

# Developing process and product innovation through internal and external knowledge sources in manufacturing Malaysian firms the role of absorptive capacity

Developing:  
role of  
absorptive  
capacity

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## Abstract

**Purpose** – Firms' knowledge-processing capabilities have a central role in achieving innovation performance and competitive advantage. Absorptive capacity capabilities and innovation are viewed as essential for enterprise success. Absorptive capacity is deemed as a highly important organizational capability to recognize value and assimilate both external and internal knowledge in order to enhance firm innovation. The aim of this study is to determine if innovation performance can be improved through absorptive capacity (knowledge acquisition, dissemination and utilization), when it is supported by internal (firm experience) and external knowledge sources (R&D cooperation and contracted R&D).

**Design/methodology/approach** – A quantitative methodology based on employing a structured questionnaire was used for data collection. The proposed research model and its associated hypotheses are tested by using Partial Least Squares (PLS) structural equation modelling (SEM) on a data set of 248 manufacturing companies located in the Northern Region of Malaysia.

**Findings** – Results showed that firms' experience is significantly related to absorptive capacity, while for R&D cooperation and contracted R&D findings were mixed. In addition, absorptive capacity was found as a strong predictor of innovation performance.

**Originality/value** – One of the defining features of competition in many industries has been the extremely rapid pace of technological change, marked by a continuous stream of innovations. Manufacturing firms, therefore, face the challenge of nurturing existing knowledge and developing novel knowledge in order to create new business opportunities. This study makes valuable contributions with regard to understanding the behavioural of manufacturing firms towards process and product innovation.

**Keywords** Absorptive capacity, Firm experience, R&D cooperation, Contracted R&D, Product innovation, Process innovation

**Paper type** Research paper

## Introduction

In a world of greater globalization and tougher competition, firms are becoming increasingly knowledge-based in order to compete against with each other to grasp more market share and survive (Bresciani *et al.*, 2018; Vătămañescu *et al.*, 2016; Xin *et al.*, 2014). Firms strive to learn and develop capabilities faster than their rivals (Meroño-Cerdan and Soto-Acosta, 2005; Soto-Acosta and Meroño-Cerdan, 2008, 2009). As the innovation paradigm has changed from being discovery-based to more centrally learning-based (Lundvall and Borrás, 1997; Soto-Acosta *et al.*, 2016a, 2016b), the way in which knowledge processes are managed within and between firms has emerged as a major theme in recent research (Soto-Acosta *et al.*, 2018) (see Figure 1).



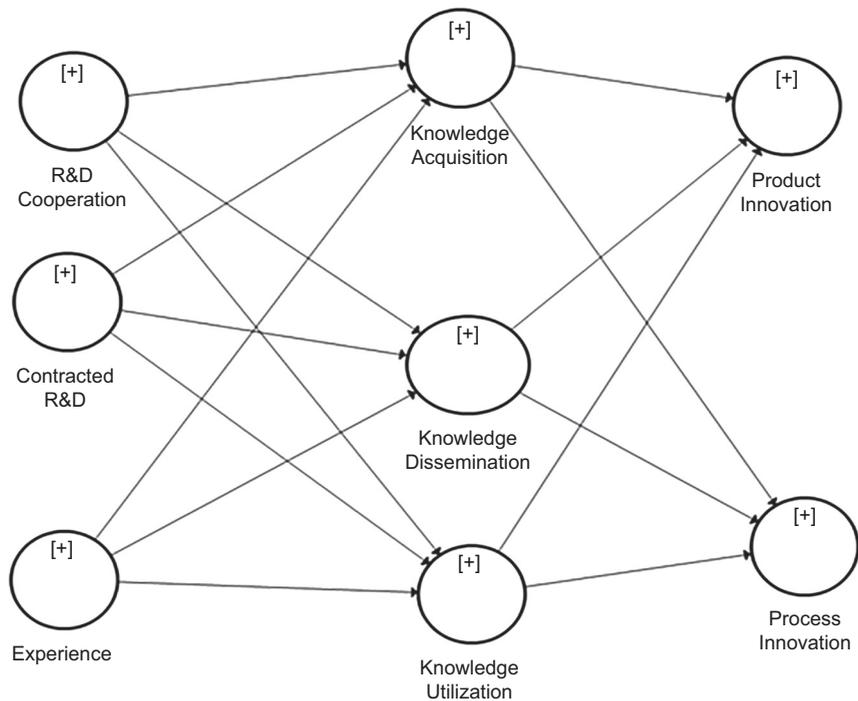


Figure 1.  
Research model



The concept of manufacturing today does not solely refer to the process of transforming raw materials into products on a factory floor, but it also includes a more holistic view, which deals with a wide range of skills, knowledge and competency that need to be managed over functional, corporate and cultural borders. As a consequence, the sources of manufacturing competitiveness have shifted from managing tangible resources efficiently into both the integration and coordination of knowledge (Kogut and Zander, 1996; Soto-Acosta *et al.*, 2017) and the creation of valuable and idiosyncratic organizational capabilities (Helfat and Lieberman, 2002; Helfat and Peteraf, 2003; Makadok, 2001). Manufacturing firms, therefore, face the challenge of nurturing existing knowledge and developing novel knowledge in order to create new business opportunities (Popa *et al.*, 2017; Scuotto *et al.*, 2017a; Soto-Acosta *et al.*, 2017). According to Bustinza *et al.* (2019), R&D-intensive industry manufacturers are more likely to benefit from implementing service provision than firms in other sectors because of industry dynamics and reduced customer uncertainty.

This rapid rate of knowledge obsolescence makes it imperative for firms to renew their technological bases constantly (Bresciani *et al.*, 2018; Popa *et al.*, 2018; Soto-Acosta *et al.*, 2014). The ability of a firm to commercialize new ideas and products is crucial for their survival (Meroño *et al.*, 2008; Rossi *et al.*, 2017). The fast and changing business environment that characterizes many firms today means that the role that absorptive capacity plays is an important focus of all firms. Cohen and Levinthal (1990) coined the term absorptive capacity as a firm's ability to recognize the value of new external knowledge, assimilate it and apply it to commercial ends. Given the wide array of technological fields to draw on, no single firm can possibly hope to come up with all the required research by its own, therefore, every firm needs to look outside its boundaries. Firms are increasingly dependent on their customers, suppliers and other stakeholders and sources of new ideas and initiators of product and process

innovation (Jantunen, 2005; González-Gallego *et al.*, 2015; Leal-Millán *et al.*, 2016). With the greater availability of external knowledge source in modern economics, a dynamic capability that influences a firm's ability to target, absorb and deploy the external knowledge necessary to feed the internal innovation process becomes a crucial source of competitive advantage. Lau and Lo (2019) argued that pursuing innovation performance and product competitiveness within the industrial environment are important to improve the technological innovation capability by means of increasing absorptive capacity.

This research largely focuses on knowledge acquisition, knowledge dissemination and knowledge utilization as dimensions that make absorptive capacity potentially valuable for increasing strategic flexibility in dynamic environments (Cegarra-Navarro *et al.*, 2016; Colomo-Palacios *et al.*, 2011). Knowledge acquisition refers to a firm's capability to identify and acquire externally generated knowledge (Zahra and George, 2002). Knowledge dissemination involves the process that converts knowledge into a transferable form, which can be distributed internally, so that it can be used in business. Knowledge-utilization refers to how effectively a firm can exploit acquired knowledge in the form of new and improved products (Jantunen, 2005; Cegarra-Navarro *et al.*, 2016). In these circumstances, external knowledge sources and firm's experience may be two important antecedents of absorptive capacity. Vekstein (1998) showed that in the automobile industry the complementary use of external and internally developed knowledge is an important source of competitive advantage. Recent research also concluded that for science-dependent industries, knowledge accumulation and knowledge combination increase the ability of the organizations to capture value from scientific knowledge (Kuo *et al.*, 2019).

This research builds upon the model developed by Jantunen (2005) to further empirically explore the predictors of absorptive capacity. Ari's model presents the concept of the firm's absorptive capacity of knowledge-processing capabilities in relation to firm's innovative performance. More specifically, this paper attempts to explore if innovation performance can be improved through absorptive capacity (knowledge acquisition, dissemination and utilization) supported by prior knowledge (external knowledge sources and firm's experience). The research address whether firms' innovation incorporates or is based on knowledge obtained from external partners. Our thesis is that firms that introduce innovations, which are based on external knowledge, necessarily have the ability to exploit knowledge from external sources, thus evincing absorptive capacities. In addition, a firm which is able to exploit external knowledge usually also has the ability to identify and assimilate it (Schmidt, 2005; Cegarra-Navarro *et al.*, 2016), which leads to better innovation performance in terms of product and process innovation (Ferrerás-Méndez *et al.*, 2019).

Malaysia through the Knowledge-Based Economy Master Plan has embarked on the transformation from an input-driven growth strategy to one that is increasingly driven by knowledge in order to achieve sustainable economic growth and development, recognizing the critical need for knowledge as input. The intention is to migrate from a production-based economy to a knowledge-based economy (Falahat *et al.*, 2020). Therefore, this study can make a valuable contribution toward understanding the behavioural of Malaysia manufacturing firms towards the various aspects of innovation.

To respond to the above gaps in the literature, this work organizes the subsequent sections as follows: The next section presents the literature review and hypotheses. Following that, the methodology used for sample selection and data collection is discussed. Then, data analysis and results are examined. Finally, the paper ends with a discussion of research findings, limitations and concluding remarks.

### Literature review and hypotheses development

Zahra and George (2002) identified two channels through which experiential learning significantly influence absorptive capacity: interaction with external knowledge sources and

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knowledge complimentary. External knowledge sources include acquisitions; purchasing, through licensing and contractual agreements and inter-organizational relationships such as R&D consortia, alliances, and joint ventures. The greater the interaction with external knowledge sources, the larger the experiential learning accumulated by an organization in dealing with outside information.

The ability to exploit external knowledge is thus a critical component of innovative capabilities. [Cohen and Levinthal \(1990\)](#) argued that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge and the organization needs prior related knowledge to assimilate and use new knowledge. At its lowest level, prior knowledge includes basic abilities or even just shared language, but it can also refer to awareness of the most recent technological or scientific advances in each field. [Mason et al. \(2019\)](#) argued the difference between potential absorptive capacity and realized absorptive capacity, being the former the capability of firm to understand, acquire and assimilate external knowledge and, the latter, the capacity of a firm to transform and utilize knowledge within the organization. In our case, we consider absorptive capacity as the acquisition, assimilation and utilization of external knowledge.

A firm's exposure to knowledge might influence decision making and the development of future capabilities. Accumulating absorptive capacity in one period might permit its more efficient accumulation in the next ([Cohen and Levinthal, 1990](#)). [Fosfuri and Tribo \(2008\)](#) indicated that firms which are involved in R&D collaborations and market-based transactions regarding R&D develop stronger abilities to understand and assimilate knowledge flows from the external environment. Recent research also showed that absorptive capacity influences innovation outcomes which, in turn, lead to competitive advantage ([Daspit et al., 2019](#)). This suggests that the breadth and depth of knowledge exposure positively influence a firm's propensity to explore new and related knowledge. The network of relations is illustrated in [Figure 1](#) and is elaborated further in the following subsections.

#### *Relationship between firms' external knowledge and absorptive capacity*

In a world of increasing competition and rapid technological change, firms cannot rely only on its own capabilities and knowledge base but need to benefit from the experience and knowledge of other economic actors. Externally acquired information and knowledge may embody heuristics that differ significantly from the existing knowledge base within a firm, which may minimize the risk of familiarity traps. As a result, more and more innovative companies establish linkages with other actors and access external knowledge in order to benefit from the dynamic effects of interactive processes.

External knowledge sources include arms' length contracts, such as licensing, inter-firm relationships, R&D collaborations, knowledge-driven acquisitions and others. The greater the interaction with external knowledge sources, the larger the experiential learning accumulated by an organization in dealing with outside information ([Cohen and Levinthal, 1990](#); [Fosfuri and Tribo, 2008](#); [Zahra and George, 2002](#)). According to [Schmidt \(2005\)](#), a firm which is able to pick up impulses from external parties and turn them into innovations is certainly able to exploit external knowledge; it thus possesses absorptive capacity capabilities as well. [Jantunen \(2005\)](#) divided the external knowledge source into two variables, R&D cooperation and contracted R&D. R&D cooperation refers to R&D collaboration activities with other firms or institutions such as contractual agreements and inter-organizational relationships, including R&D consortia, alliances, and joint ventures; while contracted R&D consists of external R&D through market-based agreements such as acquisitions and licensing. [Liu et al. \(2018\)](#) confirmed the impact of absorptive capacity on organizational innovation.

One may wonder whether there exists some overlapping between the measures of external knowledge sources, R&D cooperation and contracted R&D. According to [Fosfuri and Tribo](#)

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(2008), there is no tautology here because, while organizational outcomes is obtained through a firm's subjective rating of the importance of external knowledge flows, contracted R&D and R&D cooperation capture a firm's objective exposure to external knowledge sources. A firm might, for instance, rate licensing agreements as an important source of external information but may not undertake any of such agreements. These arguments lead to the formulation of the following hypotheses:

- H1a.* Firms' interaction with R&D cooperation has a positive impact on the knowledge acquisition capability.
- H1b.* Firms' interaction with contracted R&D has a positive impact on the knowledge acquisition capability.
- H1c.* Firms' interaction with R&D cooperation has a positive impact on the knowledge dissemination capability.
- H2a.* Firms' interaction with contracted R&D has a positive impact on the knowledge dissemination capability.
- H2b.* Firms' interaction with R&D cooperation has a positive impact on the knowledge utilization capability.
- H2c.* Firms' interaction with contracted R&D has a positive impact on the knowledge utilization capability.

#### *Relationship between firms' internal knowledge and absorptive capacity*

[Cohen and Levinthal \(1990\)](#) pointed out that in order to grasp what the sources of firm's absorptive capacity are, one should concentrate on the way the communications between the firm and the external environment are organized, and also on the nature of the know-how and experience within the organization. [Nieto and Quevedo \(2005\)](#) measured the level of know-how and experience in the organization. These authors see the trade-off between internal and external components for the development of organizational absorptive capacity, considering that attention on the relationship between shared knowledge and range of knowledge among individuals may be required.

[Zahra and George \(2002\)](#) defined past experience as the locus of a firm's technological search, since firms search for information in areas where they have had past successes. According to them, by directing knowledge search areas, past experience influences the development of future acquisition capabilities. Organizational experience with knowledge search can also reduce uncertainty and thus increase a firm's procedural rationality, which is defined as the extent to which decision makers collect, analyse and rely upon relevant information ([Fosfuri and Tribo, 2008](#)). The outcome of greater procedural rationality is an enhanced ability to identify and assimilate external knowledge.

According to [Zahra and George \(2002\)](#), firms gain experience through the exposure to skills and capabilities. Experience is the product of environmental scanning, benchmarking, interactions with customers and alliances with other firms. Experiences are also gained from learning-by-doing, which enables the firm to develop new routines that influence the locus of a firm's future search for knowledge. This suggests the fact that a company's absorptive capacity in the present is dependent on past efforts made to innovate ([Cohen and Levinthal, 1990](#)).

Memory affects new product development by influencing the process by which firms interpret incoming information and act upon it ([Zahra and George, 2002](#)). Experience is related to the learning an organization has accumulated through prior activities. Firms with greater experience enhance their ability to identify external knowledge. Experience reflects a firm's successes and failures over time; it can determine the capability of firms to absorb

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knowledge and further develop new products, processes or services (Cohen and Levinthal, 1990). The following hypotheses incorporate these expectations:

- H3a. Firms' experience has a positive impact on the knowledge acquisition capability.
- H3b. Firms' experience has a positive impact on the knowledge dissemination capability.
- H3c. Firms' experience has a positive impact on the knowledge utilization capability.

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#### *Relationship between absorptive capacity and innovation performance*

Zahra and George (2002) argued that a firm's absorptive capacity can be source of competitive advantage. Cohen and Levinthal (1990) related absorptive capacity to, among others, innovative capabilities, innovative performance and expectation formation. Here, our study focuses specifically on how a firm's ability to first recognize external knowledge and then adapt it to its organization routines is mapped onto innovation outcomes. An important implication is that heterogeneity in the level of absorptive capacity translates into differences in the benefits from otherwise similar stocks of external knowledge. Hence, absorptive capacity is a source of competitive advantage through innovation.

What is innovation? Although the term is often used to refer to new technology, many innovations are neither new nor involve new technology (Soto-Acosta *et al.*, 2016a, 2018). It may involve running a business in a different way rather than making a technological breakthrough. Innovation is not about an invention. New products might be an important part of the innovation process, but they are not the essence of it (Martinez-Conesa *et al.*, 2017; Popa *et al.*, 2017; Scutto *et al.*, 2017a). These days much innovation happens in processes and services. Innovation can be defined as new products, business processes and structural changes that enable to create wealth or social welfare (Soto-Acosta *et al.*, 2016b, 2017). It is about fresh thinking that creates the value.

Many business organizations and government departments profess innovation as part of their strategic intent. They all recognize that the age of optimization (product, process, business etc.) is quickly giving way to the age of innovation. Many management gurus insist that innovation is the only strategy for maintaining competitive advantage. Peter Drucker has gone as far as saying that "a company which, is not capable of innovating, is doomed to decline and extinction. Gary Hamel says that "innovation is the fuel for growth. When a company runs out of innovation, it runs out of growth".

Past research has revealed that numerous variations have been used to measure innovation performance of organizations. Fosfuri and Tribo (2008) measured innovation performance by the percentage of total annual sales which come from new or substantially improved products introduced over a period of time. Nieto and Quevedo (2005) assessed the innovative behaviour of a firm in terms of its effort to innovate. There are many other variables that have been used as proxies of innovation performance such as the number of patents obtained (Kim and Inkpen, 2005), firms' net profit (Zahra and Hayton, 2008) and intellectual property (Rajiv and Karuna, 2006). Prajo and Ahmed (2006) built the construct for measuring product and process innovation on the basis of several criteria that were conceptualized and used in previous empirical studies of innovation. These criteria are the number of innovations, the speed of innovation, the level of innovativeness (novelty or newness of the technological aspect) and being the "first" in the market. These four characteristics of innovation were transposed into two major areas of innovation, namely product innovation and process innovation.

Conceptually, a firm's product innovation is concerned with generating ideas or the creation of something entirely new or significantly improved with respect to its capabilities, which is reflected in changes in the end product or service offered by the organization, such as improved software, user friendliness, components or sub-systems. Whereas a firm's process

innovation represents changes in the way firms produce end-products or services through the diffusion or adoption of an innovation developed new practices developed internally or elsewhere (Prajogo and Ahmed, 2006). This can be the implementation of new or significantly improved production processes, distribution methods, or supporting activities for goods and services.

The number of patents or intellectual property, R&D spending and the effort to innovate are not easily obtained. Therefore, this study adopted the product innovation and process innovation concepts to measure the innovation performance in manufacturing firms. The distinction between these two areas of innovation has been extensively recognized in the literature on innovation (Gobeli and Brown, 1994; Yamin *et al.*, 1997). This approach corresponds to perceptual data obtained by respondents being asked to evaluate the company's innovation performance against the major competitors within the industry in order to minimize industry effects. The advantages of this approach were discussed in detail by Kraft (1990).

Many studies have shown that absorptive capacity has a positive effect on the productivity of innovative activities, improving the efficiency of the process of development of new products (Jantunen, 2005; Cohen and Levinthal, 1990; Fosfuri and Tribo, 2008; Nieto and Quevedo, 2005; Zahra and George, 2002). As mentioned earlier, and consistent with Jantunen (2005), this study posits that absorptive capacity consists of three major components (external knowledge acquisition, knowledge dissemination and knowledge utilization) which may influence product and process innovation. Thus, the following hypotheses are proposed:

- H4a.* Knowledge acquisition capability is positively related to process innovation.
- H4b.* Knowledge acquisition capability is positively related to product innovation.
- H5a.* Knowledge dissemination capability is positively related to process innovation.
- H5b.* Knowledge dissemination capability is positively related to product innovation.
- H6a.* Knowledge utilization capability is positively related to process innovation.
- H6b.* Knowledge utilization capability is positively related to product innovation.

## Methodology

The population of this study included all the manufacturing companies located in the Northern Region of Malaysia. The target respondents were senior managers, managers and engineers or executives from factory supply chain, production, quality or engineering that have direct contact with manufacturing, who have knowledge of present organizational practices relating to organizational innovation. The sample was selected randomly from the directory of Federation of Malaysia Manufacturers (FMM). These manufacturing firms are from various industries such as fabricated metal product, furniture, electric and electronic product and others. The participations in this study were on a voluntary basic. Anonymity and confidentiality of the information provided by the participants was strictly guarded to ensure high level of openness so that the respondents were able to express a certain level of sensitive information in the questionnaire. Data was collected in 2018. The Gpower software was used to calculate the minimum sample size with a predictive power of 0.95 by following the research of Alzahrani *et al.* (2019) and Ahmad *et al.* (2019). Calculations suggested that, with a maximum of three predictors, the required sample size was 119 (effect size is 0.15). Five hundred and fifty questionnaires were distributed to the manufacturing firms located at the Northern Region of Malaysia, with 248 valid questionnaires being returned.

### Questionnaire design

The questionnaire of the study was adapted and derived from the previous research. Pilot test was conducted to assess the quality of the measure items prior to the survey. A brief questionnaire containing the items and additional scales designed to assess the measure properties was administered in person to five managers from manufacturing firms. They were asked to complete the questionnaire and point out any item that was either ambiguous or otherwise difficult to answer. Minor refinement was then made on the questionnaire based on the feedback. The first section related to participant's personal information. The second section contained some general information about the surveyed firms. The third section asked for sources of external knowledge and experience of the organization. Section four evaluated the firm's absorptive capabilities. Finally, in last section, information regarding the organization's innovation performance was collected. This core section concentrated on the organization's innovation activities during the last three years.

External knowledge consisted of R&D cooperation and contracted R&D. A total of four items were used to measure R&D cooperation. Two items were adapted from CIS Survey 2006, one from Nieto and Quevedo's work (2005) and another one from that of Zahra and Hayton (2004). Contracted R&D construct consisted of four items, three from Nieto and Quevedo's research (2005) and another one from that of Zahra and Hayton (2004). Experience of the organization was evaluated using ten items, which were all adapted from Nieto and Quevedo's (2005) study. A five-point Likert scale ranging from "1 = strongly disagree" to "5 = strongly agree" was used to measure the level of external knowledge sources within the respondent's organization.

Absorptive capacity (knowledge-processing capabilities) is the mediating variable for this study. It consisted of three dimensions, namely, knowledge acquisition, knowledge dissemination and knowledge utilization. Two of the items included to measure knowledge acquisition were based on the work by Jantunen (2005) and another two were adapted from Jansen *et al.* (2005). Five items were used to assess knowledge dissemination, all items being adapted from Jantunen (2005). Similarly, knowledge exploitation was also assessed by five items, four from Jantunen (2005) and one from Jansen *et al.* (2005). A five-point Likert scale ranging from "1 = strongly disagree" to "5 = strongly agree" were used to evaluate the knowledge-processing capabilities within the respondent's organization.

Innovation performance consisted of product innovation and process innovation. A total of nine items were used to measure innovation performance; five items for product innovation while another four items for process innovation. All the items were adapted from Prajogo and Ahmed's (2006) work. A 5-point Likert scale ranging from "1 = worst in the industry" to "5 = best in the industry" was used to assess how the respondent's organization has been doing so far relative to the major competitors in the respective industry.

### Data analysis

Due to the complexity of the model which had eight constructs with 15 hypotheses, we employed partial least squares (PLS) structural equation modelling, using the SmartPLS software version 3.2.8 (Ringle *et al.*, 2005). The reason why is because this statistical tool enables to examine the proposed measurement and structural model, since survey research is normally not normally distributed and this have the advantage of being able to accommodate small sample sizes without data normality assumption (Chin *et al.*, 2003).

Multivariate normality was tested by following Webpower website as suggested by Cain *et al.* (2017). The results showed that Multivariate Skewness was 11.878 ( $p < 0.01$ ), while multivariate Kurtosis was 81.531 ( $p < 0.01$ ), indicating that the data was not normal. As such we ran the bootstrapping procedure to generate the standard errors when testing the structural model.

Since data was collected using a single source, we first tested the issue of Common Method Bias by testing the full collinearity as suggested by Kock and Lynn (2012) and Kock (2015). In this method, all the variables are regressed against a common variable and if the variance inflation factor (VIF) is less than or equals 3.3, then, there is no bias from the single data source. As shown in Table 1, the analysis yielded a VIF less than 3.3 and, therefore, common method bias is not a serious threat in our study.

### Measurement model

The measurement model was assessed by examining the loadings, average variance extracted (AVE) and composite reliability (CR) as suggested by Hair et al. (1998) and Ramayah et al. (2018). More specifically, the fulfilment of following three criteria was assessed: all indicator loadings should exceed 0.5, the AVE for each construct should be greater than 0.5 and the CR should exceed 0.7. As shown in Table 2, that all the indicator loadings are above 0.5, the CR values range from 0.79 to 0.92, and the AVE ranges from 0.50 to 0.74. All three conditions for reliability and convergent validity of the measures thus hold.

Next, to assess the discriminant validity, the more recent criterion called Heterotrait-monotrait ratio (HTM) suggested by Henseler et al. (2015) was used, instead of the usual Fornell and Larcker's (1981) criterion. If the HTMT ratio is less than 0.85, then the constructs are distinct. As shown in Table 3, all the ratios are less than 0.85, thus, discriminant validity was also confirmed.

### Structural model

Following the suggestions of Hair et al. (2019b) and Ramayah et al. (2018), path coefficients, standard errors, *t*-values and *p*-values for the structural model using a 5,000-sample re-sample bootstrapping procedure were reported. Also, based on the criticism of Hahn and Ang (2017), who argued that *p*-values are not a good criterion for testing the significance of hypotheses, a combination of criterions such as *p*-values, confidence intervals and effect sizes was employed. Table 4 shows the summary of the criterions used for hypotheses testing.

As shown in Table 4, R&D cooperation had a positive effect on Knowledge Utilization ( $\beta = 0.166, p < 0.01$ ), while it did not have any effect on Knowledge Acquisition and Knowledge Utilization, providing support to hypothesis H1a, while hypotheses H1b and H1c were not supported. In addition, contracted R&D had positive effect on knowledge dissemination ( $\beta = 0.166, p < 0.01$ ), but no effect on Knowledge Acquisition and Knowledge Utilization. Therefore, support for hypothesis H2b was found, while hypotheses H2a and H2c were not confirmed. Finally, experience had a positive effect on Knowledge Acquisition ( $\beta = 0.658, p < 0.01$ ), Knowledge Dissemination ( $\beta = 0.558, p < 0.01$ ) and Knowledge Utilization ( $\beta = 0.455, p < 0.01$ ), providing support for hypotheses H3a, H3b and H3c.

Knowledge Acquisition had a positive effect on Process Innovation ( $\beta = 0.170, p < 0.01$ ), but a non-significant effect on Product Innovation. Unlike, Knowledge Dissemination had positive effect on Process Innovation ( $\beta = 0.285, p < 0.01$ ) and on Product Innovation

	CR&D	EXP	KA	KD	KU	Proc	Prod	R&DC
VIF	1.556	2.532	2.060	2.524	1.952	1.781	1.790	1.897

**Note(s):** CR&D = contracted R&D, EXP = experience, KA = knowledge acquisition, KD = knowledge dissemination, KU = knowledge utilization, Proc = process innovation, Prod = product innovation, R&DC = R&D cooperation

**Table 1.**  
Full collinearity  
analysis

BPMJ	Construct	Item	Loadings	CR	AVE
	R&D cooperation	EK1	0.783	0.851	0.589
		EK2	0.735		
		EK3	0.768		
		EK4	0.782		
	Contracted R&D	EK5	0.570	0.788	0.562
		EK7	0.919		
		EK8	0.720		
	Experience	Exp2	0.661	0.888	0.500
		Exp3	0.636		
		Exp4	0.712		
		Exp5	0.796		
		Exp6	0.646		
		Exp7	0.790		
		Exp8	0.746		
		Exp9	0.647		
		Knowledge acquisition	KA1		
	KA2		0.818		
	KA3		0.791		
	KA4		0.588		
	Knowledge utilization	KU1	0.610	0.791	0.559
		KU2	0.807		
		KU3	0.926		
	Knowledge dissemination	KD1	0.677	0.830	0.626
		KD2	0.817		
		KD3	0.743		
	Process innovation	Process1	0.836	0.921	0.746
		Process2	0.914		
		Process3	0.873		
		Process4	0.828		
	Product innovation	Product1	0.812	0.914	0.680
		Product2	0.802		
		Product3	0.843		
		Product4	0.801		
		Product5	0.863		

**Table 2.**  
Measurement model



	1	2	3	4	5	6	7	8
1. Contracted R&D	–							
2. Experience	0.499	–						
3. Knowledge acquisition	0.404	0.801	–					
4. Knowledge dissemination	0.531	0.793	0.816	–				
5. Knowledge utilization	0.491	0.767	0.659	0.813	–			
6. Process innovation	0.230	0.376	0.515	0.628	0.559	–		
7. Product innovation	0.228	0.456	0.404	0.660	0.628	0.676	–	
8. R&D cooperation	0.827	0.641	0.484	0.547	0.612	0.183	0.253	–

**Table 3.**  
Discriminant  
validity (HTMT)

( $\beta = 0.333, p < 0.01$ ), whereas Knowledge Utilization had positive effect on Process Innovation ( $\beta = 0.160, p < 0.05$ ) and Product Innovation ( $\beta = 0.235, p < 0.01$ ). Through these analyses, hypotheses H4a, H5a, H5b, H6a and H6b found support, while H4b was not confirmed.

According to Hair *et al.* (2019a),  $R^2$  values of 0.75, 0.50 and 0.25 are considered as substantial, moderate and weak. The in-sample explanatory power  $R^2$  from the results were

Hypothesis	Relationship	Std beta	Std error	t-value	p-value	BCI LL	BCI UL	f2
H1a	R&D cooperation → Knowledge acquisition	-0.021	0.059	0.353	0.362	-0.114	0.079	0.000
H1b	R&D cooperation → Knowledge dissemination	0.008	0.066	0.125	0.450	-0.116	0.099	0.000
H1c	R&D cooperation → Knowledge utilization	0.166	0.068	2.432	0.008	0.049	0.269	0.023
H2a	Contracted R&D → Knowledge acquisition	0.045	0.056	0.802	0.212	-0.057	0.128	0.002
H2b	Contracted R&D → Knowledge dissemination	0.191	0.053	3.589	0.000	0.090	0.264	0.042
H2c	Contracted R&D → Knowledge utilization	0.047	0.063	0.753	0.226	-0.063	0.141	0.002
H3a	Experience → Knowledge acquisition	0.658	0.046	14.227	0.000	0.571	0.726	0.561
H3b	Experience → Knowledge dissemination	0.558	0.053	10.603	0.000	0.473	0.646	0.392
H3c	Experience → Knowledge utilization	0.455	0.056	8.199	0.000	0.354	0.538	0.228
H4a	Knowledge acquisition → Process innovation	0.170	0.070	2.427	0.008	0.035	0.271	0.026
H4b	Knowledge acquisition → Product innovation	0.031	0.068	0.453	0.325	-0.094	0.132	0.001
H5a	Knowledge dissemination → Process innovation	0.285	0.089	3.192	0.001	0.131	0.425	0.052
H5b	Knowledge dissemination → Product innovation	0.333	0.073	4.569	0.000	0.208	0.445	0.072
H6a	Knowledge utilization → Process innovation	0.160	0.078	2.047	0.021	0.051	0.299	0.021
H6b	Knowledge utilization → Product innovation	0.235	0.072	3.251	0.001	0.114	0.336	0.046

**Table 4.**  
Hypothesis testing

0.42 (Knowledge Acquisition), 0.439 (Knowledge Dissemination), 0.423 (Knowledge Utilization), 0.274 (Process Innovation) and 0.284 (Product Innovation). In summary, the  $R^2$  values were considered all acceptable for a model like this.

## Discussion



The results from this study had mixed findings for the hypotheses concerning firms' interaction with external knowledge sources and absorptive capacity for both R&D cooperation and contracted R&D. In this sense, R&D Cooperation had a positive effect on Knowledge Utilization only, while Contracted R&D had positive influence on Knowledge Dissemination only as well. These are surprising findings considering the results reported by Cohen and Levinthal (1990), Fosfuri and Tribo (2008) and Liao *et al.* (2003). Nonetheless, our results are in line with other paper in the literature such as that of Hadjimanolis's (2000), conducted in Cyprus, a small developing country, who found that there was low level of cooperation of Cypriot firms, especially with universities and other academic centres. Furthermore, Lall *et al.* (1994) found that the limited demand for technological services was a usual situation in developing countries such as Ghana. Therefore, the mixed findings of our research regarding firms' interaction with external knowledge sources and absorptive capacity may be attributed to the fact that the investigation was conducted in Malaysia, which is also a developing country.

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Although there are many foreign firms investing in Malaysia, the study showed that R&D cooperation and contracted R&D are still very low. This may be due to the not-up-to-date technological quality of universities, governments and/or public research institutes in Malaysia. These foreign firms always strike for latest technological innovation success, but the research institutes in Malaysia's may not be able to provide the state-of-the-art technical consultation. Therefore, these firms are more likely to cooperate with overseas research institutes rather than Malaysia's research institutes. They are also less likely to acquire Malaysian companies for its technology.

An further explanation to this may be offered based on the nature of a small developing country where innovation is relatively rare, while pricing and marketing are the main competitive weapons of local firms (Hadjimanolis, 2000). Local firms try to lower down the product price rather than spending money in R&D. Other explanation can be the increased likelihood of local firms from the information-intensive sector to make use of already available training as an input to innovations. A possible explanation to this can be that the knowledge that the local firm require might already be available in the market because most of the local firms do not focus on high-end products. These arguments explain why R&D cooperation and contracted R&D are not associated with absorptive capacity.

#### *Firm's experience and absorptive capacity*

The hypotheses suggesting a positive relationship between firms' experience and absorptive capacity were fully supported and highly significant. Results also supported the hypotheses concerning the relationships between firms' experience and the entire three dimensions of absorptive capacity, namely, knowledge acquisition, knowledge dissemination and knowledge utilization. These findings are in line with previous research (Cohen and Levinthal, 1990; Fosfuri and Tribo, 2008; Liu *et al.*, 2018).

Furthermore, findings revealed that firms' experience is a key predictor of absorptive capacity. Prior literature has also pointed to the importance of the "quality" of one's prior experience. Strengthening experience increases the likelihood of increasing knowledge acquisition and knowledge utilization and, as a result, brings fresh thinking and value for firm innovation. This is in line with the argument that a company's absorptive capacity in the present may be dependent on the efforts the firm made in the past to innovate (Cohen and Levinthal, 1990).

Firm's experience is the locus of a firm's technological search. Firms search for information and knowledge in areas where they had past successes. According to Zahra and George (2002), by directing knowledge search areas, past experience influences the development of future acquisition capabilities. Organizational experience with knowledge search can also reduce uncertainty and, thus, increase a firm's procedural rationality, which is defined as the extent to which decision makers collect, analyze and rely upon relevant information (Fosfuri and Tribo, 2008).

Results also support the hypotheses analysing the relationships concerning that the ability to utilize or exploit different types of external knowledge is influenced by the firms' experience. In industry, experienced engineers are needed to exploit the scientific knowledge developed by scientists into scalable products. Naturally, one would assume that it is easier for employees who have attended university to use knowledge from this domain. They know how to use the knowledge as well as how and where to get it. However, the differences between the absorptive capacity are not limited to the number and educational achievement of employees. Our research confirms that experience does matter as well. This finding is in line with the work by Schmidt (2005), who emphasized about the importance of experience. According to him, to exploit knowledge from one's own industry, experience is more relevant than high levels of education. Even though having a large share of highly educated personnel

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is important, firms should incorporate highly experienced employees to be able to exploit knowledge from within their own industries.

Developing:  
role of  
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### *The relationship between absorptive capacity and innovation performance*

Based on the recent research of [Xie et al. \(2018\)](#), we hypothesized a positive relationship between absorptive capacity (knowledge acquisition, dissemination and utilization) and innovation performance. More specifically, we conceptualized innovation performance into two categories: product and process innovation ([Prajogo and Ahmed, 2006](#)).

With regard to product innovation, no significant relationship was found between knowledge acquisition and product innovation. However, noteworthy associations with product innovation were observed for knowledge dissemination and utilization. These results are in line with previous research conducted by Fosfuri and Tribo (2008) and [Prajogo and Ahmed \(2006\)](#).

Concerning process innovation, significant positive relationships between knowledge acquisition, dissemination and utilization with firms' process innovation performance were found. These findings confirm previous research by [Jantunen \(2005\)](#), [Zahra and George \(2002\)](#), Fosfuri and Tribo (2008), [Todorova and Durisin \(2007\)](#) and [Scuotto et al. \(2017b\)](#).

The positive relationship between absorptive capacity and innovation performance is, then, confirmed. Although external knowledge searches (acquisition and dissemination) have become increasingly important for firms to achieve and maintain innovation performance ([Xe et al., 2018](#)), our findings demonstrate that knowledge utilization is also crucial for firms to produce essential competencies. Knowledge acquisition capability may have an essentially enabling and supporting role in innovation activities. In other words, firms also need the ability to embed acquired knowledge in products in order to enhance performance. The implication here is that firms with well-developed knowledge dissemination capability and knowledge utilization capability are well-equipped to renew their asset base and exploit the assets they already have in order to develop products or improve the processes that are able to match the market needs.

### **Theoretical and practical implications**

This study contributes to the existing innovation management and absorptive capacity literature in five areas.

First, the present study contributes to scholars' understanding as to why certain units can acquire new external knowledge but are not able to exploit it successfully. [Zahra and George \(2002\)](#) have advanced our understanding of this process by suggesting, first, that absorptive capacity is a multidimensional construct that impinges at different times on different capabilities and routines, and, second, by pointing out to the existence of two subsets of absorptive capacity: potential and realized. 

Second, the result supports [Zahra and George's \(2002\)](#) argument that potential absorptive capacity is a necessary condition for achieving competitive advantage through innovation, but firms also need to develop the ability to transform and exploit external knowledge in order to fully benefit from it. Firms need to possess realized absorptive capacity to excel in innovation. Put in other words, potential absorptive capacity enables a firm's receptiveness to external knowledge while realized absorptive capacity reflects a firm's capacity to leverage absorbed knowledge and transform it into innovation outcomes. 

Third, this work validated previous work of Fosfuri and Tribo  (2008) that absorptive capacity will be developed when a firm has more in-depth experience. The influences of experience on the elements of absorptive capacity were identified to improve the understanding of the movement of knowledge along with the intra-organizational environment, and the importance of innovation in terms of process and product. 

Further, as fourth contribution, unlike measuring absorptive capacity as a uni-dimension construct (Liu *et al.*, 2018), we measured the elements of absorptive capacity separately. This idea will assist academician and practitioners to understand independent influence of knowledge acquisition, assimilation and utilization on product and process innovation.

Furthermore, knowledge dissemination was recognized as a more impactful factor for product and process innovation. Recent works such as that of Daspit *et al.* (2019) have argued about the direct association of assimilation and innovation outcomes. In this respect, our empirical investigation covered this gap in the literature as the fifth theoretical contribution.

This research also offers several insights to practitioners. The empirical results show five paths which are very crucial to enhance firms' product innovation and process innovation. Further, our results also suggest that firms' experience (internal source) is relatively more important than R&D cooperation and contracted R&D (external sources).

### Limitations

The main limitation of this study is that it focuses on Malaysian firms only, so it could be questioned whether the findings are generalizable to other countries. To make the theory more commonly adaptive, more data from various developing economies are needed. A longitudinal study could be also useful to test changes on the absorptive capacity dimensions and their impact on firm innovation over time.

### Future research

Future studies could be directed to mitigate the above limitations and might also deepen on the analysis by studying, for instance, potential absorptive capacity and realised absorptive capacity, collecting more precise measures of both potential absorptive capacity and realized absorptive capacity. A higher absorptive capacity helps a firm comprehend developments taking place in various technological fields and incorporate the new knowledge into its own innovations. Thus, it explains that a higher absorptive capacity will help a firm come up with innovations that are of broader applicability. This is an interesting area for possible future works, which could examine the influence of external knowledge sources, experience and the dimensions of absorptive capacity on all phases of innovation.

### Conclusion

In summary, this paper develops and tests an integrative research model which assesses the effect of R&D cooperation and contracted R&D on absorptive capacity (knowledge acquisition, dissemination, and utilization); the impact of firm experience on absorptive capacity (knowledge acquisition, dissemination and utilization) and whether absorptive capacity (knowledge acquisition, dissemination and utilization) leads to product and process innovation. Experience was found to be the most crucial factor for any firm to influence its absorptive capacity, with knowledge assimilation being the most important absorptive capacity process for product and process innovation. The relationships conceptualized and tested herein advance our understanding of how absorptive capacity and innovation management works in Malaysia.

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