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Determinants of Firm's open innovation performance and the role of R & D department: an empirical evidence from Malaysian SME's

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Abstract

The prime objective of the current study is to investigate the major determinants of firm's open innovation performance in Malaysian small and median-sized enterprises (SMEs). Recently, Malaysian SMEs have suffered from low open innovation performance. These SMEs are still struggling to get success in open innovation adoption. Decline in open innovation practices hampered the overall SMEs performance. To address this issue the current study adopted quantitative research approach and cross-sectional research design. A 5-point Likert scale was used to collect the data through mail survey. Two hundred (200) questionnaires were distributed among the managerial staff of SMEs in Malaysia by using area cluster sampling. Smart PLS3 (SEM) was utilized as a statistical tool. It was found that external knowledge, internal innovation and R & D department were the major determinants of firm's open innovation performance. Thus, the current study contributed in the body of knowledge by revealing the real determinants of open innovation performance and R & D department as a mediator. Therefore, the current study is beneficial for SMEs to boost up the overall performance by accelerating open innovation system.

Keywords: Open innovation, SMEs, External knowledge, Internal innovation, R & D department, Performance

JEL classification: 03

Background

Innovation has long been seen as a key factor of economic growth and development (De Silva, Howells, & Meye, 2018). The postmodern era of business which come with many new technologies and challenges, innovation has become a key to the success of any organization (Gómez, Salazar & Vargas, 2017). Considering this fact, the open innovation has gained a considerable attention from both researchers and practitioners and has emerged as a distinct area of research. In the field of innovation, open innovation gained much attention (Popa, Soto-Acosta, & Martinez-Conesa, 2017: Dahlander and Gann 2010; Chesbrough & Rogers 2014; Randhawa, Wilden, & Hohberger 2016; West and Bogers, 2014) to boost up the performance of various firms,

particularly in small and median-sized enterprises (SMEs). Small and medium enterprises are the most important sector to improve the economy of every country.

The open innovation (OI) is a process of distribution of innovation whose prime function is to manage the flow of knowledge within and outside of the organization, whereas the term innovation refers to the development of new or novel ways of sharing knowledge (Chesbrough & Bogers 2015, p. 3). The inflow and outflow of knowledge are two most important kind of knowledge which underpin the open innovation (Chesbrough & Bogers 2016). Randhawa (2017) has argued that the open innovation has helped the organizations in creating a synergic relationship between the internal and external source of innovative knowledge. More recently organizations have started involving consumers and other who has immediate stakes in end product development or end product in their innovation process (Randhawa, 2017). Today, the concept has progressed to include business model innovation and services innovation, in contexts that include multiple collaborations, communities, and entire ecosystems.

R & D department is a key element of open innovation. Basically, R & D department is the basic and necessary element of openness of ideas as well as also one of the resources as an external actor (Chesbrough, 2003). Incorporation of external knowledge and maximization of internal innovations require R & D department. Proper utilization of external knowledge in a final shape of a latest idea requires a good R&D department. It is helpful to generate new ideas within the boundaries of the firm which enhance internal innovation level. Hence, R&D department plays a mediating role to enhance open innovation performance. Therefore, the current study introduces R & D department as a mediating variable between the determinants of open innovation success (external knowledge incorporation, maximization of internal innovation) and firm's open innovation performance. This study carried out to find the determinants of firms open innovation success because literature is rarely discussed the key determinants and rarely documented the issue of low open innovation performance in Malaysian SMEs.

Despite significant contribution in the Malaysian economy, the Malaysian SMEs are struggling in developing and installing open innovation systems, the lower open innovation affecting their overall performance and competitiveness in local as well as international markets. According to the report of global innovation index the Malaysia which since 1980 is an upper-middle-class income country ranked 72nd in term of business innovation. Kaufmann and Tödtling (2002) stated that the SMEs in Malaysia encountered problems such as poor collaboration with technical institutes and lose focus on research and development which constrained their various innovation activities. Moreover, according to Tehseen et al., (2017), argued that the SMEs in service sector particularly in retail services are most vulnerable to poor development in open innovation. He continued and argued that slow adaption of innovation and knowledge base systems are among key reason behind this slow growth of open innovation. Based on authors on estimates, due to the above-mentioned issues, Malaysian SMEs are struggling to develop a good open innovation system which could enhance the performance. Not-Invented-Here (NIH) syndrome is created which is one of the crucial determinants to detract SMEs from open innovation adoption (Chesbrough & Crowther, 2006; Lichtenthaler & Lichtenthaler, 2009; Spithoven, Vanhaverbeke, & Roijakkers, 2013).

Various studies discussed open innovation in SMEs (see, for instance, Christensen et al., 2005; Hassan, Iqbal, Malik, & Ahmad, 2018; Lecocq & Demil, 2006; Parida, Westerberg, & Frishammar, 2012; Van de Vrande et al., 2009), however, in rare cases any comprehensive research study carried out to address the issue of low open innovation performance in SMEs. Additionally, in rare cases, any study formally documented the determinants of open innovation success. Therefore, this study is one of the attempt to answer the research question; what are the determinants of open innovation success? Thus, the prime objective of the current study is to examine the effect of external knowledge and internal innovation on firm's open innovation performance in Malaysian SMEs related to the service sector. To achieve the main objectives of the study, below sub-objectives are given:

1. To examine the role of external knowledge in firm's open innovation performance.
2. To examine the role of internal innovation in firm's open innovation performance.
3. To examine the mediating role of R&D department in firm's open innovation performance.

Thus, the current study contributed to the body of knowledge by revealing the real determinants of open innovation success. Moreover, a mediating variable (R&D department) is introduced by the current study.

Literature review

Open innovation is a process in which external knowledge enters in boundaries of a firm to accelerate internal innovation and internal knowledge outflows in the final shape of various ideas which in turn expand the market for external utilization of innovation (Chesbrough, 2006). According to Lichtenthaler (2008), open innovation is gateway which connects both outside-in as well as inside-out transfer of different types of technologies and ideas. Open innovation shows that innovative performance can be enhanced by both attaining pieces of knowledge from outside sources as well as employing external paths to commercialize knowledge resources developed internally (Jasimuddin, & Naqshbandi, 2018). Further, it can be defined as: "open innovation is a system in which internal knowledge and external knowledge are combined to create something new".

As open innovation is an outside-in and inside-out transfer of different types of technologies and ideas, that is why it needs incorporation of external knowledge within the boundaries of the firms which is an outside-in process and maximization of internal innovation to facilitates the inside-out process. To manage external knowledge and internal innovation, R&D department has to play the key role. However, most of the firms face difficulty while maintaining the internal R&D investment (Chesbrough, 2006). A long time ago, R&D department was considered to be important. According to the Cohen and Levinthal's (1989), R&D department plays a dual role in the firm's development. Firstly, it develops the firm internally by creating new ideas within the boundaries of the firms and secondly it creates the ability to build up absorptive capacity to track as well as to check developments outside the boundaries of the firm.

The argument broached by Tehseen et al., (2017) shown consistency with the report by Organization for Economic Co-operation and Development (OECD), in which it was reported that more than 60% of the firms in the wholesale and retail industry do not engage themselves in innovation. Many prior studies (De Wit, Dankbaar & Vissers,

2007; Lichtenthaler & Ernst, 2009) also argued that majority of the firms are wither not will or not giving due attention to OI. However, the question arises that why firms are not showing interest in open innovation. It is being argued that the SMEs are facing many challenges which are based on external knowledge incorporation (Rodríguez & Lorenzo, 2011), internal innovation improvement (West & Gallagher, 2006), motivating spillovers (Güngör, 2011; Sajjad, Eweje & Tappin, 2015) and most importantly intellectual property management (Hagedoorn & Ridder, 2012). Because of these issues, the SMEs in Malaysia are underperforming, and this, in turn, affects the economic growth of Malaysia.

Gómez, Salazar, and Vargas, (2017), discussing the solution of the issue argued that the issues of low engagement in business innovation can be increased by accelerating the knowledge sharing within and outside of the organization. He continued and argued knowledge sharing as a key factor of a successful open innovation process because external knowledge sharing helps in establishing new knowledge base, whereas the internal knowledge sharing helps in installing a knowledge-based system. Recently McKelvie, Wiklund, and Brattström, (2018) argued that the internal generation of new knowledge promotes various innovation activities (McKelvie, Wiklund, & Brattström, 2018). Moreover, open innovation is a two-way process in which external knowledge enters in the boundaries of the firm and final ideas go out after licensing (Chesbrough, 2012). Thus, external knowledge and internal innovation are the essential elements of open innovation. Without these two elements, open innovation is not possible. That is the reason why these two elements were selected for this study. Because the external knowledge is important to generate something internally (Grigoriou, & Rothaermel, 2017). Both external and internal knowledge are crucial for innovation (Pangarkar, 2018). However, the proper utilization of external knowledge and maximization of internal innovation requires research and development department (R & D department).

Resource Based View (RBV) demonstrates that firm's success is mainly determined by its internal resources, such as assets and competencies (Umrani, 2016). Assets or resources of the firm could be tangible as well as intangible (Collis, 1994). Competencies are intangible, such as skills as well as knowledge (Teece et al., 1997). In the context of the current study, external knowledge, internal innovation, and R&D department are the resources or assets of SMEs. Therefore, Resource-Based View (RBV) explains that the SMEs could enhance open innovation performance if firms have good resources of internal innovation and external knowledge, and R&D department to finalize the ideas (Fig. 1).

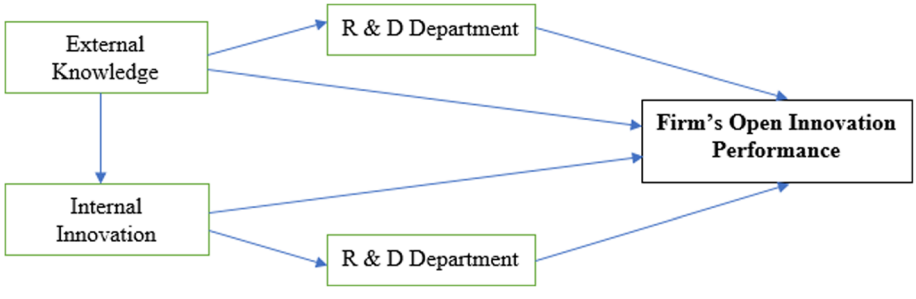

Fig. 1 Theoretical Framework. It contains the main idea of this study including the key variables namely: external knowledge, internal innovation, R & D department and firm's open innovation performance. It also demonstrates the relationship between variables

Hypotheses development

External knowledge

In the postmodern era of business, the increasing role of innovation and technology in business has merged as biggest challenges. The knowledge management and its importance is among the most debated issues of modern times and considering the importance of innovation in the success of any business, the organizations are installing the knowledge-driven systems (Lehner, 2009; Probst, Raub, & Romhardt, 2010; Fteimi & Lehner, 2018). The knowledge-based view of firm views the knowledge as one of the most valuable resources of organization (Guile & Fosstenløkken, 2018: Cohen & Levinthal, 1990. However, a long-established view of knowledge management considers internally generated knowledge as the biggest contributor to the success of any company and the role of inflow of knowledge is largely ignored.

The innovation has emerged as a biggest competitive tool, the organization has started realizing its importance and open their doors to external knowledge. Consequently, the management of highly specific knowledge of markets, consumers and technologies have emerged as a key to innovation. The role of external knowledge as source of innovation is well documented (Chesbrough, 2003; Chesbrough, 2017; Appleyard et al., 2017) and it is providing organization endless possibilities of opening their innovation process to a well-diversified external source (Gava et al., 2017; Kovács et al., 2015). The engagement with external partner offers a firm with incentives for accessing her most valuable resources such as complementary knowledge and business innovativeness.

The impact of involvement of external knowledge on the performance of open innovation is ambiguous. A group of studies (West & Bogers, 2014; Brunswicker & Vanhaverbeke, 2015; Ritala et al., 2015) show that the external knowledge improve the performance of open innovation, whereas another group of researchers (Tranekjer & Søndergaard 2013; Knudsen & Mortensen 2011) proposed a negative relation and argued that the increasing openness makes the innovation more expensive. Despite of ambiguous relation, it's a now a validated from the literature that trend of innovation has been changed; now companies are working differently on conceptualization and commercialization due to which the boundaries of companies are becoming permeable (Trott & Hartmann, 2009). It is observed that a number of external bodies are taking part in the innovation process, such as customers, dealers, suppliers, research related organizations, competitors etc. (Wallin & von Krogh, 2010). A large amount of external knowledge is mandatory to bring creativity which could lead new ideas (Conboy & Morgan, 2011). Moreover, SMEs have significant contacts with various sources of external expertise, such as knowledge acquisition, marketing, consultancy, subcontracting etc. (Oakey, 2013). Oakey (2013) further described that, in principle, external relationships are essential for open innovation, otherwise close innovation system might be enhanced rather than open innovation. According to West & Gallagher (2006), external knowledge is a key factor of open innovation and it is one of the challenges for open innovation.

Hence, external knowledge is a vital element of open innovation success. As the close model of innovation is transferred to the new model which requires collaboration with external partners like customers, dealers, suppliers, research related organizations, competitors etc. (Abulrub & Lee, 2012; Belussi et al., 2010; Fichter, 2009; Laursen, 2006). External market knowledge could be the knowledge of customer wants, and needs (McKelvie, Wiklund, & Brattström, 2018). Therefore, Malaysian SMEs need to strengthen their relations

with external partners, suppliers and customers to introduce latest ideas inside the boundaries of the firm to boost up the SMEs' open innovation performance. Thus, it is concluded that:

H_1: There is a relationship between external knowledge and firm's open innovation performance.

The, R&D department is important for adequate incorporation of external knowledge. The usefulness and importance of external knowledge are well explained in the last section, however, the way and source of acquisition of this knowledge is yet to discuss. Organizations usually acquire knowledge through a well-equipped R & D department. According to Chesbrough (2003), the investment in R& D is in direct relation to knowledge acquisition.

Despite of the fact that the R&D departments are playing an important role in the success of any SME, but the management of R&D department in SMEs is different from those in large firms (Oakey, 2013). In large firm's senior management try to disassociate the R&D from other operation in the firm (Oakey, 2013). However, like SMEs, the large firms also consider R&D department as a vital department in the development of an open innovation process. Moreover, the primary objective of R&D department is to develop new products (Oakey, 2013) by incorporating external knowledge. Therefore, R&D department plays a mediating role in external knowledge acquisition and firm's open innovation success. Additionally, collaborative R&D department might be one of the ways to accelerate the limited condition of open innovation system by the help of internal R&D projects (Chesbrough, Vanhaverbeke & West, 2006; Inauen & Shenker-Wiki, 2011).

Hence, without R&D department, utilization of external knowledge is rarely possible. It has the capability to enhance firm's open innovation performance. Therefore, R&D department has a relationship with firm's open innovation performance. Thus, from the above discussion, it is concluded that:

H_2: There is a relationship between external knowledge and R&D department.
H_3: R&D department mediates the relationship between external knowledge and firm's open innovation performance.

Internal innovation

Apart from external knowledge incorporation, internal innovation is also essential for open innovation success. However, internal innovation maximization is one of the crucial challenges for open innovation (West & Gallagher, 2006). It requires the communication with all stakeholders especially among the employees (de Jong & Den Hartog, 2007). The inflow of external knowledge required and outflow of internal knowledge needed is a function of the level of internal knowledge any organization process. In an open innovation system firms desire to maintain a balanced blend of in-flow and outflow of knowledge. However, in most of the cases the role of internal knowledge because of firm-specific factors such as internal R&D, a collaboration between employees, management etc. undermine the external knowledge.

Moreover, firms that have joint intention in both internal innovation and external relationships with suppliers, have a stronger effect on innovativeness as compared to other firms (Oke, Prajogo, & Jayaram, 2013). According to Oakey (2013), internal R&D of any firm is a major resource by which growth could be attained. Firm's internal know-how generally raises the marginal return with the help of adequate external knowledge incorporation strategies (Cassiman & Veugelers, 2006).

Therefore, with external knowledge incorporation, internal innovation maximization is equally important. According to Chesbrough (2006), internal innovation is the key to success for open innovation performance. Internal idea generation is vital for the growth of open innovation. Thus, internal innovation has a relationship with firm's open innovation performance. Hence, from the above discussion, below hypothesis is developed:

H_4: There is a relationship between internal innovation and firm's open innovation performance.

SMEs mainly depend on internal R&D activities (Oakey, 2013). However, it requires investment in R&D department to accelerate internal innovation. It is also observed that the firms that invest more in R&D take more benefits as compared to other firms (Cohen & Levinthal, 1990). Therefore, to take maximum advantage from internal ideas, internal R&D department is an essential element. Employees' communication generates new ideas which require R&D department to make final shape of different ideas.

Although, according to the recommendations of transaction cost theory, external knowledge achievement could be a substitute for internal R&D investment process (Pisano, 1990; Williamson, 1985), however, other studies advocate that firm's in-house R&D, as well as external know-how of every firm, are complementary (Cassiman & Veugelers, 2006). Therefore, investment in R&D department is crucial like external knowledge acquisition.

Most of the firms accelerate R&D department activities within the boundaries of the firms so that the other competitors could not know about their innovative ideas (Hossain, 2012). This R&D department represents closed innovation as described by Chesbrough (2003). Conventionally, firms use closed innovation (Alencar, Porter, & Antunes, 2007; Chang, Chen, Hua & Yang, 2006; Lee, Lee & Kim, 2008; Porter, 2005). However, it does not matter whether R&D department is within the boundaries of the firm because it has the ability to maximize the internal innovation as well as external knowledge acquisition.

Therefore, there is a link between internal innovation and R&D department. R&D department has a major role to enhance internal innovation. Thus, R&D department plays a mediating role in internal innovation and firm's open innovation. Hence, by summing up the discussion, it is concluded that;

H_5: There is a relationship between internal innovation and R&D department.
H_6: R&D department mediates the relationship between internal innovation and firm's open innovation performance.

Nevertheless, the above discussion revealed that there is a relationship between R&D department and firm's open innovation. R&D department is an essential element of open innovation. Hence, the following hypothesis is developed;

H_7: There is a relationship between R & D department and firm's open innovation performance.

Nonetheless, external knowledge acquisition expediates internal innovation. As external knowledge from stakeholders such as partners, customers, suppliers etc. is valuable to enhance internal innovation (Chesbrough, 2006). Because open innovation is 'outside-in' and 'inside-out' process to knowledge and technologies, therefore, Thus, the association between external knowledge and internal innovation enhance the open innovation (Chesbrough, 2012). Díaz-Díaz and de Saá Pérez (2014) attempted to explore the relationship between external and internal knowledge sources through 6330 observations from 1266 firms. The author found a significant relationship between external and internal knowledge sources.

Additionally, Choi (2017) identified the determinants of innovation by using a large number of samples of Tunisian manufacturing firms from 1997 to 2007. The author found that both internal and external enhances the firm productivity. Therefore, to carried out the open innovation activities, SMEs require external knowledge acquisition which more important to enhance internal innovations. Hence, below hypothesis is proposed;

H_8: There is a relationship between external knowledge and internal innovations.

Research methodology

Research methodology is one of the major parts of every study to achieve its objectives. The choice of suitable technique for the analysis should be accordance with the type of problem (Hameed et al., 2017). Therefore, by considering the research problem, objectives and nature of this study, quantitative research approach and cross-sectional design have been selected.

Population and sampling

The current study is based on Malaysian SMEs and managerial staff of these SMEs was selected as the respondents of this study. The managerial staff, we mean only those personnel who are sitting at the managerial position and has an influence on open innovation activities. The SMEs which were listed on the public website(Malaysian SME Business Directory by SME Info Portal) are chosen as a sample of the current study. This list of registered SMEs comprises all categories of business sectors such as manufacturing, services, manufacturing-related services, quarrying, agriculture, services (including Information Communication Technology (ICT), and others. However, this study is only based on those services related SMEs which are listed in Malaysian SME Business Directory by SME Info Portal.

Questionnaires were distributed through mail survey. The 5-point Likert scale was used for data collection. A 5-point Likert-type scale was used to increase response rate

and response quality along with reducing respondents' "frustration level" (Babakus & Mangold, 1992). A 5-point Likert scale ranging from 'strongly agree' to 'strongly disagree' was employed as it has been most recommended by the researchers that it would reduce the frustration level of patient respondents and increase response rate and response quality (Sachdev & Verma, 2004).

Moreover, area cluster sampling was used to collect the data. Formation of clusters was based on states of Malaysia. Each state was taken as one cluster and from all the clusters, 05 clusters, namely, Kedah, Kuala Lumpur/Selangor, Johor, Sabah, and Terengganu were chosen randomly. As in cluster sampling, we generally make all clusters and then chose few clusters randomly. Therefore, this study comes up with above 05 clusters. After selection of clusters, respondents were chosen randomly from each cluster. Various researchers, for example, Sekaran and Bougie (2016) recommended all these steps for area cluster sampling. Area cluster sampling was selected based on the reason that it is the most cost-effective (Sekaran & Bougie, 2006) and most importantly it is suitable when the population is speared on the wide area because it is adequate to cover the maximum population.

Sample size

The sample size was selected based on Comrey and Lee (1992) inferential statistics. According to this statistic, a sample size of below 50 respondents is a weaker sample, a sample size of 100 respondents is weak, 200 respondents sample size is adequate, 300 is good, 500 is very good, and 1000 is excellent. Therefore, a sample size of two hundred (200) respondents was selected.

Statistical tool

Smart PLS 3 (SEM) was used to analyze the data. Selection of Smart PLS was based on the sample size. In the current study, the response rate was too low.

Only seventy-two (72) valid responses were used to analyze the data. According to Hair, Babin, and Krey (2017), the complications of a structural model do not need large sample size because "PLS algorithm does not compute all the relationships at the same time." Few prior studies have thoroughly evaluated PLS-SEM with small sample size (e.g., Chin & Newsted 1999; Hui & Wold 1982). Reinartz, Haenlein & Henseler (2009) revealed that PLS-SEM has the ability to attain high levels of statistical power, even if the sample size is small. Moreover, various studies support that Smart PLS is adequate while analyzing the data with small sample size (see, for example, Goodhue, Lewis & Thompson., 2012; Reinartz et al., 2009; Rigdon, 2016). Additionally, Table 1 shows the response rate.

Table 1 Response from respondents

Response	Frequency/Rate
Total questionnaires distributed	200
Total questionnaires returned	77
Total Useable questionnaires	72
Total questionnaires excluded	05
Total response rate	38.5%
Total response rate after data entry	36%

Source: Authors' own estimates based on survey data

According to Sekaran (2003), 30% response rate is sufficient if the data is collected through a mail survey. However, in the current study, the total response rate was 36% which is adequate to proceed with the analysis.

Analysis and results

In the current the analysis is based on two-step approach for reporting PLS-SEM results provide by Henseler et al., (2009). It is one of the important to the element to state that according to various studies such as Henseler and Sarstedt, (2013) and Hair et al., (2014), the goodness-of-fit (GoF) index is not appropriate for model validation. It is based on the reason that GoF could not separate the valid and invalid models. Moreover, this evidence was available in a simulated study that was conducted by using PLS path models (Hair, Ringle, & Sarstedt, 2013). Below Fig. 2 shows the two-step PLS-SEM process.

Measurement model assessment

Measurement model has been analyzed based on PLS-SEM with the help of Smart PLS 3.0 (Ringle, Wende & Becker, 2015). For the assessment of measurement model, factor loading, composite reliability, Cronbach's alpha, average extracted variance (AVE), and discriminant validity were examined. Figure 3 and Table 2 show the results of the assessed measurement model.

Open innovation as systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels (Cohen & Levinthal, 1990) such as R & D department. External knowledge comes from customers, suppliers, partners etc. (von Hippel, 1988), on the other hand, internal innovations are based on this external knowledge and employee capabilities who utilize this knowledge to generate innovations. However, to best utilize external knowledge through internal capabilities of employees, R & D department is most important determinants of open innovation system (Chesbrough, 2006).

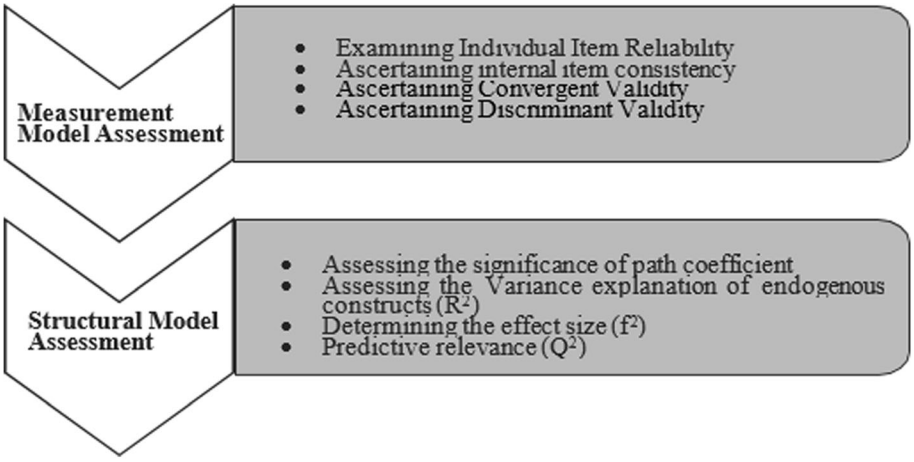

Fig. 2 A Two-Step Process of PLS Path Model Assessment. Source. Henseler et al., (2009). It contains the complete process of structural equational modeling (SEM) through partial least square (PLS)

Without R & D department, proper utilization of external knowledge through internal capabilities is crucial. Therefore, external knowledge, internal innovations and R & D department are the real determinants of firm's open innovation performance. Measures of all these determinants and firm's open innovation performance are given below.

Firm's open innovation performance (FOIP) is measured by 07 items. FOIP1 measures the firm's open innovation performance through commercialization of idea, FOIP2 measures through collaboration, FOIP3 measures through outsourcing of expertise, FOIP4 measures through new idea generation, FOIP5 measures through out-or-in licensing of intellectual property, FOIP6 measures through sharing of internal and external knowledge and finally, FOIP7 measures the firm's open innovation performance through licensing of latest ideas. Additionally, all the scale items are available in the Appendix.

Scales items of external knowledge (IK1, IK2, IK3, IK4, IK5, IK6) measures external knowledge through the collaboration with firm's employees with external partners, suppliers, customers etc. In case of internal innovation II1 measures internal innovation (II) through the introduction of the internal idea, II2 measures through communication between partners, II3 measures through available resources for internal innovation, II4 measures through R & D activities and finally, II5 measures internal innovation through sharing of knowledge between internal partners. Moreover, scale items of R & D department (R & D1, R & D2, R & D3, R & D4, R & D5) measures through the role R & D department in open innovation project success.

Figure 3 shows the factor loading of all the constructs. All the constructs have factor loading of more than 0.8. Factor loading should be at least more than 0.5 to attain the acceptable level of convergent validity (Hair et al., 2010). Therefore, in this study convergent validity was attained.

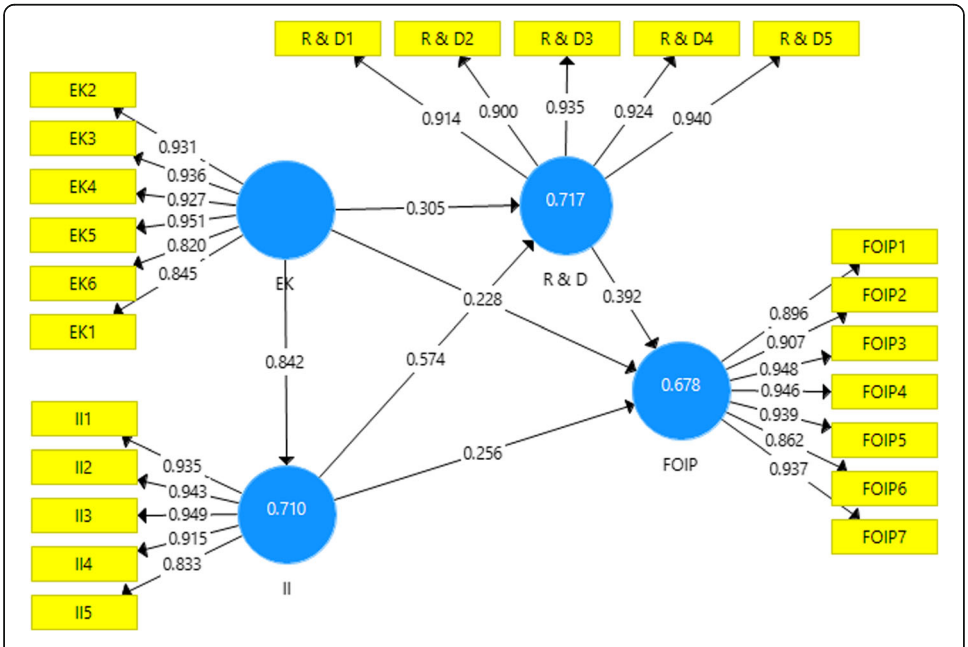

Fig. 3 Measurement Model Assessment. It contains the measurement model assessment before hypotheses testing. It shows the factors loadings of each item and R^2 value

Table 2 Internal Consistency, Convergent Validity, composite reliability and AVE

Construct	Indicators	Loadings	Cronbach's alpha	Composite Reliability	AVE
External Knowledge	EK1	.845	.954	.963	.815
	EK2	.931			
	EK3	.936			
	EK4	.927			
	EK5	.951			
	EK6	.820			
Internal Innovation	II1	.935	.951	.963	.839
	II2	.943			
	II3	.949			
	II4	.915			
	II5	.833			
R & D Department	R & D1	.914	.956	.966	.851
	R & D2	.900			
	R & D3	.935			
	R & D4	.924			
	R & D5	.940			
Firm's Open Innovation Performance	FOIP1	.996	.969	.975	.846
	FOIP2	.907			
	FOIP3	.948			
	FOIP4	.946			
	FOIP5	.939			
	FOIP6	.862			
	FOIP7	.937			

Source: Authors' own estimates based on survey data

Table 2 shows the values of factor loading, values of Cronbach's alpha, values of composite reliability and values of AVE. George and Mallery (2003) mentioned that Cronbach's alpha more than 0.7 ($\alpha > 0.9$) is excellent. In the current study, it is more than 0.9 which is excellent. Moreover, AVE should be equal or more than 0.5 and composite reliability should be 0.7 or above (Fornell & Larcker, 1981; Hair & Lukas, 2014). In the current study both AVE and composite reliability is more than acceptable range. Moreover, Table 3 shows that the discriminant validity.

Structural model assessment

After assessment of measurement model, a structural model was analyzed with the help of Smart PLS 3. To achieve this purpose, direct and indirect effect was examined. The

Table 3 Discriminant Validity

	EK	FOIP	II	R&D
EK	0.903			
FOIP	0.753	0.920		
II	0.842	0.774	0.916	
R&D	0.789	0.785	0.831	0.923

Source: Authors' own estimates based on survey data

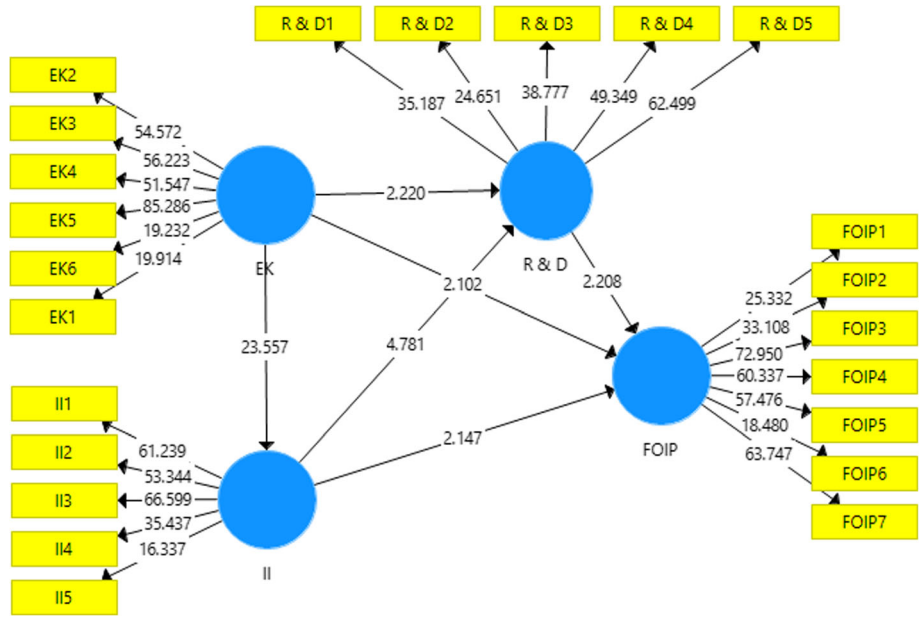

Fig. 4 Structural Model Assessment (Direct Effect). It contains the hypotheses testing for direct and indirect relationships. Majorly, it shows path coefficient and t-value to accept or reject the hypotheses

hypothesis was confirmed by considering the path coefficient and "t" value. Moreover, R-Squared (R^2) and predictive relevance (Q^2) were examined.

The current study has five (06) direct hypotheses as shown in Table 4 and Fig. 4. All direct hypotheses (H_1, H_2, H_4, H_5, H_7, H_8) were accepted as the t-value was greater than 1.96.

Moreover, PLS (SEM) bootstrapping was selected to observe the mediation effect. Hair et al., (2014) explained that this is one of the suitable techniques while analyzing through the small sample. Moreover, by following the recommendations of Hair et al., (2014), while examining the mediation effect, the procedure of Preacher and Hayes (2004, 2008) was followed and the in-direct effect was examined. Hence, the current study analyzed the effect of R&D department as a mediator through Smart PLS 3.0 (Ringle et al., 2015) by bootstrapping method and did the re-sampling of 500 to examine the t-value.

Table 5 displays the results of mediation analysis. It is clear that t-value is more than 1.96. Therefore, the mediation effect is significant. Hence, R&D department mediates the relationship. Hence, H_3 and H_6 are accepted.

Table 4 Structural Model Assessment (Direct Effect Results and Decision)

Hypothesis	Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*p* Values	Decision
H_1	EK - > FOIP	0.228	0.247	0.109	2.102	0.036	Accepted
H_2	EK - > R & D	0.305	0.312	0.138	2.220	0.027	Accepted
H_4	II - > FOIP	0.256	0.263	0.119	2.147	0.032	Accepted
H_5	II - > R & D	0.574	0.569	0.120	4.781	0.000	Accepted
H_7	R & D - > FOIP	0.392	0.375	0.177	2.208	0.028	Accepted
H_8	EK - > II	0.842	0.840	0.036	23.557	0.000	Accepted

Source: Authors' own estimates based on survey data

Table 5 Structural Model Assessment Results and Decision (In-direct Effect)

Hypo-thesis	Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*p* Values	Decision
H_3	EK - > R & D - > FOIP	0.234	0.238	0.118	1.986	0.048	Mediation
H_6	II - > R & D - > FOIP	0.459	0.460	0.116	3.945	0.000	Mediation

Source: Authors' own estimates based on survey data

Table 6 shows that the R^2 value is 67.8%. It indicates that by putting all the constructs together have the tendency of influencing 67.8% change in the dependent variable (firm's open innovation performance). Nevertheless, predictive relevance (Q^2) is 0.532 for firm's open innovation performance (OIP) and 0.570 for R&D department which validates the predictive relevance (Q^2). According to Chin (1998) and Henseler, Ringle & Sinkovics (2009), it should be greater than zero.

Furthermore, Table 7 shows the effect size (f^2). Cohen (1988) described that f^2 values of 0.02 are small, 0.15 is moderate and 0.35 is strong. In the current study, the f^2 for all variables are small. Moreover, predictive relevance (Q^2) is given below in Table 8, which is more than zero. As the value of predictive relevance (Q^2) should be greater than zero (Henseler, Ringle & Sinkovics, 2009).

Research findings and discussion

The purpose of this study was to reveal the major determinants of firm's open innovation performance and to explore the mediating role of R&D department. Therefore, the effect of external knowledge and internal innovation was examined with mediating role of R&D department on firm's open innovation performance in Malaysian SMEs.

The direct effect of internal innovation and external knowledge on firm's open innovation performance shows t-value of 2.147 and 2.102, respectively with β-value of 0.256 and 0.228, respectively. These values show a significant positive impact on external knowledge on firm's open innovation performance, internal innovation and firm's open innovation performance. Therefore, increase in internal innovation and external knowledge will enhance the firm's open innovation performance. Moreover, the more the internal innovation and external knowledge, the more the SMEs' open innovation performance. According to findings of West and Gallagher (2006), maximization of internal innovation and incorporation of external knowledge enhance the open innovation. Therefore, the current study is in line with West and Gallagher (2006).

Furthermore, while examining the effect of internal innovation and external knowledge on R&D department, it is found that t-values are 4.781 and 2.220, respectively with β-values of 0.574 and 0.305, respectively. These values show that both variables internal innovation and external knowledge have a significant positive impact on R&D department. It indicates a direct positive relationship between internal innovation and R&D department, external knowledge and R&D department. Investment in R&D department will enhance the acquisition of

Table 6 R-Square (R^2) Value

Latent Variable	Variance Explained (R^2)
Firm's Open Innovation Performance	67.8%

Source: Authors' own estimates based on survey data

Table 7 Effect Size (f^2)

R-Squared	f-squared	Effect Size (f^2)
External Knowledge (EK)	0.043	Small
Internal Innovation (II)	0.044	Small
R & D Department (R & D)	0.135	Small

Source: Authors' own estimates based on survey data

external knowledge and it will facilitate the internal innovation within the boundaries of the firm.

Moreover, it was found that R&D department has a significant positive impact on firm's open innovation performance. While analyzing the data it was found that t-value was 2.208 and β-value was 0.392. These values demonstrate a direct positive impact of R&D department on firm's open innovation performance. Thus, R&D department facilitates open innovation system in Malaysian SMEs.

Additionally, regarding the relationship between external knowledge and internal innovation, it is found that both have a significant positive relationship with each other with t-value 23.557 and β-0.842. Díaz-Díaz and de Saá Pérez (2014) also found a significant relationship between external and internal knowledge sources. It indicates that external knowledge is a most important element to enhance internal innovation.

Nevertheless, while examining the mediating role of R&D department, it was found that t-value was 1.986 and β-value was 0.234 for external knowledge and firm's open innovation performance. The mediating effect was found to be significant and positive which demonstrated that R&D department mediated the relationship between external knowledge and firm's open innovation performance. On the other hand, t-value was 3.945 and β-value was 0.459 for internal innovation and firm's open innovation performance. Significant mediation effect showed that R&D department mediated the relationship between internal innovation and firm's open innovation performance. Hence, it could be described that R&D department reflects the positive effect of external knowledge and internal innovation on firm's open innovation performance in Malaysian SMEs.

Conclusion

The current study provides indicative evidence that internal innovation and external knowledge enhance the firm's open innovation performance in Malaysian SMEs. Maximum, as well as better utilization of external knowledge and maximization of internal innovation, enhance the firm's open innovation performance. Moreover, it is investigated that adequate utilization of external knowledge and maximum output from internal innovation is rarely possible without R&D department. Therefore, R&D department is essential to expedite the SMEs' open innovation system. Hence,

Table 8 Construct Cross-Validated Redundancy

Total	SSO	SSE	$Q^2 = (1\text{-SSE/SSO})$
Firm's Open Innovation Performance (FOIP)	504.000	236.085	0.532
R & D Department (R & D)	360.000	155.781	0.567

Source: Authors' own estimates based on survey data

external knowledge, internal innovation, and R&D department are the major determinants of firm's open innovation performance in Malaysian SMEs. Additionally, SMEs require a certain level of external knowledge acquisition. As the external knowledge expedite internal innovations which automatically increases firm's open innovation performance.

This study has provided considerable evidence on the implication of R & D department to act as one of the potential mediators expedite the positive effect of external knowledge and internal innovation on service SMEs open innovation performance. Moreover, this study has forwarded many practical considerations in connection to open innovation as well as related practices in Malaysian service related SMEs. The results suggested that effective acquisition of external knowledge, maximization of internal innovations and investment in R & D department are an imperative consideration for the open innovation performance. SMEs should take reasonable efforts to exploit their open innovation performance by fostering external knowledge, internal innovation, and R & D department.

It is recommended that Malaysian SMEs must incorporate external knowledge and maximize internal innovation. Additionally, more investment is required in R&D department. It will automatically boost up the firm's performance. Future research is required to include other variables, such as, intellectual capital (IP) management and motivating spillovers. Moreover, social capital and venture capital could be used as moderating variables in the future research.

Appendix

Scale Items

External Knowledge

1. Bringing of external knowledge to internal system enhance open innovation system.
2. Our organization encourage employees to initiate new external collaboration practices.
3. Collaboration with external partners adds value to our innovation resources.
4. Collaboration with external partners/suppliers or customers adds value to our innovation activities.
5. Collaboration with external partners add value to customer relations.
6. Just extending the external relations with customers and suppliers are beneficial for innovation.

Internal Innovation

1. Internal ideas are always welcomed in our organization.
2. Communication between partners occurs without problems.
3. Sufficient non-financial resources are available in our organization to achieve desired internal innovation.
4. Carrying out open innovation activities requires an internal R & D activity.
5. Degree of knowledge which is shared between me and my partners is sufficient to promote internal innovation.

R & D

1. R & D contributes towards commercial success of project.
2. R&D generally given very specific preference during the development of project.
3. Relationship between R & D and innovative personals effect on project success or failure
4. Effective coordination between R & D and innovative personals is helpful in project success
5. R&D receive commercial information related to project which is helpful to commercialize the projects.

Firm's Open Innovation Performance

1. I choose to engage in open innovation model, believed that it is a way to commercialize the idea.
2. Collaboration efforts with a number of individuals outside the organization to work on a project for mutual gain are the best description of open innovation.
3. I choose to engage in open innovation model believe that outsourcing of expertise would benefit.
4. New ideas are always welcomed for open innovation in our organization.
5. In my opinion, out-or-in licensing of intellectual property is the best description of open innovation.
6. In my opinion sharing of internal and external knowledge enhances the open innovation.
7. In my opinion licensing of latest ideas promotes open innovation.

Abbreviations
AVE: Average variance extracted; EK: External Knowledge; FOIP: Firm's Open Innovation Performance; II: Internal Innovation; R & D: Research and Development; SMEs: Small and Median-sized Enterprises

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Availability of data and materials
Secondary data from prior studies were used to build the theoretical basis of the current study, as cited in the body of manuscript and references are given in bibliography. However, primary data were collected from respondents. The dataset used and analyzed during this study is available from the corresponding author on reasonable request.

Authors' contributions
The corresponding author WUH presented the main idea and worked on key section of this study. The author namely; MFB majorly worked on proof reading and data collection. The author namely; JI worked on the literature of this study. The author namely; AA majorly worked on data collection and analysis of this study. Finally, the author namely; HKA worked on findings, discussion and conclusion of this study. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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References

Abulrub, A.-H. G., & Lee, J. (2012). Open innovation management: challenges and prospects. *Procedia - Social and Behavioral Sciences, 41*, 130–138.
Alencar, M. S. M., Porter, A. L., & Antunes, A. M. S. (2007). Nano patenting patterns in relation to product life cycle. *Technological Forecasting & Social Change, 74*(9), 1661–1680.
Appleyard, M. M., He, F., Henkel, J., & Olk, P. M. (2017). Knowledge Flows at the Interface: Unmonetized Revealing in Outbound Open Innovation. In *Academy of Management Proceedings* (Vol. 2017, No. 1, p. 13072). Briarcliff Manor, NY 10510: Academy of Management.
Babakus, E., & Mangold, W. G. (1992). Adapting the SERVQUAL scale to hospital services: an empirical investigation. *Health services research, 26*(6), 767.
Belussi, F., Sammarra, A., & Sedita, S. R. (2010). Learning at the boundaries in an "Open Regional Innovation System": A focus on firms' innovation strategies in the Emilia Romagna life science industry. *Research Policy*, 39(6), 710–721.
Brunswicker, S., & Vanhaverbeke, W. (2015). Open innovation in small and medium-sized enterprises (SMEs): External knowledge sourcing strategies and internal organizational facilitators. *Journal of Small Business Management*, 53(4), 1241–1263.
Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management science, 52*(1), 68–82.
Chang, Y. C., Chen, M-H., Hua, M. & Yang, P. Y. (2006). Managing academic innovation in Taiwan: towards a scientific-economic change - *Technological Forecasting & Social Change*, 73(2), 199–213.
Chesbrough, H., (2003). *Open Innovation: The new imperative for creating and profiting fromtechnology*. Harvard Business School Press, Boston, MA.
Chesbrough, H. (2012). Open innovation: Where we've been and where we're going. *Research-Technology Management, 55*(4), 20–27.
Chesbrough, H. (2017). The Future of Open Innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants. *Research-Technology Management*, 60(1), 35–38.
Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. *R&d Management, 36*(3), 229–236.
Chesbrough, H. W. (2006). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press, Brighton, Boston, Massachusetts, United States.
Chesbrough, H. W., Vanhaverbeke, W., & West, J. (2006). *Open Innovation: Researching a New Paradigm* (pp. 1–12). *Oxford*: *Oxford University Press*.
Chin, W. W. (1998). Commentary: Issues and opinion on structural equation modeling. *MIS Quarterly, 22*(1), vii–xvi.
Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small samples using partial least squares. *Statistical strategies for small sample research, 1*(1), 307–341.
Choi, J. (2017). *" Create" or" buy": internal vs. external sources of innovation and firm productivity (No. 8121). The World Bank eLibrary.* Retrieved from https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-8121.
Christensen, J. F., Olesen, M. H., & Kjær, J. S. (2005). The Industrial Dynamics of Open Innovation: Evidence from the Transformation of Consumer Electronics. *Research Policy, 34*(10), 1553–1549.
Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R&D. *The economic journal*, 99(397), 569–596.
Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, 35(1), 128–152.
Collis, D. J. (1994). Research note: how valuable are organizational capabilities? *Strategic management journal, 15*(S1), 143–152.
Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd ed.). Hillside, NJ: Erlbaum.
Conboy, K., & Morgan, L. (2011). Beyond the customer: Opening the agile systems development process. *Information and Software Technology, 53*(5), 535–542.
De Jong, J. P., & Den Hartog, D. N. (2007). How leaders influence employees' innovative behaviour. *European Journal of innovation management*, 10(1), 41–64.
De Silva, M., Howells, J., & Meyer, M. (2018). Innovation intermediaries and collaboration: Knowledge–based practices and internal value creation. *Research Policy, 47*(1), 70–87.
De Wit, J., Dankbaar, B., & Vissers, G. (2007). Open innovation: the new way of knowledge transfer? *Journal of Business Chemistry*, 4(1), 11–19.
Díaz-Díaz, N. L., & de Saá Pérez, P. (2014). The interaction between external and internal knowledge sources: an open innovation view. *Journal of Knowledge Management, 18*(2), 430–446.
Fichter, K. (2009). Innovation communities: the role of networks of promotors in Open Innovation. *R&D Management, 39*(4), 357–371.
Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research, 18*(1), 39–50.
Fteimi, N., & Lehner, F. (2018). Analysing and classifying knowledge management publications–a proposed classification scheme. *Journal of Knowledge Management*. Emerald Publishing Limited 2018. https://doi.org/10.1108/JKM-07-2017-0284.
Gava, O., Favilli, E., Bartolini, F., & Brunori, G. (2017). Knowledge networks and their role in shaping the relations within the Agricultural Knowledge and Innovation System in the agroenergy sector. The case of biogas in Tuscany (Italy). *Journal of Rural Studies*, 56, 100–113.

George, D., & Mallery, M. (2003). *Using SPSS for Windows step by step: a simple guide and reference*. Boston: Allyn & Bacon.
Gómez, J., Salazar, I., & Vargas, P. (2017). Does Information Technology Improve Open Innovation Performance? An Examination of Manufacturers in Spain. *Information Systems Research, 28*(3), 661–675.
Goodhue, D. L., Lewis, W., & Thompson, R. (2012). Does PLS have advantages for small sample size or non-normal data? *MIS Quarterly, 36*(3), 981–1001.
Grigoriou, K., & Rothaermel, F. T. (2017). Organizing for knowledge generation: internal knowledge networks and the contingent effect of external knowledge sourcing. *Strategic Management Journal, 38*(2), 395–414.
Guile, D., & Fosstenløkken, S. M. (2018). *Introduction to the special issue: knowledge dynamics, innovation and learning*.
Güngör, P. (2011). The relationship between reward management system and employee performance with the mediating role of motivation: A quantitative study on global banks. *Procedia-Social and Behavioral Sciences, 24*(2011), 1510–1520.
Hagedoorn, J., & Ridder, A. (2012). Open innovation, contracts, and intellectual property rights:an exploratory empirical study. In *UNU-MERIT Working Papers* ISSN (pp. 1871–9872).
Hair, J. F., Babin, B. J., & Krey, N. (2017). Covariance-Based Structural Equation Modeling in the Journal of Advertising: Review and Recommendations. *Journal of Advertising*, 46(1), 163–177.
Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate Data Analysis*. Prentice Hall, Upper Saddle River, New Jersey, United States.
Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). *Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance*.
Hair Jr., J. F., & Lukas, B. (2014). *Marketing research*. Australia: McGraw-Hill Education.
Hameed, W. U., Azeem, M., Ali, M., Nadeem, S., & Amjad, T. (2017). The Role of Distribution Channels and Educational level towards Insurance Awareness among the General Public. *International Journal of Supply Chain Management*, *6*(4), 308–318.
Hassan, M. U., Iqbal, Z., Malik, M., & Ahmad, M. I. (2018). Exploring the role of technological developments and open innovation in the survival of SMEs: an empirical study of Pakistan. *International Journal of Business Forecasting and Marketing Intelligence, 4*(1), 64–85.
Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In *New challenges to international marketing, (Advances in International Marketing, Volume 20)* (pp. 277–319). Emerald Group Publishing Limited.
Henseler, J., & Sarstedt, M. (2013). Goodness-of-fit indices for partial least squares path modeling. *Computational Statistics, 28*(2), 565–580.
Hossain, M. (2012). Performance and potential of open innovation intermediaries. *Procedia-Social and Behavioral Sciences, 58*(2012), 754–764. https://doi.org/10.1016/j.sbspro.2012.09.1053
Hui, B. S., &Wold, H.O. A. (1982). Consistency and consistency at large of partial least squares estimates. *Systems under indirect observation*, part II, 119–130. Amsterdam: North Holland.
Inauen, M., & Schenker-Wicki, A. (2011). The impact of outside-in open innovation on innovation performance. *European Journal of Innovation Management, 14*(4), 496–520.
Jasimuddin, S. M., & Naqshbandi, M. M. (2018). Knowledge-oriented leadership and open innovation: Role of knowledge management capability in France-based multinationals. *International Business Review,* 27(3), 701-713.
Kaufmann, A., & Tödtling, F. (2002). How Effective Is Innovation Support For Smes? An Analysis of The Region of Upper Austria. *Technovation, 22*, 147–159.
Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal, 27*(2006), 131–150.
Lecocq, X., & Demil, B. (2006). Strategizing Industry Structure: The Case of Open Systems in a Low-Tech Industry. *Strategic Management Journal, 27*(9), 891–898.
Lee, C.-Y., Lee, J.-D., & Kim, Y. (2008). Demand forecasting for new technology with a shorthistory in a competitive environment: the case of the home networking market in South Korea. *Technological Forecasting & Social Change, 75*(1), 91–106.
Lichtenthaler, U. (2008). Open innovation in practice: an analysis of strategic approaches to technology transactions. *IEEE transactions on engineering management*, 55(1), 148–157.
Lichtenthaler, U., & Ernst, H. (2009). Opening up the innovation process: the role of technology aggressiveness. *R & D Management, 39*(1), 38–54.
Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability based framework for open innovation: Complementing absorptive capacity. *Journal of management studies, 46*(8), 1315–1338.
McKelvie, A., Wiklund, J., & Brattström, A. (2018). Externally acquired or internally generated? Knowledge development and perceived environmental dynamism in new venture innovation. *Entrepreneurship Theory and Practice, 42*(1), 24–46.
Oakey, R. P. (2013). Open innovation and its relevance to industrial research and development: The case of high-technology small firms. *International Small Business Journal, 31*(3), 319–336.
Oke, A., Prajogo, D. I., & Jayaram, J. (2013). Strengthening the innovation chain: The role of internal innovation climate and strategic relationships with supply chain partners. *Journal of Supply Chain Management,* 49(4), 43–58.
Pangarkar, N. (2018). The formula for successful innovation at SAS: Integrating internal and external knowledge. *Global Business and Organizational Excellence, 37*(2), 24–31.
Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound open innovation activities in high-tech SMEs: the impact on innovation performance. *Journal of small business management*, 50(2), 283–309.
Pisano, G. (1990). The R&D boundaries of the firm: An empirical analysis. *Administrative Science Quarterly., 35*(1), 153–176.
Popa, S., Soto-Acosta, P., & Martinez-Conesa, I. (2017). Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs. *Technological Forecasting and Social Change, 118*(2017), 134–142.
Porter, A. L. (2005). QTIP: quick technology intelligence processes. *Technological Forecasting & Social Change, 72*(9), 1070–1081.
Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior research methods, instruments, & computers, 36*(4), 717–731.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior research methods, 40*(3), 879–891.
Reinartz, W. J., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing, 26*(4), 332–344.
Rigdon, E. E. (2016). Choosing PLS path modeling as analytical method in European management research: a realist perspective. *European Management Journal, 34*(6), 598–605.
Ringle, C. M., Wende, S., & Becker, J. M. (2015). *Smart PLS 3*. Boenningstedt: Smart PLS GmbH. Retrieved from: http://www.smartpls.com
Ritala, P., Olander, H., Michailova, S., & Husted, K. (2015). Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study. *Technovation*, 35, 22–31.
Rodríguez, J. L., & Lorenzo, A. G. (2011). Open innovation: Organizational challenges of a new paradigm of innovation management. *European Research Studies, 14*(1), 75.
Sachdev, S. B., & Verma, H. V. (2004). Relative importance of service quality dimensions: A multisectoral study. *Journal of services research, 4*(1). Retrieved from: http://www.jsr-iimt.in/freesample/Relative.pdf
Sajjad, A., Eweje, G., & Tappin, D. (2015). Sustainable supply chain management: motivators and barriers. *Business Strategy and the Environment, 24*(7), 643–655.
Sekaran, U. (2003). Towards a guide for novice research on research methodology: Review and proposed methods. *Journal of Cases of Information Technology*, 8(4), 24–35.
Sekaran, U., & Bougie, R. (2006). *Method for Business*. Wiley.
Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. Wiley.
Spithoven, A., Vanhaverbeke, W., & Roijakkers, N. (2013). Open innovation practices in SMEs and large enterprises. *Small Business Economics, 41*(3), 537–562.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509–533.
Tehseen, S., Sajilan, S., Adaha, N. M. A., & Abadi, H. (2017). Barriers to Retail Innovation: Evidence from Malaysian Retail SMEs. *Australian Academy of Business and Economics Review, 2*(1), 1–21.
Trott, P., & Hartmann, D. A. P. (2009). Why'open innovation'is old wine in new bottles. *International Journal of Innovation Management, 13*(04), 715–736.
Umrani, W. A. (2016). *Moderating effect of organizational culture on the relationship between corporate entrepreneurship and business performance in Pakistan's banking sector* (Doctoral dissertation, Universiti Utara Malaysia).
Van de Vrande, V., De Jong, J. P., Vanhaverbeke, W., & De Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation,* 29(6), 423–437.
von Hippel, E. (1988). *The Sources of Innovation*. New York, NY: Oxford University Press.
Wallin, M. W., & von Krogh, G. (2010). Organizing for Open Innovation: Focus on the Integration of Knowledge. *Organizational Dynamics, 39*(2), 145–154.
West, J., & Bogers, M. (2014). Leveraging external sources of innovation: a review of research on open innovation. *Journal of Product Innovation Management*, 31(4), 814–831.
West, J., & Gallagher, S. (2006). Challenges of open innovation: the paradox of firm investment in open-source software. *R & D Management*, 36(3), 319–331.
Williamson, O. (1985). *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. New York: The Free Press.