneous innovation performance. The literature explicitly examines the relationship between AC and product innovation by using two respective means of AC. Firstly, they defined AC as an external knowledge search i.e. a firm involved in active information search from external actors or external codified sources, and innovation collaboration with external actors. Secondly, they defined AC as a firm's capacity or capability in acquiring or identifying, assimilating, transforming and exploiting the external knowledge into a firm's domain.

There are several findings (Fosfuri & Tribo, 2008; Murovec & Prodan, 2009; Franco, Marzucchi, & Montresor, 2014) that indicate the AC as a firm's external knowledge search. These studies operationalised the concept of AC as the effort of a firm engaging in a diversity of external knowledge searches. Indeed, AC is beyond engagement in the external search because it involves internalisation processes, which makes use of external knowledge into a firm's domain (Cohen & Levinthal, 1990). The mere existence of valuable external knowledge is a necessary but not a sufficient condition for a firm to develop AC (Lane et al., 2006). Hence, postulating AC as the mean of a firm in capturing external knowledge sources is certainly undermining the richness of the concept of AC.

Following several justifications of AC from prominent pioneers studying the effect of AC towards firm innovation performance, the definition of AC is indeed comprised of more complex and implicit means. For instances, AC is defined as a function of prior knowledge of a firm (Cohen & Levinthal, 1990) as a set of dynamic capabilities that is embedded in a firm's routine, structure, and system (Zahra & George, 2002), organisational learning processes (Lane & Lubatkin, 1998) and a firm's ability to adapt to changing environments (Van den Bosch et al., 1999). Despite various definitions of AC, it calls an attention in exploring AC means for innovation studies.

Escribano et al. (2009) operationalised AC by using a proxy, such as a firm's R&D expenditures and employees' education levels in their study, and found that a firm with greater AC is more likely to have a higher level of PIP. Likewise, Kostopoulos et al. (2011) used similar indicators and found that AC recorded positive impact on PIP, and thus suggested that AC is a source of competitive advantage.

Moilanen et al. (2014) combined the R&D related activities, learning activities and knowledge management in defining a firm's AC. They found significant and positive relationships between AC and firm's PIP. Interestingly, Stock, Greis, and Fischer (2001) did not get a similar positive result in studying the linkages between AC and PIP. By measuring AC as a firm's internal R&D, they found a curvilinear relationship between a firm's AC and PIP.

Tavani et al. (2013) employed a different set of proxies in constructing AC measurements. Typically, their study is different from the previous studies because they measure the proxies of AC by using latent measurements. There are five proxies used in the study; this includes worker knowledge, manager knowledge, communications networks, communication climates, and knowledge scanning. Based on the analysis from the Structural Equation Modeling (SEM), they found that these five factors produced 'significant validity' and 'reliability statistical results'. In the context of examining the linkages between AC and PIP, they found that all proposed components of AC are positively related with PIP, except communication networks.

In the same manner, Tavani et al. (2014) studied the impact of AC on both agile PIP (new product development that is responding to uncertain and changing business ‘environments) and general PIP (financial and non-financial product-achievement) by using the similar AC as proposed by Tavani et al. (2013). Their study indicated a direct and positive impact on AC on agile PIP. However, they also found that excessive investments in AC lead to diminishing returns in financial and non-financial product performances.

Instead of operationalising the AC based on proxy indicators, there are some researchers who use perceptive instruments to measure AC in a direct way. Schmidt (2010) stated that perceptive instruments overcome the limitation of many proxy indicators. Indeed, perceptive instruments allow the researcher to capture the rich multidimensional and structure nature of the AC concept. For instance, multidimensional perceptive instruments can be used in capturing special organisational routines and processes that constitute AC of a firm or the learning mechanism of a firm (Camison & Fores, 2010; Flatten et al., 2011; Jimenez-Barrionuevo et al., 2011; Lewin et al., 2011).

In the context of positing the link between AC and PIP, capturing AC in multidimensional perceptual instruments allow for greater understanding of the AC link in the context of a firm’s operational level and PIP, as well as explain more variance between the linkages (Schmidt, 2010). Prior researchers defined AC following the dimensions of acquisition, assimilation, transformation and exploitation. For instances, Chang et al. (2014) defined AC by using direct measures (perceptual instruments) in studying the linkages between AC and new product development performance.

Intensively, the study indicated that AC has direct and positive linkages with PIP in Taiwanese manufacturing enterprises.

In the same manner, Wang and Han (2011) also employed simple and direct measures for AC following the dimensions of acquisition, assimilation, transformation and exploitation. They found that AC has direct and positive linkages with innovation performance (includes product innovation) and is moderated between the linkages of knowledge properties (complex, tacit, ambiguity). Indeed, their study indicated that the ability of a firm in accessing the knowledge from the external network does not mean they have sufficient capacity to absorb complex, tacit and ambiguous knowledge. AC plays an essential role in the form of absorbing complex, tacit and ambiguous knowledge, and thus making this complex, tacit and ambiguous knowledge more meaningful to a firm's innovation performance.

Apart from simple measures for AC dimensions, there are studies that employed rather comprehensive measures for AC in linking with a firm's PIP. Exposito-Langa, Molina-Morales, and Capo-Vicedo (2011) employed a multi-item scale in distinguishing different dimensions (knowledge identification, knowledge assimilation, and knowledge exploitation) and independently linked with PIP in the Spanish textile sector. They found that knowledge identification and knowledge exploitations are positively and significantly linked to product innovation, while there is an insignificant relationship between knowledge assimilations and product innovation. Knowledge assimilations refer to internal communication and employees' education levels. This result is contrasting compared to other prior studies that indicated positive findings of a firm's assimilation with a firm's innovation performance (Escribano et al., 2009; Tavani et al., 2013).

In essence, AC is a broad concept. The applied AC concept in prior studies is varied across the literature. Indeed, the differences between the operationalised concept of AC could lead to a different understanding of the mechanism of a firm's access to surrounding technological opportunities and the mechanism of firms in extracting the valuable external knowledge as well as using it in innovation processes. Using proxy in measuring AC has its limitation in its validity that covers an implicit aspect of AC. Thus, prior researchers proposed to measure AC in a direct way that includes all related dimensions, as well as with a fine defining item scale in each of the dimensions. Hitherto, there is limited literature that has done it this way. Thus, there exists a gap in the literature and allows the researchers to conduct further studies in closing the knowledge gaps.

Instead of the ambiguity of the concept of AC, literature that links between AC and PIP are also varying in their operationalised definitions of PIP. Generally, PIP is largely defined as the number of new products introduced by firms for the past three years (Escribano et al., 2009; Fosfuri & Tribo, 2008; Franco et al., 2014; Kostopoulos et al., 2011; Moilanen et al., 2014; Murovec & Prodan, 2009). Indeed, the definition emphasises on the number of new products introduced only captures simple information about a new product that has been introduced in the past. This indicator does not include the measure of the success of new products that have been introduced.

According to KBV, innovation is the way for a firm to achieve competitive advantage. In this respect, a firm will achieve competitive advantage only when the product is different from the competitors in the market. Although some researchers have defined PIP in the context of it's financial and non-financial achievements in the market (Tavani et al., 2014; Tavani et al., 2013), yet, it is still limited. Thus, there exists a gap in the literature and allows the researcher to conduct further research in closing the knowledge gaps.

2.10 Chapter Summary

This chapter reviewed the literature on the concept of innovation in management disciplines, the definition of innovation, and product innovation. It also discusses on the types of external knowledge sources, which includes external collaborations (collaboration with customers, supplier, competitors, and knowledge institution) and external information searches. Based on the breadth and depth strategy, both the impact of external collaborations and external information searches are examined towards PIP. Subsequently, the impact of external knowledge sources towards AC and PIP is also examined. The next chapter discusses the research methodology.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the theoretical framework, hypotheses development based on the framework and research design. Next, this chapter elaborates on the operational definition, measurement of items and scales, sampling procedures, survey administration, and pilot study. Then, data preparation, assessment of potential bias, descriptive analysis, and data analysis using the Structural Equation Modeling (SEM) are discussed. Finally, this chapter is concludes with a chapter summary.

3.2 Theoretical Framework

In order to adapt to the changing environment, firms see themselves as learning entities and trying to improve their knowledge capital continuously through innovation. In the manufacturing sector, firms' capabilities to bring new products (product innovation) to the market that can comply with its quality, cost and development time goals is important for its survival in a competitive environment (Mild & Taudes, 2007). Therefore, product innovation is important for manufacturing firms to achieve competitive advantage.

Product innovation is a very high-risk endeavour activity that is fraught with difficult encounters with high failure rates (Cooper & Kleinschmidt, 1987; Ernst, 2002). Thus, firms that engage in product innovation activities do not automatically signify that it have achieved competitive advantage. Competitive advantage is achieved when firms obtained economic rent (financial value), comparable benefits from competitors regarding market demand and result in higher customers' satisfaction, and a higher performance compared to its rivals (Theriou, Aggelidis, & Theriou, 2014). Therefore, competitive success of firms are beyond the ability of introducing new products (product innovation). Indeed, it includes firms' achievement in product's innovativeness, financial performance, product development speed and costs (Zhang et al., 2015), customer value, and product quality (Paladino, 2007).

As to ensure the effectiveness of firms' investments in product innovation, there is the need for firms to measure the outcome of product innovation in achieving competitive success in the market. In this respect, PIP refers to the outcome of product innovation. Based on KBV logic, knowledge is the origins of competitive advantage and superior performance and it is the focal concern in examining the factors that account for performance variation (Grant, 1997). In other words, KBV suggested knowledge and capabilities as firms' key resources and suitable to explain firms' PIP.

New product development requires knowledge searching and knowledge combinations that can be organised in different ways (Kohlbacher, 2008). In this respect, KBV theorists suggested that knowledge assets are tradable across firms and thus firms can acquire useful knowledge sources from its external environment (Grant, 1996b; Som, 2012). Firms serve as a semi-permeable membrane that allows the knowledge to pass at different rates and to a different degree. Fey and Birkinshaw (2005) stated that in reality, the market for knowledge assets is not perfect. In this sense, a firm will find it difficult to realise or identify potential knowledge sources for value creation, as well as free to acquire the knowledge needed from others due to the knowledge protection mechanisms set by some market players. Thus, a firm's ability to appropriate value from external knowledge sources requires a firm's ability to leverage external knowledge and resources through inter-organisational co-operations or external information searching (Kirsimarja & Aino, 2006).

Fundamentally, KBV proposed that knowledge that flows externally lead to accumulation of knowledge stocks, as well as contributing to the renewal of a firm's existing knowledge stocks. Integration mechanisms serve as firm-internal routines and mechanisms to coordinate and integrate knowledge stocks and knowledge flows, and this enables a firm to exploit existing knowledge and explore potentially new or recombined knowledge that is essential for a firm's value creation process (Kogut & Zander, 1992; Som, 2012). Implicitly, AC is indeed serving as the integrative mechanism that enables the coordination and integration of knowledge stocks and externally flows knowledge.

KBV and AC are interconnected (Volberda et al., 2010). In fact, AC emphasises on a firm's mechanisms in coordinating, integrating knowledge flows (from external sourcing mechanisms), and knowledge stocks in a more specific manner. In this study, the researcher proposed to integrate both KBV and AC to develop a current study framework. In this respect, collaboration depth and breadth, and information search breadth and depth are external knowledge search strategies that represent the 'external knowledge flow' to a firm. On the other hand, AC represents the integrative mechanisms that integrate and coordinate external knowledge and information into a firm's knowledge stock, and subsequently contribute to a firm's PIP.

Based on the literature reviewed, a theoretical framework has been developed as in Figure 3.1 to demonstrate the links between the independent, mediating and dependents' variables. The independent variables in the present study are external knowledge search (collaboration breadth and depth, information search breadth and depth). The mediating variable is AC and the dependent variable is PIP.

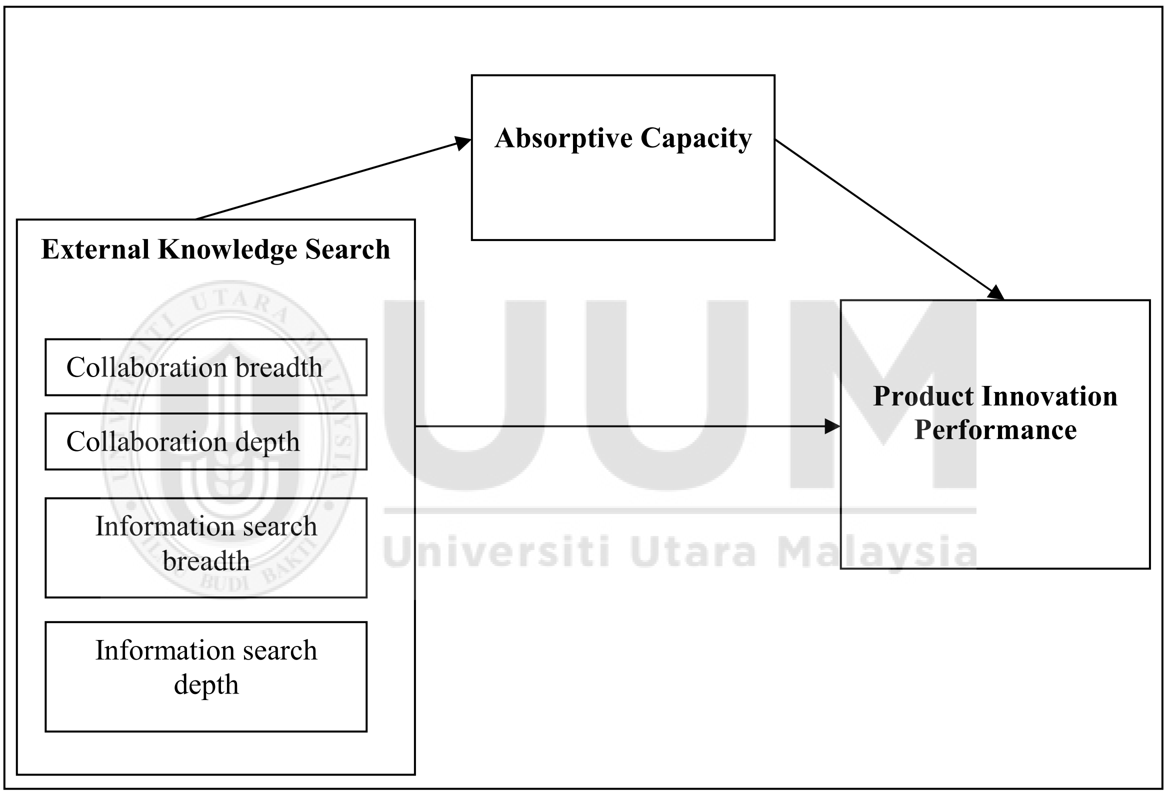


Figure 3.1
The Schematic Diagram of Theoretical Framework

3.3 Hypotheses Development

Previous sections have discussed prior studies regarding product innovation, external knowledge search and AC literature. Thus, in this section, based on literature, the researcher has developed hypotheses for current studies.

3.3.1 Development of External Knowledge Search and Product Innovation Performance Hypotheses

Product innovation requires a broad knowledge base because of the development of a new product involves multi-discipline of knowledge (Annique et al., 2010). In this respect, a firm's open access to external sources exposes greater opportunities for firms to access to knowledge that is needed in product innovation processes (Chesbrough, 2003; West & Bogers, 2014). Collaboration with external partners enables the firm to fill up the knowledge gaps and enable them to successfully commercialise new knowledge to the market (Chesbrough, 2003; Nieto & Santamaria, 2007).

Collaboration breadth is one of the open search strategies that enables firms to source for important knowledge for their product innovation. Collaboration breadth refers to the extent of firms having relationships with different types of external partners (Laursen & Salter, 2006). Typically, collaboration with diverse partners enables firms to access different types of knowledge that are important for innovation to take place (Nieto & Santamaria, 2007). The findings of empirical studies in investigating linkages between collaboration breadth and product innovation are mixed. Some prior studies indicated direct positive linkages of collaboration breadth with PIP (Ebersberger & Herstad, 2011; Katila & Ahuja, 2002; Love et al., 2014; Nieto & Santamaria, 2007), some indicated inverted U-relationships with PIP (Chen et al., 2011; Kang & Kang, 2009), and others indicated insignificant relationships with PIP (Ferreras-Mendez et al., 2015).

The possible explanation for this incongruent result is because of the different geographical areas that produce different findings. For example, Chen et al. (2011) conducted their study in the context of Taiwanese manufacturing companies from different industries that found significant and positive relationships between collaboration breadth and PIP, whereas, Ferreras-Mendez et al. (2015) conducted their study in the context of the biotechnological industry in Spain that recorded insignificant relationships between collaboration breadth and PIP.

In the Malaysian context, the National Survey of Innovation (2010) suggested the need for private companies to engage in external knowledge searching. Intensively, this survey indicated that tapping the vast wealth of knowledge provides a quick route for firms to achieve greater innovation. In this regard, Chandran et al. (2014) indicated that local firms' interactions with multiple external linkages can lead to accumulation of knowledge and provide greater opportunities for firms in upgrading their technology, production, and innovation. On the other hand, Ng and Thiruchelvam (2012) indicated that Malaysia's wooden furniture industries are characterised as a collective innovation, whereby, the linkages with various actors, such as customers, suppliers, competitors are important for firms' PIP.

Collaborations with various external partners contribute to firms' PIP. Prior studies indicated that collaborations with external partners exerted positive impacts on PIP related to the rate of new product introductions (Laursen & Salter, 2006; Kang & Kang, 2009), novelty of new products (Nieto & Santamaria, 2007; Ebersberger & Herstad, 2011; Bengtsson et al., 2015; Monteiro et al., 2016), financial performances from new products sales, compatibility of new products (Ferreras-Mendez et al., 2015), speed of new product introductions and relative better market value and quality (Brettel & Cleven, 2011). Hence, in this study, the researcher considers the effects of external collaboration breadth on PIP through the following hypothesis:

H1: Collaboration breadth is positively related to product innovation performance.

Collaboration depth refers to the extent to which a firm draws intensively from different collaborating partners (Ferreras-Mendez et al., 2015). In this regard, a deeper relationship between the collaborating partners enable firms to understand more of the knowledge that has been acquired (Hsieh & Tidd, 2012), facilitate the transfer of knowledge, and greater access to tacit knowledge, such as a partner's experiences and skills. There are prior studies that found positive linkages between collaboration depth and PIP (Chen et al., 2011; Katila & Ahuja, 2002), while another found an inverted U-relationship between collaboration depth and PIP (Ferreras-Mendez et al., 2015).

Typically, collaboration depth allows a firm to maintain a stronger relationship with external partners and result in a deeper level of trust and communication among partners (Laursen & Salter, 2006; Terjesen & Patel, 2015). Consequently, this will lead to a greater understanding of a firm with external sources. In this regard, it allows firms to develop common knowledge with external sources, which support new product development processes in firms, hence, lead to greater PIP (Zhang et al., 2015). Several prior studies indicated that collaboration depth has positive impact on the rate of the introduction of new products, sales and speed of new products (Chen et al., 2015), novelty and sales of new products (Monteiro et al., 2016), and efficiency of new products (Bengtsson et al., 2015).

In Malaysia's context, Chin, Abu Bakar Abdul Hamid, Amran Rasli, and Tat (2014) suggested that SMEs that have a close relationship with suppliers and customers, lead to better performance in achieving the stated financial goals, customer satisfaction, and customer responsiveness. Likewise, Chandran et al. (2014) annotated that close relationships with industrial associates and 'skills development organisations' play important roles in supporting the manufacturing innovations through contributing on 'skills formation' and help to work closely with a firm in designing the suitable training or course for employees to upgrade their skills and knowledge. Therefore, in this study the researcher considers the effects of external collaboration depth on PIP through the following hypothesis:

H2: Collaboration depth is positively related to product innovation performance.

Instead of collaboration with external partners, external information searching is another type of external knowledge search. Information search breadth is defined as the number of external sources of information used by firms in its innovative activities (Laursen & Salter, 2006). Product innovation entails the creation and new ideas' development through the combination of different types of information sources (Chiang & Hung, 2010). Such variety of information increases the likelihood of firms to spot problems on the earlier development process, spur multiple designs' iterations, increase the chances to find well-working designs for new products, and thus help to reduce new product development costs and speed (Patel & Van der Have, 2010).

The search for information sources is the systematic scanning of external environment, using mechanisms ranging from codified sources (Brusoni et al., 2005), informal networks with supply chain actors (Lau et al., 2010; Casanueva, Castro, & Galan, 2012; Fu et al., 2013), conferences and trade fairs (Rinallo, Borghini, & Golfetto, 2010), networks with public supportive agencies, professional technical agencies (Huang, Chen, Wang, Ning, Sutherland, Zhou, & Zhou, 2015), and networks with non-profit organisations and competitors (Hwang & Lee, 2010). Indeed, the prior studies show that each type of information sources contributes to PIP.

Brunswicker and Vanhaverbeke (2015) found that interaction with supply chain members, universities and research organisations, experts and intellectual property rights and network partners contribute to the success of a firm's launching of innovative products and also the gain or appropriate financial value from the sales of innovative products. Likewise, Huang et al. (2015) found that interaction with competitors, value chain partners, professional technical agencies and public supportive agencies has a positive impact on new product sales revenue, the annual number of new product introductions, and the speed of new product developments. In the same manner, Brusoni et al. (2005) also found that codified sources (patent, journals), conferences and trade fairs also contribute to the novelty of product innovation in Dutch manufacturing firms.

Information search breadth refers to the search for information ranging from different types of information sources as stated in the paragraph above. This type of search is different compared to collaboration breadth because this type of search does not involve any contact or formal statements on the sharing of tasks, costs, benefits and revenues (Barrutia et al., 2014). While the literature above examine single or a combination of two to four types of information sources, the incorporation or search breadth strategy took a different approach by indicating how many different information channels is used by a firm. This approach provides greater insight on the total of information sources used by a firm for its product innovation activities (Backfish, 2014).

In essence, the findings from Laursen and Salter (2006) and Chen et al. (2011) found the inverted-U-relationship between information search breadth and PIP. In fact, the findings from Laursen and Salter (2006) and Martini et al. (2012) showed that the inverted-U relationship between information search breadth and product innovation indicated that excessive information search breadth is detrimental to a firm's innovation performance. Accordingly with this finding, Martini et al. (2012) found that excessive external search entails significant managerial challenges while Laursen and Salter (2006) indicated that external search needs to be alleviated by understanding the costs for such efforts. Otherwise, the excessive search may indeed hinder innovation performance.

However, in contrast to the findings from Laursen and Salter (2006) and Chen et al. (2011), there are several prior studies that indicated positive linkages between information search breadth and PIP. This includes the empirical study conducted by Katila and Ahuja (2002) and Esbersberger & Herstad (2011), whereas, other studies found non-significant linkages of information search breadth with radical and incremental

PIP. Despite the mixed result from prior studies, further assessment is required on the relationship between information search breadth and PIP.

External information search requires less monetary payment and less interaction with the information provider. Therefore, diversity of information search is likely to be less costly to administer and associated with lower risk of knowledge leakage (Foss, 2007). Moreover, KBV suggested that knowledge is characterised as complementary and indivisible, thus, diversity of information search contributes to enlarge a firm's knowledge base (Antonelli, 2009), and contributes to PIP (Ferreras-Mendez et al., 2015). As firms expand the information search breadth, "they search for complementary and novel solutions" that accelerate the speed of introducing new products (Xu, 2014, p. 613). Also, having a greater number of complementary information sources could improve firms' search of a technological opportunity that could lead to greater benefits for customers regarding product quality and performance (Atuahene-Gima & Li, 2004). Therefore, in this study, the researcher considers the effects of information search breadth on PIP through the following hypothesis:

H3: Information search breadth is positively related to product innovation performance.

On the other hand, information search depth is defined as the extent to which a firm's draws intensively from different external information sources (Cruz-Gonzalez et al., 2015). Extensively, information search depth can facilitate the comprehensive information for product innovation and speedy problem-solving processes (Patel & Van der Have, 2010). Furthermore, information search depth helps firms to understand the distant knowledge and information that are different to a firm's existing knowledge base

(Hsieh & Tidd, 2012). Information search depth contributes positively to PIP. Fundamentally, past research findings found a positive relationship between information search depth and PIP (Katila & Ahuja, 2002; Chiang & Hung, 2010; Ebersberger & Herstad, 2011; Martini et al., 2012). In essence, in this study, the researcher considers the effects of information search depth on PIP through the following hypothesis:

H4: Information search depth is positively related to product innovation performance.

3.3.2 Development of External Knowledge Search and Firm's Absorptive Capacity Hypotheses

Fundamentally, studies of external sourcing always links with AC in explaining the impact on a firm's innovation performance. Indeed, the relationship between AC and external knowledge search is twofold. Typically, a firm that engages in external knowledge search contributes in developing a firm's AC (Ferreras-Mendez et al., 2015), while, the firm also needs AC in absorbing external knowledge or information from its external knowledge search strategies (Clausen, 2013; Lee et al., 2010).

AC is a broad concept, which allows for different operational meanings (Murovec & Prodan, 2009). For the current study, the researcher operationalised AC as a set of dynamic capabilities that acquire, assimilate, transform, and exploit external knowledge sources for a firm's innovation process. Unlike other research that operationalised AC as a firm's internal R&D (Bougrain & Haudeville, 2002; Poldahl, 2012), defining AC in a multidimensional context enables the researcher to collect more information on a firm's internal mechanism in absorbing external knowledge sources (Lewin et al., 2011).

Therefore, to suitably apply it in a broad context is to include non-research intensive firms (Oliver, Garrigos, & Gil-Pechuan, 2011).

Collaboration with diverse partners enables a firm to access to different types of knowledge sources. In this respect, Fosfuri and Tribo (2008) stated that greater interaction with different types of external partners lead to greater AC of a firm. Likewise, Enkel and Heil (2014) found that interaction with diverse partners has widened a firm's awareness of new knowledge values. In the same manner, Morovec and Prodan (2009) and Ferreras-Mendez et al. (2015) supported that the broader collaborative networks contribute to a firm's AC. In essence, this study considers the effects of collaboration breadth on AC through the following hypothesis:

H5: Collaboration breadth is positively related to a firm's absorptive capacity.

On the other hand, a firm that develops a deep connection with external partners tends to increase the potential information and tacit knowledge transfer from its focal firms (Vinding, 2006). Likewise, Rowley, Behrens, and Krackhardt (2000) contended that strong relationships between the collaborating partners produce thick information exchanges that allow firms to better assimilate, transform and exploit the knowledge. Intensively, Murphy et al. (2012) stated that deep connections with external partners bridge the knowledge gaps between firms. Indeed, this can make a firm better in identifying the valuable external knowledge, enhancing a firm's understanding of the knowledge, and improving a firm's transformation and exploitation on valuable external knowledge sources. In this respect, Ferreras-Mendez et al. (2015) found a positive relationship between collaboration depth and a firm's AC. In essence, in this study, the researcher considers the effects of collaboration depth on AC through the following hypothesis:

H6: Collaboration depth is positively related to a firm's absorptive capacity.

The infusion of diverse information sources can have potential benefits to a firm only if a firm has acquired and assimilated such information inputs, as well as, developed and refined the routines that facilitate combining existing knowledge with newly acquired and assimilated information with its transformation and exploitation capability (Xia, 2013). Intensively, the inflow of different types of information sources creates growth opportunities. Hence, it is likely to stimulate the level of its AC, and thus, result in value creation outcomes (Moilanen et al., 2014).

Zahra and George (2002) indicated that greater exposure to external information leads to greater AC. Indeed, information provision is an important factor that is influencing firms' AC. The greater the information provision, the greater managerial awareness on the information that is necessary for a firm to recognise and disseminate (Lenox & King, 2004). Moreover, information flows are likely to broaden a firm's internal knowledge stock (Van Wijk et al., 2012). Ultimately, this promotes the level of experiential learning accumulated, hence, improve firm ability to manage and generate value from external information (Norman, 2004).

Access to information search breadth enriches a firm's recombination and integration capabilities that could integrate newly acquired knowledge into a firm's knowledge bases (Leiponen & Helfat, 2010; Nelson & Winter, 1982). In this regard, Kostopoulos et al.

(2011) indicated that firms having access to diverse information sources allow firms to take advantage of two learning opportunities. Firstly, access to diverse information enhances firms' abilities to identify and assimilate the diverse array of novel knowledge in the firms. Secondly, it improves firms' abilities to interpret and apply this diverse input by integrating the acquired information, transforming it into the useful manner for the firms, and exploiting it in new product development processes. In essence, this study considers the effects of information search breadth on AC through the following hypothesis:

H7: Information search breadth is positively related to a firm's absorptive capacity.

External search depth reinforces the use of external knowledge, and this reduces the distance of the external information and knowledge and a firm's extant knowledge, thus, enhance a firm's ability in identifying, assimilating, transforming and exploiting the relevant external information (Patel & Van der Have, 2010). Indeed, information becomes more reliable through repeated use (Caner & Tyler, 2014). With repeated use of the knowledge, firms gain experience with the same set of knowledge concepts, and this enables firms to develop deeper understanding of those concepts, hence, resulting in a higher level of sophistication of common knowledge, and are better able to use them in creative ways to solve new product development problems (Katila & Ahuja, 2002).

Intensively, greater access (high frequency) on external information will facilitate comprehensive understanding on the acquired information, and this might contribute to a firm's AC (Dahiyat & Al-Zu'bi, 2012). With greater understanding of the acquired information contributes to a firm in terms of identifying the value of information, and thus create collective understanding between members. This also allows greater assimilation of the knowledge in a firm, and contributes to a firm to transform and exploit the acquired knowledge (Van Wijk et al., 2012). In essence, in this study, the researcher considers the effects of information search depth on AC through the following hypothesis:

H8: Information search depth is positively related to a firm's absorptive capacity.

3.3.3 Development of Firm's Absorptive Capacity and Product Innovation Performance Hypothesis

Following the proposed model by several prominent past researchers, AC is linked to innovation performance (Cohen & Levinthal, 1990; Lane et al., 2006; Lichtenthaler, 2009; Van Den Bosch et al., 1999; Zahra & George, 2002). In this regard, AC has an equally important role for PIP because the AC allows firms to utilise new knowledge to increase its PIP (Stock et al., 2001), as well as to help guide the uncertain search for innovations (Fabrizio, 2009).

There is a great deal of research done on investigating the relationship between AC and PIP. However, prior studies are not in consensus in conceptualising the concept of AC. In this respect, past research conceptualised AC in two respective means, which are, AC as external knowledge search and AC as a firm's ability in acquiring, assimilating, transforming, and exploiting the external knowledge.

For the first conceptualised meaning of AC, the researcher indicated that it is possible to jeopardise the original meaning of AC. In this regard, AC is indeed comprised of complex meanings and it is reflecting a firm's ability in absorbing external knowledge for a firm's innovation process rather than a firm's external search strategies. This is because the search for external knowledge does not necessarily internalise the knowledge or exploit the knowledge in new product developments (Cohen & Levinthal, 1990; Zahra & George, 2002).

For the second conceptualised mean of AC, there are two types of operationalised measurements. Firstly, the proxies' types of measurements, secondly, the direct measurements. Proxies' types of measurements potentially underestimate the AC in a firm (Schmidt, 2010). Direct measurements overcome the limitation of proxies because it allows researchers to capture the rich structured nature of AC.

In general, majority findings from prior studies found a positive and significant relationship between AC and PIP. However, the application of the concept of AC varies across the literature. Indeed, the differences of the operationalised concept of AC could lead to a different understanding of the mechanism of a firm's access to surrounding technology opportunity and the mechanism of firms in extracting the valuable external knowledge as well as using it in the innovation process. On the other hand, literature that links between AC and PIP are also varying in their operationalised definitions of PIP. Generally, PIP is from past research are simple, and includes the measurement such as, the number of new products introduced by firms (Escribano et al., 2009; Fosfuri & Tribo, 2008; Franco et al., 2014; Kostopoulos et al., 2011; Moilanen et al., 2014; Murovec & Prodan, 2009). Based on KBV, innovation is beyond from just introduces new products to the market. Indeed, it is way for a firm to achieve competitive advantage. In this respect, PIP is necessary to include financial and non-financial achievements of new products in the market.

In this study, the researcher proposed multi-dimensional AC and PIP. Since, majority findings indicated positive linkages between AC and PIP (Escribano et al., 2009; Wang & Han, 2011; Tavani et al., 2013; Chang et al., 2014; Moilanen et al., 2014), the researcher considers the effect of AC on PIP through the following hypothesis:

H9: Absorptive capacity is positively related to performance innovation performance.

3.3.4 Development of Firm's Absorptive Capacity as Mediator between External Knowledge Search and Product Innovation Performance Hypotheses

The presence of valuable external sources of knowledge does not imply that firms are automatically or directly utilising the external knowledge sources in its innovation process. Principally, KBV suggested that knowledge assets can be traded, but it does not indicate that firms can recognise the potential value of the external knowledge as well as utilise it in the production factor (Aranda & Molina-Fernandez, 2002; Grant, 1996b).

The KBV suggests that a firm is a knowledge processing entity (Almedia, Song, & Grant, 2002). This is linked to the AC concept, whereby, AC processed the acquired external knowledge sources and applied this knowledge to the commercial end (Cohen & Levinthal, 1990; Malhotra, Gosain, & El Sawy, 2005; Zahra & George, 2002). In this regard, AC plays an intermediate role in explaining how external knowledge search could drive innovation benefits to firms. For instance, Kostopoulos et al. (2011) annotated that

AC may contribute to a firm's innovation performance in two folds; firstly, undertaking the role as a tool for processing new external knowledge that can contribute to innovation performance, and secondly, as a pathway to transfer the knowledge for cross-organisation activities. Likewise, Moilanen et al. (2014) also stated that without AC, external knowledge has no value for a firm's innovation performance.

To date, there is only limited empirical research that has investigated the mediating role of AC between the external knowledge search and PIP. Although Kostopoulos et al. (2011) and Moilanen et al. (2014) have conducted the empirical research in investigating the mediating role of AC, they tend to used proxies rather than direct measures in capturing a firm's AC, and this might potentially underestimate the AC of firms (Schmidt, 2010). In this regard, both studies proposed that future research should use quality measures when capturing different dimensions of AC in studying the role AC plays in external knowledge search and PIP.

In this study, due to the limitation of using proxies to measure the AC, the researcher proposed direct measures that include four dimensions of AC in studying the role AC plays in external knowledge search and PIP. This includes collaboration breadth, collaboration depth, information search breadth and information search depth. The researcher attempts to investigate how a firm can benefit (regarding product innovation) from engaging in these four types of external knowledge search through AC. Based on the discussions in previous sections, there is indication of the positive link between these four types of external knowledge search and AC, and the positive link between AC and PIP. Thus, this led to the development of the following hypotheses:

H10: Absorptive capacity is a mediator between collaboration breadth and product innovation performance.

H11: Absorptive capacity is a mediator between collaboration depth and product innovation performance.

H12: Absorptive capacity is a mediator between information search breadth and product innovation performance.

H13: Absorptive capacity is a mediator between information search depth and product innovation performance.

3.4 Research Design

Research design refers to the plan or strategy of investigation devised to enable a researcher to answer the research questions as validly, reliably, and economically as possible. Current studies use the cross-sectional sample survey, which is a non-experimental research method or ex-post facto research (Kerlinger & Lee, 2000). According to Kerlinger & Lee (2000), most social science problems are ex-post facto in nature and do not lend themselves to experimentation. Sample survey research allows the researcher to “generalise from a sample to a population so that inferences can be made about some characteristics, attitudes, or behaviour of this population” (Cooper & Schindler, 2014, pp. 131-132). In the innovation context, sample survey allows researchers to focus on a specific sector or issues and enable researchers to apply them in different contexts (Hong et al., 2012). Also, sample survey research is well suited for measuring attitudes and orientations in a large population and is appropriate for research questions about self-reported beliefs or behaviours (Neuman, 2011). Furthermore, self-administered sample surveys also have additional advantages regarding the economy, speed, lack of interviewer bias, and the possibility of anonymity and privacy to encourage more candid responses on sensitive issues (Cooper & Schindler, 2014, see pp. 226-231). This study involves collecting data on many variables that measure perception and attitudes from a large number of subjects. Hence, the cross-sectional sample survey research design is considered appropriate.

The unit of analysis refers to the level of aggregation of the data collected to answer the research questions in a study (Sekaran & Bougie, 2013). Current studies focus on investigating the effects of external knowledge search and AC on PIP. Therefore, the level of analysis of this study is focused on firm-level analysis. Typically, the unit of analysis is emphasised on Malaysian manufacturing firms in the manufacturing sector whereby the "process of converting raw materials into products" (Kalpakjian & Schmid, 2006, p. 1) is being observed as it is involved in new product developments or NPD activities (Jamaliah & Zain, 1999). This study employed all types of industry within the manufacturing sector in Malaysia that includes both high and low technology industries. Past innovation studies suggested that various manufacturing firms of all sizes (consisting of both high and low technology industries) in various countries such as European Countries (Grimpe & Sofka, 2008), China (Kim & Atuahene-Gima, 2010) and German (Kirner, Kinkel, & Jaeger, 2009) practice innovation. In Malaysia, it is a common practice among manufacturing firms. Therefore, this study focuses on all industries that properly represent the manufacturing sector since the shared contribution of the

Malaysian manufacturing sector to GDP is based on all industries using the Federation of Malaysian Manufacturers Directory (FMM, 2015).

3.5 Operational Definition

After reviewing the literature in PIP, collaboration depth and breadth, information search breadth and depth, related literature in AC, the related terms and variables are operationalised according to the purpose and context of this study as follows:

1. PIP involves successful exploitation of new product ideas and realisation of these ideas into the market. Hence, PIP is operationalised in two measurement dimensions, which are, financial and non-financial performances for new or improved products that have been introduced by a firm during the last three years.
2. AC is operationalised as a set of dynamic capabilities, namely, acquisition capability, assimilation capability, transformation capability, and exploitation capability as to reflect firm level AC.
3. Acquisition capability operationalised as a firm's motivation and ability to recognise the potential value of external knowledge sources and ability to make sense on these new pieces of knowledge.
4. Assimilation capability operationalised as a firm's capability in resolving inconsistencies between newly acquired knowledge and a firm's existing knowledge bases through creating a collective understanding throughout a firm's members on newly acquired knowledge as to enable the integration of newly acquired knowledge with a firm's existing knowledge base.

5. Transformation capability operationalised as a firm's ability to maintain and reactivate knowledge, interpretation and combination of knowledge, and integration of new knowledge with the existing knowledge base.
6. Exploitation capability operationalised as a firm's ability to use and implement the acquired knowledge into commercial applications.
7. Collaboration depth is operationalised as the extent of a firm drawing intensively from a different collaborating partner.
8. Collaboration breadth is operationalised as the relationship of a firm with different types of external partners that are formally bound by formal agreements.
9. Information search depth is operationalised as the extent of firms drawing intensively from different external information sources.
10. Information search breadth is operationalised as the number of external information sources used by firms in its innovative activities.

3.6 Measurement of Items and Scales

The main variables in this study are PIP, external knowledge sources, and AC. In order to observe and measure these variables, the related items are explained and each item is operationalised (Sekaran & Bougie, 2013). This study employed the structured close-ended questions with dichotomous, multiple-choice, and 'rating response options type' of questionnaires (Cooper & Schindler, 2014, see pp. 302-313). The open-ended questions will provide richer information, but it is forecasted to be very demanding for the respondents (Salant & Dillmant, 1994), and thus it is not considered when knowing that the response rate will be declining (Stoop, Billiet, Koch, & Fitzgerald, 2010).

Furthermore, data on firms and respondent demographics are asked as part of the close-ended questions with dichotomous and multiple-choice options as it is also needed to understand the characteristics of related industries within the Malaysian manufacturing sector. The data on firms are corresponding to the current situation in Malaysia. Hence, all of these data was taken from the previous three years of completed product innovation projects; which is also not too long to be recalled by respondents.

3.6.1 Measurements of Firms' Demographics

In reflecting the characteristics of the Malaysian manufacturing sector, there are six relevant demographics being asked, namely, respondents' positions, the length of services, types of product innovation projects, the age of firms, the number of employees, and types of industry. The measurements of these items for firms' demographics are discussed in the following sections.

3.6.1.1 Position of Respondents

The target respondents consist of Product/ R&D Manager which is responsible towards the production of new products. Apart from this, other managers with a comparable obligation to Product/ R&D Managers are also contemplated as respondents in this study. This is because Chen, Reilly, and Lynn (2005) found that Product or R&D Managers can be any managers with diverse of backgrounds namely, Senior Engineers, Technical Managers and even Department Managers. As a result, another category of respondents is created and termed as "equivalents of Product/ R&D Managers". Table 3.1 summarises the categorical items for respondents' positions.

Table 3.1
Items on Respondent's Position

Source	Items
Rauniar, Doll, Rawski, & Hong (2008)	I am Product/ R&D Manager. I am equivalent to Product/ R&D Manager.

3.6.1.2 Respondents' Length of Service

In recognising the suitability of the respondents to complete the questionnaire, the data on respondents' length of service is important. This is because the respondents are asked to provide information on product innovation projects that are completed within the previous three years. Therefore, a question on how long a particular respondent's service in the selected firms (in the sample) was included in the demographic section. The designed question captured the ratio scale, whereby, the respondents were asked to give an exact year or month of his or her service length in the selected firms. This is because respondents' length of service is an objective factor and the respondents can give any reasonable figure range, from zero to infinity (Sekaran & Bougie, 2013).

3.6.1.3 Types of Product Innovation Project

The measures of 'firm involvement' in product innovation are adapted from Mat and Jantan (2009). These measures are suitable for this study as they refer to the levels of sophistication of innovation in product innovation projects (Bauly, 2004). Product innovation project for existing product modification refers to the modification made on existing product, whereas product innovation project for product line extensions refers to the established new item in the same product category. On the other hand, product innovation project for "me-too product" refers to the new product introduced by firm after it has seen that other firms had introduced similar type of product. This type of innovation focus on achieving breakthroughs in the production technology to slash product costs, cut inventory levels, and other relevance breakthroughs that makes the new product although similar but difference in other related factors. Lastly, product innovation project for true innovation refers to the new product introduced by firms that are new not only to firm, but also to industry. The items are summarised in Table 3.2.

Table 3.2
Items on Product Innovation Project

Source	Items
Mat & Jantan (2009)	1. Product innovation project for existing product modification. 2. Product innovation project for product line extensions. 3. Product innovation project for “me-too-product”. 4. Product innovation project for true innovation.

3.6.1.4 Firm’s Age

Firm age refers to the number of years in business since it is founded. The age of the firms is asked so that the level of experience in product innovation projects can be identified because it is found that older firms may have more product innovation projects and greater cumulative experience within this field (Sorensen & Stuart, 2000). Therefore, a question on how long a particular firm is established was included in the demographic section. The designed question required the respondent to give an exact year or month of the year of a firm establishment. Indeed, the ratio scale is used to capture the information in this section, because firm age is an objective factor and the respondents can give any reasonable figure range, from zero to infinity (Sekaran & Bougie, 2013).

3.6.1.5 Number of Employees

The number of employees represents the size of a firm and is measured by the number of employees currently working in the firm.

3.6.1.6 Types of Industry

In this study, all types of manufacturing industries are included to get a better response rate and representativeness of the sample. The types of manufacturing industries are based on the FMM Directory 2015 that is grouped either in high technology or low technology related industries. For example, the electrical and electronics industry is related to high technology groups whereas textile, wearing apparel and leather industry is related to low technology groups. These high and low technology industries stimulate the types of product innovation projects undertaken by Malaysian manufacturing firms. The types of industry are listed in Table 3.3.

Table 3.3
Types of Industry

Source	Items
FMM (2015)	1. Basic metal 2. Chemicals including petroleum 3. Electrical and electronics 4. Fabricated metal 5. Food, beverage and tobacco 6. Machinery 7. Manufacturing of furniture 8. Medical, precision and optical instruments 9. Non-metallic mineral 10. Paper, printing, and publishing 11. Plastic 12. Rubber 13. Textile, wearing apparel and leather 14. Transport 15. Recycling 16. Wood and wood products, including furniture 17. Others

3.6.2 Measurement of Product Innovation Performance

PIP is measured with dimensions, namely, financial and non-financial dimensional PIP measures. Fundamentally, innovation is a continuous activity (Fagerberg, 2004). Therefore, it is essential to measure product innovation based on the observation period. OECD (2005) provided the guideline on the observation period for questions on innovation which "should not exceed three years nor be less than one year" (pp. 129-130). Based on the OECD proposed guideline, the researcher sets a three-year-observation period in examining the effects of PIP for this study. Furthermore, the current study used a benchmarking way in measuring the PIP. Typically, benchmarking is a method that is useful in comparing a firm's performance relative to average or other firms (Maravelakis et al., 2006).

Intensively, benchmarking enables a firm to better understand the gaps between current practices and performance with competitors, its target objectives, or other similar practices in a firm, and this allows a firm to develop improvement actions (Maravelakis et al., 2006; OECD, 2005). Moreover, benchmarking enables the researcher to distinguish the performance of firms compared to its competitors, its target objectives, or other similar practices in a firm (Coulter, Baschung, & Bititci, 2000).

On the other hand, this study uses a 'seven-point Likert-type scale format' in measuring a firm's PIP, following several prior researchers that also measure PIP in 'seven-point Likert-type scales' (Alegre et al., 2006; Lin et al., 2013; Tavani et al., 2013; Tsai et al., 2011). However, few prior researchers used 'five-point Likert-type scales' (Hannachi, 2015), while a few used 'ten-point Likert-type scales' (De-Luca & Atuahene-Gima, 2007). For standardisation purposes, this study measured all items in PIP using a 'seven-point Likert-type scale'. In this study, measurements of PIP are illustrated in the following subsections.

3.6.2.1 Financial Product Innovation Performance

'Product innovation financial performance' is the dimension to measure the level of success of a new or improved product through specific accounting measures, such as market shares, sales growth in profits and return in investments. Indeed, obtaining the relevant financial information for a new or improved product is difficult due to financial information of firms being often confidential in Malaysia's context (Lily Julienti Abu Bakar & Hartini Ahmad, 2010). Moreover, some firms, typically SMEs, have limited performance measures for the PIP (Coulter et al., 2000; Hudson, Lean, & Smart, 2001).

Therefore, in this study, the researcher suggests the use of subjective measures for financially related measurements. Product innovation financial performance is operationalised as the criteria to measure a firm's performance based on the respondents' perceptions of an overall new or improved product introduced during the last three-year-period with regards to the extent of profit, market share, and sales growth that is relatively compared to a firm's stated objectives (Griffin, 1997; Tsai et al., 2012; Tavani et al., 2013; Zhang et al., 2015; Hannachi, 2015).

Fundamentally, profit refers to financial gain from new or improved product investments after subtracting all related expenses (Ernst, 2002). Market share refers to a firm's total share in industry sales. Market share growth refers to change in a firm's total share in industry sales from the start of product commercialising in the market until the end of the period. Sales growth refers to the change in sales revenue from the beginning when a product started to commercialise in the market until the end of the period (Ishikawa, Fujimoto, & Tomoyose, 2010). The following table shows the items in measuring financial PIP that are adapted from past research.

Table 3.4
Items on Financial Product Innovation Performance

Sources	**Items**
Tsai et al. (2012)	To what extent your firm met the following goals for the new or improved product introduced during the past three years period: 1. Achieve sales goals relative to the stated objectives. 2. Achieve profit goals relative to the stated objectives. 3. Achieve market share growth relative to the stated objectives. 4. Achieve sales growth relative to the stated objectives.

Based on Table 3.4, all the items were adapted from Tsai et al. (2012) for financial PIP. Indeed, these four items were selected to measure financial PIP because these items have achieved a larger value of indicator's reliability (with the factor loading higher than 0.80) compared to other items suggested by Tsai et al. (2012).

3.6.2.2 Non-Financial Product Innovation Performance

'Product innovation non-financial performance' is the dimension to measure the level of success of new or improved products through latent measurements that cannot be precisely measured by specific accounting measures. This dimension captures the indirect performance of introduced products. There are four important measures for non-financial PIP, and this includes, new or improved product's technical performance, development speed and cost performance, innovativeness and market performance.

Fundamentally, product technical performance is operationalised based on the respondent's perception of overall new or improved products introduced during the last three-year-period concerning the extent of how well a product achieved the functionality desired, and product reliability - relatively compared to competitors and a firm's other products (Lin et al., 2013; Hannachi, 2015). On the other hand, product development speed and cost performance are operationalised based on the respondent's perception of overall new or improved products introduced during the last-three-year-period with regards to the extent of product launch-time and development costs that meet a firm's target objective, or faster than the competitors for similar products (Tavani et al., 2013; Zhang et al., 2015).

Lastly, product innovativeness is operationalised based on the respondent's perception of overall new or improved products introduced during the last-three-year-period with regards to the extent of a product technological know-how and market know-how that is new to a firm; or new to the industry (Garcia & Calantone, 2002; Brettel & Cleven, 2011; Zhang et al., 2015). On the other hand, product innovation market performance is operationalised based on the respondent's perception of overall new or improved products introduced during the last-three-year-period about the extent of a product in improving customers' satisfaction in comparison with competitors (Hannachi, 2015). Table 3.5 shows the items in measuring the non-financial PIP that are adapted from past research.

Table 3.5
Items on Non-Financial Product Innovation Performance

Sources	**Items**
Garcia & Calantone (2002); Lin et al. (2013); Hannachi (2015)	To what extent your firm met the following goals for the new or improved product introduced during the past three years period: 1. The product met the stated performance specification. 2. The product provided better quality compared to the past similar type of product. 3. The product provided better quality compared to competitors of a similar type of product. 4. The product development cost met the stated objectives. 5. The product is launched within the stated deadlines. 6. The product is launched in a relatively shorter time than competitors. 7. The product improved customer satisfaction. 8. Customers perceived that the product is more reliable compared to competitors' product. 9. The product improved customer loyalty. 10. The product is new to your firm's technology know-how. 11. The product is new to your firm's market know-how. 12. The product is new to your industry technology know-how. 13. The product is new to your industry market know-how.

Based on Table 3.5, the first, second and third items are designed to measure product quality, while the fourth, fifth and sixth items are designed to measure a firm's new product development speed and cost performance (adapted from Lin et al., 2013). Furthermore, item number seven, eight, nine and 10 are designed to measure a new product's level of innovativeness (adapted from Garcia & Calantone, 2002). Moreover, item number 11, 12 and 13 are designed to measure market performance of the new product (adapted from Hannachi, 2015).

3.6.3 Measurement for Collaboration Breadth

Collaboration for innovation refers to the partnership between innovating firms built on 'mutual dependency basics' that enables a firm to interact with firms and institutions, other firms and communities for acquiring the knowledge needed for their activities of developing and commercialising new products or processes. Collaboration breadth refers to the relationship of a firm with different types of external partners that are formally bound by formal agreements.

Following the studies conducted by Laursen and Salter (2006), current studies measure collaboration links of a firm by looking at whether a firm is involved in formal innovation collaboration links with eight different external partners, including: (1) suppliers, (2) clients or customers, (3) competitors, (4) consultants, (5) commercial laboratories/R&D enterprises, (6) universities or other higher education institutes, (7) government research organisations, or (8) private research institutes. Typically, the eight types of external partners are coded in binary scale, whereby the answers for this binary scale are one and zero. The answer for the binary scale is zero if the firm has no collaboration links with a stated external partner, and the answer for the binary scale is one if a firm has collaboration links with a stated external partner.

Collaboration breadth of a firm is measured by summing up eight dummies. In order to measure the extent of collaboration breadth, it is indicated by Laursen and Salter (2006), when the firm has no collaboration links with stated partners, a firm gets a score of zero, while a firm gets a value of eight when a firm has collaborated with all stated external partners.

3.6.4 Measurement for Collaboration Depth

In this study, collaboration depth is operationalised as the extent of a firm drawing intensively from a different collaborating partner. In order to measure collaboration depth, the researcher follows the method proposed by Ferreras-Mendez et al. (2015). First of all, respondents are asked to indicate whether their firm has collaborations with the eight different external partners, including: (1) suppliers, (2) clients or customers, (3) competitors, (4) consultants, (5) commercial laboratories/R&D enterprises, (6) universities or other higher education institutes, (7) government research organisations, or (8) private research institutes.

Subsequently, respondents are asked to rate based on an eight-point Likert scale for each type of collaboration link regarding its level of importance in contributing to a firm's innovation and AC. In this regard, the score of one represents low importance and the score of eight is highly importance. In order to measure the depth of collaboration, the score of the level of importance for each type of collaboration links are calculated. Then, the sum of the score is divided with the total collaboration links stated by a firm. In other words, collaboration depth is measured with the average of the eight scores represented by the depth of collaboration link with the external partners. If a firm gets an average score of zero, this indicates that the firm has no deep relationship with collaborated partners while a firm that obtained a value of eight indicates that the firm has a deep relationship with collaborated partners.

3.6.5 Measurement for Information Search Breadth

External information or knowledge can flow into a firm, but, with efforts of a firm in searching, building or acquiring through an informal relationship with economic actors, codified sources, and attending functional events (i.e. trade fairs) for complementing a firm's internal knowledge (OECD, 2005). Thus, external information search refers to the search of information through building an informal relationship with economic actors and the search of information through access to codified sources, as well as attending functional events. Information search breadth is operationalised as the number of external sources of information used by firms in its innovative activities. The external information sources are listed in the following table:

Table 3.6
List of External Information Sources

Informal contacts or networks with:

1. Suppliers
2. Clients or customers
3. Competitors
4. Consultants/ Consultancy firms
5. External commercial laboratories/ R&D enterprises
6. Universities or other higher education institutes
7. Government research organisations
8. Private research institutes/ Private non-profit research institutes
9. Other local associations
10. Professional associations/ Trade unions
11. Standard or standardisation agencies

General information sources:

12. Patent disclosures
13. Professional conferences, meetings, branch literature and journals
14. Exhibitions and trade fairs
15. Internet

Source: OECD (2005, p. 81).

The current study measures information search breadth of a firm by looking at whether a firm is using the external information search based on the list stated in Table 3.6. Typically, the 15 types of external information sources are coded in binary scale. If a firm has not used any information sources, then the answer is zero. If a firm has used all information sources stated, then the answer is 15.

3.6.6 Measurement for Information Search Depth

Information search breadth is operationalised as the extent to which a firm draws intensively from different external information sources. In order to measure external information search, firstly, respondents are asked to indicate whether a firm used the external information sources based on the list stated in Table 3.6. Subsequently, respondents are asked to rate based on an eight-point Likert scale for each type of information sources regarding its level of importance in contributing to a firm's innovation and AC.

In this regard, the score of one represents low importance and the score of eight is highly importance. In order to measure the depth of external information search, the score of the level of importance for each external information source is calculated. Then, the sum of the score is divided with the total external information sources used by a firm. In other words, information search depth is measured with the average of the eight scores represented by the depth of external information search. For a firm that gets an average score of zero, it indicates that the firm has not drawn intensively on the selected information sources while a firm that obtains a value of eight indicates that the firm has drawn intensively with all information sources.

3.6.7 Measurement of Absorptive Capacity

AC is operationalised as a firm's capabilities to acquire, assimilate, transform, and exploit knowledge from external knowledge sources (e.g. collaboration with customers). In this study, the researcher attempts to operationalise AC in firm level with four dimensions, namely, acquisition capability, assimilation capability, transformation capability, and exploitation capability. Each dimension plays a different role in explaining the AC concept (Camison & Fores, 2010; Flatten et al., 2011; Ferreras-Mendez et al., 2015; Jimenez-Barrionuevo et al., 2011).

The measurement is based on past research (Lichtenthaler, 2009; Flatten et al., 2011; Jimenez-Barrionuevo et al., 2011) that used seven-point Likert-type scale formats to measure a firm's AC and only Camison and Fores (2010) employed a five-point Likert-type scale in measuring the AC concept. For standardising purposes, all items in AC are measured with a seven-point Likert-type scale in the current study. In this study, the measurements scales for each dimension of AC are illustrated in following sub-sections. Following sub-sections further discuss each of the related dimensions and the operationalised measurement scales of the dimensions.

3.6.7.1 Acquisition Capability

Acquisition capability refers to a firm's capability to localise and acquire critical external knowledge for its activity (Exposito-Langa et al., 2011). Camison and Fores (2010) have operationalised the dimension of acquisition capability as openness towards the environment through active engagement in external knowledge search or collaboration with external actors, while there are a few researchers who operationalised these dimensions as a firm's ability that is designed to collect information and knowledge sources outside a firm's boundary (Camison & Fores, 2010; Flatten et al*.,* 2011; Jimenez-Barrionuevo et al., 2011; Gebauer et al., 2012).

As for the current study's purposes, the researcher excludes external knowledge search strategies (i.e., engage in collaboration, alliances, external information search) which merely measures a firm engaged in external sourcing strategies rather than a firm's ability in acquiring external knowledge. Indeed, a firm that engages in external knowledge search denoted that the firm has access to external knowledge and information openly, and yet, it does not denote that the firm has successfully acquired the knowledge unless the firm has efforts in recognising the potential value from external knowledge sources, and the ability to make sense on these new pieces of knowledge before proceeding to analyse further and to understand the particular pieces of knowledge (Lichtenthaler, 2009).

Therefore, in this study, the researcher attempts to operationalise the acquisition capability dimension as a firm's motivation and ability to recognise the potential value of external knowledge sources and ability to make sense on these new pieces of knowledge.

The following table shows the items in measuring knowledge acquisition dimensions that are adapted from prior studies.

Table 3.7
Items on Acquisition Capability

Sources	Items
Gebauer et al. (2012)	Please indicate to what extent of the following items apply to your firm: 1. We are motivated to use various external knowledge sources. 2. We are able to acquire valuable knowledge through various external sources. 3. We are able to identify the valuable knowledge from various external sources. 4. We are able to select valuable knowledge obtained from various external sources. 5. We are able to classify the acquired knowledge in finer categories.

Referring to Table 3.7, the items of acquisition capability dimensions are adapted from the constructs developed by Gebauer et al. (2012). These indicators capture the operationalised meaning specified in this study. Typically, all of the designed items are ready for capturing the acquisition capability in a firm starting from employees' motivation to use external knowledge and to put their effort to acquire the external knowledge, their ability to identify, select and retain, and classify the acquired knowledge.

3.6.7.2 Assimilation Capability

Assimilation capability refers to a firm's capability to analyse, process, interpret, and understand the information obtained from external sources (Zahra & George, 2002). The assimilation capability dimension is closely intertwined with the knowledge acquisition dimension. Typically, assimilation plays a critical role in resolving inconsistencies between newly acquired knowledge and a firm's existing knowledge bases (Exposito-Langa et al., 2011).

In this regard, shared languages and symbols (Grant, 1997; Flatten et al., 2011), communication and dissemination of newly acquire knowledge internally across different departments in order to achieve collective understanding on newly acquired knowledge (Camison & Fores, 2010; Schmidt, 2010; Zahra & George, 2002), and shared understanding and interpretation of the newly acquired knowledge (Flatten et al., 2011; Gebauer et al., 2012) are the activities that resolve the inconsistencies between newly acquired knowledge and a firm's existing knowledge bases. Moreover, Exposito-Langa et al. (2011) indicated that the ability of a firm in assimilating external knowledge into a firm's existing knowledge bases require the aid of information tools to speed up the process of integration, as to quickly respond to the change of environment.

In essence, the assimilation capability is operationalised as a firm's capability in resolving the inconsistency between newly acquired knowledge and a firm's existing knowledge bases through creating a collective understanding throughout a firm's members on newly acquired knowledge as to enable the integration of newly acquired knowledge with a firm's existing knowledge bases. Table 3.8 shows the items in measuring knowledge assimilation dimension that are adapted from prior studies.

Table 3.8
Items on Assimilation Capability

Sources	Items
Camison & Fores (2010); Flatten et al. (2011); Gebauer et al. (2012)	Please indicate to what extent of the following items apply to your firm: 1. We emphasise a shared language for intra-corporate communication. 2. We are using an information system as the tool to facilitate the spreading of knowledge throughout the firm. 3. In our firm, employees are willingly to share their knowledge, information and experiences with their colleagues. 4. In our firm, employees exchange new ideas and concepts in a cross-departmental manner. 5. We periodically organise cross-departmental meetings to interchange new developments, problems, and achievements. 6. In our firm, employees have the ability to understand the acquired knowledge based on their competencies, skills and experiences. 7. Overall, we are able to achieve a collective understanding of the acquired knowledge.

Based on Table 3.8, the first five items are adapted from Flatten et al. (2011), whereas, item six is adapted from Camison and Fores (2010) and item seven is adapted from Gebauer et al. (2012). In essence, the measurement scales for the assimilation capability dimension includes shared languages used in the firm (first item), the aid of information tools to speed up the process of integration (second item), communication and dissemination of the knowledge internally to resolve the inconsistencies between newly acquired knowledge and a firm's existing knowledge bases (third, fourth, and fifth item), ability of employees to achieve collective understanding of the acquired knowledge (sixth item), and extent of employees to achieve shared understandings and interpretations of newly acquired knowledge (seventh item).

3.6.7.3 Transformation Capability

Transformation capability received great attention from researchers after the introduction of the dynamic capabilities-based AC concept (Zahra & George, 2002) due to its role in transforming the acquired knowledge into a firm's knowledge bases. However, the operationalised concept of the transformation capability shares overlaps and similarities with other dimensions, such as assimilation capability and exploitation capability (Flatten et al., 2011; Todorova & Durisin, 2007). In this regard, prior researchers have clarified the dimensions and distinguished the transformation capability from other dimensions (Lane et al., 2006; Lichtenthaler, 2009).

Todorova and Durisin (2007) stated that the assimilation capability is different compared to the transformation capability because assimilation does not change the existing cognitive structures, whereas transformation occurs in the case where there is a need to alter the acquired knowledge to fit into existing knowledge structures. On the other hand, Flatten et al. (2011) indicated that the transformation capability is distinguished from the exploitation capability because the transformation capability is a firm's ability to modify its knowledge base, whereas, the exploitation capability is a firm's ability to transmute and apply knowledge into commercial applications.

In this regard, the researcher defined transformation capability as a firm's abilities to maintain and reactivate the knowledge (Lichtenthaler, 2009), interpreting and combining knowledge, and integrates new knowledge with the existing knowledge base (Camison & Fores, 2010; Flatten et al., 2011; Gebauer et al. 2012; Todorova & Durisin, 2007; Zahra & George, 2002). The following table shows the items in measuring the knowledge assimilation dimension that are adapted from prior studies.

Table 3.9
Items on Transformation Capability

Sources	Items
Lichtenthaler (2009); Flatten et al. (2011); Gebauer et al. (2012)	Please indicate to what extent of the following items applies to your firm: 1. In our firm, employees are able to store externally acquired knowledge for future references. 2. When recognising a business opportunity, our employees are proficient in reactivating existing knowledge for new uses. 3. Our employees are able to use and structure the collected knowledge. 4. Our employees are able to transform information from internal and external sources into valuable knowledge for our firm. 5. Our employees have successfully linked existing knowledge with new insights. 6. Our employees are able to create new knowledge based on the acquired knowledge.

Based on Table 3.9, the first and second items are designed to measure a firm's ability in maintaining and reactivating knowledge (adapted from Lichtenthaler, 2009). On the other hand, the third and fourth items are designed to measure a firm's ability in interpreting and combining knowledge (adapted from Flatten et al., 2011). Finally, item number five and six are designed to measure a firm's ability to integrate knowledge (adapted from Flatten et al., 2011; Gebauer et al., 2012).

3.6.7.4 Exploitation Capability

Exploitation capability refers to a firm's ability to apply and transmute acquired knowledge into commercial applications. This dimension is strategic to the firms since it generates outcome for the firms (Jimenez-Barrionuevo et al., 2011). Moreover, this dimension is important to a firm because a firm can only achieve its profit target after converting the acquired knowledge into new products or processes (Zahra & George, 2002). Although the exploitation capability is essential for a firm to transmute or apply knowledge to commercial purposes, it does not mean the final success of a firm achieving both financial and non-financial performance (Lichtenthaler, 2009). In essence, the researcher attempts to operationalise the exploitation capability as the capability of a firm to use and implement the acquired knowledge into commercial applications in the following table.

Table 3.10
Items on Exploitation Capability

Sources	Items
Flatten et al. (2011); Gebauer et al. (2012)	Please indicate to what extent of the following items apply to your firm: 1. Our firm strives to convert acquired knowledge into commercial applications. 2. Our employees are able to apply acquired knowledge for commercial purposes. 3. Our employees launch innovative products to the market with regard to the new knowledge that they have acquired.

Based on Table 3.10, the first item is adapted from Flatten et al. (2011) to measure an attempt of employees to convert acquired knowledge into commercial applications. Typically, this item does not directly measure the capability of employees to use and implement the acquired knowledge into commercial applications, but rather to measure the extent of enthusiasm of employees to convert the acquired knowledge into the commercial end. Indeed, this item is essential because it can intuitively determine the extent of employees' efforts which are delicate to convert acquired knowledge into commercial applications. Furthermore, the second item is adapted from Gebauer et al. (2012) to measure the ability of employees who use the acquired knowledge for commercial purposes. Finally, the third item is adapted from Flatten et al. (2011) to measure the implementation of new knowledge to the market.

3.6.8 Measurement Scale

The measurement scale used in this study is the Likert scale. According to Sekaran and Bougie (2013, p. 197), "The Likert scale is designed to examine how strongly subjects agree or disagree with the statements". Following subsections discuss further the measurement scale used in this study.

3.6.8.1 Product Innovation Performance and Absorptive Capacity

In the studies of Malaysian manufacturing firms, the odd numbered categories of the Likert scale is used to measure PIP and AC. Indeed, the used of an odd numbered Likert scale is relevant for PIP and AC because it is believed that a part of the sample is likely to feel neutral about the issue being examined (Mukesh Kumar, Salim Abdul Talib, &

Ramayah, 2013). The topic regarding PIP and AC are in fact subjective (depending on the thoughts or feelings) and some measure aspects that required the respondents to recall in their memories to answer the questions. Therefore, a neutral scale is needed to provide respondents with an easy way to express their feelings (Hair, Celsi, Ortinau, & Bush, 2013).

There is always an argument about the selection of scale points that should be used in creating a scale. However, prior studies do not reach a consensus about the absolute rules about the selection of scale points (Hair et al., 2013). In this regard, the selection of scale points relies on practical considerations, which is a balance between the desire for the discriminatory power of scale to capture the relative magnitudes of responses and the demands placed on the respondents (Mukesh Kumar et al., 2013). In this study, the items adapted from past studies employed two types of scale points, namely the five-point Likert scale and the seven-point Likert scale. Following this, it suggests that a five-point Likert scale or seven-point Likert scale is suitable for this study.

In order to standardise the measurement of PIP and AC in the questionnaire, all items are measured with a seven-point Likert scale (refer Table 3.11). This is because all the items in the questionnaire are taken from various sources and their measurement scales are varied and un-standardised. The standardisation appears to be possible because “it seems reasonable to conclude that data gathered from a five-point format can be readily transferred to a seven-point equivalency using a simple rescaling method” (Dawes, 2008, p. 75).

Table 3.11
Likert Scale Used for Product Innovation Performance and Absorptive Capacity

Likert Scale Type	**Descriptions**
Seven-point Likert scale	1- Strongly Disagree 2- Disagree 3- Slightly Disagree 4- Neither Agree Nor Disagree 5- Slightly Agree 6- Agree 7- Strongly Agree

3.6.8.2 Collaboration Depth and Information Search Depth

The measurement of collaboration depth and information search depth used the eight-point Likert scale. Given the used of forced scale in this case, respondents are forced to answer either a favourable or unfavourable response on a question (Mukesh Kumar et al., 2013). This approach is reasonable in this case because after a respondent answers the first question to indicate if they have used a particular external source, they should have an opinion on how important that external source is in contributing to their firm's product innovation. In addition, the exclusion of neutral points for the measurement of collaboration depth and information search depth allows the researcher to assign the extent of collaboration depth and information search depth from the value of one if the firms viewed that particular external source is very unimportant for their product innovation, and value of eight if the firms viewed that particular external source is very important for their product innovation. The interval scale is adopted from previous research (Ferreras-Mendez et al., 2015; Vagias & Wade, 2006). The Likert scale used in this study is illustrated in Table 3.12.

Table 3.12
Likert Scale Used for Collaboration Depth and Information Search Depth

Likert Scale Type	Descriptions
Eight-point Likert scale	1- Very unimportant 2- Unimportant 3- Moderately unimportant 4- Slightly unimportant 5- Slightly important 6- Moderately important 7- Important 8- Very important

3.6.9 Control Variables

This study included two control variables to reduce the possibility of alternative explanations. The first control variable is 'firm size' and the second control variable is 'firm age'. Past studies indicated that 'firm size' has an effect on PIP (Wakasugi & Koyata, 1997; Laursen & Salter, 2006; Damanpour, 2010). Large firms are expected to have more financial and technical capabilities, more economies of scope to absorb the cost and spread the risk of failures compared to a small firm, thus, large firms are viewed to be more innovative than small firms (Wakasugi & Koyata, 1997; Damanpour, 2010). In this study context, controlling 'firm size' is particularly important, because 'firm size' may affect not only PIP but also the level of AC (Fabrizio, 2009; Moilanen et al., 2014; Ferreras-Mendez et al., 2015). Typically, 'firm size' may affect the flexibility and willingness of firms to invest in the development of AC, while, it also affects the PIP (Ferreras-Mendez et al., 2015). 'Firm size' is measured by using logarithm on the number of employees of a firm because it is more stable across time and less sensible to macroeconomic shocks (Tsai et al., 2012; Ferreras-Mendez et al., 2015; Bianchi et al., 2015). On the other hand, 'firm age' needs to be controlled because younger firms tend to be more flexible, whereas older firms may develop a more rigid bureaucratic structure and encounter the competency trap, hence affecting PIP (Tushman & Anderson, 1986; Gopalakrishnan & Bierly, 2006; Tsai et al., 2012). Moreover, studies have suggested that a 'firm age' can affect the extent to which a firm is receptive to new ideas and thus, may affect a firm's AC (Hurley & Hult, 1998; Lane et al., 2006; Sorensen & Stuart, 2000). 'Firm age' can be measured by the number of years since its foundation in logs (Sok & Cass, 2015; Bianchi et al., 2015).

3.7 Sampling Procedures

The study is interested in the manufacturing sector and not the specific industries within the sector. In order to generalise the findings of this research, a random sampling technique is being used. The random sampling can represent the said population since the samples are drawn from the same population (Banning, Camstra, & Knottnerus, 2012). Therefore, the sample is selected using a random sampling technique since it is considered as "the best single way to obtain a representative sample" (Gay & Diehl, 1992, p. 129) whereby every firm across various industries in the Malaysian manufacturing sector "have an equal opportunity to be selected as a test subject" (Sekaran & Bougie, 2013, p. 247). This study follows the three steps of sampling procedures suggested by Banning et al. (2012) and Gay and Diehl (1992), whereby (1) the population should be identified, (2) the desired sample size is being determined and (3) the random selection of the sample from the population is being performed.

3.7.1 Population

The population frame is a listing of all the elements in the population from which the sample is drawn (Sekaran & Bougie, 2013, p. 245). The population frame is based on the 46th Edition of Federation of Malaysian Manufacturers (FMM) Directory 2015 which provides a comprehensive list of manufacturing firms. Past researchers widely employed this directory for their research in the Malaysian manufacturing sector, as it is the most reliable list for collecting data on various manufacturing firms (Jabar, Soosay, & Santa, 2011; Jamaliah & Zain, 1999; Mokhtar & Yusof, 2010). According to the FMM Directory 2015, there are 2812 firms listed and this represents the total population of this study.

3.7.2 Sample Frame

The sample frame is the manufacturing firms in Malaysia that manufacture or produce physical products themselves (Kalpakjian & Schmid, 2006) which include both the consumer goods and capital or industry goods (Cao, Zhao, & Nagahira, 2011). The information obtained from the limited number of respondents in the sample frame should be capable of representing the elements of the studied population (Latham, 2007; Salant & Dillmant, 1994). In other words, samples should be selected from "the sample frame that is almost similar to the 'population under study' and imparts only the correct and completed number of elements from where the actual samples are drawn" (Cooper & Schindler, 2014, p. 345).

The FMM Directory 2015 listed a total of 2812 firms which are categorised into manufacturing and services sectors. From the total number of firms, there were 2544 manufacturing firms that manufacture the physical products themselves while the other 268 firms are service-based which includes accountancy, financing, consultancy, forwarding and distribution, all of which are excluded from this study. Likewise, out of 2544 manufacturing firms, there are 174 subsidiaries owned by other members of FMM (e.g., same postal address/ contact persons), and 10 non-members of FMM (as stated in the directory) that are also omitted to avoid bias (Ahmed, 2011). Consequently, there were 2360 valid manufacturing firms in the sample frame as shown in the following table:

Table 3.13

Number of Firms Based on FMM Directory 2015 Developed by Researcher

ALPHABETICAL ORDER	MANUFACTURERS			SERVICES		
	VALID FIRMS	SUBSIDIARIES (S)	NON-MEMBER (NM)	VALID FIRMS	SUBSIDIARIES (S)	NON-MEMBER (NM)
A	174	11	0	17	0	0
B	84	7	2	14	0	1
C	162	13	1	22	0	4
D	86	7	0	10	0	1
E	91	8	0	8	0	1
F	87	12	1	8	0	1
G	91	2	0	6	0	1
H	100	3	0	11	0	0
I	70	4	1	6	0	1
J	36	4	0	4	0	0
K	120	8	0	9	0	1
L	75	5	0	11	0	0
M	197	12	0	22	0	3
N	70	3	0	8	0	0
O	44	4	0	6	0	0
P	164	15	2	21	0	1
Q	11	3	0	3	0	0
R	54	5	0	10	0	2
S	278	25	1	28	0	1
T	160	16	1	9	0	1
U	54	4	0	5	0	1
V	42	0	0	4	0	0
W	50	2	1	4	0	0
X	6	0	0	0	0	0
Y	38	1	0	2	0	0
Z	16	0	0	0	0	0
TOTAL	2360	174	10	248	0	20
GRAND TOTAL:	2812					

Source: FMM Directory (2015).

3.7.3 Selection of Respondents

Respondents are selected based on the functional areas that are usually involved in product innovation projects and the managers of these functional areas. Page (1993) found that functional areas that most of the time involved in product innovation projects are R&D, marketing, engineering, and manufacturing. In Malaysia context, Al-Shalabi and Rundquist (2009) reported that Malaysian manufacturing firms had shown product innovation projects are the responsibility of R&D functions (36%), all functions (36%), engineering, strategic planning, and marketing functions (28%).

The respondents are managers who had conducted product innovation projects or involved in product innovation processes (Cao et al., 2011). The respondents ranged from Managing Directors, R&D Managers, NPD Managers, Product and Design Managers (Ebrahim, Ahmed, & Taha, 2010), Chief Executive Officers, Marketing Managers, and/ or Manufacturing Managers (Gonzalez & Palacios, 2002). According to Ernst (2002), the most critical success factor for product innovation project depends on top management and senior management support (e.g., project champions, commitments, and resource allocations). Hence, managers of these functional areas are assumed to have the knowledge and responsibility for executing product innovation projects (Krishnan & Ulrich, 2001; Page & Schirr, 2008).

However, this study mainly focused on Product/ R&D Managers. One of the reasons is because the Product/ R&D Managers play an important role in product innovation projects that has an overall positive impact on product performance (Henard & Szymanski, 2001). Besides, this study emphasises on the completed product innovation projects produced within the last three years. The role of a Product/ R&D Manager is more noticeable than any other managers such as an R&D Manager who is only relevant during the early stages of product innovation processes. Edwards, Roberts, Clarke, DiGuiseppi, Pratap, Wentz, and Kwan (2002) found that a questionnaire is more likely to be returned if respondents are competent to answer the questions. In this regard, Product/ R&D Managers are viewed more competent to answer the questions since the completed product innovation projects are under their responsibility. Therefore, this research sends a cover letter with attention to the Product/ R&D Manager. However, if a firm does not have a Product/ R&D Manager (especially for low and medium technology industry or small and medium enterprises), then the managers who are responsible for product innovation in their firm is the study's target respondent.

3.7.4 Size of Sample

This study applies the formula of Bartlett, Kotrlik, and Higgins (2001) in determining the appropriate sample size to represent the Malaysian manufacturing sector as below:

$$n_o = (t)^2 * (p)(q) \div (d)^2 \quad \text{and} \quad n1 = n_o \div (1 + n_o / Population) \qquad (3.1)$$

where,

n_o = required return sample size according to Cochran's formula

t = value for selected alpha level of .025 in each tail (1.95)

$(p)(q)$ = estimate of variance (.25)

d = acceptable margin of error for proportion being estimated (.05)

$n1$ = required return sample size because sample > 5% population

Based on the calculation using the formula 3.1, it is proposed that the required sample size for a given sampling frame of 2360 is 331. This is similar with Krejcie & Morgan (1970) table for determining sample size, where the sample size for population N=2360 is 331. In order to obtain a higher number of responses, Ahmed (2011) and Lazim (2011) recommend sending more than double of the required sample size due to a trend of low response rates. The fact is that higher sample sizes will increase the number of responses when compared to lower sample sizes at the same response rate. As a result, this study sends 700 questionnaires after given the likelihood of low response rates and affordable mailing cost.

3.7.5 Random Selection of Samples

A random sampling technique is commonly used in a quantitative research to attain sample representativeness of the population (Bryman & Bell, 2011). All firms in the sampling frame are numbered from one to 2360 according to the original sequence in the FMM Directory 2015. The samples are then selected based on the numbers that match the firms' sequence in the directory. In order to randomly select the samples, a programme called the Research Randomiser (Kelley, Clark, Brown, & Sitzia, 2003) is used to generate 700 samples from 2360 firms randomly by following these simple steps:

1. Go to the Research Randomiser website at www.randomiser.org.
2. Click on the "Randomise" button in the menu to display the Randomiser form.
3. In the Randomiser form:
    a. Key in "1" for the set of numbers to be generated,
    b. Key in "700" for the numbers in the set,

c. Key in “1” to “2360” for the range of numbers to be randomised in the set,

d. Click “Yes” for generating unique numbers in the set,

e. Click “Yes: Least to Greatest” for sorting the numbers in set,

f. Click on the “Randomise Now!” button to generate the random numbers.

3.8 Survey Administration

This study used a mail survey method for data collection. However, this method has a few weaknesses, such as, respondents are unlikely to respond and having no control of what happens after the questionnaire is mailed. However, “mail survey is the easiest and cheapest method that requires fewer resources such as no interviewers and no special skills are needed to conduct the survey” (Cooper & Schindler, 2014, p. 225). Instead of that, this method allows, “minimal sampling errors at a relatively low cost, gives a sense of privacy to respondents, less sensitive to bias as no interviewers are involved in the process and the ability to cover a wide geographical area” (Sekaran & Bougie, 2013, p. 147). Therefore, the mail survey method is applied in this study by using normal stamp postal services provided by Pos Malaysia Berhad for sending and receiving questionnaires from the respondents.

3.8.1 Mailing Procedures

This study employed a mailing procedure steps recommended by Salant and Dillmant (1994) with some adjustments as below:

1. A personalised advanced notice via email to each selected firm to inform them of the survey and upcoming questionnaire. Sekaran and Bougie (2013, p. 147) stated

that “a better response rate for mail surveys could be achieved if respondents are notified in advance on the forthcoming survey”.

2. After informing the firms, a personalised cover letter with a questionnaire and a stamped return envelope is mailed to each respondent.
3. The envelope is enclosed with a cover letter that mentioned attention to the Product/ R&D Manager. However, in the cover letter also stated, if a firm does not have a Product/ R&D Manager (especially for low and medium technology industry or small and medium enterprises), then the managers who are responsible for product innovation in their firm is the study's target respondent. In addition, respondents were also instructed to consult with other knowledgeable members if they are not in the field of interest (for example, R&D Manager may have knowledge about the external knowledge used and the extent of AC in their firm, but they may have to consult a marketing manager about the financial performance of their new product).
4. A week after sending the questionnaire, a follow-up (by company email) to respondents is done to confirm the acceptance of the questionnaire and to remind them to complete it. In certain cases, the follow-up is done several times up until the due date of the survey.

3.8.2 Method to Increase Response Rate

This study expects to receive between 15% and 35% of questionnaires posted out based on the response rate obtained from the previous study on the Malaysian manufacturing sector (Jabar et al., 2011; Jamaliah & Zain, 1999; Mokhtar & Yusof, 2010). Instead of the mailing procedures stated in the previous section, Dhanani, O'Shaughnessy, and Louw (1997) outlined a six-step procedure to encourage participation of respondents as below:

1. Each respondent is informed (via telephone, email or both) about the survey and upcoming questionnaire.
2. The questionnaire is sent using a registered postal service to the named respondents instead of the department's name to reduce the chances of bureaucracy in mail handling. In this case, the questionnaire is marked with "Attention to Product/ R&D Manager".
3. The stamped return envelope with the researcher's address is included for ease of returning the questionnaire.
4. Each question is written in a short and concise manner for better interpretation.
5. The respondents are assured with secrecy of the data.
6. The respondents are offered a copy of results upon request.

For step (1), the researcher strives to get the name of respondents for the study via the first contact by telephone or email. Subsequently, for step (2), the researcher sends the envelope to the address of the name of the target respondents if they provide their names in the first step. As for step (4) stated above, all items for the interval scale is adapted instead of directly adopted from the original sources to suit the respondents' context because “a mail survey using a well-designed questionnaire will be able to elicit the information required” (Dhanani et al., 1997, p. 161). The adaptation is made since the respondents may not be familiar enough with the specific terms of the original scales. Instead of that, the respondents’ proficiency in English may spread across the spectrum, and hence making it difficult to answer the questionnaire. In order to improve the response rate, interval scales are adapted to match the local context and to simplify the questionnaires.

Based on step (5) and step (6) above, a cover letter has made clear the secrecy of data provided by the respondents and they are offered a copy of results upon request. The data collection letter from the Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia (refer Appendix C) attached to the questionnaire (refer Appendix D) is one of the steps to increase the response rate because Edwards et al. (2002) found that respondents are more willing to respond to a survey that came from a university. This study also enclosed an endorsement letter from FMM (refer Appendix A and Appendix B) so as to increase the response rate.

3.9 Pilot Study

Before the questionnaires were distributed to the respondents, a series of pilot tests were conducted to examine its validity and reliability. Instead of that, it serves the purpose to identify whether the questions in the questionnaire are easy to understand, the concept used is clear and not confusing and lastly it is directed to the research questions. The next session discuss the goodness of measures by assessing the validity and reliability of the measures. Based on the results of the pilot study, enhancements on the questionnaire were recommended.

3.9.1 Content Validity

Validity refers to "the extent to which a test measures what we actually wish to measure" (Cooper & Schindler, 2008, p. 289) and it is crucial in research (Onwuegbuzie & Johnson, 2006; Sim & Arnell, 1993). The measures of variables included in the questionnaire are pre-tested to assess the validity and improve its quality (Cao et al., 2011). This study employed two types of validity tests whereby face validity is performed at the preliminary stage of the study and construct validity is evaluated using factor analysis in the next chapter.

According to Sim and Arnell (1993, p. 104), face validity is "based on the personal opinions of those either taking or giving a test". Therefore, the researcher approached three experts in the related fields to validate the questionnaire. The experts are selected based on their knowledge of the processes in empirical research, their background in NPD and/ or related fields, and last but not least, their in-depth experience in the Malaysian manufacturing industry. These experts are able to give the best feedback as they understand the importance of getting the questionnaire validated. In particular, the experts selected in this study involved the top management in the Malaysian manufacturing firms and subject matter experts in this particular research area and interest.

The discussion with experts focused on (1) the relevance of measurement items item in the questionnaire, (2) the level of their understanding of the questions, phrasings, wordings, and jargons, and (3) the arrangement of the questionnaire itself. In essence, the experts suggested the need for further clarification of Question 1 in Section C and Question 2 in Section C. Typically, they suggested the need to put notes on the terms of "collaboration" and "external information search" to clarify the differences between them. Secondly, the experts also mentioned that they found it difficult to understand the statements in Section B (Question 14, 15, 16, 17). They suggested further clarification and examples should be provided for each of the stated statements for the reader to capture the exact meaning of the designed questions. As a result, the researcher had revised the questionnaire according to the experts' opinions as follows:

1. Notes in Section C to define the terms of collaboration and external information search.
2. Notes (definition of the keywords and example provided) in Section B to clarify Question 14, 15, 16, 17.

3.9.2 Reliability

Reliability refers to the extent a measurement is consistent "across time and the various items in the instrument" (Sekaran, 2003, p. 203) and also the "accuracy and precision of a measurement procedure" (Cooper & Schindler, 2008, p. 289). This study used a Likert scale, and thus internal consistency reliability was performed to test the consistency of respondents' answers. Cronbach's alpha is the most commonly accepted measure of internal consistency reliability (Price & Mueller, 1986). The Cronbach's alpha is appropriate for measuring scale reliability because it measures "the degree to which the items on a measure are representative of the domain of the construct being measured" (Pedhazur & Schmelkin, 1991, p. 104).

According to Nunnally (1994), the recommended minimum acceptable standard of internal consistency reliability is .70. However, Nunnally (1994) also suggests that relatively low reliability coefficients value of .50 or .60 are tolerable during early stages of research on predictors' tests or hypothesised measures of constructs. Likewise, Price and Mueller (1986, p. 6) also note that ".60 is viewed as the minimum acceptable level". Therefore, this study considered .60 as the minimum acceptable standard of internal consistency reliability.

For lower reliability coefficients that are less than .70, the measures of the reliability tests from previous studies were compared. If the previous studies using the same measurement recorded reliability coefficient lower than .70, the respondents' answers in this pilot study are still consistent across various studies and time (Sekaran, 2003). In addition, low reliability of the measurement may suggest it had suffered from the following conditions: (1) the value of Cronbach's coefficient alpha tends to get smaller since the number of items in the scale are small (Pallant, 2007), (2) the Cronbach's coefficient alpha "is used more often as a measure of internal consistency than as an estimate of reliability" (Sijtsma, 2009, p. 107), and (3) the reliability test is necessary but is not sufficient to examine the "psychometric properties of a survey instrument" (Litwin, 1995, p. 33).

In order to assess the reliability of the questionnaire, a pilot study is conducted using 30 samples selected randomly from the FMM Directory of 2015 and these samples not included in the actual field study later. According to Emory and Cooper (1991), the total sample for the pilot study between 25 to 100 respondents is sufficient. This study involved 30 samples because "the questionnaire should be piloted on a smaller sample of intended respondents, but with a sample size sufficient to perform systematic appraisal of its performance" (Rattray & Jones, 2007, p. 237) and 30 samples are the minimum acceptable sample size to perform analysis (Sekaran, 2003). The result of the reliability test is summarised in Table 3.14.

Table 3.14
Summary of Reliability Pre- Test

Variables	**Dimensions**	**Reliability**
Product Innovation Performance	Financial performance	0.948
(Dependent variable)	Non-financial performance	0.850
Absorptive Capacity	Acquisition	0.892
(Mediator)	Assimilation	0.892
	Transformation	0.905
	Exploitation	0.860

Based on Table 3.14, six variables in PIP and AC achieved a reliability coefficient that is greater than .70. Hence, this implies that the measurement used to measure each of the variables is consistent across time and items in the instruments.

3.10 Data Preparation

The collected data will be processed, analysed, and interpreted with the SPSS v.19 software. All necessary processes such as data gathering, coding, editing, and dealing with incomplete responses will be performed. Firstly, the return questionnaires have to be checked for completeness. Blank returns and those returns that have many incomplete sections (over 50% incompleteness) be rejected (Hair et al., 2010, p. 48). After removing the unusable questionnaires, each of the usable questionnaires provided an identification number for coding and editing purposes in the SPSS software. Furthermore, the process of cleaning, treating missing data, testing for the univariate and multivariate outlier, the univariate and multivariate normalities were conducted by using the SPSS software at this stage to examine the suitability of the data for the next statistical analysis.

3.11 Assessment of Potential Bias Existing in the Study

There are two potential biases that could exist in this study, namely common-method bias and non-response bias. Common-method bias is always a potential threat in behavioural studies. It is the spurious "variance that is attributable to the measurement method rather than to the constructs the measures represent" (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003, p. 879). Common-method bias is one of the main sources of measurement error that potentially threatens the external validity of the conclusions about the relationship between the measures (Bagozzi & Yi, 1991). This study follows the adopted Harman's one-factor test which tests the common method bias (Podsakoff et al., 2003). On the other hand, non-response bias is the statistical error which occurs when the answers of the respondents differs from the potential answer to others who did not answer [out from the sample in a defined population] (Deming, 1990). Non-response bias potentially threatens the ability of a study to generalise the findings to a defined population (Bryman, 2012). Non-response bias can be detected by conducting the Levene's Test (Pallant, 2007).

3.12 Descriptive Analysis of the Study

Descriptive analysis is performed by using the SPSS to respond to the patterns revealed in the preliminary analysis of data (Cooper & Schindler, 2014). The descriptive information, such as a firm's demographic and univariate characteristics of the main variables analysed and interpreted in its frequency, percentage and means distribution to capture the patterns of the data. After the data is processed and the descriptive analysis of the data is completed, the next step is to determine the statistical techniques for addressing the research questions.

3.13 Data Analysis- Structural Equation Modelling

Structural Equation Modelling (SEM) is selected in this study as the statistical technique for hypotheses testing (answering research questions). Before the application of this statistical method, it is important to justify why SEM was chosen as the statistical technique over traditional multivariate analysis methods, such as multiple regression.

Furthermore, this section further discusses the type of SEM that is usually applied by the researchers, and the justification for the selection of the SEM method.

3.13.1 Justification of Structural Equation Modelling as a Statistical Technique for Answering Research Questions

Structural equation modeling (SEM) is second-generation multivariate analysis techniques that overcome the weakness of first generation multivariate analysis (i.e. logistic regressions, multiple regressions). Beyond traditional multivariate analysis, SEM seeks to explain the relationship between multiple variables. In doing so, this statistical method allows the analysis of the complex relationships between one or more independent variables and one or more dependent variables (Hair et al., 2010, p. 616). It also enables researchers to incorporate unobservable variables in the analysis and take account of measurement errors in observed variables (Hair, Hult, Ringle, & Sarstedt, 2014).

Furthermore, unlike first generation multivariate analysis (two-step approaches), SEM can simultaneously test the validity of measures and the plausibility of a theory (Anderson & Gerbing, 1988). Lowry and Gaskin (2014) mentioned that separation testing of the theory and measurement could cause incorrect explanations, incorrect measurements and incorrect predictions. For instance, empirical research carried by Chin (1998) showed that the measures of a construct that were validated separately from the theory do not necessarily remain valid when the same construct was validated jointly between measurement and theory. There are two reasons that cause the incorrect measurement. First, two-stage approaches do not take into account the causal connection between the constructs. This enables it to tap in how well of a construct is predicted by another construct (Lowry & Gaskin, 2014). Secondly, two-stage approaches ignore the measurement errors in a reliability test (i.e. Cronbach's Alpha test typically sums the items into a scale with a single score), and this tends to underestimate the internal consistency reliability (Hair et al., 2014). In general, SEM overcomes the limitation of traditional multivariate analysis with providing the causal connection between the constructs and testing composite reliability that takes into account individual construct's measurement errors (Hair et al., 2010).

Compared to traditional multivariate analysis, SEM is better in handling testing of the multistage model. Traditional multivariate analysis, such as hierarchical multiple regressions tests each theoretical proposition separately from other propositions (Hair et al., 2010). According to Lowry and Gaskin (2014) piecemeal testing (tested separately of the proposition) tends to encounter the problem of an inflated *t*- statistic and diminishing R^2 statistic in explaining the overall variations of the model. This would lead to the increased likelihood of overestimating or underestimating the magnitude of effects. On the other hand, the SEM statistical model defines a model to explain "the entire set of relationships by defining the path for every proposition in theory and simultaneously analyses all parts at one time" (Hair et al., 2010, p. 617). In doing so, it overcomes the problems encountered by traditional multivariate analysis.

In conclusion, SEM is a suitable analysis method to be applied in this study. The SEM allows the researcher to 1) identify the relationship between multiple predictors and criterion variables, 2) simultaneously analyse mediation effects of path modeling in the structural model, and 3) statistically test a priori theory and measurement assumptions against empirical data.

3.13.2 Comparison between CB-SEM and PLS-SEM

There are two types of SEM, covariance- based SEM (CB-SEM), and variance- based SEM (PLS-SEM). Covariance- based SEM (CB-SEM) is primarily used to confirm (or reject) theories (Wong, 2013). It does this by determining how well a proposed theoretical model can estimate the covariance matrix for a sample data set. The PLS-SEM (PLS Path Modeling) is primarily used to develop theories in exploratory research (Hair et al., 2014). It does this by focusing on explaining the variance in the dependent variables when examining models. There are several differences between covariance and variance- based SEM methods suggested by past researchers (Hair et al., 2010; Hair et al., 2014; Lowry & Gaskin, 2014) as summarised in Table 3.15. The choice between variance- based SEM and covariance- based SEM as a method analysis in this research follows the criteria as mention in Table 3.15.

Table 3.15
Differences between Variance- Based and Covariance- Based SEM

Criteria	Variance- Based SEM (PLS-SEM)	Covariance- Based SEM (CB-SEM)
Type of SEM	Partial Least Square (variance-based).	Covariance- based.
Research objective (RO)	Use when the RO is predicting key target constructs or identifying key driver constructs. Predictive-oriented.	Use when the RO is theory testing, theory confirmation or comparison of alternative theories. Parameter-oriented.
Requirement of theory	Require little or limited theory information.	Require theory foundation.
Sample size	Suitable for small sample size (achieves high level of statistical power with small sample size with minimal sample size follows ten times the rule of thumb).	More sensitive to sample size than variance- based SEM. Some of the statistical algorithms used by SEM programmes are unreliable with small samples.
Distribution	Non-parametric statistic (no distribution assumption- suitable for non-normal distribution data).	Parametric statistic (typically multivariate assumption- require normal distribution).
Model setup	Only recursive relationships within the structural model. No causal loops allowed in the structure. Thus not suitable for theory confirmation/ testing/ comparison.	Non-recursive relationships may occur within structural model. Causal loops among the variables allowed in the structure.
Model complexity	Use when the structural model is complex (many indicators and constructs).	Suitable for small to moderate model complexity.
Number of construct	Suitable for both single construct and multiple constructs.	Difficult to validate single construct.
Type of measurement models	Suitable for both formative and reflective measurement model.	Suitable for reflective measurement model and limited application for formative measurement model.
Availability of Global Goodness of Fit (GoF)	GoF is not required (typically not applicable for formative measurement model).	GoF required.
Includes interaction effects	Preferably, as it is designed for easy interactions.	Difficult with small models and nearly impossible with large one.

3.13.3 Justifications of Applying PLS-SEM as a Method of Analysis

PLS-SEM is an alternative analysis method compared to component based SEM (CB-SEM). This research adopted the PLS- SEM method for the following reasons:

1. **The phenomenon to be investigated is relatively new and the measurement model consists of newly developed constructs**. In this study, the phenomenon under investigation is PIP in the manufacturing sector. The proposed model integrates two open innovation aspects, that is, breadth and depth with two types of external knowledge search, that is, external collaboration and external information in one integrated model, which is newly examined in this research. To the best knowledge of the researcher, no study has tested these integration models as a single model. Furthermore, the concept of AC is widely applied in various fields, and up to now, this concept receives various modifications of its dimensions, as well as its indicator for each of the dimensions. In this study, the construct's measurement was adapted from various prior studies and was modified to suit this study context. Hence, it is consider as relatively new developed measurement model. Moreover, to the best of the researcher's knowledge, no study has used the average value (sum of total scale of importance divided with information search breadth-sum of information sources used) for the measurement of information search depth. Hence, it consider as relatively new developed construct.

2. **Prediction is more important than parameter estimation**. According to Lowry and Gaskin (2014), PLS-SEM is a preference for researchers when engaging in theory development or exploratory causal modeling. In contrast, CB-SEM is used

for theory testing, and it often ends with factor indeterminacy (without providing a means to determine which of the several solutions correspond to the hypothesis being tested). In this study, the theoretical framework is not yet fully crystallised. In this context, predicting the newly established relationship is the objective of the research. In other words, the primary objective of this research is to demonstrate the extent of the proposed predictors (independent variables) in explaining the variance on criterion variables, hence, enabled the researcher to draw a conclusion on the proposed theoretical model.

3. **Data distribution flexibility.** Distribution assumptions for PLS-SEM and CB-SEM differ in the way it deals with the unknowns in model estimation (Lowry & Gaskin, 2014). Typically, PLS-SEM allows the analysis of non-normal data, whereas CB-SEM requires only the normal distributed data for further analysis, although for multivariate analysis, non-normal data tends to produce invalid statistical tests (Hair et al., 2010). On the other hand, Kock, Parente and Verville (2008) mentioned that the multivariate analysis does not necessarily have to follow the normality assumptions. In the situation where the newly integrated variable is inserted into a causal relationship, or relatively new developed constructs are inserted in a variable, the distribution of that data tends to be non-normal (due to the possibility of a random chance of respondent's answer). This is because the variable is not yet linked to the constructs, and the constructs are not integrated into causal relationships. Therefore, in this context, PLS-SEM is suitable to be applied as a method of analysis, because it can reveal the unexpected existence of correlations among variables.

4. **The sample size is not met.** In business research, there are generally low response rates (Hak, 2007). For innovation surveys, the OECD OSLO Manual (2005) also stated that if the research is voluntary-based, higher non-response rates should be expected. In other words, the low response rate is expected in the research. This study received 137 responses from the target respondents. Following the rule of thumb suggested by Hair et al. (2010), the minimum sample size for a model that consists of seven variables or less for CB-SEM is 150. This number shows that current study samples do not fulfill the minimum sample size for CB-SEM analysis. However, current study samples with 137 responses fulfilled the minimum requirement of PLS-SEM. According to Hair et al. (2014), the minimum sample size for PLS-SEM follows the rule of thumb, that is, 10 times the largest number of structural paths directed at a particular construct in the structural model. The current study (endogenous variable- PIP) has the largest number of structural paths with a total of five structural paths that are directed at it. In other words, it means a minimum of 50 responses are required for the PLS-SEM analysis. Hence, this study met the minimum requirement sample size suggested for a PLS-SEM analysis with a total of 137 responses.

3.13.4 Software Used for PLS-SEM Analysis

The software selected for this study is the Smart-PLS due to two reasons. Firstly, the Smart-PLS is freely available to the research community across the globe. Secondly, this software has maintained an active online discussion (refer to http://www.smartpls.de).

3.13.5 Steps in Applying PLS-SEM for the Mediation Model

Before analysing using PLS-SEM, the researcher needs to specify the structural model or path model based on theory and logic to display the hypotheses that were developed in the study. The structural model describes the relationships between latent variable, and this model is also called the inner model in PLS-SEM. After the structural model is established, the measurement model, which describes the relationship between the latent variables and their indicators (measures), is established to the test. The measurement model is also called the outer model in PLS-SEM. There are two types of measurement models - formative and reflective measurement models. The formative model refers to "the measurement model that indicates that the indicator variables cause the measurement of the construct, whereas, the reflective model refers to the assumption of the construct that causes the measurement" (Hair et al., 2010, p. 735).

Subsequently, PLS algorithmic options need to be identified before starting the analysis. According to Hair et al. (2014), several PLS algorithmic options should be set before start the analysis. These are:

1. A maximum number of iterations should be set at 300.
2. Stop criterion is set at a value of 0.00001.
3. The data metric option that z-standardises the data input for PLS-SEM indicator variables is used.
4. +1 is used as an initial value for all outer weights.
5. Bootstrapping samples should be 5000.

Next, assessing validity and reliability of measurement models are required for the next analysis. Typically, reflective measurement models and formative measurement models should follow different evaluation guidelines (Hair et al., 2014; Lowry & Gaskin, 2014). The reflective measurement model requires internal consistency, indicator reliability, convergent validity (average variance extract) and discriminate validity. On the other hand, the formative measurement model do not require indicator reliability as the reflective measurement does. Although the formative measurement model does not need to conduct reliability test, however, it needs to conduct convergent validity, collinearity among indicators, as well as, significance and relevance of outer weights.

After the assessment of measurement models, the next step is to assess the structural model. Instead of applying measures of goodness of fit (GoF), PLS-SEM assesses based on the basics on examining the exploratory power of the structural model and the path coefficient (Ringle, Sarstedt, & Straub, 2012). There are several properties that need to be assessed to provide the support for the proposed model in PLS-SEM. This includes the coefficient of determination R^2, predictive relevance Q^2, effect size f^2 and path coefficient (Hair et al., 2014). In addition to the structural model test, for predicting the mediation effect in PLS-SEM model, direct effects and indirect effects need to be assessed. The basic mediation model followed the assumptions proposed by Baron and Kenny (1986). According to Hair et al. (2014), mediation analysis in PLS-SEM focuses on the assessment of variation path coefficients (R^2) and magnitude of the path (β) on (in order) direct effects, then indirect effects, then assess the size of indirect effects relative to the total effects (variance accounted for-VAF). Finally, based on the results from previous steps, the interpretation of results and drawing conclusions are the final steps to conclude the study. Figure 3.2 illustrates the steps in applying PLS-SEM for mediation model.

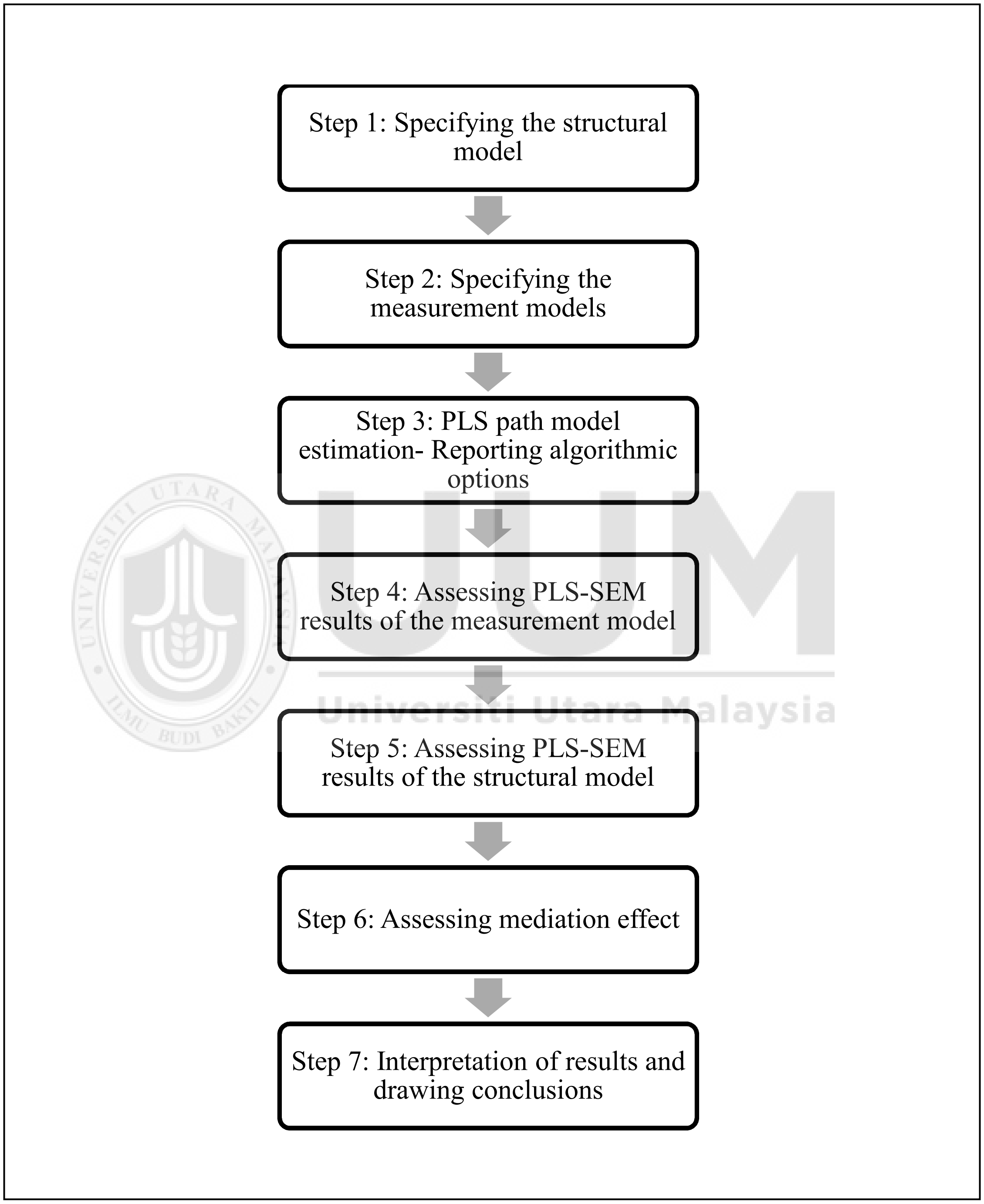


Figure 3.2
Steps in Applying PLS-SEM for Mediation Model
Source: Adopted from Hair et al. (2014).

3.13.6 The PLS-SEM Measurement Model

This study employed all reflective constructs except the measure for independent variables (Collaboration breadth and depth, and information search breadth and depth). Independent variables in this study are a single-item construct, thus neither reflective constructs nor formative constructs. Assessment of reflective measurement models involves internal consistency, individual indicator reliability, average variance extracted (AVE) to evaluate the convergent validity and Fornell-Larcker criterion and cross loading to assess discriminate validity. General guidelines for the reflective measurement model assessment provided by Hair et al. (2014) are presented as below:

1. Composite reliability for internal consistency must not be lower than .60.
2. Convergent validity – absolute-standardised outer loading should be higher than .70. However, it is frequently observed in social sciences for weak outer loading. Thus, when loading is between the range of .40 to .70 the researcher should carefully examine whether the deletion of the item increases the average variance extracted (AVE) and composite reliability.
3. Discriminant validity checks by conducting the Fornell-Larcker criterion. Typically, AVE of each latent variable should be higher than the squared correlations with all other latent variables. In other words, it means each latent variable shares their block of indicators. AVE should be higher than .50.
4. Cross-loading is to check discriminant validity if any of the indicators have a higher correlation with other latent variables. The presence of cross-loadings that exceed the indicators' outer loadings represents a discriminant validity problem.

3.13.7 The PLS-SEM Structural Model

Reliable and valid outer models permit an evaluation of inner models (structural model). Before the evaluation of the structural model, the collinearity test requires applying each set of predictor constructs separately for each subpart of the structural model (Hair et al., 2014). Tolerance and VIF values should be above 0.2 and below 5.0. After assessing the collinearity test, the next step is to assess the structural model. The assessment of PLS-SEM structural model is rather heuristic compared to covariance SEM since the chi-square (X^2) statistic or various fit indices are not applicable for PLS-SEM (Hair et al., 2014). Following Henseler, Ringle, and Sinkovics (2009), the evaluation of a structural model for PLS-SEM includes the coefficient of determination R^2, estimates of path coefficients (standardised betas in a regression analysis), predictive relevance Q^2 and effect size f^2. They provide some general guidelines for the structural measurement model assessment as below:

1. The coefficient of determination (R^2) is the measure used to assess the effect of predictor constructs in explaining the variance on the endogenous construct. In general, R^2 value of 0.67 (substantial), 0.33 (moderate), 0.19 (weak) represent the guideline in explaining the magnitude of the effects of predictors' constructs on endogenous constructs.
2. The estimates of path coefficients are to explain the sign, magnitude and significance of the path relationship for the structural model.
3. Effect size f^2 refer to the measure used to assess the relative predictive relevance of a predictor construct on an endogenous construct [f^2= (R^2 included- R^2

excluded)/ (1-R^2 included)]. The values of 0.02, 0.15 and 0.35 represent a latent predictor variable has weak, medium, or large effect respectively at the structural model.

4. Q^2 is calculated based on the blindfolding procedure. The calculation of Q^2 is $\left(Q^2 = 1 - \left(\sum_{D} SSE_{D)} \,\middle|\, \sum_{D} SSO_{D}\right)\right)$. D is the omission distance, SSE is the sum of squares of prediction errors, SSO is the sum of squares of observation. The Q^2 value above zero indicates that the observe values are well reconstructed; whereas, the Q^2 value below zero indicates a lack of predictive relevance. The relative size for predictive relevance q^2= (Q^2 included-Q^2 excluded)/ (1-Q^2 included). The Q^2 values 0.02, 0.15, and 0.35 represents small, medium, and large effect respectively.

3.13.8 The PLS-SEM Mediation Effect

Mediation refers to a situation in which the third variable accounts for the effects on the relations between independent [predictor] and dependent [outcome variable] (Hair et al., 2010). Fundamentally, assessment of mediation is based on Baron and Kenny's (1986) guideline to show that the mediating effect exists between the relationship of a predictor and an outcome variable. Following are the steps to examine the mediation effect between the relationship of a predictor and an outcome variable.

1. Step 1: To show the significant relationship between the predictor and the outcome. In PLS-SEM, this relationship is named direct effect (illustrated in Figure 3.3).
2. Step 2: To show the significant path between the mediator and the predictor variable. In PLS-SEM, this relationship is named indirect effect (illustrated in Figure 3.4).
3. Step 3: To show the significant path between the mediator and the outcome variable. In PLS-SEM, this relationship is named indirect effect (illustrated in Figure 3.4).
4. Step 4: For the full mediation effect, direct path of part c' will not differ from zero, whereas, the partial mediation effect, direct path c' value will be significantly smaller compared to path c.

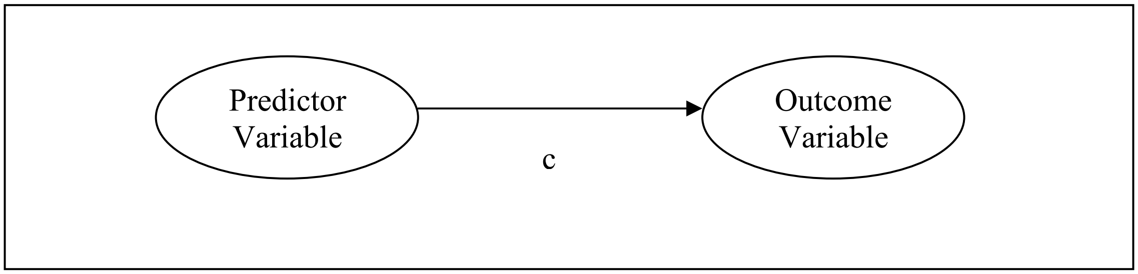


Figure 3.3
Direct Path between Predictor and Outcome Variable

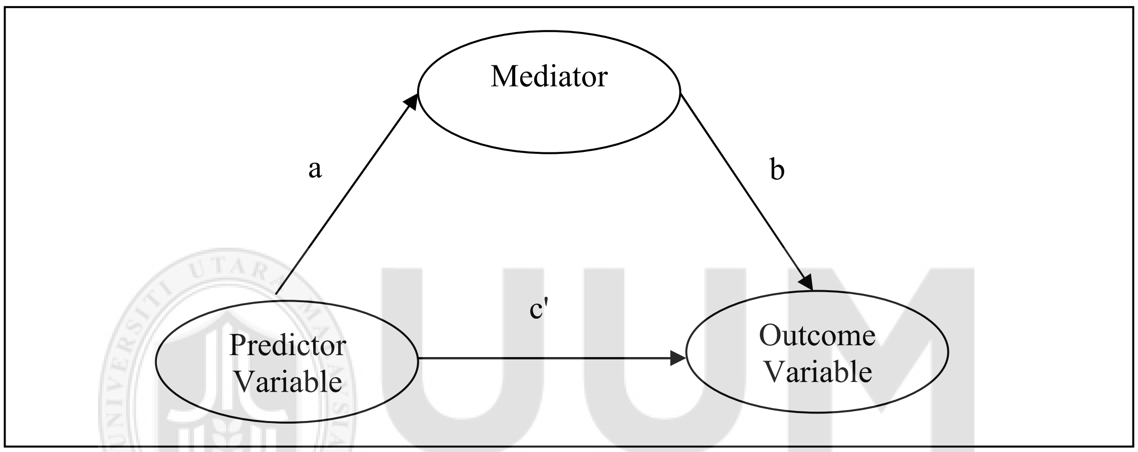


Figure 3.4
Mediation Model

In PLS-SEM, the mediation effect can be tested based on Preacher and Hayes' (2008) recommendation to bootstrap the sampling distribution of the direct and indirect effect. Firstly, assess the significance of the direct effect and indirect effect. If the indirect effect is significant means it has a mediating effect, whereas if the indirect effect is non-significant it means there is no mediating effect. Secondly, if the indirect effect is significant, then assessing the variance accounted for (VAF= (path a * path b)/ (path a * path b + path c') for the effect size of mediation exists between the relationship of a predictor and an outcome variable. VAF with less than 20%, has no mediation power, VAF between 20% and 80 % refers to a partial mediation effect, while, VAF larger than 80% refers to a full mediation model.

3.14 Chapter Summary

This chapter discussed the research methodology such as theoretical framework, hypotheses development, research design, operational definitions, measurements of items and scales, sampling procedures, survey administration, and data analysis and interpretations. This research referred to the FMM Directory of 2015 to obtain the samples of various Malaysian manufacturing firms in which 700 of them were selected with a random sampling technique. The questionnaire was devised to adapt from well-established measurement items from a variety of related studies. The questionnaire was mailed to Product/ R&D Managers who are the most suitable respondents for this study. The questionnaire was face-validated by three experts and a pilot test was performed to confirm its reliability. After all the related methodologies were followed, the actual data analysis and its interpretations with SPSS v. 19 statistical techniques as well as advanced statistical technique (Smart-PLS) performed is discussed in the next chapter.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 Introduction

This chapter reports and discusses the data analysis results of the study. The preliminary data analysis involving the response rate, assessment of potential bias (non-response bias and common method bias) and missing data treatment are discussed. Next, this chapter focuses on the profile of respondents, multivariate assumptions (outliers and normality), descriptive statistics, and followed by exploratory factor analysis. The specifying path model in PLS-SEM (measurement model and structural model), evaluation of the measurement model (internal consistency reliability and indicator reliability), and evaluation of the structural model are reported. This chapter concludes with a summary of hypothesis testing results and a chapter summary.

4.2 Response Rate

The questionnaires were sent out in September 2015 and the collection process ended in December 2015. The process of data collection ran for four months. Out of the total 700 questionnaires sent, there were 148 returned questionnaires. There was a total of 11 unusable responses with seven questionnaires returned blank, or answered with less than half of the total questions, and four questionnaires stated that they have less than three years experience in the firm that they are working in. This leaves this study with 137 usable responses giving the final percentage of 19.6% response rate over n=700. The response rate is acceptable since other similar studies reported a response rate that falls below the trend, such as Mohamad Faizal Ahmad Zaidi and Siti Norezam Othman (2014) with 17.6% of response rate and Ferreras-Mendez et al. (2015) recorded a 17% response rate.

In general, the acceptable response rate for mail surveys should be at a minimum rate of 30% (Sekaran, 2003; Pallant, 2007). However, in this study, due to the lower response trend reported in past research, the researcher has increased the sample size (original sample size n=331) two folds to n=700 to increase the chances of getting a higher return. Table 4.1 showed the comparison of response rates between n=700 and n=331.

Table 4.1
Comparisons of Response Rate between the Study's Sample Size (n=700) and the Bartlett, Kotrlik, and Higgins's Sample Size (n=331)

Descriptions	**n=700**	**n=331**
Numbers of usable response	137	137
Response rate over sample (%)	19.6	41.4
Population-N	2360	2360
Response rate over population (%)	5.8	4.9

Refer to Table 4.1, 137 usable responses indicated a 41.4% response rate over a sample size of 331 in the same population size (N=2360). This suggested that the 137 usable responses are sufficient for the study since it falls within the acceptable response rate of 30%. Furthermore, the minimum sample size that is required to carry out PLS-SEM analysis is n=50 (Hair et al., 2014). As a result, that indicates that the current response rate is adequate for carrying out the PLS-SEM analysis.

4.3 Assessment of Potential Bias

Two biases are potentially threatening the validity and reliability of the result to be generalised in the study. First is the non-response bias, and second is the common-method bias. The following subsections discuss the methods used to check the biases in this study.

4.3.1 Non-Response Bias

Non-response bias occurs when there is a difference between the respondents and non-respondents on the answers given in the questionnaires (Sheikh & Mattingly, 1981). This problem arises when the response rate is low and the survey validity tends to be biased between the respondents and non-respondents (Lahaut, Jansen, van de Mheen, Garretsen, Verdurmen, & van Dijk, 2003). Indeed, the past research indicates that if the respond rate is less than 80%, then a non-response bias test should be conducted (Graham, 2006). This study collected a total of 137 responses, which indicates only a 41.4% response rate from the total sample (n= 331). Therefore, a non-response bias test should be conducted to examine whether there are differences between the respondents and non-respondents regarding their questionnaires' answers.

Non-response bias can be detected by performing the Levene's test (Pallant, 2007). The Levene's test is a type of inferential statistic used to assess the equality variance for two or more groups of a variable (Levene, 1960). Intensively, the Levene's test for non-response bias can be applied to determine if there is a difference in the answer given by early and late respondents (Chang & Lee, 2007). It can be tested by comparing the early respondents' answers and late respondents' answers using the Levene's statistic for homogeneity of variance and analysis of variance, similar to suggestions in past research for innovation studies (Baruch & Holtom, 2008). This study has to conduct the non-response bias test based on the extrapolations method or wave analysis (Armstrong & Overton, 1977). The reason for the researcher to select this method is because the distance between the mail location (Kedah) and other states could affect the return time frame from the respondents, whereby it could include early and late respondents.

In this study, an early respondent is defined as a respondent that could return the questionnaire in the first two months after sending out a total of 700 questionnaires. A late respondent is defined as a respondent that returns the questionnaire after more than two months after a series of follow-up processes. There are 137 observations that comprised of 75 early respondents (54.7%) and 62 late respondents (45.3%) in this study. The Levene's test of all the constructs for PIP and AC variables in this study showed that there is no significance differences between the early and late respondents, t(137)= t, p> .05 except items ab14, ab15 and dc4 (refer Appendix E). In conclusion, this indicates that non-response bias is not an issue in this study.

4.3.2 Common Method Bias

When a survey method is used to collect data using a single source (i.e. common rater effects, common scale formats, positive common scale anchors and measurement context effects) may cause systematic measurement errors and further bias the estimates of the true relationship between theoretical constructs (Podsakoff et al., 2003). In this study, all the data is self-reported by a single individual (i.e. an R&D Manager) to represent an organisation and this indicates that there is a potential of the data suffering from bias from common rater effects. Moreover, this study uses the same questionnaire with the same period of time (common scale formats) with a cross-sectional research design (measurement context effects), and these potentially resulted in common-method bias in the research.

Common-method variance can be tested by using the Harman' one-factor rule (Podsakoff et al., 2003). The objective of the test is to determine whether the variances of all the items from all of the constructs in the study can be accounted by one general factor (Jean, Sinkovics, & Hiebaum, 2014). In this study, the four independent variables, mediator and dependent variable are included in the exploratory test, using unrotated principal components factor analysis to examine the number of factors with an eigenvalue greater than 1.0. The study produced nine factors that accounted for a total of 78.1% of the variance. Neither a single factor nor a general factor emerged that could account for the majority of the variance, which is more than 38.5% (refer Appendix F), and this indicates that common-method bias is not likely contaminating the research results.

4.4 Missing Data Treatment

Missing data can "affect the generalisability of the result of research" (Hair et al., 2010, p. 42). According to the guidance provided by Hair et al. (2010),variables with missing data more than 50% should be excluded in the study while variables with missing data less than 50% can be treated using the statistical method. In this study, the researcher filters out the response cases that have a missing value more than 50%. However, there is no missing value of any of the variables in this study that shows below 50%. Hence, the treatment of missing data statistically is not necessarily needed in this study.

4.5 Profile of Respondents

The next section discusses the general profile and background of the population. A respondents' profile includes job positions and service length whereas a firm's background involves a firm's age, a firm's size, types of industry, and types of innovation project.

4.5.1 Job Position

The survey was responded by a total of 137 respondents. The respondents who took part in answering the survey questions include 85 respondents (62%) who are Product Managers or Research and Development (R&D) Managers and 52 respondents (38%) who are equivalents to the Product Manager or R&D Managers as shown in Table 4.2.

Table 4.2
Job Position

Job Position	**Frequency**	**Percentage (%)**
Product Manager or R&D Manager	85	62.0
Equivalent to Product Manager or R&D Manager	52	38.0
Total	137	100.0

4.5.2 Length of Service

The respondents of this study indicate their experience in terms of length of service from the previous three years of completed projects. There are 29 respondents (21.2%) having less than five years of experience and 36 respondents (26.3%) having more than five to ten years of experience. In addition, there are 28 respondents (20.4%) having more than ten to fifteen years of experience and 16 respondents (11.7%) having more than fifteen to twenty years of experience. On the other hand, 19 respondents (13.9%) reported having more than twenty to twenty-five years of experience and 9 respondents (6.6%) having more than twenty-five years of experience as shown in Table 4.3.

Table 4.3
Length of Service

Length of Service	**Frequency**	**Percentage (%)**
<5 years	29	21.2
>5 to 10 years	36	26.3
>10 to 15 years	28	20.4
>15 to 20 years	16	11.7
>20 to 25 years	19	13.9
>25 years	9	6.6
Total	137	100.0

4.5.3 Firm's Age

A firm's age indicates the establishment in terms of maturity or survival of a firm. The majority of firms were established for more than ten years. Accordingly, 17 firms (12.4%) were established for less than ten years, 40 firms (29.2%) were established for more than ten to twenty years, 44 firms (32.1%) were established for more than twenty to thirty years, 19 firms (13.9%) were established for more than thirty to fourty years, and 17 firms (12.4%) were established for more than fourty years as shown in Table 4.4.

Table 4.4
Firm's Age

Firm's Age	**Frequency**	**Percentage (%)**
< 10 years	17	12.4
>10 to 20 years	40	29.2
>20 to 30 years	44	32.1
>30 to 40 years	19	13.9
> 40 years	17	12.4
Total	137	100.0

4.5.4 Firm's Size

A firm's size is indicated based on the number of employees. This study recorded 45 firms (32.8%) having less than 75 employees, 44 firms (32.1%) having more than 75 to 200 employees and 48 firms (35.1%) having more than 200 employees as summarised in Table 4.5.

Table 4.5
Firm's Size

Firm's Size	Frequency	Percentage (%)
< 75 employees	45	32.8
75 - 200 employees	44	32.1
> 200 employees	48	35.1
Total	137	100.0

4.5.5 Types of Industry

The types of industry are indicated based on the FMM list. This study listed 15 types of industry based on FMM list. There are 21 respondents from the food, beverage and tobacco industry (15.3%), 20 respondents from the electrical and electronics industry (14.6%), 12 respondents from manufacturing of furniture (8.8%), ten respondents from the chemicals-including-petroleum industry (7.3%), nine respondents from the plastic industry (6.6%), and eight respondents from the fabricated metal industry (5.8%). The machinery industry and paper, printing, and publishing industry recorded seven respondents (5.1%) respectively and six respondents from wood products, including the furniture industry (4.4%). Besides that, five respondents (3.6%) are from the medical, precision and optical instruments industry and the non-metallic mineral industry respectively while three respondents (2.2%) are each from the rubber industry and textile, wearing apparel and leather industry. There is one respondent (.7%) each in the basic metal industry and transportation industry as summarised in Table 4.6.

Table 4.6
Types of Industry

Types of Industry	Frequency	Percentage (%)
Basic metal	1	0.7
Chemicals including petroleum	10	7.3
Electrical and electronics	20	14.6
Fabricated metal	8	5.8
Food, beverage and tobacco	21	15.3
Machinery	7	5.1
Manufacturing of furniture	12	8.8
Medical, precision and optical instruments	5	3.6
Non-metallic mineral	5	3.6
Paper, printing, and publishing	7	5.1
Plastic	9	6.6
Rubber	3	2.2
Textile, wearing apparel and leather	3	2.2
Transportation	1	0.7
Wood and wood products, including furniture	6	4.4
Others	19	13.9
Total	137	100.0

On the other hand, there are 19 respondents from other industries that include each respondent (0.7%) in the aluminium extrusions industry, the automotive coil spring industry, the automotive heat exchange component, and others as summarised in Table 4.7.

Table 4.7
Other Types of Industry

Other Types of Industry	Frequency	Percentage (%)
Aluminium extrusions	1	0.7
Automotive coil spring	1	0.7
Automotive heat exchange component	1	0.7
Automotive parts	1	0.7
Candle and incenses	1	0.7
CD manufacturing, software contract manufacturing	1	0.7
Ceramic bathroom accessories	1	0.7
Ceramic wall tiles	1	0.7
Cleaning chemical	1	0.7
Filtration manufacturer	1	0.7
Glass	1	0.7
Include content creation and development	1	0.7
Industrial equipment and related parts	1	0.7
Industrial filters	1	0.7
Industry helmet	1	0.7
Machining	1	0.7
Manufacturer of health supplement	1	0.7
Manufacturing of empty tin cans	1	0.7
Personal care cosmetic	1	0.7
Total	19	13.9

4.5.6 Types of Innovation Project

This study listed four types of innovation project based on previous research namely innovation projects corresponding to existing product modifications, product line extensions, “me-too-products”, and true innovations. One hundred and two respondents (45.1%) involve in innovation project corresponding to existing product modification, 59 respondents (26.1%) participate in innovation projects corresponding to product line extensions, 24 respondents (10.6%) engage in innovation project corresponding to “me-too-product”, and 40 respondents (17.7%) involve in innovation project corresponding to true innovation. Instead of that, there is one respondent (0.5%) who participates in cost saving exercise. The responses to the types of innovation project are illustrated in Table 4.8.

Table 4.8
Types of Innovation Project

Types of Innovation Project	Frequency	Percentage (%)
Corresponding to existing product modification.	102	45.1
Corresponding to product line extensions.	59	26.1
Corresponding to “me-too-product”.	24	10.6
Corresponding to true innovation.	40	17.7
Others: Cost saving exercise.	1	0.5
Total	226	100.0

4.6 Multivariate Assumptions

According to Hair et al. (2010), two multivariate assumptions need to be fulfilled before proceeding to further analysis-testing namely outliers analysis and data normality. The next subsections explain further on these multivariate assumptions.

4.6.1 Outliers Analysis

Outliers are observations with a unique combination of characteristics that are clearly distinct from other observations (Hair et al., 2010). The presence of outliers can be simply the extreme value compared to the normal distribution in that population (Grubbs, 1969) or caused by human error such as data entry error (Tabachnick & Fidell, 2007) or because it comes from a different population. Hair et al. (2010) mentioned that outliers cannot be categorically characterised as either beneficial (when the outliers represent the characteristics of the population) or problematic (when the outliers are not representative of the population and would distort the statistical result) within the context of analysis and should be evaluated by the types of information that they may provide. There are several methods to detect outliers, namely univariate, bivariate and multivariate perspectives.

Univariate outliers' detection refers to the analysis and selecting the cases from the observations of each variable that falls at the outer range of the distribution. Bivariate outliers' analysis identifies the cases from pairs of variables that fall markedly outside the range of the other observations. On the other hand, multivariate outliers' analysis identifies the cases with the extreme values of the scores involving more than two variables. In this research, the researcher used univariate and multivariate methods to identify the outliers in the examined data. The bivariate outliers' analysis is not addressed in this study because a large amount of scatter plots arise as the number of variables increases (Hair et al., 2010). Furthermore, with the multivariate outlier analysis, the assessment of each observation across a set of variables is achieved, and this makes bivariate analysis inadequate since it can analyse two variables at a time.

In this research, both univariate and multivariate outliers' identification were done through the SPSS version 19. Univariate outliers can be identified through the Z-score of the dependent variable. For the research that has "a sample size of more than 80 cases, the Z-score out of the range of ± 3 is considered as an outlier case" (Mukesh Kumar et al., 2013, p. 171). On the other hand, multivariate outliers can be detected through Mahalanobis D^2 measure. According to Hair et al. (2010), the significance testing for Mahalanobis is the measure of D^2 divided by the number of variables involved in the analysis (D^2/ df), whereby the levels of significance is either .005 or .001 that are used as the threshold value for designation as an outlier. Both univariate and multivariate outliers' analysis in this research showed that the case ID 111 is an outlier for both the univariate and multivariate tests. Table 4.9 illustrates the results of univariate and multivariate outlier analysis in this study.

Table 4.9
Outliers' Detection

Case ID	Multivariate (Mahalanobis Test)	Univariate Outlier (Standard Score)
111	.000	-4.020

In conclusion, the case ID 111 has recorded significant Mahalanobis value and has Z-scores out of the range of ± 3. This shows that the pattern of the response is extreme compared to normal distributions in that population. Therefore, the researcher decided that this respondent does not portray a representative element or segment of the population and is thus removed from the dataset. This makes the total usable questionnaires to be 136 sets.

4.6.2 Data Normality

The assessment of normality is essential for the majority of multivariate analysis and this includes covariance-based SEM. The normality assumption for covariance SEM includes univariate and multivariate normality because the maximum likelihood estimator is considered relatively robust to violations of normality (Diamantopoulos & Siguaw, 2006; Hair et al., 2010). The current study applied SEM as the statistical method. This study assesses both univariate and multivariate normality of the data as to select covariance or variance approach of SEM. For the univariate normality test, the statistical analysis used in this research is by calculating the critical ratio of skewness and kurtosis. Hair et al. (2010) suggested that the critical value is ± 1.96, at the level of significance of .05 to identify whether the data is normally distributed. For the multivariate normality test, Mardia's test is conducted using the AMOS software version 16. Bentler (2005) that suggested the cut-off point of the critical ratio for Mardia's test is five. Table 4.10 illustrated the result of the univariate and multivariate normality test for this study.

Table 4.10

Univariate and Multivariate Normality Test- Skewness and Kurtosis for Product Innovation Performance and Absorptive Capacity

Items	Min	Max	Skewness	Critical Ratio	Kurtosis	Critical Ratio
dd3	2.000	7.000	-.025	-.120	-.457	-1.091
dd2	1.000	7.000	-.328	-1.567	.331	.792
dd1	2.000	7.000	-.315	-1.503	-.484	-1.156
dc6	1.000	7.000	-.762	**-3.643**	.706	1.688
dc5	1.000	7.000	-.496	**-2.368**	-.045	-.107
dc4	2.000	7.000	-.191	-.913	-.488	-1.165
dc3	1.000	7.000	-.321	-1.534	-.101	-.240
dc2	2.000	7.000	-.179	-.858	-.348	-.831
dc1	2.000	7.000	-.172	-.820	-.633	-1.513
db7	2.000	7.000	-.666	**-3.180**	.868	**2.075**
db6	2.000	7.000	-.467	**-2.230**	.253	.604
db5	2.000	7.000	-.548	**-2.617**	.031	.075
db4	2.000	7.000	-.564	**-2.693**	-.037	-.090
db3	2.000	7.000	-.755	**-3.607**	.319	.761
db2	1.000	7.000	-.840	**-4.015**	.361	.862
db1	3.000	7.000	-.333	-1.591	-.325	-.776
da5	3.000	7.000	-.262	-1.253	-.413	-.987
da1	2.000	7.000	-.570	**-2.723**	.205	.489
da2	2.000	7.000	-.298	-1.426	-.144	-.345
da3	2.000	7.000	-.498	**-2.380**	.345	.825
da4	2.000	7.000	-.556	**-2.655**	.323	.771
ab17	1.000	7.000	-.045	-.214	-.722	-1.724
ab16	1.000	7.000	-.046	-.221	-.790	-1.887
ab15	1.000	7.000	-.277	-1.322	-.510	-1.218
ab14	1.000	7.000	-.314	-1.502	-.557	-1.332
ab13	2.000	7.000	-.454	**-2.169**	-.366	-.874
ab12	2.000	7.000	-.849	**-4.055**	.713	1.703
ab11	2.000	7.000	-.850	**-4.063**	.607	1.451
ab10	1.000	7.000	-.135	-.645	-.503	-1.201
ab9	1.000	7.000	-.612	**-2.924**	.280	.668
ab8	1.000	7.000	-.873	**-4.173**	1.245	**2.973**
ab7	1.000	7.000	-.705	**-3.368**	.686	1.638
ab6	1.000	7.000	-.824	**-3.937**	1.001	**2.392**
ab5	1.000	7.000	-1.367	**-6.530**	3.039	**7.261**
aa4	1.000	7.000	-.697	**-3.330**	-.190	-.453
aa3	2.000	7.000	-.556	**-2.655**	-.551	-1.316
aa2	2.000	7.000	-.685	**-3.272**	-.302	-.722
aa1	2.000	7.000	-.596	**-2.849**	-.679	-1.623
Multivariate Normality Mardia's Test					153.396	14.431

The univariate normality test on all the related items in this study shows a total of 23 items' critical value for skewness and 4 items' critical value for kurtosis is out of the cut-off range (± 1.96) as suggested by Hair et al. (2010). The test indicated that the data in this study were not normally distributed. On the other hand, multivariate normality in Mardia's test recorded 14.43 and it shows that the value is larger than five. This suggested that the multivariate non-normality would affect the results when used with the Maximum Likelihood Estimation (Bentler, 2005). In conclusion, the use of variance-based SEM (PLS-SEM) is suitable for this study, since the PLS approach of SEM is a distributional-free statistical modelling technique that is able to handle non-normal data and tests for hypothesised relationships (Lowry & Gaskin, 2014).

4.7 Descriptive Statistics

The Table 4.11 shows the descriptive statistics of dependent, independent, and mediating variables that include the minimum, maximum, mean and standard deviation values (refer Appendix G). The mean value for product information performance is 5.046 (SD = 0.831). On the other hand, collaboration breadth possessed a mean value of 3.184 (SD = 1.735) while information search breadth recorded a mean value of 6.552 (SD = 3.231). Collaboration depth and information search depth respectively possessed a mean value of 5.945 (SD = 2.005) and a mean value of 6.663 (SD = 0.832). The mediating variable, AC, recorded a mean value of 5.134 (SD = 0.764).

Table 4.11
Descriptive Statistics for Main Variables

Variables	N	Min.	Max.	Mean	Standard Deviation
Product information performance	136	2.94	7.00	5.046	0.831
Collaboration breadth	136	0	8.00	3.184	1.735
Collaboration depth	136	0	8.00	5.945	2.005
External information search breadth	136	1.00	15.00	6.552	3.231
External information search depth	136	4.89	8.00	6.663	0.832
Absorptive capacity	136	2.90	7.00	5.134	0.764

4.8 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is a statistical approach for determining the factor structure of a dataset according to the grouping of variables based on the correlations (Ho, 2014). In general, EFA is conducted to explore the data and provide the information about the number of factors that is extracted from the dataset and the items that can represent the factor extracted (Hair et al., 2010). An EFA prepares the variables to be used for SEM, and it should always be conducted on the new dataset to examine the number of factors that could be extracted from the dataset (Williams, Onsman, & Brown, 2010). Specifically for the reflective type of measurement model, the EFA is essential to be conducted to test the unidimensionality of the variables (Straub, Boudreau, & Gefen, 2004; Lewis, Templeton, & Byrd, 2005). The unidimensionality test cannot be conducted directly from PLS-SEM, thus, the assessment of EFA should be first assessed by the SPSS software before it can proceed to test further its validity that is multidimensionality factor loading in PLS-SEM (Wan Mohamad Asyraf, 2014). This study has two latent variables, namely PIP and AC that are reflective types of the measurement model. Therefore, it is necessary for both the variables to check the unidimensionality using the assessment of EFA based on principal components analysis in the SPSS software.

Fundamentally, the results of factor analysis for PIP shows that the item ab5 has high cross-loading between the financial component and non-financial C1 component with the factor loading value of .602 and .477 respectively (refer Appendix H1). According to Hair et al. (2010), factor loading value of greater than ± .500 is considered necessary for practical significance. For the item ab5, the cross-loading value of .477 is close to .500, and this indicates that the value of factor loading is considered to be significant in the dataset. In this extent, Hair et al. (2010) suggested the researcher to find the different rotation methods to eliminate any cross-loadings and thus defined as a simple structure.

According to the suggestion by Hair et al. (2010), the researcher runs the factor analysis again with the OBLIQUE rotation - OBLIMIN rotation method to find a more simplified factor loading matrix. The result shows that the item ab5 still has the cross-loading problem with the factor value of .410 for the financial component and - .545 for the non-financial component C1 (refer Appendix H2). The result suggested that item ab5 is item for deletion. Moreover, deletion of item ab5 also provides a clear definition of the financial component because this component originally does not include the item ab5. After the deletion of item ab5, the researcher runs again the factor analysis using the VARIMAX rotation method and the result is illustrated in Table 4.12.

Table 4.12
Summary of Exploratory Factor Analysis Result for Product Innovation Performance

Items	Descriptions	Factor Loading			
		Financial	Non-financial		
			C1	C2	C3
aa1	Achieve sales goals relative to the stated objectives.	.939			
aa3	Achieve market share growth relative to the stated objectives.	.918			
aa4	Achieve sales growth relative to the stated objectives.	.907			
aa2	Achieve profit goals relative to the stated objectives.	.897			
ab16	The product is new to your industry technology know-how.		.909		
ab17	The product is new to your industry market know-how.		.890		
ab15	The product is new to your firm's market know-how.		.828		
ab14	The product is new to your firm's technology know-how.		.816		
ab7	The product provided better quality compared to competitors of a similar type of product.			.819	
ab12	Customers perceived that the product is more reliable compared to the competitors' product.			.789	
ab11	The product has improved customer satisfaction.			.738	
ab13	The product improved customer loyalty.			.704	
ab6	The product provided better quality compared to past similar type of product.			.697	
ab9	The product is launched within the stated deadlines.				.851
ab10	The product is launched in relatively shorter time than competitors.				.815

Table 4.12 (Continued)

Items	Descriptions	Factor Loading			
		Financial	Non-financial		
			C1	C2	C3
ab8	The product development cost met to the stated objectives.				.628
	Eigenvalues	7.063	2.542	1.870	1.176
	% of variance	44.14	15.89	11.69	7.35
	Cronbach's Alpha	.959	.923	.890	.783
	Kaiser-Meyer-Olkin	.834			
	Bartlett's Test of Sphericity	1885.010			
	Df. (sig.)	120 (p<.001)			
	Cumulative variance %	79.07			

Intensively, the result of factor analysis, after deletion of item ab5, has a clean rotation with the entirely high factor loading on the specific component (refer Appendix H3). There are no cross-loading values with more than .400 and all the communalities' values are above the threshold value of .500 as suggested by Hair et al. (2010). Furthermore, Williams et al. (2010) suggested that the measure of sampling adequacy (MSA) and Bartlett's test of sphericity of PIP also show the value (MSA> .500) and (sig.< .05). Thus, it indicates that the sufficient correlation among the variables in the dataset and it is appropriateness for factor analysis. On the other hand, to confirm the unidimensionality of the extracted component, Price and Mueller (1986, p. 6) and Nunnally (1994) suggested should reach a threshold value of .600. Table 4.13 shows Cronbach's Alpha value of all components reach the threshold value, thus, indicates that the unidimensionality of the extracted components. Moreover, the result shows that PIP has four components that accounted 79.07% of variance explains for the PIP. The first component-financial accounted for 44.14% variance for the variable, whereas the second component-non-financial C1 accounted for 15.89% variance for the variable. On the other hand, the non-financial C2 explains 11.69% variance for the variable, whereas, the non-financial C3 only explains 7.35% variance for the PIP.

Factor analysis can be used for determining the structure or relationship between variables (Williams et al., 2010). In this study, items for the financial dimension for PIP are loading highly among each other. However, the non-financial dimension of PIP shows additional extracted components (refer Table 4.13). There are three components extracted under the non-financial dimension. The non-financial C1 with four items (aa1, aa2, aa3, aa4), the non-financial C2 with four items (ab14, ab15, ab16, ab17), and the non-financial C3 with three items (ab8, ab9, ab10). The increase of the extracted components indicates the need to re-specify the factor model.

The non-financial C1 has the combination of items that show the product innovativeness and thus renaming this component as product innovativeness. On the other hand, non-financial C2 has the combination of items that show both technical performance and market performance and thus renaming the component as product performance. Product performance is defined as the product performance regarding the quality and the market performance of a new product. Finally, the non-financial C3 has the combination of items that show the development speed and cost performance, thus, renaming the component as the speed and cost performance. In essence, the PIP components are indicated in Table 4.13.

Table 4.13
Dimensions of Product Innovation Performance

Components	**Items**
Financial performance	aa1-Achieve sales goals relative to the stated objectives. aa2-Achieve profit goals relative to the stated objectives. aa3-Achieve market share growth relative to the stated objectives. aa4-Achieve sales growth relative to the stated objectives.
Product innovativeness	ab14-The product is new to your firm's technology know-how. ab15-The product is new to your firm's market know-how. ab16-The product is new to your industry technology know-how. ab17-The product is new to your industry market know-how.
Product performance	ab6-The product provided better quality compared to the past similar type product. ab7-The product provided better quality compared to competitor of a similar type of product. ab11-The product improved customer satisfaction. ab12-Customers perceived that the product is more reliable compared to the competitors' product. ab13-The product improved customer loyalty.
Product development speed and cost performance	ab8-The product development cost met to the stated objectives. ab9-The product is launched within the stated deadlines. ab10-The product is launched in relatively shorter time than competitors.

As for the AC, the first factor analysis is conducted, and the result showed that item db6 has a cross-loading problem between the acquisition component and assimilation component with the factor loading value of .435 and .767 respectively (refer Appendix H4). Although the cross-loading problem is not major (since .435 is not a significant factor loading value), it is necessary to take a subsequent step to test the need to drop or retain the item. Therefore, the researcher runs the factor analysis again using OBLIQUE rotation based on the OBLIMIN rotation method to find a more simplified factor loading matrix. The result shows that the cross-loading problem of db6 does not exist in OBLIQUE rotation (refer Appendix H5). Furthermore, item db6 is indeed a relevant scale to measure the ability of employees in achieving the collective understanding of the acquired knowledge. Therefore, the researcher decided to retain the item db6. Table 4.14 illustrates the final result of factor analysis for AC with the OBLIQUE rotation - OBLIMIN rotation method.

Table 4.14
Summary of Exploratory Factor Analysis Result for Absorptive Capacity

Items	**Descriptions**	**Factor Loading**			
		Tr	**Ac**	**Ex**	**As**
dc5	Our employees have successfully linked existing knowledge with new insights.	.913			
dc4	Our employees are able to transform information from internal and external sources into valuable knowledge for our firm.	.906			
dc6	Our employees are able to create new knowledge based on the acquired knowledge.	.884			
dc3	Our employees are able to use and structure the collected knowledge.	.875			
dc1	In our firm, employees are able to store externally acquired knowledge for future references.	.743			
dc2	When recognising a business opportunity, our employees are proficient in reactivating existing knowledge for new uses.	.684			
da2	We able to acquire valuable knowledge through various external sources.		.921		
da3	We able to identify the valuable knowledge from various external sources.		.881		
da1	We are motivated to use various external knowledge sources.		.860		
da4	We able to select valuable knowledge obtained from various external sources.		.841		
da5	We able to classify the acquired knowledge in finer categories.		.692		
dd1	Our firm strives to convert acquired knowledge into commercial application.			.881	
dd2	Our employees are able to apply acquired knowledge for commercial purposes.			.855	
dd3	Our employees launch innovative products to the market with regard to the new knowledge that they have acquired.			.855	

Table 4.14 (Continued)

Items	Descriptions	Factor Loading			
		Tr	Ac	Ex	As
db4	In our firm, employees exchange new ideas and concepts in a cross-departmental manner.				.914
db3	In our firm, employees are willingly to share their knowledge, information and experiences with their colleagues.				.775
db5	We periodically organise cross-departmental meetings to interchange new developments, problems, and achievements.				.770
db6	In our firm, employees have the ability to understand the acquired knowledge based on their competencies, skills and experience.				.769
db7	Overall, we are able to achieve a collective understanding of the acquired knowledge.				.747
db2	We are using an information system as the tool to facilitate the spreading of knowledge throughout the firm.				.737
db1	We emphasise a shared language for intra-corporate communication.				.593
	Eigenvalues	10.376	2.519	1.923	1.291
	% of variance	49.407	11.993	9.156	6.149
	Cronbach's Alpha	0.947	0.922	0.908	0.913
	Kaiser-Meyer-Olkin	0.903			
	Bartlett's Test of Sphericity	2610.695			
	Df. (sig.)	210 (p< .001)			
	Cumulative variance %	76.705			

Note: Tr (Transformation), Ac (Acquisition), Ex (Exploitation), As (Assimilation)

In essence, the KMO value (MSA> .500) and Bartlett's Test of Sphericity (sig.< .05) of factor analysis for AC reach the threshold value as suggested by Hair et al. (2010) and Williams et al. (2010). Thus, it indicates that the correlation between the variables in the dataset is sufficient and appropriate for factor analysis. The four components (Acquisition-Ac, Assimilation-As, Transformation-Tr, Exploitation-Ex) explain a total variance of 76.71% (> 60% variance explained) and have the communalities items' value above the threshold value .500, thus, indicates the sufficient variance explaining the factors, and the items are accounted at least one-half of the variance by loading on a single factor. Moreover, the Cronbach's Alpha value for each of the components indicates more than .600, and this shows that the unidimensionality of the extracted components exists.

4.9 Reliability of External Knowledge Search Strategies

Reliability refers to the extent a measurement is consistent "across time and the various items in the instrument" (Sekaran, 2003, p. 203) and also the "accuracy and precision of a measurement procedure" (Cooper & Schindler, 2008, p. 289). The reliability of the independent variables used in this study is tested using SPSS software before entering to the PLS-SEM model analysis. The result of the reliability test is summarised in Table 4.15.

Table 4.15
Reliability of External Knowledge Search Strategies (N=136)

Variables	**Reliability**
Collaboration Breadth	0.618
Collaboration Depth	0.633
Information Search Breadth	0.770
Information Search Depth	0.758

4.10 Specifying the Path Model in PLS-SEM

The path model refers to the diagrams used to visualise the hypotheses and variable relationships that will be examined when SEM is applied (Hair, Ringle, & Sarstedt, 2011). The path model consists of two elements, that is, structural model (inner model) and measurement models (outer models). The following sub-sections discuss the structural model and the measurement models in this study.

4.10.1 Measurement Models (Outer Models)

Measurement models are developed based on theory and it is used to determine how the latent variables constructs are measured. There are two types of measurement models, namely, the reflective measurement model and the formative measurement model. The reflective measurement model is based on the idea that latent constructs cause the measured variable, whereas, the formative measurement model is based on the idea that the measured variables cause the constructs. Typically, for reflective construct, all items are related conceptually due to the common cause, the domain of the items representative sample of potential items, and expectation of collinearity among items. On the other hand, the formative construct is formed from items. Thus, the items are not necessarily related and there is no expectation of collinearity among the items. Also, the domain of the items consists of all possible items rather than a representative sample of potential items.

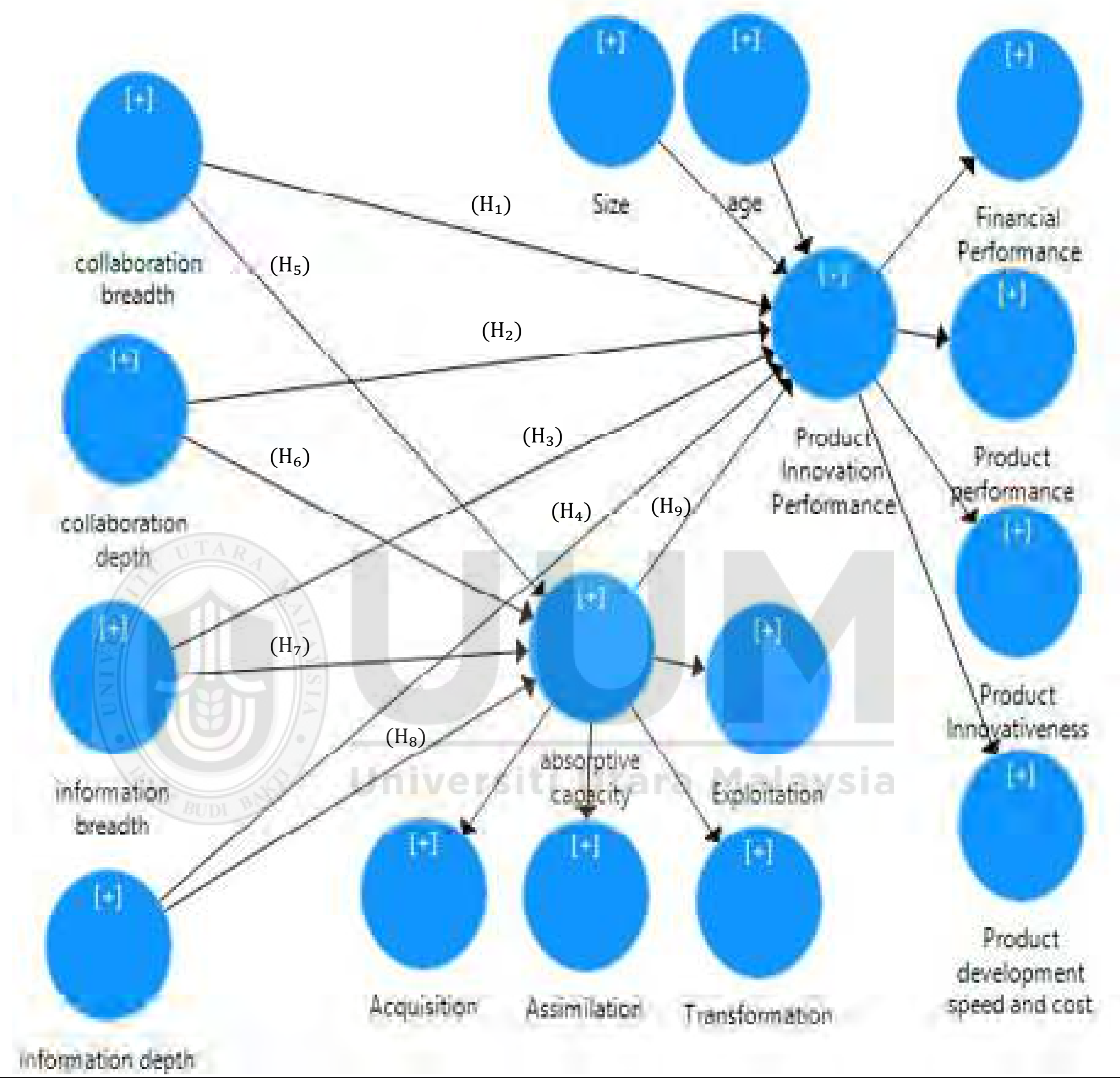
All the measurement variables in this study used the reflective measurement model, except the independent variables (collaboration depth, collaboration breadth, information search depth, information search breadth). Collaboration breadth and information search breadth are measured by the sum of the knowledge sources used, whereas collaboration depth and information search depth are measured by averaging the sum of the level of importance for each knowledge sources used (Likert scale 1-8). All these variables produced a single metric scale. Hence, these variables are neither the reflective nor formative type of construct. Indeed, the use of a single metric scale for all the independent variables is relevant, since the measurement of all the independent variables are based on the common list stated by OECD (2005, p. 81). In practice, “a single metric measurement scale can be used when an attribute is judged to be concrete” (Rossiter, 2002, p. 313).

In this study, the mediator - AC and dependent variable - PIP are the higher order factor model or hierarchical component model (HCM). The HCM is explicitly representations of multidimensional constructs that exist at a higher level of abstraction and is expected to influence other related constructs in the similar way of abstraction (Chin, 1998; Becker, Klein, & Wetzels, 2012; Hair et al., 2014). The key requirement to operationalise multidimensional concepts for a variable is derived from theories and past research (Becker et al., 2012). Typically, past research indicated that both AC and PIP are multidimensional concepts rather than unidimensional concepts.

According to Ringle et al. (2012), each of the HCM types is characterised by the nature of the relationship between higher order components (HOC) and lower order components (LOC), and the relationship between the constructs (LOCs) and their indicators. In this study, AC and PIP are characterised as a reflective-reflective type of HCM. A reflective-reflective type of HCM constructs represents the common factor of several specific factors (Lohmoller, 1989). In other words, this means that the HOC is reflected by LOCs, whereas the indicators (each item related to the sub-dimensions) reflect the LOC. This type of HCM is useful to investigate the correlation between the LOCs (whether the sub-dimensions can be held under the HOC), and it offers means to establish a more parsimonious model (Hair et al., 2010; Hair et al., 2014).

4.10.2 Structural Model (Inner Model)

The structural model in PLS-SEM, or inner model, shows the path diagram of the relationships between the variables. The purpose of establishing the structural model is to test the hypotheses developed in the study. The structural model has two classes of latent variables, namely exogenous and endogenous variables. Figure 4.1 illustrates the structural model of this study.



Note:
H_{10} mediation effect AC on CB and PIP
H_{11} mediation effect AC on CD and PIP
H_{12} mediation effect AC on IB and PIP
H_{13} mediation effect AC on ID and PIP

Control: Firm size, Firm age

Figure 4.1
Smart PLS Path Model (Representing the Structural Model of the Study)

The structural model shows in Figure 4.1 having four exogenous variables (collaboration breadth and depth, and information search breadth and depth), and two endogenous variables (AC and PIP). Intensively, the structural model of this study consists of relationships of HOC-AC with four subdimensions - LOCs (acquisition, assimilation, transformation, and exploitation), and relationships of HOC-PIP with four subdimensions (financial performance, product performance, product innovativeness and product development speed and cost). The LOCs of AC and PIP are assigned to the reflective measurement model of the HOC in the structural model. Hence, the HOC (AC and PIP that are reusing the indicators of the LOCs) is directly related to its actionable drivers and its consequences in the PLS path model. On the other hand, the structural model showed two control variables in this study, namely firm size and firm age. Both control variables pointed the arrow head on a PIP-exogenous variable in the designed structural model. There are in total nine pathways in the structural model. Each of the modelled paths is purposely designed to test the hypotheses of the study.

4.11 Evaluation of Measurement Model

The measurement model in this study is reflective in nature. The reflective measurement model should be assessed on their reliability and validity. Following the guidelines provided by Hair et al. (2014), the reflective measurement model has to check with the internal consistency reliability, convergent validity (factor loading, Cronbach's Alpha, composite reliability, average variance extracted), and discriminant validity (Fornell-Larcker criterion). Since this study has two HCMs (AC and PIP), the measurement model needs to assess at the first order (the reflective relationship between LOCs and the items related to it), and the second order (the reflective relationship between HOC and LOCs). The following subsections present the findings of reliability and validity of the measurement model for this study.

4.11.1 Internal Consistency Reliability and Indicator Reliability

Assessment of reflective measurement model required assessment of internal consistency reliability (Hair et al., 2014). Internal consistency reliability is the measure of "indicative of the homogeneity of the items in the measure that taps the construct" (Sekaran & Bougie, 2013, p. 229). There are two methods used in assessing the internal consistency reliability, namely Cronbach's Alpha and composite reliability. Cronbach's Alpha measures the reliability based on inter-correlations between the observed indicators (Blunch, 2013). The Cronbach's Alpha assumed "the equivalency of items' loadings and uncorrelated error scores" (Yang & Green, 2011, p. 379). Indeed, items do not often have equivalent loadings to a single latent factor and thus do have the same variance (Raykov, 1997). In this sense, the use of alpha values can lead to a biased estimate of reliability (Shevlin, Miles, Davies, & Walker, 2000).

Owing to the limitation of Cronbach's Alpha, it is more appropriate to apply composite reliability rather than the Cronbach's Alpha for internal consistency reliability test. Composite reliability takes account of the individual contribution of each latent factor to each item and each item's error; this indicates that this method is based on proportions of variance rather than the common variance of latent factors (Bentler, 2007). In other words, this method takes into account of different indicators' factor loading (also called outer loading in Smart PLS) to evaluate the extent of a variable or a set of variables is consistent with what it intends to measure. According to the guideline provided by Hair et al. (2014), composite reliability should not be lower than .600, while the value above .800 or .900 in more advanced stages of research is regarded as satisfactory. As the composite reliability accounted the individual contribution of each item and item's error, the reliability of each indicator should be assessed. By following the guideline provided by Hair et al. (2014), the outer loading of the items should be above .708 to represent the construct exerted satisfactory internal consistency reliability. The Table 4.16 showed the measurement model result of this study.

Table 4.16
Measurement Model Result

Factors	**Factor Loading**	**Standard Error**	**t**	**α**	**CR**	**AVE**
AC				0.947	0.953	
Acquisition				0.922	0.942	0.764
da1	0.796***	0.057	14.034			
da5	0.841***	0.028	29.721			
da2	0.884***	0.030	29.288			
da4	0.918***	0.015	63.114			
da3	0.925***	0.014	66.815			
Assimilation				0.916	0.934	0.670
db1	0.701***	0.050	13.961			
db2	0.713***	0.052	13.29			
db5	0.787***	0.042	18.707			
db3	0.840***	0.027	31.003			
db7	0.885***	0.020	46.325			
db6	0.886***	0.020	44.819			
db4	0.894***	0.021	43.967			
Transformation				0.947	0.958	0.793
dc2	0.845***	0.028	30.090			
dc6	0.870***	0.020	42.502			
dc1	0.874***	0.021	41.799			
dc3	0.888***	0.023	38.996			
dc5	0.926***	0.012	77.773			
dc4	0.936***	0.011	82.248			
Exploitation				0.909	0.943	0.846
dd1	0.895***	0.025	35.122			
dd3	0.921***	0.018	52.520			
dd2	0.943***	0.011	84.478			

Table 4.16 (Continued)

Factors	Factor Loading	Standard Error	t	α	CR	AVE
PIP				0.914	0.923	
Financial performance				0.960	0.971	0.892
aa2	0.926***	0.019	48.220			
aa1	0.939***	0.014	67.484			
aa4	0.953***	0.010	99.663			
aa3	0.960***	0.007	129.660			
Product Performance				0.890	0.919	0.695
ab6	0.802***	0.030	26.347			
ab7	0.803***	0.039	20.494			
ab13	0.848***	0.029	29.046			
ab11	0.851***	0.032	26.419			
ab12	0.862***	0.030	29.136			
Product Innovativeness				0.923	0.945	0.813
ab14	0.860***	0.033	26.463			
ab15	0.893***	0.023	38.988			
ab16	0.922***	0.019	47.298			
ab17	0.929***	0.016	56.608			
Product Development Speed and Cost				0.785	0.874	0.697
ab10	0.832***	0.037	22.453			
ab9	0.835***	0.036	23.356			
ab8	0.838***	0.022	37.305			
Collaboration breadth	1.000	0.000	0.000		1.000	1.000
Collaboration depth	1.000	0.000	0.000		1.000	1.000
Information search breadth	1.000	0.000	0.000		1.000	1.000
Information search depth	1.000	0.000	0.000		1.000	1.000
Firm Size	1.000	0.000	0.000		1.000	1.000
Firm Age	1.000	0.000	0.000		1.000	1.000

Note: Significant level (*** p<.001), t - t value, CR- Composite Reliability, α-Alpha value, AVE-Average Variance Extracted value

The Table 4.16 showed that all items' outer loading are significant at the level of .001, and the value is above the suggested threshold value of .708, except item db1. Indeed, item db1 recorded an outer loading of 0.701 and this value is close enough to 0.708, thus it is acceptable. This indicated that the items used to represent the latent variable had satisfactory internal consistency reliability. Moreover, the value of composite reliability for each latent variables range from .874 to .971 also indicates that the variables have satisfactory internal consistency reliability.

4.11.2 Convergent Validity

Convergent validity is established to measure the correlation with two different instruments that are measuring the same concept (Sekaran & Bougie, 2013). In order to establish convergent validity, the items for a particular variable should converge or share a high proportion of variance (Hair et al., 2014). Table 4.17 illustrates the items' outer loading table.

Based on Table 4.17, each item loads more highly on its own variable than on other variables. This indicates that all variables share more variance with its own measured items rather than with other variables. Other than the assessment of outer loading, average variance extracted value is the common method used to assess the convergent validity by measuring the degree to which a latent variable explains the variance of the indicators (Zait & Bertea, 2011). The AVE displays values ranging from .670 to .892, which exceeded the recommended threshold value .500. This indicates that the measurement model of this study demonstrated adequate convergent validity.

Table 4.17
Loadings and Cross-Loadings of Items

	FP	PDCS	PP	PI	Acc	AS	TS	Ex	IB	ID	CD	CB	Age	Size
aa1	**0.94**	0.27	0.36	0.21	0.23	0.35	0.24	0.19	0.08	0.07	0.18	0.21	0.00	0.21
aa2	**0.93**	0.28	0.42	0.30	0.30	0.32	0.17	0.11	0.17	0.04	0.18	0.24	0.02	0.22
aa3	**0.96**	0.28	0.46	0.28	0.25	0.39	0.27	0.21	0.17	0.05	0.23	0.20	0.10	0.21
aa4	**0.95**	0.34	0.47	0.29	0.27	0.41	0.31	0.30	0.19	0.04	0.23	0.22	0.06	0.22
ab10	0.18	**0.83**	0.45	0.28	0.19	0.24	0.21	0.18	0.14	0.12	0.16	0.08	0.20	0.07
ab8	0.35	**0.84**	0.56	0.34	0.26	0.41	0.43	0.31	0.15	0.09	0.25	0.21	0.12	0.21
ab9	0.22	**0.84**	0.41	0.31	0.09	0.21	0.17	0.29	0.09	0.07	0.09	0.01	0.18	0.19
ab11	0.40	0.52	**0.85**	0.40	0.33	0.43	0.44	0.36	0.16	0.13	0.36	0.29	0.01	0.15
ab12	0.32	0.55	**0.86**	0.39	0.40	0.42	0.45	0.41	0.34	0.03	0.32	0.34	0.09	0.11
ab13	0.45	0.53	**0.85**	0.37	0.41	0.45	0.44	0.41	0.25	0.15	0.33	0.24	0.06	0.12
ab6	0.44	0.43	**0.80**	0.51	0.40	0.39	0.40	0.24	0.27	0.07	0.30	0.33	0.12	0.26
ab7	0.28	0.37	**0.80**	0.42	0.32	0.27	0.30	0.20	0.26	-0.02	0.31	0.26	0.08	0.27
ab14	0.30	0.33	0.43	**0.86**	0.39	0.25	0.20	0.25	0.24	0.06	0.31	0.31	0.09	0.13
ab15	0.22	0.46	0.47	**0.89**	0.37	0.36	0.35	0.29	0.27	0.10	0.37	0.34	0.06	0.07
ab16	0.27	0.24	0.42	**0.92**	0.36	0.25	0.24	0.24	0.24	0.06	0.24	0.26	0.01	0.18
ab17	0.25	0.31	0.48	**0.93**	0.32	0.34	0.33	0.29	0.24	0.06	0.36	0.29	0.04	0.19
da1	0.20	0.16	0.31	0.30	**0.80**	0.32	0.26	0.31	0.32	0.08	0.31	0.29	0.03	-0.01
da2	0.23	0.20	0.36	0.34	**0.88**	0.38	0.35	0.33	0.35	0.12	0.29	0.29	0.04	-0.02
da3	0.24	0.16	0.39	0.39	**0.92**	0.51	0.43	0.33	0.29	0.18	0.33	0.40	0.00	0.01
da4	0.26	0.19	0.44	0.34	**0.92**	0.53	0.42	0.37	0.37	0.08	0.34	0.45	0.03	0.05
da5	0.28	0.25	0.44	0.38	**0.84**	0.51	0.47	0.42	0.35	0.16	0.33	0.42	-0.08	0.07
db1	0.18	0.24	0.32	0.22	0.49	**0.70**	0.46	0.45	0.10	0.23	0.21	0.17	0.00	-0.03
db2	0.18	0.15	0.19	0.26	0.43	**0.71**	0.40	0.28	0.25	0.12	0.26	0.26	0.00	-0.08
db3	0.37	0.30	0.37	0.26	0.46	**0.84**	0.56	0.30	0.11	0.19	0.28	0.18	-0.06	0.02
db4	0.40	0.30	0.42	0.30	0.42	**0.89**	0.55	0.29	0.16	0.09	0.33	0.18	-0.04	0.08
db5	0.37	0.30	0.42	0.33	0.37	**0.79**	0.53	0.37	0.25	0.08	0.39	0.23	-0.06	0.19
db6	0.34	0.35	0.46	0.26	0.38	**0.89**	0.66	0.39	0.21	0.09	0.34	0.18	0.00	0.17
db7	0.36	0.35	0.51	0.29	0.46	**0.88**	0.64	0.47	0.24	0.07	0.31	0.25	-0.03	0.11
dc1	0.18	0.30	0.42	0.21	0.41	0.62	**0.87**	0.52	0.24	0.17	0.26	0.20	-0.09	0.10
dc2	0.24	0.33	0.51	0.29	0.43	0.59	**0.84**	0.54	0.26	0.18	0.29	0.26	-0.03	0.18
dc3	0.23	0.29	0.40	0.30	0.43	0.60	**0.89**	0.45	0.30	0.20	0.26	0.22	-0.02	0.15
dc4	0.29	0.33	0.47	0.31	0.42	0.61	**0.94**	0.52	0.25	0.19	0.31	0.21	-0.02	0.16
dc5	0.25	0.27	0.41	0.28	0.36	0.58	**0.93**	0.55	0.16	0.25	0.27	0.17	-0.04	0.15
dc6	0.23	0.30	0.41	0.26	0.35	0.58	**0.87**	0.44	0.16	0.20	0.26	0.16	0.06	0.16
dd1	0.12	0.23	0.35	0.32	0.41	0.34	0.44	**0.89**	0.42	-0.01	0.19	0.33	0.00	-0.07
dd2	0.26	0.38	0.39	0.26	0.35	0.46	0.57	**0.94**	0.30	0.10	0.23	0.21	0.11	0.09
dd3	0.21	0.25	0.35	0.25	0.36	0.43	0.55	**0.92**	0.30	0.09	0.17	0.26	-0.03	0.06
IB	0.16	0.15	0.31	0.27	0.39	0.23	0.26	0.37	**1.00**	-0.21	0.30	0.59	0.14	0.10
ID	0.05	0.11	0.09	0.07	0.14	0.15	0.22	0.07	-0.21	**1.00**	0.13	-0.15	0.08	-0.14
CD	0.21	0.21	0.39	0.35	0.37	0.37	0.31	0.21	0.30	0.13	**1.00**	0.37	0.01	0.12
CB	0.23	0.13	0.35	0.33	0.43	0.25	0.23	0.29	0.59	-0.15	0.37	**1.00**	0.03	0.09
Age	0.05	0.20	0.08	0.06	0.00	-0.03	-0.03	0.03	0.14	0.08	0.01	0.03	**1.00**	0.33
Size	0.23	0.19	0.21	0.16	0.03	0.08	0.17	0.03	0.10	-0.14	0.12	0.09	0.33	**1.00**

Note: FP-Financial Performance, PDSC-Product Development Speed and Cost, PP-Product Performance, PI-Product Innovativeness, Ac-Acquisition, As-Assimilation, Tr-Transformation, Ex-Exploitation, CB-Collaboration Breadth, CD-Collaboration Depth, IB-Information Search Breadth, ID-Information Search Depth, Size- Firm Size, Age-Firm Age.

4.11.3 Discriminant Validity

Discriminant validity is established to examine the extent of a construct to truly distinct from other constructs (Hair et al., 2014). Discriminant validity can be conducted through two methods, firstly, examine the cross-loadings of the indicators, and secondly, use the Fornell-Larcker criterion to compare the latent variable correlations with each variable's square root of AVE. Refer to the Table 4.17, where there is no cross-loading issue especially the item's outer loadings being greater than all of its loadings on other variables. The greater correlation of the items on its own variable indicates that the measurement model has established discriminant validity. On the other hand, the Fornell-Larcker criterion is the approach to assess the discriminant validity based on the idea that a variable should share more variance with its associated indicators than with any other construct (Hair et al., 2014). The Table 4.18 shows the result of Fornell-Larcker criterion assessment.

The Smart PLS software does not calculate the value of square roots of AVE. Thus, square roots of AVE are calculated manually. Based on the Fornell-Larcker criterion result, the value of square roots of AVE exceeded the intercorrelation value between the variables. The values in the parentheses represent the square root of AVE for each variable, whereas the rest represents the intercorrelation value between the variables. Based on Table 4.18, the diagonal value (square root of AVE) is greater than the intercorrelation value between the variables. Hence, it is confirmed that the Fornell-Larcker criterion assessment is met.

Table 4.18
Discriminant Validity Based on Fornell-Larcker Criterion Assessment

	AS	Acc	Ex	FP	PDSC	PI	PP	TS	CB	CD	Age	Size	IB	ID
AS	(0.82)													
Acc	0.52	(0.87)												
Ex	0.45	0.40	(0.92)											
FP	0.39	0.28	0.22	(0.94)										
PDSC	0.35	0.22	0.31	0.31	(0.84)									
PI	0.33	0.40	0.30	0.29	0.37	(0.90)								
PP	0.48	0.45	0.39	0.45	0.58	0.50	(0.83)							
TS	0.67	0.45	0.57	0.26	0.34	0.31	0.49	(0.89)						
CB	0.25	0.43	0.29	0.23	0.13	0.33	0.35	0.23	n/a					
CD	0.37	0.37	0.21	0.21	0.21	0.35	0.39	0.31	0.37	n/a				
Age	-0.03	0.00	0.03	0.05	0.20	0.06	0.08	-0.03	0.03	0.01	n/a			
Size	0.08	0.03	0.03	0.23	0.19	0.16	0.21	0.17	0.09	0.12	0.33	n/a		
IB	0.23	0.39	0.37	0.16	0.15	0.27	0.31	0.26	0.59	0.30	0.14	0.10	n/a	
ID	0.15	0.14	0.07	0.05	0.11	0.07	0.09	0.22	-0.15	0.13	0.08	-0.14	-0.21	n/a

Note: FP-Financial Performance, PDSC-Product Development Speed and Cost, PP-Product Performance, PI-Product Innovativeness, Ac-Acquisition, As-Assimilation, Tr-Transformation, Ex-Exploitation, CB-Collaboration Breadth, CD-Collaboration Depth, IB-Information Search Breadth, ID-Information Search Depth, Size- Firm Size, Age-Firm Age.

4.11.4 Hierarchical Component Measurement Model Assessment

After the assessment of first order constructs' reliability and validity, the second order constructs' reliability and validity could now be estimated. In this research, there are two hierarchical component measurement model- HCMs, namely AC and PIP. Based on the Table 4.16, the composite reliability and AVE of each of the second order constructs are above or close to the threshold value of .708 and .500 respectively. As a result, the second-order constructs for this research recorded a satisfactory reliability and convergent validity.

On the other hand, Hair et al. (2014) suggested that to establish a reflective-reflective HCM, the LOCs should be sufficiently highly correlated for HOC, and are able to explain more than 50% of each of LOC's variance. Based on Table 4.19, for AC (HOC), the R^2 of transformation, assimilation, and acquisition are greater than 50% threshold as suggested by Hair et al. (2014). Although exploitation explains 47.2% of the variance for AC (HOC), however, the correlation of exploitation shows significant and moderately strong correlation with PIP (r≈0.7) and this indicates that exploitation is a lower order component for AC. The Table 4.19 shows the correlation between AC (HOC), and transformation, assimilation, acquisition, and exploitation (LOCs) are significant in the range of .687 to .876. This result suggests that transformation, assimilation, acquisition, and exploitation (LOCs) are distinct, yet interrelated factors that may reflect the conceptualised AC (HOC).

Table 4.19
Higher Order Constructs Measurement Model Result

HOC / **LOCs**	**Absorptive Capacity (AC)**	**Product Innovation Performance (PIP)**
Transformation	r=0.876*** (t=43.529), (R^2=76.8%)	
Assimilation	r=0.871*** (t=39.081), (R^2=75.9%)	
Acquisition	r=0.721*** (t=12.210), (R^2=52.1%)	
Exploitation	r=0.687*** (t=12.303), (R^2=47.2%)	
Product Performance		r=0.873*** (t=40.857), (R^2=76.2%)
Product Innovativeness		r=0.724*** (t=15.241), (R^2=52.4%)
Financial Performance		r=0.695*** (t=11.740), (R^2=48.3%)
Product development speed and cost		r=0.693*** (t=14.712), (R^2=48.0%)

Note: r=Correlation coefficient, t=t-statistic, R^2=Variance explain, ***=Significant level ($p<0.001$)

On the other hand, PIP shows that the R^2 of product performance and product innovativeness (LOCs) are greater than 50% threshold as suggested by Hair et al. (2014). Although financial performance and product development speed and cost recorded 48.3% and 48.0% respectively of the variance for PIP, however, the correlation of both LOCs show significant and moderately strong correlation with PIP ($r \approx .7$) and this indicates that financial performance and product development speed and costs are suitable to be treated as a lower order component for PIP. In sum, Table 4.19 shows that all of PIP LOCs are significantly correlated with its HOC within the range of .693 to .873. Intensively, this result suggests that product performance, product innovativeness, financial performance, and product development speed and cost (LOCs) are distinct, yet interrelated factors that may reflect the conceptualised PIP (HOC).

4.12 Evaluation of Structural Model

The next step is to test the structural model of the study after the measurements are found to be valid and reliable. Before assessing the structural model, it is essential to examine the structural model for collinearity issues because a significant level of collinearity among the predictor constructs (independent variable) can cause a biased estimation of path coefficients. Subsequently, the predictive power of the structural model is assessed by the R^2 value of the endogenous constructs, f^2 effect size, the predictive relevance of Q^2 and q^2 that effect size. The following subsections discuss each of the criterions stated.

4.12.1 Collinearity Diagnostic for Independent Variables in Structural Model

The high correlation between two or more independent variables can cause the independent variable to be linearly predicted from another independent variable with a substantial degree of accuracy. This reduces the validity of the model prediction and causes the inaccurate path coefficients' estimation. Smart PLS does not provide the collinearity diagnostic for independent variables like SPSS. Thus, the SPSS software is used to conduct the collinearity diagnostic of independent variables for the structural model in this study. Table 4.20 illustrates the result of the collinearity diagnostic of independent variables in the structural model.

Table 4.20
Collinearity Diagnostic of Independent Variables in Structural Model

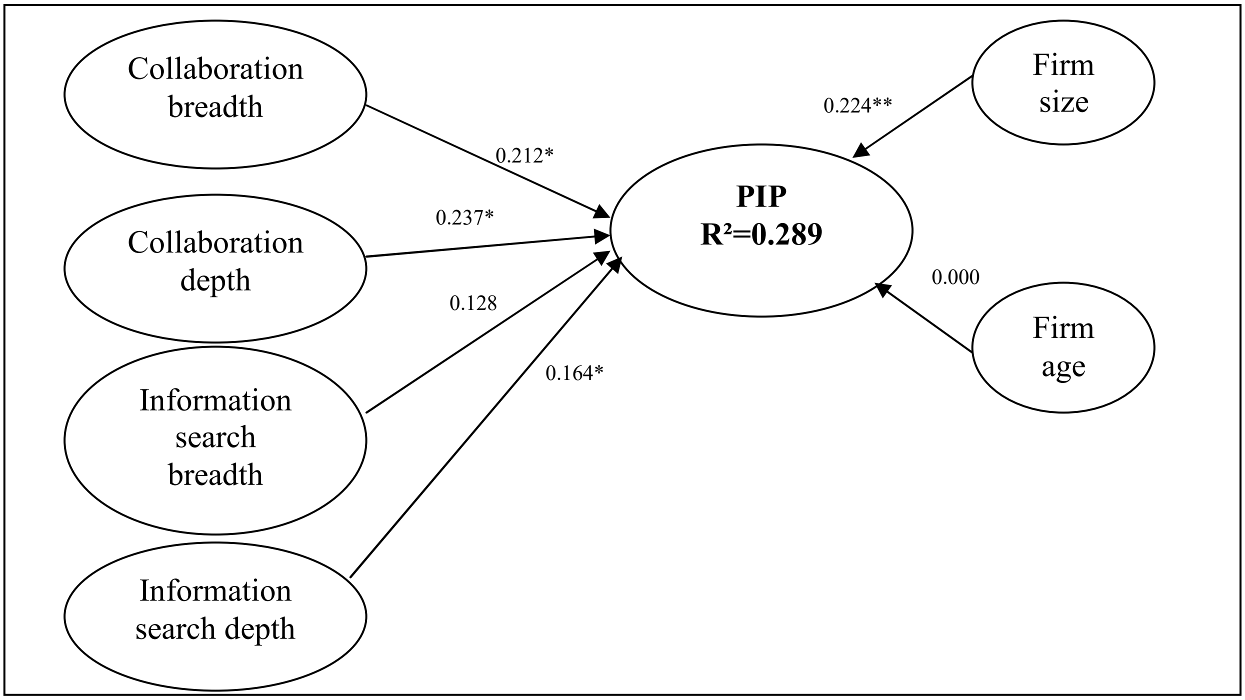
Endogenous	**Exogenous**	**Tolerance**	**VIF**
PIP	AC	.708	1.412
	Collaboration Depth	.767	1.304
	Information Search Depth	.846	1.182
	Collaboration Breadth	.591	1.691
	Information Search Breadth	.594	1.684
AC	Collaboration Depth	.815	1.228
	Information Search Depth	.910	1.099
	Collaboration Breadth	.605	1.653
	Information Search Breadth	.627	1.594

Note: VIF-Variance Inflation Factor

Table 4.20 showed the collinearity diagnostic of independent variables for two endogenous variables that are PIP and AC. The result shows that all independent variables' tolerance values are above .200, and VIF values are below 5.000 respectively. Indeed, this indicates that the structural model does not encounter multicollinearity problems.

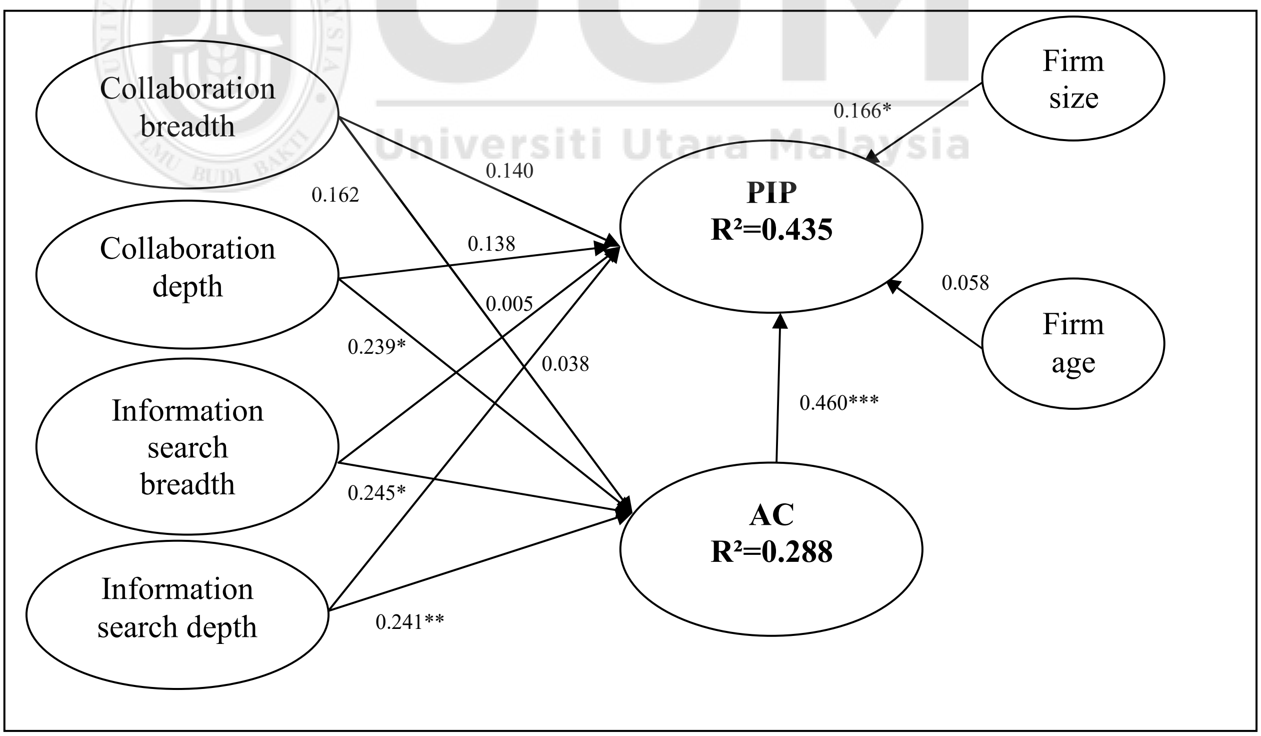
4.12.2 Structural Model Assessments

This study investigates the mediation effect of AC on the relationship between external knowledge search and PIP. Following the recommendation suggested by Hair et al. (2014), this study established two structural models to test the hypotheses of this study. Figure 4.2 shows the result of Model 1, which excluded the mediator - AC. All independent variables (collaboration breadth, collaboration depth, information search breadth, and information search depth) in Model 1 pointed its arrow-head directly on dependent variables (PIP). Figure 4.3 shows the result of Model which includes AC as a mediator between independent variables (collaboration breadth, collaboration depth, information search breadth, and information search depth) and dependent variable (PIP). All of the independent variables have an arrow pointed to AC and PIP in Model 2.



Note: Significant level (* p< .05), (**p< .01), (*** p< .001).

Figure 4.2
The Results of the Structural Model- Model 1(Without Mediation)



Note: Significant level (* p< .05), (**p< .01), (*** p< .001).

Figure 4.3
The Results of the Structural Model- Model 2 (With Mediation)

Based on Figure 4.2, Model 1 comprises only of four main direct connections. All of the four independent variables (collaboration breadth, collaboration depth, information search breadth, and information search depth) with two control variables (firm size and firm age) explain 28.9% (R^2 = .289) of the variance in PIP. On the other hand, Figure 4.3 shows the Model 2 independent variables (collaboration breadth, collaboration depth, information search breadth, and information search depth) with two control variables (firm size and firm age) can explain 28.8% (R^2 = .288) of the variance in AC. Collaboration breadth, collaboration depth, information search breadth, information search depth, and AC with two control variables (firm size and firm age) explain 43.5% (R^2 = .435) variance on PIP. The R^2 value of PIP for Model 2 is greater compared to Model 1 (from R^2 = .289 to R^2 = .435). This result suggests that the model with AC as the mediator explains greater variance for PIP, and hence have better predictive powers compared to Model 1 (exclude mediator). The contribution of R^2 in Model 2 implies that the model satisfies the requirement of Falk and Miller (1992) who stated that the value of R^2 must be higher than the required minimum of R^2 = .100.

After assessing the explanatory power of the models, the structural model coefficient results for hypothesis testing is discussed. Table 4.21 shows the results of the structural model assessment of Model 1 and Model 2.

Table 4.21
The Results of the Structural Model Assessment

	Model 1			Model 2		
R^2 for PIP	.289			.435		
Adjusted R^2 for PIP	.256			.404		
R^2 for AC				.288		
Adjusted R^2 for AC				.266		
	Path Coefficient/ Standardised Betas (*β*)	**Std. error**	**t value**	**Path Coefficient/ Standardised Betas (*β*)**	**Std. error**	**t value**
Effect						
Collaboration breadth -> PIP	0.212*	0.093	2.270	0.140	0.094	1.494
Collaboration depth -> PIP	0.237*	0.115	2.061	0.138	0.094	1.467
Information search breadth -> PIP	0.128	0.095	1.349	0.005	0.093	0.051
Information search depth -> PIP	0.164*	0.082	2.005	0.038	0.067	0.575
Collaboration breadth -> AC				0.162	0.084	1.933
Collaboration depth -> AC				0.239*	0.120	1.984
Information search breadth -> AC				0.245*	0.103	2.370
Information search depth -> AC				0.241**	0.086	2.797
AC -> PIP				0.460***	0.092	4.974
Size -> PIP (control variable)	0.224**	0.080	2.792	0.166*	0.078	2.134
Age -> PIP (control variable)	0.000	0.008	0.997	0.058	0.070	0.824

Note: Significant level (* p< .05), (**p< .01), (*** p< .001).

Table 4.21 (Model 1) shows that collaboration breadth is positively and significantly related to PIP (*β*= .212*,* t= 2.270, *p*< .05*).* Similarly, collaboration depth and information search depth is positively and significantly related to PIP with the value of (*β*= .237, t= 2.061, *p*< .05*)* and (*β*= .164, t= 2.005, *p*< .05*)* respectively. On the other hand, information search breadth did not have significant effects on PIP and indicated that the path coefficient value is *β*= .128 (t= 1.349). According to Hair et al. (2014), an easy way to detect the mediation effect is to determine the significance of the relationship between independent variables and dependent variable (as the first condition) in a study. This study has three significant direct relationships in Model 1 (collaboration breadth and PIP, collaboration depth and PIP, and information search depth and PIP), thus, warrant for a subsequent test to be carried out to determine the mediation effect in the model.

When including a mediator in the model, the direct effects between all of the four independent variables (collaboration breadth, collaboration depth, information search breadth, and information search depth) and PIP become not significant. Although Model 1 shows significant relationship of collaboration breadth, information search breadth, and information search depth with PIP, however, with the inclusion of mediator-AC in Model 2, these significant relationships turn into insignificant relationships. This indicates that the AC may absorb the effect of direct paths between independent variables and dependent variables. These results indicate failure to support H_1 (*β*= .140*,* t= 1.494), H_2 (*β*= .138*,* t= 1.467), H_3 (*β*= .005*,* t= .051), and H_4 (*β*= .038*,* t= .575).

For the indirect path between independent variables and the mediator, and the mediator and dependent variable, the result in Table 4.21 shows that collaboration depth has a significant relationship with AC (*β*= .239*,* t= 1.984, *p*< .05*).* In addition, information search breadth and information search depth also have significant relationships with AC with the value of (*β*= .245*,* t= 2.370, *p*< .05*)* and (*β*= .241*,* t= 2.797, *p*< .01*)* respectively. These results imply the support for H_6, H_7 and H_8. However, in the Model 2, collaboration breadth does not show a significant relationship with AC (*β*= .162, t= 1.933), hence, H_5 is not supported. Moreover, indirect path for AC and PIP signify a significant relationship with the value of (*β*= .460, t= 4.974, *p*< .001). Therefore, the result indicates the support for H_9.

Hair et al. (2014) suggested that a significant direct relationship between independent variables and dependent variables (excluding the mediator) is the first condition to determine the possibility of the existence of a mediation effect. However, Hayes (2012) stated that significant direct effects do not necessarily act as the first condition in determining the mediation effect. In other words, they stated that, without direct effects between independent variables and dependent variables (excluding the mediator), the mediation effect could still exist in the model testing. Therefore, following their suggestion, the subsequent mediation test is applied in this study. Typically, the mediation effect can be examined through the indirect effect (the direct path between the independent variable and mediator multiplied with the direct path between the mediator and dependent variable). There are various methods to test the indirect effects, including Sobel test (Sobel, 1982), distribution of product methods (MacKinnon, Fritz, Williams, &

Lockwood, 2007) and bootstrapping (Preacher & Hayes, 2004, 2008). This study used the bootstrapping method to test the mediating effects.

Following Preacher and Hayes (2004, 2008), the bootstrap of sampling distribution for indirect effects is suitable to be applied for simple and multiple mediator models. Indeed, bootstrapping makes no assumptions on sampling distribution, which indicates that this method is non-parametric based. Therefore, it can be concluded that this approach is perfectly suited to the PLS-SEM method. Accordingly, this study applies the bootstrapping procedure with 5,000 subsamples and no sign change, with the 'confidence interval Method-Bias-Corrected 95% bootstrap confidence interval' to test the indirect effect for Model 2. The confidence interval method-Bias-Corrected is selected because this method provides more accurate Type I error rates and have greater power for detecting indirect effects compare to other stated methods (Preacher & Hayes, 2008). Based on the structural model bootstrapping result for both direct effect (Appendix J) and indirect effect (Appendix K), the Table 4.22 shows the summary of the mediation analysis.

Table 4.22
Summary of Mediation Analysis

	Total Effect	Direct Effect	Indirect Effect					
	a.b+c´	(a/b/c´)	(a·b)	Std. error	t value	p value	Percentile (CI)	
							Lower 2.5%	Upper 97.5%
Hypothesized Effect								
Collaboration breadth -> PIP		0.140						
Collaboration depth -> PIP		0.138						
Information search breadth -> PIP		0.005						
Information search depth -> PIP		0.038						
Collaboration breadth -> AC		0.162						
Collaboration depth -> AC		0.239*						
Information search breadth -> AC		0.245*						
Information search depth -> AC		0.241**						
Collaboration breadth -> AC -> PIP	.214		0.074	0.042	1.783	0.075	0.002	0.164
Collaboration depth -> AC -> PIP	.248		0.110*	0.053	2.090	0.037	-0.002	0.205
Information search breadth -> AC -> PIP	.118		0.113*	0.054	2.082	0.037	0.013	0.225
Information search depth -> AC -> PIP	.149		0.111*	0.050	2.219	0.027	0.027	0.218
AC -> PIP		0.460***						
Size -> PIP (control variable)		0.166*						
Age -> PIP (control variable)		0.058						

Note: Significant level (* $p < .05$), (** $p < .01$), (*** $p < .001$).

Referring to Table 4.22, there are only three significant indirect effects in this study. Typically, information search breadth and information search depth show a significant indirect effect on PIP with the value of (β= .113, t= 2.082, p< .05) and (β= .111, t= 2.219, p< .05) respectively. Furthermore, collaboration depth also shows positive and significant indirect relationships with PIP with the path coefficient of (β= .110, t= 2.090, p< .05). On the other hand, collaboration breadth does not have a significant indirect effect on PIP with the value of (β= .074, t= 1.783).

The total effect is calculated in this study to focus solely on the underlying mediation process, thus, the significance test for the total effect should not be used as a prerequisite for the test of indirect effects (Loeys, Moerkerke, & Vansteelandt, 2014). Thus, the total effect displayed in Table 4.22 is simply used to examine the size of the mediation effect by calculating the size of indirect effects relative to the total effect - variance accounted for (VAF) in the model (Hair et al., 2014). The VAF value is in the range between 0 and 1 while the higher results indicate stronger mediation effects. The VAF for the information search breadth-AC-firm's PIP is .958 and thus indicates that 95.8% of information search breadth's effects on a firm's PIP is explained via the AC. This result indicates full mediation effects of the role of AC in the relationship between information search breadth and PIP, thus, provide support for H_{12}.

On the other hand, the VAF for the information search depth-AC-firm's PIP is .745 and thus indicates that 74.5% of information search depth's effects on firm's PIP is explained via the AC. This result indicates partial mediation effects (VAF < 80%) of the role of AC in the relationship between information search breadth and PIP, thus, provide partial support for H_{13}. Moreover, the VAF value for collaboration depth-AC-firm's PIP is .444, which indicates only 44.4% of collaboration depth effects on a firm's PIP is explained via the AC. Indeed, this result suggests that the exits of mediation effects (VAF < 80%) of the role of AC in the relationship between collaboration breadth and PIP, hence, provide partial support for H_{11}.

4.12.3 Effect Size

The effect size f^2 is a "measure used to assess the relative predictive relevance of a predictor construct on endogenous constructs" (Hair et al., 2014, p. 201). Indeed, the measure of the effect size serves as a practical guide for interpreting the magnitude of a particular relationship, and the effect size f^2 *is* to explain the magnitude of a predictor construct on endogenous constructs (Preacher & Kelley, 2011). The effect size f^2 can be calculated directly from Smart PLS Version 3, and the results are shown below in Table 4.23.

Table 4.23
Effect Size Result

Relationship	f^2	Effect
AC -PIP	0.258	Medium
Collaboration depth -AC	0.065	Small
Information search depth-AC	0.074	Small
Information search breadth-AC	0.053	Small

The effect size f^2 is useful to provide a practical guide for interpreting the practical importance of a relationship (Preacher & Kelley, 2011). In this regard, a statistically significant relationship is deemed important and meaningful judging by the effect size found. Table 4.23 shows only the effect size for significance direct paths in Model 2.

According to Cohen's (1988) rule of thumb, AC has a medium effect on PIP amounting to 25.8%. On the other hand, information search depth and collaboration breadth has a small effect on AC amounting to 7.4% and 6.5% respectively. Information search breadth has a small effect on AC compared to information search breadth and depth which amounts to 5.3% variance in AC.

4.12.4 Predictive Relevance *Q^2*

The predictive relevance of the structural model can be assessed by calculating the Stone-Geisser's Q^2 value (Stone, 1974; Geisser, 1975). The Q^2 value can be obtained by "using the blindfolding procedure for a ceratin omission distance D.=." (Hair et al., 2014, p. 178). Hair et al. (2012) stated that the omission distance between five and 10 should be used for most applications. In this study, the omission distance used is seven, followed by the default setting in Smart PLS 3. Table 4.24 shows the result of Q^2 value and its effects.

Table 4.24
The Result of Predictive Relevance Q^2

Variables	Q^2 Redundancy	Effect
AC	0.130	Small
PIP	0.175	Medium

Hair et al. (2014) recommended the cross-validated redundancy approach because it fits the PLS-SEM approach perfectly since it includes the key element of the path model, structural model and to predict eliminated data points. In accord with the rule of thumb suggested by them, the Q^2 value for AC and PIP (greater than zero) indicates that the exogenous variables have predictive relevance on AC and PIP (refer Appendix L). In other words, these results suggest that the structural model in this study has predictive relevance.

4.13 Summary of Hypotheses Testing Result

This study tested nine direct hypotheses and four indirect hypotheses between the independent, mediating, and dependent variables. This particular section summarised the hypotheses testing result as shown in Table 4.25.

Table 4.25
Hypotheses Testing Result

Hypotheses	**Hypothesized Path**	**Result**
H_1	Collaboration breadth -> PIP	Not supported
H_2	Collaboration depth -> PIP	Not supported
H_3	Information search breadth -> PIP	Not supported
H_4	Information search depth -> PIP	Not supported
H_5	Collaboration breadth -> AC	Not supported
H_6	Collaboration depth -> AC	Supported
H_7	Information search breadth -> AC	Supported
H_8	Information search depth -> AC	Supported
H_9	AC -> PIP	Supported
H_{10}	Collaboration breadth -> AC -> PIP	Not supported
H_{11}	Collaboration depth -> AC -> PIP	Partial Supported
H_{12}	Information search breadth -> AC -> PIP	Supported
H_{13}	Information search depth -> AC-> PIP	Partial Supported

4.14 Chapter Summary

This chapter discussed the findings of this research. The response rate is 41.4% that is sufficient for this study as it falls within the acceptable 30%. The study found that the non-response bias, common-method bias and missing data are not an issue in this research. Next, the profiles of the respondents are described using frequency and percentage. The study also fulfilled the multivariate assumptions that include outliers' analysis and data normality. This chapter also describes the descriptive statistics, and an exploratory factor analysis is conducted to identify the dimensions. Next, this chapter elaborates on both the measurement and structural models accompanied by the evaluation of both models. The final part of this chapter provides the summary of hypotheses testing results. The next chapter elaborates more on the findings and makes further discussions.

CHAPTER FIVE

DISCUSSION, IMPLICATIONS AND CONCLUSION

5.1 Introduction

This chapter recapitulates the study and summarised the findings based on the research questions and research objectives that are being proposed in Chapter One. The focus of the discussion is towards the research findings and justifications based on previous research.

5.2 Recapitulation of the Study

Malaysia's comparative advantage in unskilled labour-intensive manufacturing has been eroded by the emerging of low-wage countries, such as Vietnam, Indonesia and China. Hence, Malaysia wishes to move away from low-value added labour intensive manufacturing to skill-intensive and technology-intensive manufacturing. The success of product innovation is a key here to upgrade Malaysia's manufacturing status. Based on the literature review, there are several issues arising in investigating PIP in the Malaysia manufacturing sector. Following are the research questions related to the topic:

1. Do external knowledge search strategies have an effect on product innovation performance in Malaysian manufacturing firms?
2. Do external knowledge search strategies have an effect on absorptive capacity in Malaysian manufacturing firms?
3. Does absorptive capacity has an effect on product innovation performance in Malaysian manufacturing firms?
4. Does absorptive capacity mediate between the external knowledge search strategies and product innovation performance in Malaysian manufacturing firms?

In answering the research questions stated above, this study seeks to achieve the research objectives as below:

1. To determine the effect of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) on product innovation performance in Malaysian manufacturing firms.
2. To determine the effect of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) on absorptive capacity in Malaysian manufacturing firms.
3. To determine the effect of absorptive capacity on product innovation performance in Malaysian manufacturing firms.
4. To examine the mediating effect of absorptive capacity on the relationship between each type of external knowledge search strategies (collaboration breadth, collaboration depth, information search breadth, and information search depth) and product innovation performance in Malaysian manufacturing firms.

5.3 Summary of the Results

Based on the research questions developed in previous sections, the concept of PIP and AC are explored using the exploratory factor analysis, whereas, the relationship between the variables are explored using the PLS-SEM analysis. This study found that firms' external knowledge search strategies (collaboration breadth, collaboration depth, information search depth, and information search breadth) do not have direct effects on firms' PIP.

Furthermore, the study found that firms' external knowledge search strategies (collaboration depth, information search breath, and information search depth) have indirect effects on firms' PIP, through AC. Collaboration breadth does not have indirect effects on firms' PIP, through AC. On the other hand, the analysis result shows that AC has the effects on firms' PIP with the value of (β= .460, t= 4.974, p< .001).

The mediation analysis of AC shows that AC exists as a mediator, which mediates between the relationship of external knowledge search strategies (collaboration depth, information search breadth, and information search depth) and firms' PIP. The results showed that partial mediation effects (VAF=74.5%) of the role of AC in the relationship between information search breadth and firms' PIP, and partial mediation effects of AC in the relationship between collaboration depth and firms' PIP which explains only VAF=44.4%. On the other hand, there are 95.8% of information search breadth's effects on firms' PIP which is explained via the AC, hence, indicating a full mediation effect of AC in the relationship between information search breadth and firms' PIP.

5.4 Discussion

This study draws on the KBV theory and the concept of AC to illuminate the nature of the relationship between external knowledge search, AC and PIP. This session discusses the direct effects between external knowledge search and PIP and the effects of external knowledge search on AC. In addition, this session also discusses the effects of AC on firm PIP and mediation effects of AC between external knowledge search and firm's PIP.

5.4.1 Relationship between External Knowledge Search and Product Innovation Performance

The structural model analysis for Model 1 that excludes AC in the model indicated collaboration breadth, collaboration depth and information search depth have a significant relationship with PIP. However, when AC is included in Model 2, these relationships become insignificant. This result indicates that firms engage in external knowledge search practices does not necessary contributes directly to firms' PIP.

The result is in contrast to prior studies that indicate the direct effects of external knowledge search on PIP. In this regard, prior research indicated a direct relationship between collaboration breadth and depth with firms' PIP (Beers & Zand, 2014; Chen et al., 2011; Ebersberger & Herstad, 2011; Laursen & Salter, 2006; Love et al., 2014; Monteiro et al., 2016; Nieto & Santamaria, 2007). Moreover, prior research also indicated the direct relationship between information search breadth and depth with firms' PIP (Chiang & Hung, 2010; Esbersberger & Herstad, 2011).

Indeed, this study indicated that firms engaged in external knowledge search contribute indirectly to PIP. Typically, the result indicated that external knowledge search has a direct relationship with AC, but not PIP. There are two reasons to justify the current findings. Firstly, based on KBV, knowledge is characterised as partial public goods. In this notion, knowledge can be transmitted between one with another party, or with multiple parties, but with time and investments and resources devoted to it (Galende, 2006). In fact, knowledge is not a "scale free reproduction property" because of the replication of knowledge concerning processes, organisational arrangements that required significant efforts, costs, and degrees of uncertainty about the ultimate success (Dosi & Nelson, 2009). This provides a fundamental explanation of the reason firms that engage in external knowledge search practices (collaboration breadth and depth, information search breadth and depth) do not directly lead to improvements of the PIP.

Secondly, acquired knowledge from external search practices offers greater opportunities for firms to gain greater external knowledge and information (Foss et al., 2013). However, this knowledge and information does not directly generate valuable outcome if firms do not realise its value (filtering and selecting the suitable knowledge), assimilate it (transmit and share information as a pre-requisite to integrate the knowledge in firms' existing knowledge base), transform (integrates the new knowledge with the existing knowledge base) and exploit the knowledge for commercialisation. In order to bring a new product to markets, it entails a complex process because the well-codified ex-ante knowledge does not sufficiently establish the detailed properties in the ways of the product production process or artefact to carry out in bringing a new product to the market (Pavitt, 1984).

The AC helps to translate the external knowledge and information into a meaningful way for firms, eventually applying it in new product development processes. Typically, there are two reasons for the necessity to translate the external knowledge, before firms can use them in their new product development processes (Dosi & Nelson, 2009). Firstly, the efforts of inventing and solving technological problems may be reaching beyond the range of options that are perfectly understood. Ultimately, knowledge acquired from external sources need to be learned, through disseminating and integrating processes. Secondly, firms in an industry tend to differ from one another in their product development routines. Hence, the external knowledge needs to integrate into firms' existing knowledge base, and this would result in a new routine for product development processes that create new products to the market.

In essence, the results of this study suggest the role AC plays as the intermediate role in between external knowledge search and PIP. External knowledge search has an indirect effect on PIP rather than a direct effect as proposed in past research. In addition, the prior research that found the direct effect of external knowledge search on PIP, although, some of them include AC, but they operationalised AC mainly based on R&D related factors (Esbersberger & Herstad, 2011; Laursen & Salter, 2006; Nieto & Santamaria, 2007; Xu, 2014). Indeed, they do not treat AC as an internal mechanism to process the externally acquired knowledge from external search practices, hence, do not reveal how firms could turn the external knowledge into outcomes (PIP).

The current study takes into account the capabilities of firms in acquiring, assimilating, transforming and exploiting the external knowledge in translating external knowledge to firms' PIP. In this respect, AC is treated as an internal mechanism to process the externally acquired knowledge from external search practices. The approach of this study is also aligned with the prior's conceptualised models of AC in the innovation context that suggests the mediating role of the AC in between the relationship of external knowledge search and innovation performance (Lane et al., 2006; Lewin et al., 2011; Zahra & George, 2002). Therefore, the study found no direct effects between external knowledge search and PIP.

5.4.2 Relationship between External Knowledge Search and Absorptive Capacity

This section discussed the findings of the relationship between collaboration breadth and firms' AC, collaboration depth and firms' AC, information search breadth and firms' AC, and information search depth and firms' AC.

5.4.2.1 Collaboration Breadth and Firms' Absorptive Capacity

The first finding from this research indicates that collaboration breadth does not have a significant relationship with firms' AC. Firms engage in formal collaboration with external partners signify there exists of formal arrangements based on contractual agreements between firms and external partners, which allow firms to exchange the technical resources, share innovation costs, and exchange information and knowledge between two parties (Bonte & Keilbach, 2005). Collaboration leads to inflow of primary knowledge that would increase the existing knowledge and capabilities of the firms (Fey & Birkinshaw, 2005). However it requires time, financial costs and effort that are required to manage the coordination (Bougrain & Haudeville, 2002). Collaboration breadth refers to the collaboration with diverse external agents. Indeed, collaboration with broad partners entails significant managerial and financial challenges, and cognitive costs (Chen et al., 2011).

Setting up formal collaborations are more problematic for managers because of consideration appropriability issues when entering collaboration relationships (joint ventures, alliances), higher costs and much more resources; demanding the firms to engage in formal collaborations (Bonte & Keilbach, 2005). In this respect, firms with limited resources (especially small and medium enterprises) are unlikely to engage in this type of knowledge search method, and this shows a drive in an insignificant relationship between collaboration breadth and firms' AC in this study. According to the descriptive result illustrated in Chapter Four, collaboration breadth recorded a mean value of 3.184 from the total of eight partners, and the sample of this study indicated almost 65% of small and medium firms, it explains that Malaysia manufacturing firms are unlikely to engage in this external knowledge search practice (collaboration breadth).

In addition, Bengtsson et al. (2015) found that the firms manage to restrict boundary crossing by deeply involving in a few selected partners in collaboration on knowledge-content related to firms' desired outcomes rather than focus on diverse collaborations. This result is in contrast with prior research that indicate positive benefits of collaboration breadth in leveraging overall ecosystems of new ideas that could offer the greatest opportunity for firms to absorb it and hence resulted increase in the income from innovation (Brunswicker & Vanhaverbeke, 2015). Indeed, collaboration of firms depend on the linking to knowledge contexts and partners' types as to align to the objectives of firms that wish to achieve, rather than maximize the collaboration partners (Annique et al., 2010; Bengtsson et al., 2015; Emden, Calantone, & Droge, 2006; Tsai, 2009). This is because firms are characterised as bounded rationality and they have limited resources. Therefore, managers need to concentrate their energy, effort and mindfulness on a limited number of issues to achieve firms' objectives (Huang et al., 2015). As a result, collaboration breadth strategy does not contribute to firm's AC.

5.4.2.2 Collaboration Depth and Firms' Absorptive Capacity

The findings on external knowledge search on AC indicates that collaboration depth has positively contributed on AC. This result suggested that firms engage in collaboration and draws intensively from different collaborating partners contributing to the increase of firms' AC. AC is firms' ability to realise the value from acquired external knowledge (Gebauer et al., 2012), integrate external knowledge to current knowledge bases (Flatten et al., 2011), store and reactivate the external knowledge when needed (Lichtenthaler, 2009), and apply it in new product developments (Flatten et al., 2011). Collaboration depth allows firms to deepen into the knowledge of external partners and this enables the firm to easily understand the pieces of knowledge and information provided by its partners (Cruz-Gonzalez et al., 2015). As a result, this increases firms' realised value from acquired external knowledge and consequently have the competitive advantage in improving the integration and application of this knowledge in commercial ends (Xu, 2014).

Moreover, collaboration depth with external partners create a deep connection, and this enhances communication (Patel & Van der Have, 2010) and allows firms to sustain a pattern of interaction with external agents over times (Ferreras-Mendez et al., 2015). Firms interact with external agents to build up a shared understanding and common ways of working [assimilation] and these allow the transfer of fine-grained knowledge (Carnabuci & Operti, 2013) that will facilitate the transfer and combination of the knowledge [transformation] with the already existing knowledge base (Chen et al., 2011). Recombination of the existing knowledge and firm's knowledge base lead to better exploitation of knowledge in new product development processes (Knudsen, 2007).

Deep connections with external agents overtimes increases trust between firms and external agents (Ferreras-Mendez et al., 2015) by unlocking sticky knowledge, such as skills and processing ability. Moreover, this enhances the transfer of knowledge of external agents to the firms and support acquisition, assimilation, transformation and exploitation of knowledge to create innovation (Datta, 2011). Instead of that, deep connections allow firms to identify and evaluate the arbitrage opportunities, such as differences between firms' existing knowledge and newly acquired sticky knowledge, and hence, lead to alteration of firms' AC levels in capturing these opportunities for future developments (Hughes & Wareham, 2010).

5.4.2.3 Information Search Breadth and Firms' Absorptive Capacity

Instead of participating in collaboration, there is another type of external knowledge search, that is, information search. Information search is the systematic scanning of external environments, using mechanisms ranging from informal networks with external agents, participation at conferences or trade fairs, patents, and internet search that does not involve formal contractual agreements with external agents (Ebersberger et al., 2012). Information search is a form of soft openness (Laursen & Salter, 2014). This study found that information search breadth is positively contributing in the increase of firms' AC.

The combination of greater types of information sources is required for product innovation developments due to new product development requirements of a series of stages starting from ideation, design, manufacturing, and market (Kahn, 2013). In this regard, information search breadth contributes different types of knowledge. For instance, codified knowledge provided by patent disclosures such as journals that are based on science and technology knowledge (Brusoni et al., 2005) and establishment of informal relationships with external agents allow for a transfer of specific and commercially sensitive information about new product designs, new production processes or market development trends without writing and enforcing contracts (Bonte & Keilbach, 2005).

Based on KBV, a firm is subjected to bounded rationality (Simon, 1957). In other words, firms do not have full information about which external sources will provide the critical knowledge inputs to innovation (Terjesen & Patel, 2015). Thus, given by this uncertainty, the firm engages in broad information search to expose to a large variety of potential knowledge inputs (Ebersberger & Herstad, 2011). Broad search across a variety of external channels leads to new or additional ideas and resources that facilitate the creative potential for improvisation and flexibility when problems are encountered, and it also helps in earlier problem detection during new product development processes (Patel & Van der Have, 2010).

Firms' engagement in information search breadth enhances the firms' ability to recognise new and unfamiliar knowledge from non-local domains and this provides firms with distinct informational advantages to solve the problems (Rosenkopf & Nerkar, 2001). In this regard, as firms are exposed to great amounts of information, they tend to increase their abilities to realise the potential benefits derived from distinct informational advantages, thus motivate firms to pay attention to these benefits and foster firms in translating the acquired information into valuable knowledge for the firms (de Araujo Burcharth, Lettl, & Ulhoi, 2015). In other words, engaging in broad information search leads to the improvement of a firm's AC to capture the distinct informational advantages through identifying, assimilating, transforming and exploiting it into firm's new product development process.

5.4.2.4 Information Search Depth and Firms' Absorptive Capacity

On the other hand, this current study also found a positive and significant relationship between information search depth and firms' AC. This result suggested that the intense of using information from various sources resulted in greater firms' AC. AC is path-dependent and accumulates over time (Cohen & Levinthal, 1990). In this regard, firms engage in information search depth not as a one-time activity, but it is a continuous process that signifies the reuse of the information sources to enhance its understanding of the distant knowledge (Chen et al., 2011) and this gradually improves the firms' AC.

Typically, reinforcement of informal relationship with external agents, enable effective communication and mutual understanding between firm and agents, and this bears different cognitive proximity for the firms, and this facilitates the knowledge proximities between the firm and the agents that will improve the firms' understanding on the provided information (Boschma, 2005). Also, intensive search for codified sources (journals and scientific readings, patent disclosures), frequently attending conferences, and access to the internet also allow a better understanding of the information that is provided by particular types of resources (Brusoni et al., 2005). All of this allow the firms to recognise the value of knowledge easily, understand, analyse, interpret, integrate the knowledge, and apply this knowledge in new product developments (Lane & Lubatkin, 1998).

5.4.2.5 Different Search Strategies and Firms' Absorptive Capacity

Interestingly, the findings of the study indicates the differences between collaboration breadth and information search breadth on firms' AC. Intensively, collaboration breadth is not significant in explaining the variance of firms' AC, but information search breadth is positively contributing to firms' AC. Indeed, information search breadth is less costly, reversible and post low levels of commitment compared to formal types of search through collaborations (Van de Vrande, Lemmens, & Vanhaverbeke, 2006). Hence, a search broadly enables a firm to be exposed to large varieties of potential knowledge inputs that could enhance firms' AC. As mentioned in the paragraph above, firms are unlikely to engage in collaboration breadth, since, collaboration require resources, costs, and it often has objective and direction rather than explored broadly and diversely without a match to firms' desired outcomes (Leiponen, 2012).

This study indicates that both information search breadth and depth are positively contribute to firms' AC, On the other hand, collaboration depth is positively contributes to firms' AC, but collaboration breadth does not contributes to firms' AC. This is because the searching costs for collaboration is high, thus, firm maintain with few partners but manage the intense relationship with them and search deeply from these partners. Conversely, information search strategy involves lower costs, less commitments (Van de Vrande et al., 2006), and it is much easier for firms to access compared to collaboration strategies. Hence, firms are able to search deeply and broadly. Moreover, Kang and Kang (2009) stated that the growth of information system - internet enhances the information search breadth and depth and this open up firms to more information and opportunities that could be absorbed by the firms and apply it in the innovation process.

5.4.3 Relationship between Absorptive Capacity and Product Innovation Performance

Relationship between firms' AC and its effect on PIP is varied due to wide and distributed operationalized concepts of AC and PIP. In this regard, past research has linked different perspectives of AC, such as R&D expenditures (Murovec & Prodan, 2009; Stock et al., 2001), employees' education level in their research (Escribano et al., 2009), workers' knowledge, managers' knowledge, communication networks, communication climates (Tavani et al., 2013) with multiple perspectives of PIP, such as the number of new products introduced by the firms in the past three-year period (Escribano et al., 2009; Fosfuri & Tribo, 2008; Franco et al., 2014; Kostopoulos et al., 2011; Moilanen et al., 2014; Murovec & Prodan, 2009; Sun, Xu, & Wan, 2015), product innovativeness (Kocoglu, Akgun, & Keskin, 2015; Kotabe, Jiang, & Murray, 2014) and product quality (Stock et al., 2001). These suggest the heterogeneous explanation on the effect of AC on firms' PIP.

This study provides a new insight in linking multidimensional AC with multidimensional PIP. Typically, AC is reflected as a set of dynamic capabilities, namely, acquisition capability, assimilation capability, transformation capability, and exploitation, whereas, PIP is reflected as financial performance, product performance, product innovativeness and product development speed and costs. The results indicated that a firm's AC positively contribute to a firm's PIP.

Product innovation requires a large amount of knowledge that includes simple codified knowledge, and complex and highly tacitness knowledge (Kotabe et al., 2011). The AC helps a firm to evaluate, interpret, assimilate, and integrate external knowledge with the internal knowledge base that enables a firm to exploit it in their product innovation process. Indeed, AC facilitates organisational learning (Lane & Lubatkin, 1998), and is perceived as valuable firms' capabilities that integrate, build, and reconfigure available knowledge that enables firms to sustain superior performance (Cohen & Levinthal, 1990; Zahra & George, 2002).

In a more comprehensive manner, AC adds value to firms' internal knowledge base through the continuous integration of new knowledge from the external environment, the application in new product developments, and this allows the firm to attain greater PIP (Exposito-Langa et al., 2011). Typically, firms that are equipped with AC are able to obtain key information and business opportunities (acquisition), create a shared understanding regarding new insights (assimilation) to overcome some of the competency traps, internalise the external knowledge as it generate new ideas and opportunities, and apply these transform knowledge to product developments and market launches (Sun et al., 2015).

Intensively, firms with better AC effectively access new knowledge and create an appropriate knowledge base for firms; this facilitates decision-making relevant to new product development activities (Tavani et al., 2013). The appropriate knowledge base enables firms to utilise appropriate knowledge and new technology at a right time in NPD projects, and this allows firms to enter new markets and earn economic rents, such as profit, market share, and sales growth (Kotabe et al., 2014). In addition, AC is important for firms to keep themselves updated with the external environment (Tavani et al., 2013), stipulate useful external knowledge that could provide new insights regarding facts, specifications and technical details that are needed in new product development processes (Nonaka & Takeuchi, 1995; Kotabe et al., 2014). By applying proper knowledge, this eventually leads to better new product quality, reduce development time and costs (Kostopoulos et al., 2011), and with that, the firms would be able to exceed customer's satisfaction by producing good quality products at the right time (Tavani et al., 2013).

5.4.4 Mediating Effects of Absorptive Capacity Towards External Knowledge Search and Product Innovation Performance

Innovation is known as the "outcome of an interactive process between firms and its environment" (Mention, 2011, p. 44). Access to external knowledge does not imply that a firm is neither able to absorb that knowledge nor use the acquired knowledge. Likewise, Nooteboom (2000) stated, "information is useless if it is not new, but it is also useless if it is so new that it cannot be understood" (p. 72). This indicated that new information from external sources needed to be understood by a firm to enable the firm to use the information. AC is a key here to increase learning and enlarges an organisation's knowledge base, thus, result in an increase of a firm's members' ability to interpret external incentives and enhance a firm's ability to draw on external knowledge and fuse it with other existing technologies (Anatoliivna, 2013).

This study found that AC plays a mediating role between the relationship of external knowledge search (collaboration depth, information search depth and breadth) and PIP. This result suggested that firms that engage in greater external knowledge search and high AC is associated with better chances to successfully apply new external knowledge in new product developments, and producing greater PIP. In a comprehensive view, external knowledge is not readily applied in developing new products without interpreting and processing it, reconfigured the acquired knowledge, store and reactivated it when needed, as well as integrating the knowledge in daily operations as well (Moos, Beimborn, Wagner, & Weitzel, 2013).

The connection between external knowledge search and PIP is not direct, but it goes through an intermediate - AC (Anatoliivna, 2013). AC is a cumulative process (Cohen & Levinthal, 1990). Typically, AC evolves over time as the external knowledge search triggers it to continuously refine the acquired knowledge, integrate it, and apply it when needed (Lewin et al., 2011). As a result, AC serves as sources of competitive advantage of firms in elucidating why some firms are performing better than others.

This study found that AC partially mediates between collaboration depth and PIP. Typically, collaborations could involve joint decision making or engage in co-marketing, co-production, shared resources or joint developments in new product developments (Bonte & Keilbach, 2005). In this regard, a firm that engages in collaboration depth implies that firms build a deep relationship with its collaboration partners, and this allows firms to take advantage in acquiring proximate knowledge that is related to the specific field that it needs (Patel & Van der Have, 2010). This explains that firms that engage in collaboration depth has more or less contributed directly to the outcome (PIP) and AC only mediates partially between the relationship of collaboration depth and PIP. In other words, this means some of the new information sources from collaboration depth requires a firm to allocate an effort - AC to absorb it, while some of the new knowledge are co-developed by the firm and its partners, hence, is directly contributing to PIP.

On the other hand, this study indicates that AC fully mediates between information search breadth and PIP, and partially mediates (close to full mediation effect) between information search depth and PIP. Information search involves involuntary knowledge spillovers and search for codified knowledge, without engaging in any formal contracts or agreements between the parties (Escribano et al., 2009). This knowledge source from the information search method mainly consists of freely available knowledge although some involve costs to acquire (Brusoni et al., 2005; Ebersberger et al., 2010) that are different in the technological domain (Patel & Van der Have, 2010). Information sources from various external sources create opportunities for a firm to stimulate AC, which could create value for firms in return (Kostopoulos et al., 2011). Intensively, information or informal sharing from agents provides a large quantity of knowledge and this knowledge and information disperses across different actors and environmenst, and may not necessarily associate to a firm's current technological regime (Ebersberger et al., 2012).

Although a firm can obtain more comprehensive information through repeated search (intensively search-search depth), the obtained knowledge and information does not sufficiently apply (directly) in new product development processes. This is because the underlying information and knowledge could be weak without the engagement of outside parties in sharing a more complex technical, skills, and formulas that are needed to apply in product development processes (Cardinal et al., 2001). As a result, AC is essentially playing its part in identifying the value of this knowledge and information, translate and assimilate it, integrate with existing knowledge, and apply in future new product developments when they identify the market opportunities. Eventually, this leads to the greater mediation effect of AC which plays a part in between information search breadth and information search depth with PIP rather than collaboration depth with PIP.

5.5 Implications

This section discusses the implications of the current study. The implications of this study include theoretical implications, method implications, practical implications and policy implications.

5.5.1 Theoretical Implications

KBV indicates that the competitive success is governed by a firm's capabilities to develop new knowledge- based assets that create core competencies for firms in return (Pemberton & Stonehouse, 2000). In this regard, KBV emphasises that the critical input in production and the primary source of value is knowledge (Grant, 1996b). However, not all knowledge sources could create value for firms or become a strategic resource for a firm. Indeed, the bundling and revitalising of multiple, distinctive firms' knowledge resources that are highly specific to a firm and are difficult to imitate by others is the key strategic asset for a firm that is critical for competitiveness (Grant, 1996a, 1996b, 1997; Foss & Foss, 2000).

KBV suggests that knowledge is a special type of resource because it is characterised as partial public goods, which indicate that knowledge could be leaked out to third parties. In this regard, an important question is "how knowledge can be strategic resources for a firm if this knowledge leaks out and becomes not specific to a firm?" Under this circumstance, a firm's critical knowledge resources should be extended beyond its boundaries and enable knowledge- flows externally (Vanhaverbeke et al., 2008), to keep updating and enlarge its existing knowledge base, and to create new knowledge- based assets (Theriou et al., 2014). By doing this, a firm is able to preserve the strategic value of its key knowledge resources over the time.

Fundamentally, prior literature in the KBV stream are concerned about interpreting the capabilities of firms (as key knowledge resources) that effectively integrate the specialised knowledge from its members and external knowledge as sources of competitive advantage (Grant, 1996a). However, this stream of literature is introspective and failed to explain how firms learn from the external environment in extending their knowledge base and create new knowledge- based assets that are hardly imitable by others. The current research took a step further by linking firms' external search strategies, and AC – firms' integrating capabilities (strategic resources that are hard to imitate by others) in explaining firm's PIP. Accordingly, it is comprehended in the current literature that by suggesting the learning of firms from the external environment, and its internal capabilities in integrating external and internal knowledge to apply in product innovation processes - could lead to better PIP.

The AC is a broad concept. This research borrowed from the KBV's underlying concept of integrative capabilities that define AC as a firm's strategic resources in explaining a firm's integration of external and internal knowledge that could generate new knowledge. As a result, it contributes to enhancing a firm's PIP. In this regard, this study has found the empirical evidence that supports the intermediate role of AC in explaining the effects of external knowledge search on a firm's PIP. This enhances the KBV theoretical frame by opening the black box to explain how a firm can be profiting from various external interfaces and acknowledge AC as strategic resources for a firm to achieve competitive advantage. In essence, this clarifies the concept of AC as a firm's capabilities (higher order routines) that are firm-specific, idiosyncratic, complex, and is difficult to imitate as sources of competitive advantage that could account for better a firm's product innovation in return (Lewin et al., 2011).

The outcome of this empirical research provides fruitful extensions of refining the concept of AC in innovation studies. As various empirical research viewed AC as a facilitator to increase advantages in a firm's external search activities (Ebersberger & Herstad, 2011; Escribano et al., 2009; Laursen & Salter, 2006), few have linked the external knowledge search as an antecedent to AC and the outcome of AC (Kostopoulos et al., 2011). In this regard, as proposed by Volberda et al. (2010), integration of external search with a firm’s internal ability in absorbing the external knowledge is necessary to explain whether a firm can tap into external knowledge sources. Indeed, a firm engaged in external search may contribute to enhancing a firm's AC cumulatively over time by accumulating a relevant knowledge base that can be further used to generate new products.

In sum, the findings of this study provide empirical support for the AC model established in past research (Torodova & Durisin, 2007; Zahra & George, 2002), which indicates that AC could explain a substantial part of cross-firm heterogeneity in profiting from external knowledge search (Kostopoulos et al., 2011). In this regard, firms engaged in external search activities are not directly derived to the outcome, but, tends to contribute in developing AC over time. Eventually, with greater AC in firms, the more likely it is that firms will be proactive in exploiting opportunities present in the environment, thus contributing to better outcomes.

5.5.2 Method Implications

Product innovation requires a wide range of external ideas. Therefore, firms compose, establish, and maintain complex learning interfaces (Danneels, 2002). However, current research has not captured the combination effects of different dimensions of external interfacing which co-exist at the level of firms and capture the impact of this behaviour on firms' PIP (Ebersberger & Herstad, 2011). This study suggested four types of search strategies to capture firms' external search behaviours. Typically, this study differentiates search strategies with combining information search and collaboration with the search breadth and search depth. Indeed, this provides insights not only on the different search space (encompassing different institutional norms, habits and rules) but extend beyond these by incorporating different search methods (encompassing different costs, the level of interactions) in defining a firm's external search behaviour. As a result, this contributes to the literature by suggesting a new model of measurement for capturing a firm's external search behaviour.

Besides that, this study contributes to defining the measurement scales of PIP in Malaysia manufacturing sector. This provides insights for managers in setting performance targets towards innovative products, and therefore, pinpoints the necessary changes by determining the strength and weakness of a given product innovation (Hannachi, 2015). Moreover, this study also suggested multidimensional AC measurement scales in the Malaysia manufacturing sector. Indeed, this scale could be a convenient tool for both academics (to ease theorising and hypothesis building) and practitioners (better assessment of the required competencies).

5.5.3 Practical Implications

Firms are increasingly drawing knowledge from external sources in their innovation activities. Existences of different external interfacing contribute in increased firms' AC, and therefore, PIP. Typically, this study indicates that collaboration depth, information search depth and information search breadth contribute in explaining variance in firms' PIP through AC. This suggests that the co-existence of information search depth and breadth and collaboration depth contribute in enhancing firms' internal learning base AC that later could translate into a better PIP. Thus, it gives the implication for managers and suggests that building and maintaining different search practices contribute to a firm's interactive learning from external agents and learning from the external environment.

Since external search is essential for firms to achieve better PIP, it is suggested that firms should maintain good relationships with various actors, such as customers, suppliers, competitors, government agencies and education institutions. Forming relationship is the initial step for firms before they engaged in external knowledge search with the actors. Instead of that, it is important for firms to formed a team of members that actively involved in external knowledge searching. In particular, the team members are responsible to acquire, filter, and select useful knowledge for their organisation. Moreover, team members are also responsible for managing the relationships with various actors so as to enable firms to acquire valuable knowledge from them from time to time.

On the other hand, AC is the key for facilitating greater learning of firms because AC helps to understand the nature of new knowledge and becomes a decisive competitive factor (Anatoliivna, 2013). Developing and maintaining AC is critical for firms' long-term success and survival because it reinforces complements and changes the focus of their knowledge base (Zahra & George, 2002). Moreover, high AC is associated with better chances to produce successful product innovation, showing better performance, as well as overcoming the "Not-Invented-Here" syndrome. Indeed, investing in external knowledge search is only the first step for firms for product innovation. Managers should also devote more effort to develop their AC to capture valuable knowledge from the external search and translate this knowledge into tangible and intangible outcomes for firms in return. In this regard, AC is a source of competitive advantage for a firm, which is valuable, rare, inimitable and non-transferable during the process of catching up with a firm's counterparts.

In this study, AC is view as multidimensional and it is dynamic since the AC could increase along the time when firms involve more in external knowledge search in the future. In this regard, it is suggested that firms should invest in information system that helps them in collecting, processing, and storing the external knowledge. The new knowledge that gathered from external search should code in a simple way to enables firms' members to interpret and transform it in the future. With information system, adding, amending or deleting is allowed and this improves firms' AC over the time. In addition, it is suggested that firms should create a knowledge internal network across various levels throughout the whole organisations to improve firms' AC. This helps firms to foster socialisation process between members that eventually resulted in improved AC for the firms.

5.5.4 Policy Implications

This research offers some policy implications. First, this study suggests that investment in external knowledge search and developing AC is the key that contributes to firms' successful product innovation. AC enlarges the knowledge base of a firm through cumulative integration of reconfiguring external knowledge and internal knowledge that results in deploying knowledge to create technology and new products (Gebauer et al., 2012). As Malaysia wishes to move to a high value added manufacturing industry, it is important for policymakers to acknowledge the role of AC in catching up to the opportunities for product innovation, and improve greater success of product innovation. As this research found that external knowledge search enhances a firm's AC, it gives implication for policymakers to promote better business environments that could facilitate greater firms' external knowledge search.

Intensively, firm building and maintaining different search practices are essential for firms to foster its AC and trigger successful product innovation. Therefore, the formulating policies should aim at generating industrial cluster or geographically agglomerated industries to encourage firms to maintain better relationships with its external agents (enabling the firm to acquire quality information), and this could foster greater firms' learning. Moreover, policies also need to support intermediate institutions (universities, public research centers, local and professional associations), encourage participation in exhibitions and trade fairs, as well as, promote greater internet speed accessibility because information from these external sources also play an important role in fostering greater learning of local manufacturing firms.

Secondly, this study suggests the four dimensions' capabilities' base model of AC in explaining the way firms extract valuable knowledge from external knowledge search practices. This suggested that the development of AC is not a straightforward process as prior research suggested - merely through conducting R&D activities (Murovec & Prodan, 2009), hiring qualified employees (defined as greater education qualifications) and training (Mancusi, 2008); but it is embedded in organisational routines, which means that employees should be able to learn and turn new knowledge into organisational knowledge. This indicates that it is an organisational learning process through facilitating motivation of employees to acquire and filter knowledge (acquisition capability), trigger mutual/collective understanding in a firm (assimilation capability), store and maintain, transform and reconfigure knowledge (transformation capability) and exploit knowledge in commercialised ends (exploitation).

Consequently, a policy that is designed to improve AC needs to focus on motivating a firm's capability to acquire knowledge, facilitate knowledge sharing in the organisation, trigger cognitive thinking to transform and reconfigure knowledge, as well as motivate them to apply new knowledge in commercialisation ends. Typically, a policy that is designed to provide an incentive for a firm is essential to trigger a firm's motivation to innovate that will lead to the improvement of a firm's AC. Indirectly, this will benefit a firm in terms of their future product innovation. Moreover, since AC is collectively based for a firm, human capital is still the key to sustain the AC of a firm. Thus, a policy that is designed to provide a quality education system that is matching with industrialised requirements tends to improve firms' AC.

5.6 Limitations and Recommendations for Future Research

This study has some inherent limitations that may also suggest future research lines. Firstly, the model introduced in the study does not allow for the analysis of external search strategies within each search channel, and the way of it that contributes to improve a firm's PIP through AC. Future research may assess this aspect by developing several fine-grained items for each of the external search channels.

Secondly, this study found that external knowledge search (collaboration depth, information search breadth and depth) explain only a 28.8% variance on firms' AC. Therefore, suggests that there is room for further exploration regarding possible antecedents that contribute to a firm's AC. According to Volberda et al. (2010), intra-organisational factors, such as organisational form, incentives structures, as well as managerial antecedents, such as, individual knowledge development and sharing and managerial cognitions are important factors that also contribute to a firm's AC. Hence, future studies could include the stated factors to explain the current framework.

Thirdly, it is suggested by some of the prior research about learning of firms from external knowledge search being affected by different environmental conditions (Laursen & Salter, 2014; Cruz-Gonzalez et al., 2015). In this vein, in order to comprehend about current knowledge, it is suggested that future research should develop a model incorporating environmental conditions as a moderator to explain the linkages of external knowledge search, AC and PIP. This helps to explain firms' learning process under different environmental conditions.

Fourthly, the data for this study was gathered at one point at a time (cross-sectional) and this presents itself as a limitation for this study. Indeed, the development of AC is a path-dependent process. Therefore, cross-sectional data analysis may not capture the dynamics of a firm's learning from external knowledge search activities. Hence, future research could apply longitudinal designs to study linkages between external knowledge search, AC and PIP. By doing so, it provides insights on how firms could generate competitive advantage from external knowledge search, and how these learning mechanisms affect a firm's PIP across time.

5.7 Conclusion

Product innovation draws on a wide range of external ideas, therefore, firms compose, establish and maintain complex learning interfaces (Danneels, 2002). Combination effects of different dimensions of external interfacing which co-exist at the level of a firm contributes in building and developing a firm's AC. AC adds value to firms' internal knowledge base through continuously integrating new knowledge from the external environment. This allows a firm to attain greater PIP. By means of including AC in the current research model, it advances existing literature by explaining the way firms attain superior PIP and this provides insights for managers in developing suitable strategies to gain and sustain competitive advantage. As firms improve in its PIP, it could move up the value chain of a country, and encourage better economic development of a nation.

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APPENDIX A
APPLICATION FOR SUPPORT LETTER (FEDERATION OF MALAYSIAN MANUFACTURERS)

OTHMAN YEOP ABDULLAH
GRADUATE SCHOOL OF BUSINESS
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

KEDAH AMAN MAKMUR ■ BERSAMA MEMACU TRANSFORMASI

Date: 11 September 2015

Manager
FMM Kedah/Perlis Branch
No. 2, Lorong BLM 1/4
Bandar Laguna Merbok
08000 Sungai Petani
Kedah Darul Aman, MALAYSIA.

Dear Sir/Madam,

APPLICATION FOR SUPPORT LETTER IN CONDUCTING PhD RESEARCH

Refer to the matter above, I am Miss Cheng Sey Lee, PhD, candidate from Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia. Currently, I am conducting a research focusing on the manufacturing firms' Product Innovation Performance (PIP) entitled **"External Knowledge Sourcing, Absorptive Capacity, and Product Innovation Performance of Malaysian Manufacturing Sector"**.

2. The **main objective** of the research is to explore the impact of **external knowledge sourcing** and absorptive capacity **(firm's ability to exploit external knowledge)** on Malaysia manufacturers' **product innovation performance**. External knowledge is critical to the firms' innovation performance. However, the use of external knowledge alone does not guarantee better product innovation performance. Indeed, absorptive capacity as an ability to utilize the external knowledge is critical to enable firms to profit from external knowledge and have substantial impact on firms' product innovation performance.

Universiti Di Rimba Hijau "The University in A Green Forest"

3. The research is expected to benefit the industry practitioners by suggesting the **determinant factors to improve product innovation performance**, which is very important for the survival of the firms under rapidly changing environment and globalization.

4. Based on past research, the **response rates** for surveys are **extremely low** and hence the results unable to fully described the **actual phenomenon**. In this regard, I hope that FMM could kindly assist in providing a **support letter** to be attach with the survey form. This will lead to a higher response rates among the FMM members. All the information gathered will be **strictly confidential** and used for academic purposes only. I will provide a report of my study for FMM reference and records. I hereby attach a copy of certification of study, letter for data collection and research work, and survey form for your kind attention.

Thank you for your assistance and cooperation.

Yours Sincerely,

(CHONG SAY LEE)
Othman Yeop Abdullah Graduate School of Business
Universiti Utara Malaysia
Tel : +6012-472 8221
E-Mail : chongsaylee@gmail.com

APPENDIX B
SUPPORT LETTER FROM FEDERATION OF MALAYSIAN MANUFACTURERS

FEDERATION OF MALAYSIAN MANUFACTURERS

Kedah/Perlis Branch — *Making Malaysian Industries Globally Competitive*

Our Ref:

Your Ref:

18 September 2015

Chong Say Lee
PHD Candidate
Othman Yeop Abdullah Graduate School of Business
Universiti Utara Malaysia,
06010 UUM Sintok
Kedah, Malaysia

Endorsement by FMM Kedah/Perlis to Carry Out Research for Postgraduates Projects: "External Knowledge Sourcing, Absorptive Capacity, and Product Innovation Performance of Malaysian Manufacturing Sector".

I would like to refer to our discussion on the above mentioned research project.

2. We, therefore, **would like to extend our full support for you to conduct the data collection among FMM members in Kedah/Perlis ONLY**. We, however, note that this exercise is voluntary and would depend on the individual company's consent.

3. We also would like to stress that all submissions by interested companies / individuals **should be kept STRICTLY CONFIDENTIAL**. Furthermore, participating companies should be offered the final outcomes of the research projects. A copy of the research findings should also sent to FMM for our reference and records.

4. We sincerely hope that the outcomes of this research projects would benefit both the academic and the related manufacturing sector.

Thank you.

Yours sincerely,

Mazlan Kassim
Manager, FMM Kedah/Perlis

FEDERATION OF MALAYSIAN MANUFACTURERS

APPENDIX C
LETTER FOR DATA COLLECTION

OTHMAN YEOP ABDULLAH
GRADUATE SCHOOL OF BUSINESS
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

Tel [illegible]
Faks (Fax): [illegible]
Laman Web (Web): [illegible]

KEDAH AMAN MAKMUR • BERSAMA MEMACU TRANSFORMASI

UUM/OYAGSB/K-14
30 July 2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER FOR DATA COLLECTION AND RESEARCH WORK

This is to certify that **Chong Say Lee (Matric No: 94702)** is a bonafied student of Doctor of Philosophy (PhD), Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia. She is conducting a research entitled ***"External Knowledge Sourcing, Absorptive Capacity, and Product Innovation Performance of Malaysian Manufacturing Sector"*** under the supervision of Assoc. Prof. Dr. Faudziah Hanim Bt Fadzil.

In this regard, I hope that you could kindly provide assistance and cooperation for her to successfully complete the research. All the information gathered will be strictly used for academic purposes only.

[illegible]

Thank you.

"SCHOLARSHIP, VIRTUE, SERVICE"

Yours faithfully,

ROZITA BINTI RAMLI
Assistant Registrar
for Dean
Othman Yeop Abdullah Graduate School of Business

c.c - Supervisor
- Student's File (94702)

Universiti Pengurusan Terkemuka
The Eminent Management University

APPENDIX D
QUESTIONNAIRE

PRIVATE AND CONFIDENTIAL

Othman Yeop Abdullah
Graduate School of Business
Universiti Utara Malaysia

THE IMPACT OF EXTERNAL KNOWLEDGE SEARCH STRATEGIES TOWARD PRODUCT INNOVATION PERFORMANCE IN MALAYSIAN MANUFACTURING FIRMS: THE MEDIATING ROLE OF ABSORPTIVE CAPACITY

The purpose of this study is to examine the relationship between external knowledge search strategies, absorptive capacity, and product innovation performance of Malaysian manufacturing firms. It is being conducted as part of the requirements for a Ph.D. degree at Universiti Utara Malaysia.

Target respondent of this research is the key person that is knowledgeable in the scope of product innovation activities. The respondent of this questionnaire includes Product Manager, R&D Manager, Production Manager, General Manager, Operation Manager, Managing Director or equivalent to the said job positions that are knowledgeable in the scope of product innovation activities.

The data will be aggregated and analysed in a group basis only. The information you provide will remain strictly confidential and will be used solely for the purpose of academic research.

Please read the instructions in each section carefully and answer all the questions without discussing with anyone. There are no right or wrong answers to these questions. Usually, your first reaction to a question is a good indication of how you really feel.

After completing the questionnaire, please insert it in the attached envelope and return the sealed envelope **within ONE WEEK** to the researcher.

Your participation is the key success of this study and your assistance is greatly appreciated. Please do not hesitate to contact the researcher if you have any questions.

MISS CHONG SAY LEE
Tel: +6012-472 8221
E-Mail: chongsaylee@gmail.com

SECTION A

Instructions:

1) Please provide us some **information** about **yourself** and **your firm**.
2) **Fill in the blanks** and **tick** (/) in the box provided to indicate your answer.

1. Job Position :
   - ☐ I am Product/ R&D Manager.
   - ☐ I am equivalent to Product/ R&D Manager.

2. You have been working in this firm since year ____, month ___ (i.e. year 2010, month 6).

3. Number of Employees: ______________________________

4. Your firm has been established since year _____, month ___ (i.e. year 2010, month 6).

5. Types of Industry :
   - ☐ Basic Metal
   - ☐ Chemicals including Petroleum
   - ☐ Electrical and Electronics
   - ☐ Fabricated Metal
   - ☐ Food, Beverage and Tobacco
   - ☐ Machinery
   - ☐ Manufacturing of Furniture
   - ☐ Medical, Precision and Optical Instruments
   - ☐ Non-Metallic Mineral
   - ☐ Paper, Printing, and Publishing
   - ☐ Plastic
   - ☐ Rubber
   - ☐ Textile, Wearing Apparel and Leather
   - ☐ Transport
   - ☐ Recycling
   - ☐ Wood and Wood Products, including Furniture
   - ☐ Other (Please specify: ______________________)

6. Types of product innovation projects or activities that your firm has been involved in for the past three years (tick whichever applicable):

- ☐ Corresponding to existing product modification.
- ☐ Corresponding to product line extensions.
- ☐ Corresponding to “me-too-product”.
- ☐ Corresponding to true innovation.
- ☐ Others: (please specify: ______________________ ____)

SECTION B

Instructions:

1) This section related to your firm's product innovation performance.
2) Think ***one new product*** that has been introduced in ***past three years*** in your firm and you ***have been handling this product*** development process.
3) The following statements indicate to what extent your firm ***met the following goals*** for the stated product at above.
4) Please indicate to what extent you **AGREE** or **DISAGREE** with each statement.
5) **Circle the numbers** corresponding to your responses using the scale below.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**	**6**	**7**

1.	Achieve **sales goals** relative to the stated objectives.	1	2	3	4	5	6	7
2.	Achieve **profit goals** relative to the stated objectives.	1	2	3	4	5	6	7
3.	Achieve **market share growth** relative to the stated objectives.	1	2	3	4	5	6	7
4.	Achieve **sales growth** relative to the stated objectives.	1	2	3	4	5	6	7
5.	The product **met the stated performance specification**.	1	2	3	4	5	6	7
6.	The product provided **better quality compared to the past similar type of product**.	1	2	3	4	5	6	7
7.	The product provided **better quality compared to competitors of a similar type of product**.	1	2	3	4	5	6	7
8.	The **product development costs met the stated objectives.**	1	2	3	4	5	6	7
9.	The product is **launched within the stated deadlines**.	1	2	3	4	5	6	7
10.	The product is l**aunched in a relatively shorter time than competitors**.	1	2	3	4	5	6	7
11.	The product improved **customer satisfaction**.	1	2	3	4	5	6	7
12.	Customers perceived that the product is **more reliable compared to competitors' product.**	1	2	3	4	5	6	7
13.	The product **improved customer loyalty**.	1	2	3	4	5	6	7
14.	The product is **new to your firm's technology know-how.**	1	2	3	4	5	6	7
15.	The product is **new to your firm's market know-how**.	1	2	3	4	5	6	7
16.	The product is **new to your industry technology know-how.**	1	2	3	4	5	6	7
17.	The product is **new to your industry market know-how**.	1	2	3	4	5	6	7

SECTION C

Notes:
1) Collaboration involves "active participation in joint innovation projects with other organisations" but excludes pure contracting out of innovation-related work. It can involve the joint implementation of innovations with customers and suppliers, as well as partnerships with other firms or organisations.
2) External information search involves the active search for external information sources that includes an informal relationship with other firms or organisations and search information from external sources, such as internet, exhibitions and trade fairs.
3) Kindly be informed that the external collaboration and external information search are distinct activities because collaboration involved formal linkages, whereas, external information search does not involve in any formal contract.

QUESTION 1:
Instructions:

1) The following statement indicates **whether your firm is involved in *formal collaboration links* with the listed eight external partners.**
2) Please indicate **YES** or **NO** by ticking (/) in the boxes provided accordingly on **EACH** of the external partners.
3) If **YES,** please indicate the **level of importance of the external partners in contributing to your firm's product innovation** by circling the number corresponding to your response for **EACH** contribution using the scale below.

Very Un-important	Un-important	Moderately Un-important	Slightly Un-important	Slightly Important	Moderately Important	Important	Very Important
1	2	3	4	5	6	7	8

If **YES,** please indicate the level of importance in contributing to your firm's product innovation.

1. Suppliers	☐ YES	☐ NO	1 2 3 4 5 6 7 8
2. Clients or customers	☐ YES	☐ NO	1 2 3 4 5 6 7 8
3. Competitors	☐ YES	☐ NO	1 2 3 4 5 6 7 8
4. Consultants/ Consulting firms	☐ YES	☐ NO	1 2 3 4 5 6 7 8

5. External commercial laboratories /R&D enterprises ☐ YES ☐ NO 1 2 3 4 5 6 7 8

6. Universities or other higher education institutes ☐ YES ☐ NO 1 2 3 4 5 6 7 8

7. Government research organisations ☐ YES ☐ NO 1 2 3 4 5 6 7 8

8. Private research institutes/ Private non- profit research institutes ☐ YES ☐ NO 1 2 3 4 5 6 7 8

QUESTION 2:

__**Instructions**__:

1) The following statement **concerns whether your firm is involved in *external information search*** with the listed fifteen sources (these include the informal linkages and information search).
2) Please indicate **YES** or **NO** by ticking (/) in the boxes provided accordingly on **EACH** of the external partners.
3) If **YES,** please indicate the **level of importance of the external partners in contributing to your firm's product innovation** by circling the number corresponding to your response for **EACH** contribution using the scale below.

Very Un-important	Un-important	Moderately Un-important	Slightly Un-important	Slightly Important	Moderately Important	Important	Very Important
1	2	3	4	5	6	7	8

If **YES,** please indicate the level of importance in contributing to your firm's product innovation.

1. Suppliers ☐ YES ☐ NO 1 2 3 4 5 6 7 8

2. Clients or customers ☐ YES ☐ NO 1 2 3 4 5 6 7 8

3. Competitors ☐ YES ☐ NO 1 2 3 4 5 6 7 8

4. Consultants/Consultancy firms ☐ YES ☐ NO 1 2 3 4 5 6 7 8

5. External commercial laboratories/R&D enterprises	☐ YES	☐ NO	1	2	3	4	5	6	7	8
6. Universities or other higher education institutes	☐ YES	☐ NO	1	2	3	4	5	6	7	8
7. Government research organisations	☐ YES	☐ NO	1	2	3	4	5	6	7	8
8. Private research institutes/ Private non-profit research institutes	☐ YES	☐ NO	1	2	3	4	5	6	7	8
9. Other local associations	☐ YES	☐ NO	1	2	3	4	5	6	7	8
10. Professional associations/ trade unions	☐ YES	☐ NO	1	2	3	4	5	6	7	8
11. Standard or standardisation agencies	☐ YES	☐ NO	1	2	3	4	5	6	7	8
12. Patent disclosures	☐ YES	☐ NO	1	2	3	4	5	6	7	8
13. Professional conferences, meetings, branch works of literatures, and journals	☐ YES	☐ NO	1	2	3	4	5	6	7	8
14. Exhibitions and trade fairs	☐ YES	☐ NO	1	2	3	4	5	6	7	8
15. Internet	☐ YES	☐ NO	1	2	3	4	5	6	7	8

SECTION D

Instruction:

1) The following statement indicates to what extent the following items apply to your firm.
2) Please indicate to what extent you **AGREE** or **DISAGREE** with each statement.
3) Circle the numbers corresponding to your responses using the scale below.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

1.	We are motivated to **use various external knowledge sources**.	1	2	3	4	5	6	7
2.	We are able to acquire valuable knowledge through **various external sources**.	1	2	3	4	5	6	7
3.	We are able to identify the valuable knowledge from **various external sources**.	1	2	3	4	5	6	7
4.	We are able to select valuable knowledge obtained from **various external sources**.	1	2	3	4	5	6	7
5.	We are able to classify the **acquired knowledge** in finer categories.	1	2	3	4	5	6	7
6.	We emphasise a **shared language** for intra-corporate communication.	1	2	3	4	5	6	7
7.	We are using an **information system** as the tool to facilitate the spreading of knowledge throughout the firm.	1	2	3	4	5	6	7
8.	In our firm, employees are willingly to **share their knowledge, information and experiences** with their colleagues.	1	2	3	4	5	6	7
9.	In our firm, employees **exchange new ideas** and **concepts** in a cross-departmental manner.	1	2	3	4	5	6	7
10.	We periodically **organise cross-departmental meetings** to interchange new developments, problems, and achievements.	1	2	3	4	5	6	7

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**	**6**	**7**

11. In our firm, employees have the **ability to understand the acquired knowledge** based on their competencies, skills and experiences.	1	2	3	4	5	6	7
12. Overall, we are **able to achieve collective understanding** of the acquired knowledge.	1	2	3	4	5	6	7
13. In our firm, employees are able to **store externally acquired knowledge for future references****.	1	2	3	4	5	6	7
14. When recognising a business opportunity, our **employees are proficient in reactivating existing knowledge for new uses**.	1	2	3	4	5	6	7
15. Our employees are **able to use and structure the collected knowledge.**	1	2	3	4	5	6	7
16. Our employees **are able to transform.**							
17. **information from internal and external sources**							
18. **into valuable knowledge** for our firm.	1	2	3	4	5	6	7
19. Our employees have **successfully link existing knowledge with new insights*****.	1	2	3	4	5	6	7
20. Our employees are able to **create new knowledge based on the acquired knowledge**.	1	2	3	4	5	6	7
21. Our firm strives to **convert acquired knowledge into commercial applications**.	1	2	3	4	5	6	7
22. Our employees are able to **apply acquired knowledge for commercial purposes.**	1	2	3	4	5	6	7
23. Our employees **launch innovative products** to the market with regard to the new knowledge that they have acquired.	1	2	3	4	5	6	7

~THANK YOU FOR YOUR CO-OPERATIONS~

APPENDIX E
NON-RESPONSE BIAS TEST

Group Statistics

	RESPOND	N	Mean	Std. Deviation	Std. Error Mean
aa1	EARLY RESPOND	75	5.2133	1.50937	.17429
	LATE RESPOND	62	5.0484	1.51957	.19299
aa2	EARLY RESPOND	75	5.2000	1.33558	.15422
	LATE RESPOND	62	5.0161	1.43140	.18179
aa3	EARLY RESPOND	75	4.8800	1.32502	.15300
	LATE RESPOND	62	5.0645	1.42427	.18088
aa4	EARLY RESPOND	75	4.9333	1.42690	.16476
	LATE RESPOND	62	5.0806	1.48543	.18865
ab5	EARLY RESPOND	75	5.4800	1.30860	.15110
	LATE RESPOND	62	5.4839	1.03610	.13159
ab6	EARLY RESPOND	75	5.6800	1.08004	.12471
	LATE RESPOND	62	5.3065	1.19547	.15182
ab7	EARLY RESPOND	75	5.6400	1.09840	.12683
	LATE RESPOND	62	5.2258	1.10764	.14067
ab8	EARLY RESPOND	75	5.1600	1.09100	.12598
	LATE RESPOND	62	5.3871	1.09177	.13865
ab9	EARLY RESPOND	75	4.9333	1.23391	.14248
	LATE RESPOND	62	5.0484	1.16545	.14801
ab10	EARLY RESPOND	75	4.5333	1.32882	.15344
	LATE RESPOND	62	4.9194	1.27135	.16146
ab11	EARLY RESPOND	75	5.4667	1.03105	.11906
	LATE RESPOND	62	5.4194	1.09467	.13902
ab12	EARLY RESPOND	75	5.4133	1.04096	.12020
	LATE RESPOND	62	5.3226	1.14196	.14503
ab13	EARLY RESPOND	75	5.3600	1.04804	.12102
	LATE RESPOND	62	5.3065	1.13929	.14469
ab14	EARLY RESPOND	75	4.7467	1.20912	.13962
	LATE RESPOND	62	4.4516	1.68579	.21410
ab15	EARLY RESPOND	75	4.6800	1.23201	.14226
	LATE RESPOND	62	4.2581	1.67856	.21318

ab16	EARLY RESPOND	75	4.3867	1.43219	.16538
	LATE RESPOND	62	4.0484	1.66376	.21130
ab17	EARLY RESPOND	75	4.4400	1.46343	.16898
	LATE RESPOND	62	3.9677	1.65923	.21072
da1	EARLY RESPOND	75	5.6000	1.00000	.11547
	LATE RESPOND	62	5.3387	1.24062	.15756
da2	EARLY RESPOND	75	5.3733	.98328	.11354
	LATE RESPOND	62	5.4194	1.12422	.14278
da3	EARLY RESPOND	75	5.4400	.96198	.11108
	LATE RESPOND	62	5.3548	1.21597	.15443
da4	EARLY RESPOND	75	5.5733	.91789	.10599
	LATE RESPOND	62	5.2903	1.20636	.15321
da5	EARLY RESPOND	75	5.2800	.99404	.11478
	LATE RESPOND	62	5.3226	1.17032	.14863
db1	EARLY RESPOND	75	5.2933	1.01040	.11667
	LATE RESPOND	62	5.2581	1.03916	.13197
db2	EARLY RESPOND	75	5.2933	1.28161	.14799
	LATE RESPOND	62	5.0968	1.28942	.16376
db3	EARLY RESPOND	75	5.4533	1.04356	.12050
	LATE RESPOND	62	5.2419	1.03521	.13147
db4	EARLY RESPOND	75	5.3467	.97943	.11309
	LATE RESPOND	62	5.1613	1.25703	.15964
db5	EARLY RESPOND	75	5.3333	1.06965	.12351
	LATE RESPOND	62	5.1774	1.29974	.16507
db6	EARLY RESPOND	75	5.1733	1.04459	.12062
	LATE RESPOND	62	5.1290	1.19403	.15164
db7	EARLY RESPOND	75	5.3600	.87980	.10159
	LATE RESPOND	62	5.1774	1.12387	.14273
dc1	EARLY RESPOND	75	4.7067	1.20554	.13920
	LATE RESPOND	62	4.8226	1.23506	.15685
dc2	EARLY RESPOND	75	4.9200	1.01022	.11665
	LATE RESPOND	62	4.6452	1.20241	.15271
dc3	EARLY RESPOND	75	4.8533	1.06153	.12257
	LATE RESPOND	62	4.8387	1.21727	.15459
dc4	EARLY RESPOND	75	4.8533	.96833	.11181
	LATE RESPOND	62	4.7742	1.25997	.16002

dc5	EARLY RESPOND	75	4.7467	1.17512	.13569
	LATE RESPOND	62	4.7742	1.22031	.15498
dc6	EARLY RESPOND	75	4.8000	1.26277	.14581
	LATE RESPOND	62	4.7903	1.22992	.15620
dd1	EARLY RESPOND	75	4.9333	1.17787	.13601
	LATE RESPOND	62	5.0484	1.27302	.16167
dd2	EARLY RESPOND	75	4.8000	1.06543	.12302
	LATE RESPOND	62	4.9194	1.24530	.15815
dd3	EARLY RESPOND	75	4.7733	1.13392	.13093
	LATE RESPOND	62	4.9839	1.28665	.16340

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
aa1	Equal variances assumed	.864	.354	.635	135	.527	.16495	.25987	-.34900	.67889
	Equal variances not assumed			.634	129.868	.527	.16495	.26004	-.34951	.67940
aa2	Equal variances assumed	.002	.968	.776	135	.439	.18387	.23682	-.28449	.65223
	Equal variances not assumed			.771	126.421	.442	.18387	.23839	-.28788	.65563
aa3	Equal variances assumed	.060	.807	-.784	135	.434	-.18452	.23529	-.64984	.28081
	Equal variances not assumed			-.779	126.242	.438	-.18452	.23691	-.65335	.28432
aa4	Equal variances assumed	.003	.958	-.590	135	.556	-.14731	.24951	-.64077	.34614
	Equal variances not assumed			-.588	128.109	.557	-.14731	.25047	-.64291	.34828
ab5	Equal variances assumed	2.189	.141	-.019	135	.985	-.00387	.20481	-.40892	.40118
	Equal variances not assumed			-.019	134.770	.985	-.00387	.20037	-.40014	.39240
ab6	Equal variances assumed	.738	.392	1.920	135	.057	.37355	.19459	-.01128	.75838
	Equal variances not assumed			1.901	124.402	.060	.37355	.19648	-.01533	.76242

ab7	Equal variances assumed	.069	.794	2.189	135	.030	.41419	.18925	.03991	.78848
	Equal variances not assumed			2.187	129.787	.031	.41419	.18941	.03947	.78892
ab8	Equal variances assumed	.282	.596	-1.212	135	.228	-.22710	.18733	-.59757	.14337
	Equal variances not assumed			-1.212	130.162	.228	-.22710	.18734	-.59772	.14352
ab9	Equal variances assumed	1.921	.168	-.557	135	.578	-.11505	.20657	-.52358	.29348
	Equal variances not assumed			-.560	132.583	.576	-.11505	.20545	-.52143	.29132
ab10	Equal variances assumed	.868	.353	-1.726	135	.087	-.38602	.22368	-.82840	.05636
	Equal variances not assumed			-1.733	132.110	.085	-.38602	.22274	-.82662	.05458
ab11	Equal variances assumed	.272	.603	.260	135	.795	.04731	.18199	-.31261	.40723
	Equal variances not assumed			.258	126.982	.796	.04731	.18303	-.31488	.40951
ab12	Equal variances assumed	.905	.343	.486	135	.628	.09075	.18671	-.27850	.46001
	Equal variances not assumed			.482	124.976	.631	.09075	.18837	-.28205	.46355
ab13	Equal variances assumed	.136	.713	.286	135	.775	.05355	.18713	-.31654	.42364
	Equal variances not assumed			.284	125.549	.777	.05355	.18863	-.31975	.42685
ab14	Equal variances assumed	12.541	.001	1.190	135	.236	.29505	.24788	-.19517	.78528
	Equal variances not assumed			1.154	107.838	.251	.29505	.25560	-.21159	.80170
ab15	Equal variances assumed	11.914	.001	1.694	135	.093	.42194	.24904	-.07059	.91446
	Equal variances not assumed			1.646	109.523	.103	.42194	.25629	-.08599	.92986
ab16	Equal variances assumed	1.150	.285	1.279	135	.203	.33828	.26453	-.18488	.86144
	Equal variances not assumed			1.261	121.149	.210	.33828	.26832	-.19293	.86948
ab17	Equal variances assumed	.550	.460	1.769	135	.079	.47226	.26690	-.05559	1.00011
	Equal variances not assumed			1.748	122.814	.083	.47226	.27011	-.06241	1.00693
da1	Equal variances assumed	.317	.574	1.365	135	.175	.26129	.19141	-.11727	.63985
	Equal variances not assumed			1.338	116.435	.184	.26129	.19534	-.12559	.64817
da2	Equal variances assumed	.224	.637	-.256	135	.799	-.04602	.18011	-.40223	.31018

	Equal variances not assumed			-.252	122.246	.801	-.04602	.18242	-.40713	.31509
da3	Equal variances assumed	1.471	.227	.458	135	.648	.08516	.18609	-.28286	.45319
	Equal variances not assumed			.448	115.061	.655	.08516	.19023	-.29164	.46197
da4	Equal variances assumed	2.454	.120	1.558	135	.121	.28301	.18161	-.07615	.64217
	Equal variances not assumed			1.519	112.179	.132	.28301	.18630	-.08611	.65213
da5	Equal variances assumed	.812	.369	-.230	135	.818	-.04258	.18491	-.40827	.32311
	Equal variances not assumed			-.227	120.210	.821	-.04258	.18779	-.41439	.32923
db1	Equal variances assumed	.145	.704	.201	135	.841	.03527	.17568	-.31217	.38271
	Equal variances not assumed			.200	128.771	.842	.03527	.17615	-.31326	.38379
db2	Equal variances assumed	.214	.644	.891	135	.374	.19656	.22059	-.23970	.63282
	Equal variances not assumed			.891	129.901	.375	.19656	.22072	-.24011	.63323
db3	Equal variances assumed	.345	.558	1.184	135	.238	.21140	.17848	-.14157	.56437
	Equal variances not assumed			1.185	130.576	.238	.21140	.17834	-.14141	.56421
db4	Equal variances assumed	1.888	.172	.970	135	.334	.18538	.19112	-.19260	.56336
	Equal variances not assumed			.948	113.936	.345	.18538	.19564	-.20219	.57295
db5	Equal variances assumed	1.555	.215	.770	135	.442	.15591	.20240	-.24438	.55620
	Equal variances not assumed			.756	117.949	.451	.15591	.20616	-.25234	.56417
db6	Equal variances assumed	.508	.477	.232	135	.817	.04430	.19132	-.33406	.42267
	Equal variances not assumed			.229	122.263	.820	.04430	.19376	-.33926	.42787
db7	Equal variances assumed	1.170	.281	1.066	135	.288	.18258	.17122	-.15604	.52120
	Equal variances not assumed			1.042	114.283	.300	.18258	.17519	-.16447	.52963
dc1	Equal variances assumed	.001	.979	-.554	135	.580	-.11591	.20923	-.52971	.29788
	Equal variances not assumed			-.553	128.977	.581	-.11591	.20972	-.53084	.29901
dc2	Equal variances assumed	3.431	.066	1.454	135	.148	.27484	.18902	-.09899	.64866

	Equal variances not assumed			1.430	119.436	.155	.27484	.19216	-.10565	.65533
dc3	Equal variances assumed	.417	.520	.075	135	.940	.01462	.19474	-.37052	.39976
	Equal variances not assumed			.074	122.045	.941	.01462	.19729	-.37593	.40518
dc4	Equal variances assumed	6.774	.010	.416	135	.678	.07914	.19047	-.29754	.45582
	Equal variances not assumed			.405	112.920	.686	.07914	.19521	-.30761	.46589
dc5	Equal variances assumed	.271	.603	-.134	135	.894	-.02753	.20525	-.43344	.37839
	Equal variances not assumed			-.134	128.245	.894	-.02753	.20599	-.43510	.38005
dc6	Equal variances assumed	.151	.698	.045	135	.964	.00968	.21422	-.41398	.43334
	Equal variances not assumed			.045	131.389	.964	.00968	.21368	-.41302	.43238
dd1	Equal variances assumed	.372	.543	-.549	135	.584	-.11505	.20971	-.52980	.29970
	Equal variances not assumed			-.545	125.909	.587	-.11505	.21127	-.53316	.30305
dd2	Equal variances assumed	.537	.465	-.605	135	.546	-.11935	.19743	-.50980	.27109
	Equal variances not assumed			-.596	120.721	.553	-.11935	.20037	-.51605	.27734
dd3	Equal variances assumed	.023	.880	-1.018	135	.311	-.21054	.20689	-.61970	.19863
	Equal variances not assumed			-1.005	122.761	.317	-.21054	.20939	-.62502	.20395

APPENDIX F
COMMON METHOD BIAS TEST

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	16.181	38.526	38.526	16.181	38.526	38.526
2	3.624	8.630	47.156	3.624	8.630	47.156
3	2.943	7.008	54.164	2.943	7.008	54.164
4	2.420	5.762	59.926	2.420	5.762	59.926
5	1.888	4.494	64.420	1.888	4.494	64.420
6	1.761	4.193	68.613	1.761	4.193	68.613
7	1.520	3.620	72.233	1.520	3.620	72.233
8	1.426	3.394	75.627	1.426	3.394	75.627
9	1.027	2.444	78.071	1.027	2.444	78.071
10	.853	2.030	80.102			
11	.727	1.731	81.833			
12	.673	1.603	83.436			
13	.627	1.493	84.930			
14	.518	1.234	86.164			
15	.497	1.182	87.346			
16	.438	1.043	88.390			
17	.424	1.009	89.399			
18	.409	.974	90.373			
19	.376	.895	91.267			

20	.329	.784	92.051			
21	.315	.751	92.802			
22	.300	.713	93.515			
23	.294	.700	94.215			
24	.257	.612	94.827			
25	.233	.554	95.381			
26	.222	.529	95.910			
27	.212	.505	96.415			
28	.186	.443	96.858			
29	.180	.429	97.287			
30	.160	.382	97.669			
31	.153	.364	98.034			
32	.135	.321	98.355			
33	.110	.262	98.617			
34	.099	.235	98.852			
35	.089	.213	99.065			
36	.084	.200	99.265			
37	.071	.168	99.433			
38	.062	.148	99.580			
39	.058	.137	99.718			
40	.050	.118	99.836			
41	.038	.090	99.926			
42	.031	.074	100.000			

Extraction Method: Principal Component Analysis.

APPENDIX G
Descriptive Statistics for Main Variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Collaborationdepth	136	.00	8.00	5.9448	2.00454
informationdepth	136	4.89	8.00	6.6633	.83217
collaborationbreadth	136	.00	8.00	3.1838	1.73505
informationbreadth	136	1.00	15.00	6.5515	3.23137
MeanAC	136	2.90	7.00	5.1338	.76418
MeanPIP	136	2.94	7.00	5.0458	.83145
Valid N (listwise)	136				

APPENDIX H1
Exploratory Factor Analysis Result (Product Innovation Performance with Varimax Rotation Method-Before delete item ab5)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. Chi-Square	1992.230
	df	136
	Sig.	.000

Anti-image Matrices

		aa1	aa2	aa3	aa4	ab5	ab6	ab7	ab8	ab9	ab10	ab11	ab12	ab13	ab14	ab15	ab16	ab17
Anti-image Covariance	aa1	.140	-.085	-.006	-.037	-.015	-.026	.033	-.027	-.057	.076	-.013	.027	-.006	.007	-.002	.016	-.001
	aa2	-.085	.173	-.041	.014	.015	.003	-.014	.037	.008	-.045	.045	-.013	-.032	-.009	-.006	-.029	.018
	aa3	-.006	-.041	.090	-.066	-.035	.009	-.022	.026	.048	-.038	-.012	.011	.001	.013	-.005	-.001	-.001
	aa4	-.037	.014	-.066	.097	-.002	.005	.021	-.042	-.015	.020	-.007	-.019	.005	-.021	.014	.008	-.011
	ab5	-.015	.015	-.035	-.002	.418	-.119	-.011	-.025	-.041	.012	-.030	-.009	.038	-.031	.045	-.022	.018
	ab6	-.026	.003	.009	.005	-.119	.277	-.170	-.027	.074	-.062	-.025	.057	-.067	.004	-.037	-.001	-.011
	ab7	.033	-.014	-.022	.021	-.011	-.170	.345	-.027	-.045	.075	.000	-.100	.027	-.013	.040	.012	-.028
	ab8	-.027	.037	.026	-.042	-.025	-.027	-.027	.466	-.068	-.098	.001	-.033	-.011	.036	-.081	.019	.011
	ab9	-.057	.008	.048	-.015	-.041	.074	-.045	-.068	.442	-.229	-.047	.063	-.069	-.032	-.041	.006	.006
	ab10	.076	-.045	-.038	.020	.012	-.062	.075	-.098	-.229	.439	.011	-.076	.028	-.007	.005	.011	.002
	ab11	-.013	.045	-.012	-.007	-.030	-.025	.000	.001	-.047	.011	.335	-.105	-.077	.036	.004	.000	-.026
	ab12	.027	-.013	.011	-.019	-.009	.057	-.100	-.033	.063	-.076	-.105	.252	-.129	-.009	-.032	.025	-.006

	ab13	-.006	-.032	.001	.005	.038	-.067	.027	-.011	-.069	.028	-.077	-.129	.302	-.021	.030	-.032	.030
	ab14	.007	-.009	.013	-.021	-.031	.004	-.013	.036	-.032	-.007	.036	-.009	-.021	.344	-.090	-.112	.033
	ab15	-.002	-.006	-.005	.014	.045	-.037	.040	-.081	-.041	.005	.004	-.032	.030	-.090	.243	.014	-.099
	ab16	.016	-.029	-.001	.008	-.022	-.001	.012	.019	.006	.011	.000	.025	-.032	-.112	.014	.176	-.108
	ab17	-.001	.018	-.001	-.011	.018	-.011	-.028	.011	.006	.002	-.026	-.006	.030	.033	-.099	-.108	.152
Anti-image Correlation	aa1	.838[a]	-.548	-.052	-.318	-.062	-.134	.149	-.107	-.228	.305	-.058	.141	-.027	.030	-.013	.101	-.009
	aa2	-.548	.858[a]	-.329	.107	.054	.015	-.059	.131	.030	-.164	.187	-.065	-.139	-.037	-.031	-.163	.112
	aa3	-.052	-.329	.829[a]	-.711	-.178	.058	-.125	.128	.240	-.190	-.069	.072	.008	.076	-.034	-.009	-.012
	aa4	-.318	.107	-.711	.842[a]	-.010	.029	.113	-.200	-.073	.096	-.039	-.121	.030	-.114	.093	.059	-.088
	ab5	-.062	.054	-.178	-.010	.931[a]	-.348	-.029	-.056	-.096	.028	-.080	-.029	.107	-.082	.140	-.083	.071
	ab6	-.134	.015	.058	.029	-.348	.850[a]	-.550	-.076	.211	-.177	-.081	.217	-.230	.011	-.142	-.007	-.051
	ab7	.149	-.059	-.125	.113	-.029	-.550	.831[a]	-.066	-.115	.192	.001	-.339	.084	-.039	.139	.050	-.121
	ab8	-.107	.131	.128	-.200	-.056	-.076	-.066	.913[a]	-.150	-.216	.002	-.097	-.029	.089	-.241	.066	.042
	ab9	-.228	.030	.240	-.073	-.096	.211	-.115	-.150	.756[a]	-.520	-.123	.188	-.190	-.082	-.126	.022	.024
	ab10	.305	-.164	-.190	.096	.028	-.177	.192	-.216	-.520	.747[a]	.028	-.229	.076	-.018	.014	.041	.006
	ab11	-.058	.187	-.069	-.039	-.080	-.081	.001	.002	-.123	.028	.924[a]	-.360	-.242	.105	.013	.001	-.117
	ab12	.141	-.065	.072	-.121	-.029	.217	-.339	-.097	.188	-.229	-.360	.830[a]	-.468	-.029	-.129	.118	-.032
	ab13	-.027	-.139	.008	.030	.107	-.230	.084	-.029	-.190	.076	-.242	-.468	.883[a]	-.066	.109	-.138	.140
	ab14	.030	-.037	.076	-.114	-.082	.011	-.039	.089	-.082	-.018	.105	-.029	-.066	.879[a]	-.312	-.453	.147
	ab15	-.013	-.031	-.034	.093	.140	-.142	.139	-.241	-.126	.014	.013	-.129	.109	-.312	.850[a]	.070	-.515
	ab16	.101	-.163	-.009	.059	-.083	-.007	.050	.066	.022	.041	.001	.118	-.138	-.453	.070	.798[a]	-.663
	ab17	-.009	.112	-.012	-.088	.071	-.051	-.121	.042	.024	.006	-.117	-.032	.140	.147	-.515	-.663	.799[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
aa1	1.000	.898
aa2	1.000	.845
aa3	1.000	.908
aa4	1.000	.896
ab5	1.000	.612
ab6	1.000	.732
ab7	1.000	.761
ab8	1.000	.610
ab9	1.000	.761
ab10	1.000	.721
ab11	1.000	.705
ab12	1.000	.760
ab13	1.000	.689
ab14	1.000	.743
ab15	1.000	.815
ab16	1.000	.874
ab17	1.000	.871

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.506	44.151	44.151	7.506	44.151	44.151	4.066	23.916	23.916
2	2.626	15.445	59.595	2.626	15.445	59.595	3.415	20.086	44.002
3	1.870	11.002	70.598	1.870	11.002	70.598	3.348	19.695	63.696
4	1.201	7.063	77.660	1.201	7.063	77.660	2.374	13.964	77.660
5	.727	4.277	81.938						
6	.549	3.229	85.167						
7	.438	2.578	87.745						
8	.411	2.416	90.161						
9	.367	2.160	92.321						
10	.295	1.737	94.057						
11	.239	1.408	95.465						
12	.230	1.356	96.821						
13	.173	1.018	97.839						
14	.135	.793	98.632						
15	.099	.585	99.217						
16	.082	.482	99.700						
17	.051	.300	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
ab6	.768			
ab13	.741			
ab11	.738			
aa4	.725	-.587		
aa3	.712	-.611		
ab12	.707		.416	
ab5	.694			
aa2	.680	-.572		
ab7	.656			-.515
ab17	.646	.485	-.468	
ab15	.639	.521		
ab8	.638			
ab14	.628		-.441	
ab16	.613	.428	-.560	
ab10	.499		.476	.429
aa1	.636	-.667		
ab9	.510			.559

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
aa1	.937			
aa3	.919			
aa4	.907			
aa2	.891			
ab5	.602	.477		
ab7		.828		
ab12		.755		.400
ab6	.301	.717	.351	
ab11		.714		.346
ab13		.667		.385
ab16			.908	
ab17			.890	
ab15			.830	
ab14			.814	
ab9				.843
ab10				.813
ab8		.378		.634

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.556	.573	.472	.374
2	-.786	.164	.555	.217
3	-.231	.399	-.672	.580
4	.140	-.697	.134	.691

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX H2
Exploratory Factor Analysis Result (Product Innovation Performance with Direct Oblimin Rotation Method-Before delete item ab5)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. Chi-Square	1992.230
	df	136
	Sig.	.000

Anti-image Matrices

		aa1	aa2	aa3	aa4	ab5	ab6	ab7	ab8	ab9	ab10	ab11	ab12	ab13	ab14	ab15	ab16	ab17
Anti-image Covariance	aa1	.140	-.085	-.006	-.037	-.015	-.026	.033	-.027	-.057	.076	-.013	.027	-.006	.007	-.002	.016	-.001
	aa2	-.085	.173	-.041	.014	.015	.003	-.014	.037	.008	-.045	.045	-.013	-.032	-.009	-.006	-.029	.018
	aa3	-.006	-.041	.090	-.066	-.035	.009	-.022	.026	.048	-.038	-.012	.011	.001	.013	-.005	-.001	-.001
	aa4	-.037	.014	-.066	.097	-.002	.005	.021	-.042	-.015	.020	-.007	-.019	.005	-.021	.014	.008	-.011
	ab5	-.015	.015	-.035	-.002	.418	-.119	-.011	-.025	-.041	.012	-.030	-.009	.038	-.031	.045	-.022	.018
	ab6	-.026	.003	.009	.005	-.119	.277	-.170	-.027	.074	-.062	-.025	.057	-.067	.004	-.037	-.001	-.011
	ab7	.033	-.014	-.022	.021	-.011	-.170	.345	-.027	-.045	.075	.000	-.100	.027	-.013	.040	.012	-.028
	ab8	-.027	.037	.026	-.042	-.025	-.027	-.027	.466	-.068	-.098	.001	-.033	-.011	.036	-.081	.019	.011
	ab9	-.057	.008	.048	-.015	-.041	.074	-.045	-.068	.442	-.229	-.047	.063	-.069	-.032	-.041	.006	.006
	ab10	.076	-.045	-.038	.020	.012	-.062	.075	-.098	-.229	.439	.011	-.076	.028	-.007	.005	.011	.002
	ab11	-.013	.045	-.012	-.007	-.030	-.025	.000	.001	-.047	.011	.335	-.105	-.077	.036	.004	.000	-.026
	ab12	.027	-.013	.011	-.019	-.009	.057	-.100	-.033	.063	-.076	-.105	.252	-.129	-.009	-.032	.025	-.006
	ab13	-.006	-.032	.001	.005	.038	-.067	.027	-.011	-.069	.028	-.077	-.129	.302	-.021	.030	-.032	.030

	ab14	.007	-.009	.013	-.021	-.031	.004	-.013	.036	-.032	-.007	.036	-.009	-.021	.344	-.090	-.112	.033
	ab15	-.002	-.006	-.005	.014	.045	-.037	.040	-.081	-.041	.005	.004	-.032	.030	-.090	.243	.014	-.099
	ab16	.016	-.029	-.001	.008	-.022	-.001	.012	.019	.006	.011	.000	.025	-.032	-.112	.014	.176	-.108
	ab17	-.001	.018	-.001	-.011	.018	-.011	-.028	.011	.006	.002	-.026	-.006	.030	.033	-.099	-.108	.152
Anti-image Correlation	aa1	.838[a]	-.548	-.052	-.318	-.062	-.134	.149	-.107	-.228	.305	-.058	.141	-.027	.030	-.013	.101	-.009
	aa2	-.548	.858[a]	-.329	.107	.054	.015	-.059	.131	.030	-.164	.187	-.065	-.139	-.037	-.031	-.163	.112
	aa3	-.052	-.329	.829[a]	-.711	-.178	.058	-.125	.128	.240	-.190	-.069	.072	.008	.076	-.034	-.009	-.012
	aa4	-.318	.107	-.711	.842[a]	-.010	.029	.113	-.200	-.073	.096	-.039	-.121	.030	-.114	.093	.059	-.088
	ab5	-.062	.054	-.178	-.010	.931[a]	-.348	-.029	-.056	-.096	.028	-.080	-.029	.107	-.082	.140	-.083	.071
	ab6	-.134	.015	.058	.029	-.348	.850[a]	-.550	-.076	.211	-.177	-.081	.217	-.230	.011	-.142	-.007	-.051
	ab7	.149	-.059	-.125	.113	-.029	-.550	.831[a]	-.066	-.115	.192	.001	-.339	.084	-.039	.139	.050	-.121
	ab8	-.107	.131	.128	-.200	-.056	-.076	-.066	.913[a]	-.150	-.216	.002	-.097	-.029	.089	-.241	.066	.042
	ab9	-.228	.030	.240	-.073	-.096	.211	-.115	-.150	.756[a]	-.520	-.123	.188	-.190	-.082	-.126	.022	.024
	ab10	.305	-.164	-.190	.096	.028	-.177	.192	-.216	-.520	.747[a]	.028	-.229	.076	-.018	.014	.041	.006
	ab11	-.058	.187	-.069	-.039	-.080	-.081	.001	.002	-.123	.028	.924[a]	-.360	-.242	.105	.013	.001	-.117
	ab12	.141	-.065	.072	-.121	-.029	.217	-.339	-.097	.188	-.229	-.360	.830[a]	-.468	-.029	-.129	.118	-.032
	ab13	-.027	-.139	.008	.030	.107	-.230	.084	-.029	-.190	.076	-.242	-.468	.883[a]	-.066	.109	-.138	.140
	ab14	.030	-.037	.076	-.114	-.082	.011	-.039	.089	-.082	-.018	.105	-.029	-.066	.879[a]	-.312	-.453	.147
	ab15	-.013	-.031	-.034	.093	.140	-.142	.139	-.241	-.126	.014	.013	-.129	.109	-.312	.850[a]	.070	-.515
	ab16	.101	-.163	-.009	.059	-.083	-.007	.050	.066	.022	.041	.001	.118	-.138	-.453	.070	.798[a]	-.663
	ab17	-.009	.112	-.012	-.088	.071	-.051	-.121	.042	.024	.006	-.117	-.032	.140	.147	-.515	-.663	.799[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
aa1	1.000	.898
aa2	1.000	.845
aa3	1.000	.908
aa4	1.000	.896
ab5	1.000	.612
ab6	1.000	.732
ab7	1.000	.761
ab8	1.000	.610
ab9	1.000	.761
ab10	1.000	.721
ab11	1.000	.705
ab12	1.000	.760
ab13	1.000	.689
ab14	1.000	.743
ab15	1.000	.815
ab16	1.000	.874
ab17	1.000	.871

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	7.506	44.151	44.151	7.506	44.151	44.151	5.383
2	2.626	15.445	59.595	2.626	15.445	59.595	5.209
3	1.870	11.002	70.598	1.870	11.002	70.598	4.652
4	1.201	7.063	77.660	1.201	7.063	77.660	3.376
5	.727	4.277	81.938				
6	.549	3.229	85.167				
7	.438	2.578	87.745				
8	.411	2.416	90.161				
9	.367	2.160	92.321				
10	.295	1.737	94.057				
11	.239	1.408	95.465				
12	.230	1.356	96.821				
13	.173	1.018	97.839				
14	.135	.793	98.632				
15	.099	.585	99.217				
16	.082	.482	99.700				
17	.051	.300	100.000				

Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]

	Component			
	1	2	3	4
ab6	.768			
ab13	.741			
ab11	.738			
aa4	.725	-.587		
aa3	.712	-.611		
ab12	.707		.416	
ab5	.694			
aa2	.680	-.572		
ab7	.656			-.515
ab17	.646	.485	-.468	
ab15	.639	.521		
ab8	.638			
ab14	.628		-.441	
ab16	.613	.428	-.560	
ab10	.499		.476	.429
aa1	.636	-.667		
ab9	.510			.559

Extraction Method: Principal Component Analysis.
a. 4 components extracted.

Pattern Matrix[a]

	Component			
	1	2	3	4
ab7	.894			
ab12	.766			
ab6	.703			
ab11	.702			
ab13	.638			
aa1		-.984		
aa3		-.937		
aa4		-.923		
aa2		-.919		
ab5	.410	-.545		
ab16			-.945	
ab17			-.910	
ab15			-.846	
ab14			-.837	
ab9				.861
ab10				.816
ab8				.582

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Structure Matrix

	Component			
	1	2	3	4
ab7	.853		-.422	
ab12	.834			.539
ab6	.813	-.468	-.522	
ab11	.812			.491
ab13	.779	-.449		.522
aa3	.410	-.952		
aa4	.408	-.945		
aa1		-.943		
aa2		-.916		
ab5	.600	-.693		
ab16			-.930	
ab17	.442		-.930	
ab15	.406		-.880	
ab14			-.855	
ab9				.865
ab10				.845
ab8	.541			.713

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Component Correlation Matrix

Component	1	2	3	4
1	1.000	-.393	-.411	.372
2	-.393	1.000	.268	-.211
3	-.411	.268	1.000	-.246
4	.372	-.211	-.246	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

APPENDIX H3

Exploratory Factor Analysis Result (Product Innovation Performance with Varimax Rotation Method-After delete item ab5)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.834
Bartlett's Test of Sphericity	Approx. Chi-Square	1885.010
	Df	120
	Sig.	.000

Anti-image Matrices

		aa1	aa2	aa3	aa4	ab6	ab7	ab8	ab9	ab10	ab11	ab12	ab13	ab14	ab15	ab16	ab17
Anti-image Covariance	aa1	.141	-.085	-.007	-.037	-.035	.032	-.028	-.059	.076	-.014	.026	-.004	.006	-.001	.015	-.001
	aa2	-.085	.173	-.041	.014	.008	-.014	.038	.010	-.046	.046	-.013	-.033	-.008	-.008	-.028	.018
	aa3	-.007	-.041	.093	-.069	-.001	-.024	.025	.047	-.038	-.015	.010	.005	.011	-.001	-.003	4.674E-5
	aa4	-.037	.014	-.069	.097	.005	.021	-.043	-.016	.020	-.007	-.019	.005	-.021	.015	.008	-.011
	ab6	-.035	.008	-.001	.005	.316	-.197	-.039	.071	-.067	-.038	.062	-.064	-.006	-.028	-.009	-.006
	ab7	.032	-.014	-.024	.021	-.197	.345	-.027	-.046	.075	.000	-.100	.028	-.014	.042	.012	-.027
	ab8	-.028	.038	.025	-.043	-.039	-.027	.468	-.071	-.098	-.001	-.034	-.009	.034	-.080	.018	.012
	ab9	-.059	.010	.047	-.016	.071	-.046	-.071	.447	-.230	-.051	.062	-.067	-.035	-.038	.004	.008
	ab10	.076	-.046	-.038	.020	-.067	.075	-.098	-.230	.440	.012	-.076	.027	-.006	.003	.012	.001
	ab11	-.014	.046	-.015	-.007	-.038	.000	-.001	-.051	.012	.337	-.106	-.075	.034	.007	-.001	-.025
	ab12	.026	-.013	.010	-.019	.062	-.100	-.034	.062	-.076	-.106	.252	-.130	-.009	-.032	.024	-.006
	ab13	-.004	-.033	.005	.005	-.064	.028	-.009	-.067	.027	-.075	-.130	.305	-.019	.026	-.030	.029

	ab14	.006	-.008	.011	-.021	-.006	-.014	.034	-.035	-.006	.034	-.009	-.019	.346	-.089	-.115	.035
	ab15	-.001	-.008	-.001	.015	-.028	.042	-.080	-.038	.003	.007	-.032	.026	-.089	.248	.017	-.103
	ab16	.015	-.028	-.003	.008	-.009	.012	.018	.004	.012	-.001	.024	-.030	-.115	.017	.177	-.109
	ab17	-.001	.018	4.674E-5	-.011	-.006	-.027	.012	.008	.001	-.025	-.006	.029	.035	-.103	-.109	.152
Anti-image	aa1	.821[a]	-.547	-.064	-.319	-.166	.147	-.111	-.235	.307	-.063	.140	-.021	.025	-.004	.097	-.005
Correlation	aa2	-.547	.848[a]	-.325	.108	.036	-.058	.134	.036	-.166	.192	-.063	-.145	-.033	-.039	-.160	.108
	aa3	-.064	-.325	.818[a]	-.724	-.004	-.132	.120	.228	-.188	-.085	.068	.027	.063	-.010	-.024	.000
	aa4	-.319	.108	-.724	.824[a]	.027	.112	-.201	-.075	.097	-.040	-.122	.031	-.115	.095	.058	-.087
	ab6	-.166	.036	-.004	.027	.851[a]	-.598	-.102	.190	-.179	-.117	.221	-.207	-.018	-.100	-.038	-.029
	ab7	.147	-.058	-.132	.112	-.598	.804[a]	-.068	-.118	.193	-.001	-.340	.088	-.042	.145	.048	-.120
	ab8	-.111	.134	.120	-.201	-.102	-.068	.908[a]	-.156	-.215	-.002	-.098	-.023	.085	-.236	.061	.046
	ab9	-.235	.036	.228	-.075	.190	-.118	-.156	.756[a]	-.520	-.132	.186	-.181	-.090	-.114	.014	.031
	ab10	.307	-.166	-.188	.097	-.179	.193	-.215	-.520	.741[a]	.030	-.229	.073	-.016	.011	.043	.004
	ab11	-.063	.192	-.085	-.040	-.117	-.001	-.002	-.132	.030	.918[a]	-.364	-.235	.099	.024	-.005	-.112
	ab12	.140	-.063	.068	-.122	.221	-.340	-.098	.186	-.229	-.364	.824[a]	-.468	-.031	-.127	.116	-.030
	ab13	-.021	-.145	.027	.031	-.207	.088	-.023	-.181	.073	-.235	-.468	.885[a]	-.058	.096	-.131	.133
	ab14	.025	-.033	.063	-.115	-.018	-.042	.085	-.090	-.016	.099	-.031	-.058	.876[a]	-.304	-.463	.153
	ab15	-.004	-.039	-.010	.095	-.100	.145	-.236	-.114	.011	.024	-.127	.096	-.304	.853[a]	.083	-.532
	ab16	.097	-.160	-.024	.058	-.038	.048	.061	.014	.043	-.005	.116	-.131	-.463	.083	.793[a]	-.661
	ab17	-.005	.108	.000	-.087	-.029	-.120	.046	.031	.004	-.112	-.030	.133	.153	-.532	-.661	.793[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
aa1	1.000	.905
aa2	1.000	.859
aa3	1.000	.912
aa4	1.000	.903
ab6	1.000	.699
ab7	1.000	.747
ab8	1.000	.612
ab9	1.000	.775
ab10	1.000	.731
ab11	1.000	.717
ab12	1.000	.780
ab13	1.000	.711
ab14	1.000	.743
ab15	1.000	.812
ab16	1.000	.874
ab17	1.000	.871

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.063	44.144	44.144	7.063	44.144	44.144	3.690	23.060	23.060
2	2.542	15.886	60.030	2.542	15.886	60.030	3.342	20.887	43.947
3	1.870	11.689	71.720	1.870	11.689	71.720	3.337	20.854	64.802
4	1.176	7.351	79.070	1.176	7.351	79.070	2.283	14.269	79.070
5	.655	4.094	83.164						
6	.534	3.340	86.504						
7	.433	2.705	89.209						
8	.373	2.333	91.543						
9	.296	1.849	93.391						
10	.271	1.696	95.087						
11	.238	1.488	96.575						
12	.175	1.091	97.667						
13	.139	.869	98.535						
14	.100	.628	99.163						
15	.082	.514	99.677						
16	.052	.323	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
ab6	.756			
ab13	.748			
ab11	.743			
ab12	.719		.416	
aa4	.705	-.622		
aa3	.688	-.642		
ab17	.668	.455	-.467	
ab15	.666	.484		
aa2	.663	-.610		
ab7	.655			-.507
ab8	.644			
ab14	.643		-.440	
ab16	.629	.404	-.560	
ab10	.513		.476	.441
aa1	.612	-.700		
ab9	.523			.570

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
aa1	.939			
aa3	.918			
aa4	.907			
aa2	.897			
ab16		.909		
ab17		.890		
ab15		.828		
ab14		.816		
ab7			.819	
ab12			.789	
ab11			.738	
ab13			.704	
ab6			.697	
ab9				.851
ab10				.815
ab8				.628

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.516	.500	.584	.379
2	-.816	.528	.154	.178
3	-.234	-.673	.418	.563
4	.114	.135	-.679	.713

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX H4
Exploratory Factor Analysis Result (Absorptive Capacity with Varimax Rotation Method)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	2610.695
	df	210
	Sig.	.000

Anti-image Matrices

		da1	da2	da3	da4	da5	db1	db2	db3	db4	db5	db6	db7	dc1	dc2	dc3	dc4	dc5	dc6	dd1	dd2	dd3
Anti-image Covariance	da1	.388	-.116	-.021	-.027	-.017	.056	-.028	-.001	-.025	-.033	.027	.014	.021	-.027	-.039	-.008	.007	.046	-.024	-.008	-.003
	da2	-.116	.248	-.070	-.039	-.024	.033	.039	.009	.007	.026	-.016	-.010	.010	.002	.001	.024	-2.822E-5	-.034	-.001	-.042	.041
	da3	-.021	-.070	.152	-.086	-.051	-.030	-.028	-.019	-.020	.058	-.006	.013	.022	-.042	.046	-.016	.003	-.025	-.031	.044	-.015
	da4	-.027	-.039	-.086	.196	-.036	-.013	-.042	.004	.032	-.039	.007	-.030	-.023	.038	-.027	-.013	-.004	.040	.016	-.007	-.002
	da5	-.017	-.024	-.051	-.036	.327	-.082	.073	-.025	.006	-.089	.037	.002	-.045	.046	-.068	.009	.015	.005	-.010	.008	-.031
	db1	.056	.033	-.030	-.013	-.082	.461	-.115	-.002	-.015	.035	-.011	-.044	.008	-.051	.057	-.006	-.016	.024	-.010	-.027	-.002
	db2	-.028	.039	-.028	-.042	.073	-.115	.460	-.057	-.028	-.069	-.009	.021	-.002	.054	-.058	.051	.013	-.060	-.027	.017	-.021
	db3	-.001	.009	-.019	.004	-.025	-.002	-.057	.277	-.112	.039	-.007	-.024	-.013	.005	-.027	.015	-.028	.030	.050	-.057	.053

	db4	-.025	.007	-.020	.032	.006	-.015	-.028	-.112	.193	-.098	-.057	-.001	-.001	.000	.015	-.032	.034	-.012	.008	.019	-.018
	db5	-.033	.026	.058	-.039	-.089	.035	-.069	.039	-.098	.339	-.008	-.051	.044	-.078	.031	.023	-.040	.007	.000	.004	-.001
	db6	.027	-.016	-.006	.007	.037	-.011	-.009	-.007	-.057	-.008	.181	-.104	-.003	.035	-.047	-.015	-.012	.019	.005	-.028	.036
	db7	.014	-.010	.013	-.030	.002	-.044	.021	-.024	-.001	-.051	-.104	.193	-.042	-.019	.027	.021	.024	-.045	-.014	.021	-.042
	dc1	.021	.010	.022	-.023	-.045	.008	-.002	-.013	-.001	.044	-.003	-.042	.259	-.093	-.012	-.026	-.043	.019	-.004	.008	-.007
	dc2	-.027	.002	-.042	.038	.046	-.051	.054	.005	.000	-.078	.035	-.019	-.093	.266	-.047	-.054	.001	.022	-.008	-.016	.002
	dc3	-.039	.001	.046	-.027	-.068	.057	-.058	-.027	.015	.031	-.047	.027	-.012	-.047	.224	-.047	-.022	-.034	-.005	.021	-.009
	dc4	-.008	.024	-.016	-.013	.009	-.006	.051	.015	-.032	.023	-.015	.021	-.026	-.054	-.047	.156	-.037	-.035	.021	-.030	.012
	dc5	.007	-2.822E-5	.003	-.004	.015	-.016	.013	-.028	.034	-.040	-.012	.024	-.043	.001	-.022	-.037	.136	-.087	-.005	.011	-.042
	dc6	.046	-.034	-.025	.040	.005	.024	-.060	.030	-.012	.007	.019	-.045	.019	.022	-.034	-.035	-.087	.180	-.002	-.009	.029
	dd1	-.024	-.001	-.031	.016	-.010	-.010	-.027	.050	.008	.000	.005	-.014	-.004	-.008	-.005	.021	-.005	-.002	.329	-.126	-.039
	dd2	-.008	-.042	.044	-.007	.008	-.027	.017	-.057	.019	.004	-.028	.021	.008	-.016	.021	-.030	.011	-.009	-.126	.196	-.125
	dd3	-.003	.041	-.015	-.002	-.031	-.002	-.021	.053	-.018	-.001	.036	-.042	-.007	.002	-.009	.012	-.042	.029	-.039	-.125	.254
Anti-image Correlation	da1	.909[a]	-.373	-.085	-.098	-.048	.133	-.067	-.003	-.090	-.090	.102	.050	.065	-.085	-.132	-.033	.032	.173	-.068	-.028	-.010
	da2	-.373	.890[a]	-.360	-.176	-.084	.097	.115	.035	.032	.089	-.073	-.047	.039	.009	.004	.125	.000	-.163	-.003	-.190	.163
	da3	-.085	-.360	.856[a]	-.497	-.230	-.113	-.106	-.094	-.120	.253	-.034	.077	.110	-.208	.249	-.105	.022	-.152	-.136	.257	-.078
	da4	-.098	-.176	-.497	.902[a]	-.142	-.043	-.141	.016	.163	-.152	.037	-.155	-.102	.167	-.127	-.073	-.021	.213	.065	-.035	-.008
	da5	-.048	-.084	-.230	-.142	.919[a]	-.211	.189	-.082	.022	-.269	.153	.010	-.154	.154	-.250	.039	.071	.019	-.031	.033	-.107
	db1	.133	.097	-.113	-.043	-.211	.940[a]	-.249	-.006	-.052	.089	-.037	-.148	.023	-.145	.176	-.024	-.062	.083	-.025	-.088	-.005
	db2	-.067	.115	-.106	-.141	.189	-.249	.902[a]	-.160	-.093	-.174	-.032	.071	-.006	.153	-.180	.190	.051	-.209	-.069	.057	-.061
	db3	-.003	.035	-.094	.016	-.082	-.006	-.160	.910[a]	-.487	.129	-.029	-.103	-.048	.017	-.107	.073	-.147	.135	.167	-.244	.199

	db4	-.090	.032	-.120	.163	.022	-.052	-.093	-.487	.890[a]	-.383	-.304	-.008	-.003	.001	.071	-.187	.211	-.063	.032	.100	-.079
	db5	-.090	.089	.253	-.152	-.269	.089	-.174	.129	-.383	.884[a]	-.032	-.198	.150	-.260	.112	.098	-.185	.028	.001	.014	-.004
	db6	.102	-.073	-.034	.037	.153	-.037	-.032	-.029	-.304	-.032	.906[a]	-.553	-.015	.160	-.234	-.087	-.075	.105	.020	-.149	.167
	db7	.050	-.047	.077	-.155	.010	-.148	.071	-.103	-.008	-.198	-.553	.907[a]	-.189	-.085	.132	.119	.145	-.242	-.055	.106	-.190
	dc1	.065	.039	.110	-.102	-.154	.023	-.006	-.048	-.003	.150	-.015	-.189	.948[a]	-.353	-.050	-.131	-.228	.086	-.015	.037	-.026
	dc2	-.085	.009	-.208	.167	.154	-.145	.153	.017	.001	-.260	.160	-.085	-.353	.918[a]	-.194	-.264	.008	.103	-.027	-.070	.007
	dc3	-.132	.004	.249	-.127	-.250	.176	-.180	-.107	.071	.112	-.234	.132	-.050	-.194	.922[a]	-.252	-.129	-.171	-.017	.100	-.036
	dc4	-.033	.125	-.105	-.073	.039	-.024	.190	.073	-.187	.098	-.087	.119	-.131	-.264	-.252	.935[a]	-.253	-.210	.091	-.171	.059
	dc5	.032	.000	.022	-.021	.071	-.062	.051	-.147	.211	-.185	-.075	.145	-.228	.008	-.129	-.253	.903[a]	-.557	-.023	.065	-.225
	dc6	.173	-.163	-.152	.213	.019	.083	-.209	.135	-.063	.028	.105	-.242	.086	.103	-.171	-.210	-.557	.884[a]	-.008	-.045	.136
	dd1	-.068	-.003	-.136	.065	-.031	-.025	-.069	.167	.032	.001	.020	-.055	-.015	-.027	-.017	.091	-.023	-.008	.906[a]	-.494	-.135
	dd2	-.028	-.190	.257	-.035	.033	-.088	.057	-.244	.100	.014	-.149	.106	.037	-.070	.100	-.171	.065	-.045	-.494	.838[a]	-.559
	dd3	-.010	.163	-.078	-.008	-.107	-.005	-.061	.199	-.079	-.004	.167	-.190	-.026	.007	-.036	.059	-.225	.136	-.135	-.559	.877[a]

a. Measures of Sampling Adequacy(MSA)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.376	49.407	49.407	10.376	49.407	49.407	4.815	22.928	22.928
2	2.519	11.993	61.400	2.519	11.993	61.400	4.563	21.730	44.658
3	1.923	9.156	70.557	1.923	9.156	70.557	3.960	18.859	63.517
4	1.291	6.149	76.705	1.291	6.149	76.705	2.770	13.188	76.705
5	.674	3.208	79.914						
6	.634	3.020	82.934						
7	.521	2.483	85.417						
8	.452	2.153	87.570						
9	.391	1.863	89.433						
10	.334	1.589	91.022						
11	.285	1.357	92.379						
12	.269	1.280	93.659						
13	.227	1.079	94.738						
14	.204	.970	95.709						
15	.196	.935	96.644						
16	.172	.820	97.464						
17	.146	.695	98.159						
18	.122	.579	98.738						
19	.102	.486	99.225						
20	.090	.429	99.653						
21	.073	.347	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
dc4	.815			
db7	.807			
dc1	.790			
dc5	.786			
dc3	.782			
db6	.781			
dc2	.774			
dc6	.744			
db4	.733		-.507	
db3	.728		-.443	
db5	.682			
da5	.681	.461		
da4	.679	.604		
da3	.672	.619		
db1	.664			
dd2	.657		.525	
dd3	.636		.535	
db2	.603			
da2	.575	.655		
da1	.489	.653		
dd1	.569		.592	

Extraction Method: Principal Component Analysis.
a. 4 components extracted.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
dc5	.858			
dc4	.855			
dc6	.820			
dc3	.817			
dc1	.745			
dc2	.697			
db4		.851		
db6	.435	.767		
db3		.758		
db7		.748		
db5		.725		
db2		.679		
db1		.581		
da2			.874	
da3			.866	
da4			.840	
da1			.814	
da5			.717	
dd1				.846
dd2				.840
dd3				.837

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.594	.571	.440	.357
2	-.496	-.094	.859	-.083
3	.172	-.687	.091	.700
4	-.610	.440	-.245	.612

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX H5
Exploratory Factor Analysis Result (Absorptive Capacity with Direct Oblimin Rotation Method)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	2610.695
	df	210
	Sig.	.000

Anti-image Matrices

		da1	da2	da3	da4	da5	db1	db2	db3	db4	db5	db6	db7	dc1	dc2	dc3	dc4	dc5	dc6	dd1	dd2	dd3
Anti-image Covariance	da1	.388	-.116	-.021	-.027	-.017	.056	-.028	-.001	-.025	-.033	.027	.014	.021	-.027	-.039	-.008	.007	.046	-.024	-.008	-.003
	da2	-.116	.248	-.070	-.039	-.024	.033	.039	.009	.007	.026	-.016	-.010	.010	.002	.001	.024	-2.822E-5	-.034	-.001	-.042	.041
	da3	-.021	-.070	.152	-.086	-.051	-.030	-.028	-.019	-.020	.058	-.006	.013	.022	-.042	.046	-.016	.003	-.025	-.031	.044	-.015
	da4	-.027	-.039	-.086	.196	-.036	-.013	-.042	.004	.032	-.039	.007	-.030	-.023	.038	-.027	-.013	-.004	.040	.016	-.007	-.002
	da5	-.017	-.024	-.051	-.036	.327	-.082	.073	-.025	.006	-.089	.037	.002	-.045	.046	-.068	.009	.015	.005	-.010	.008	-.031
	db1	.056	.033	-.030	-.013	-.082	.461	-.115	-.002	-.015	.035	-.011	-.044	.008	-.051	.057	-.006	-.016	.024	-.010	-.027	-.002
	db2	-.028	.039	-.028	-.042	.073	-.115	.460	-.057	-.028	-.069	-.009	.021	-.002	.054	-.058	.051	.013	-.060	-.027	.017	-.021
	db3	-.001	.009	-.019	.004	-.025	-.002	-.057	.277	-.112	.039	-.007	-.024	-.013	.005	-.027	.015	-.028	.030	.050	-.057	.053

	db4	-.025	.007	-.020	.032	.006	-.015	-.028	-.112	.193	-.098	-.057	-.001	-.001	.000	.015	-.032	.034	-.012	.008	.019	-.018
	db5	-.033	.026	.058	-.039	-.089	.035	-.069	.039	-.098	.339	-.008	-.051	.044	-.078	.031	.023	-.040	.007	.000	.004	-.001
	db6	.027	-.016	-.006	.007	.037	-.011	-.009	-.007	-.057	-.008	.181	-.104	-.003	.035	-.047	-.015	-.012	.019	.005	-.028	.036
	db7	.014	-.010	.013	-.030	.002	-.044	.021	-.024	-.001	-.051	-.104	.193	-.042	-.019	.027	.021	.024	-.045	-.014	.021	-.042
	dc1	.021	.010	.022	-.023	-.045	.008	-.002	-.013	-.001	.044	-.003	-.042	.259	-.093	-.012	-.026	-.043	.019	-.004	.008	-.007
	dc2	-.027	.002	-.042	.038	.046	-.051	.054	.005	.000	-.078	.035	-.019	-.093	.266	-.047	-.054	.001	.022	-.008	-.016	.002
	dc3	-.039	.001	.046	-.027	-.068	.057	-.058	-.027	.015	.031	-.047	.027	-.012	-.047	.224	-.047	-.022	-.034	-.005	.021	-.009
	dc4	-.008	.024	-.016	-.013	.009	-.006	.051	.015	-.032	.023	-.015	.021	-.026	-.054	-.047	.156	-.037	-.035	.021	-.030	.012
	dc5	.007	-2.822E-5	.003	-.004	.015	-.016	.013	-.028	.034	-.040	-.012	.024	-.043	.001	-.022	-.037	.136	-.087	-.005	.011	-.042
	dc6	.046	-.034	-.025	.040	.005	.024	-.060	.030	-.012	.007	.019	-.045	.019	.022	-.034	-.035	-.087	.180	-.002	-.009	.029
	dd1	-.024	-.001	-.031	.016	-.010	-.010	-.027	.050	.008	.000	.005	-.014	-.004	-.008	-.005	.021	-.005	-.002	.329	-.126	-.039
	dd2	-.008	-.042	.044	-.007	.008	-.027	.017	-.057	.019	.004	-.028	.021	.008	-.016	.021	-.030	.011	-.009	-.126	.196	-.125
	dd3	-.003	.041	-.015	-.002	-.031	-.002	-.021	.053	-.018	-.001	.036	-.042	-.007	.002	-.009	.012	-.042	.029	-.039	-.125	.254
Anti-image Correlation	da1	.909[a]	-.373	-.085	-.098	-.048	.133	-.067	-.003	-.090	-.090	.102	.050	.065	-.085	-.132	-.033	.032	.173	-.068	-.028	-.010
	da2	-.373	.890[a]	-.360	-.176	-.084	.097	.115	.035	.032	.089	-.073	-.047	.039	.009	.004	.125	.000	-.163	-.003	-.190	.163
	da3	-.085	-.360	.856[a]	-.497	-.230	-.113	-.106	-.094	-.120	.253	-.034	.077	.110	-.208	.249	-.105	.022	-.152	-.136	.257	-.078
	da4	-.098	-.176	-.497	.902[a]	-.142	-.043	-.141	.016	.163	-.152	.037	-.155	-.102	.167	-.127	-.073	-.021	.213	.065	-.035	-.008
	da5	-.048	-.084	-.230	-.142	.919[a]	-.211	.189	-.082	.022	-.269	.153	.010	-.154	.154	-.250	.039	.071	.019	-.031	.033	-.107
	db1	.133	.097	-.113	-.043	-.211	.940[a]	-.249	-.006	-.052	.089	-.037	-.148	.023	-.145	.176	-.024	-.062	.083	-.025	-.088	-.005
	db2	-.067	.115	-.106	-.141	.189	-.249	.902[a]	-.160	-.093	-.174	-.032	.071	-.006	.153	-.180	.190	.051	-.209	-.069	.057	-.061
	db3	-.003	.035	-.094	.016	-.082	-.006	-.160	.910[a]	-.487	.129	-.029	-.103	-.048	.017	-.107	.073	-.147	.135	.167	-.244	.199

	db4	-.090	.032	-.120	.163	.022	-.052	-.093	-.487	.890[a]	-.383	-.304	-.008	-.003	.001	.071	-.187	.211	-.063	.032	.100	-.079
	db5	-.090	.089	.253	-.152	-.269	.089	-.174	.129	-.383	.884[a]	-.032	-.198	.150	-.260	.112	.098	-.185	.028	.001	.014	-.004
	db6	.102	-.073	-.034	.037	.153	-.037	-.032	-.029	-.304	-.032	.906[a]	-.553	-.015	.160	-.234	-.087	-.075	.105	.020	-.149	.167
	db7	.050	-.047	.077	-.155	.010	-.148	.071	-.103	-.008	-.198	-.553	.907[a]	-.189	-.085	.132	.119	.145	-.242	-.055	.106	-.190
	dc1	.065	.039	.110	-.102	-.154	.023	-.006	-.048	-.003	.150	-.015	-.189	.948[a]	-.353	-.050	-.131	-.228	.086	-.015	.037	-.026
	dc2	-.085	.009	-.208	.167	.154	-.145	.153	.017	.001	-.260	.160	-.085	-.353	.918[a]	-.194	-.264	.008	.103	-.027	-.070	.007
	dc3	-.132	.004	.249	-.127	-.250	.176	-.180	-.107	.071	.112	-.234	.132	-.050	-.194	.922[a]	-.252	-.129	-.171	-.017	.100	-.036
	dc4	-.033	.125	-.105	-.073	.039	-.024	.190	.073	-.187	.098	-.087	.119	-.131	-.264	-.252	.935[a]	-.253	-.210	.091	-.171	.059
	dc5	.032	.000	.022	-.021	.071	-.062	.051	-.147	.211	-.185	-.075	.145	-.228	.008	-.129	-.253	.903[a]	-.557	-.023	.065	-.225
	dc6	.173	-.163	-.152	.213	.019	.083	-.209	.135	-.063	.028	.105	-.242	.086	.103	-.171	-.210	-.557	.884[a]	-.008	-.045	.136
	dd1	-.068	-.003	-.136	.065	-.031	-.025	-.069	.167	.032	.001	.020	-.055	-.015	-.027	-.017	.091	-.023	-.008	.906[a]	-.494	-.135
	dd2	-.028	-.190	.257	-.035	.033	-.088	.057	-.244	.100	.014	-.149	.106	.037	-.070	.100	-.171	.065	-.045	-.494	.838[a]	-.559
	dd3	-.010	.163	-.078	-.008	-.107	-.005	-.061	.199	-.079	-.004	.167	-.190	-.026	.007	-.036	.059	-.225	.136	-.135	-.559	.877[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
da1	1.000	.691
da2	1.000	.811
da3	1.000	.862
da4	1.000	.834
da5	1.000	.685
db1	1.000	.570
db2	1.000	.552
db3	1.000	.733
db4	1.000	.831
db5	1.000	.639
db6	1.000	.801
db7	1.000	.781
dc1	1.000	.753
dc2	1.000	.701
dc3	1.000	.806
dc4	1.000	.879
dc5	1.000	.874
dc6	1.000	.781
dd1	1.000	.820
dd2	1.000	.864
dd3	1.000	.841

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.376	49.407	49.407	10.376	49.407	49.407	7.942
2	2.519	11.993	61.400	2.519	11.993	61.400	5.897
3	1.923	9.156	70.557	1.923	9.156	70.557	5.022
4	1.291	6.149	76.705	1.291	6.149	76.705	7.719
5	.674	3.208	79.914				
6	.634	3.020	82.934				
7	.521	2.483	85.417				
8	.452	2.153	87.570				
9	.391	1.863	89.433				
10	.334	1.589	91.022				
11	.285	1.357	92.379				
12	.269	1.280	93.659				
13	.227	1.079	94.738				
14	.204	.970	95.709				
15	.196	.935	96.644				
16	.172	.820	97.464				
17	.146	.695	98.159				
18	.122	.579	98.738				
19	.102	.486	99.225				
20	.090	.429	99.653				
21	.073	.347	100.000				

Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]

	Component			
	1	2	3	4
dc4	.815			
db7	.807			
dc1	.790			
dc5	.786			
dc3	.782			
db6	.781			
dc2	.774			
dc6	.744			
db4	.733		-.507	
db3	.728		-.443	
db5	.682			
da5	.681	.461		
da4	.679	.604		
da3	.672	.619		
db1	.664			
dd2	.657		.525	
dd3	.636		.535	
db2	.603			
da2	.575	.655		
da1	.489	.653		
dd1	.569		.592	

Extraction Method: Principal Component Analysis.
a. 4 components extracted.

Pattern Matrix[a]

	Component			
	1	2	3	4
dc5	.913			
dc4	.906			
dc6	.884			
dc3	.875			
dc1	.743			
dc2	.684			
da2		.921		
da3		.881		
da1		.860		
da4		.841		
da5		.692		
dd1			.881	
dd3			.855	
dd2			.855	
db4				.914
db3				.775
db5				.770
db6				.769
db7				.747
db2				.737
db1				.593

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Structure Matrix

	Component			
	1	2	3	4
dc4	.936		.455	.550
dc5	.931		.489	.516
dc3	.891			.545
dc6	.883			.527
dc1	.856		.479	.575
dc2	.814		.516	.535
da3		.920		.488
da4		.904		.504
da2		.897		
da1		.826		
da5	.425	.801	.410	.489
dd2	.534		.918	
dd3	.512		.909	
dd1			.898	
db4	.530			.906
db6	.659			.869
db7	.621		.436	.863
db3	.543	.422		.842
db5	.496			.792
db2		.414		.729
db1		.462	.493	.681

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Component Correlation Matrix

Component	1	2	3	4
1	1.000	.333	.450	.574
2	.333	1.000	.337	.432
3	.450	.337	1.000	.335
4	.574	.432	.335	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

APPENDIX I
External Knowledge Search Reliability Result

Collaboration Breadth

Case Processing Summary

		N	%
Cases	Valid	136	100.0
	Excluded[a]	0	.0
	Total	136	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.614	.618	8

Scale: Collaboration Depth

Case Processing Summary

		N	%
Cases	Valid	136	100.0
	Excluded[a]	0	.0
	Total	136	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.630	.633	8

Scale: Information Search Breadth

Case Processing Summary

		N	%
Cases	Valid	136	100.0
	Excluded[a]	0	.0
	Total	136	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.770	.770	15

Scale: Information Search Depth

Case Processing Summary

		N	%
Cases	Valid	136	100.0
	Excluded[a]	0	.0
	Total	136	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.758	.765	15

APPENDIX J

STRUCTURAL MODEL BOOSTRAPPING RESULT (DIRECT EFFECT)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
AC -> AS	0.871	0.870	0.025	34.737	0.000
AC -> Acc	0.728	0.727	0.053	13.665	0.000
AC -> Ex	0.685	0.685	0.054	12.593	0.000
AC -> PIP	0.460	0.451	0.092	4.974	0.000
AC -> TS	0.873	0.874	0.021	41.402	0.000
PIP -> FP	0.694	0.693	0.058	12.000	0.000
PIP -> PDCS	0.690	0.693	0.049	14.140	0.000
PIP -> PI	0.725	0.723	0.052	13.931	0.000
PIP -> PP	0.875	0.876	0.022	40.234	0.000
cobreadth -> AC	0.162	0.164	0.084	1.933	0.053
cobreadth -> PIP	0.140	0.143	0.094	1.494	0.135
codpth -> AC	0.239	0.240	0.120	1.984	0.047
codpth -> PIP	0.138	0.146	0.094	1.467	0.142
firmage -> PIP	0.058	0.060	0.070	0.824	0.410
firmsize -> PIP	0.166	0.168	0.078	2.134	0.033
infobreadth -> AC	0.245	0.243	0.103	2.370	0.018
infobreadth -> PIP	0.005	0.005	0.093	0.051	0.959
infodepth -> AC	0.241	0.239	0.086	2.797	0.005
infodepth -> PIP	0.038	0.040	0.067	0.575	0.565

APPENDIX K

STRUCTURAL MODEL BOOSTRAPPING RESULT (INDIRECT EFFECT)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
AC -> AS					
AC -> Acc					
AC -> Ex					
AC -> FP	0.319	0.314	0.073	4.353	0.000
AC -> PDCS	0.317	0.313	0.070	4.510	0.000
AC -> PI	0.333	0.327	0.075	4.451	0.000
AC -> PIP					
AC -> PP	0.402	0.395	0.082	4.878	0.000
AC -> TS					
PIP -> FP					
PIP -> PDCS					
PIP -> PI					
PIP -> PP					
cobreadth -> AC					
cobreadth -> AS	0.141	0.143	0.073	1.922	0.055
cobreadth -> Acc	0.118	0.120	0.062	1.912	0.056
cobreadth -> Ex	0.111	0.112	0.058	1.916	0.055
cobreadth -> FP	0.149	0.151	0.066	2.241	0.025
cobreadth -> PDCS	0.148	0.151	0.065	2.276	0.023
cobreadth -> PI	0.155	0.158	0.070	2.225	0.026
cobreadth -> PIP	0.074	0.074	0.042	1.783	0.075
cobreadth -> PP	0.187	0.190	0.081	2.314	0.021
cobreadth -> TS	0.141	0.144	0.073	1.932	0.053

codpth -> AC					
codpth -> AS	0.208	0.209	0.106	1.968	0.049
codpth -> Acc	0.174	0.175	0.089	1.951	0.051
codpth -> Ex	0.164	0.163	0.080	2.049	0.041
codpth -> FP	0.172	0.173	0.080	2.143	0.032
codpth -> PDCS	0.171	0.173	0.080	2.144	0.032
codpth -> PI	0.180	0.181	0.084	2.149	0.032
codpth -> PIP	0.110	0.105	0.053	2.090	0.037
codpth -> PP	0.217	0.220	0.101	2.149	0.032
codpth -> TS	0.209	0.210	0.105	1.981	0.048
firmage -> FP	0.040	0.042	0.049	0.822	0.411
firmage -> PDCS	0.040	0.042	0.049	0.807	0.420
firmage -> PI	0.042	0.043	0.050	0.833	0.405
firmage -> PIP					
firmage -> PP	0.050	0.053	0.061	0.821	0.412
firmsize -> FP	0.115	0.116	0.055	2.113	0.035
firmsize -> PDCS	0.115	0.116	0.054	2.118	0.034
firmsize -> PI	0.121	0.121	0.056	2.143	0.032
firmsize -> PIP					
firmsize -> PP	0.146	0.147	0.068	2.135	0.033
infobreadth -> AC					
infobreadth -> AS	0.213	0.211	0.089	2.386	0.017
infobreadth -> Acc	0.178	0.178	0.079	2.266	0.023
infobreadth -> Ex	0.168	0.168	0.075	2.236	0.025
infobreadth -> FP	0.081	0.080	0.065	1.246	0.213
infobreadth -> PDCS	0.081	0.080	0.065	1.242	0.214
infobreadth -> PI	0.085	0.084	0.069	1.235	0.217

infobreadth -> PIP	0.113	0.110	0.054	2.082	0.037
infobreadth -> PP	0.103	0.101	0.083	1.245	0.213
infobreadth -> TS	0.214	0.212	0.091	2.360	0.018
infodepth -> AC					
infodepth -> AS	0.210	0.208	0.075	2.784	0.005
infodepth -> Acc	0.175	0.173	0.064	2.756	0.006
infodepth -> Ex	0.165	0.164	0.063	2.619	0.009
infodepth -> FP	0.103	0.104	0.057	1.818	0.069
infodepth -> PDCS	0.103	0.104	0.057	1.801	0.072
infodepth -> PI	0.108	0.109	0.060	1.810	0.070
infodepth -> PIP	0.111	0.110	0.050	2.219	0.027
infodepth -> PP	0.130	0.131	0.070	1.859	0.063
infodepth -> TS	0.210	0.209	0.076	2.763	0.006

APPENDIX L

STRUCTURAL MODEL STONE-GEISSER'S Q^2 ANALYSIS

	SSO	SSE	Q^2 (=1-SSE/SSO)
AC	2,856.000	2,484.650	0.130
AS	952.000	507.230	0.467
Acc	680.000	425.184	0.375
Ex	408.000	256.191	0.372
FP	544.000	328.008	0.397
PDCS	408.000	282.021	0.309
PI	544.000	327.509	0.398
PIP	2,176.000	1,795.308	0.175
PP	680.000	344.239	0.494
TS	816.000	356.516	0.563
cobreadth	136.000	136.000	
codpth	136.000	136.000	
firmage	136.000	136.000	
firmsize	136.000	136.000	
infobreadth	136.000	136.000	
infodepth	136.000	136.000	