Open Innovation Challenges: Empirical Evidence from Malaysian Small and Medium-Sized Enterprises (SME's)

Waseem Ul Hameed[1]
Mohsin Altaf[2]
Aqeel Ahmed[3]

Abstract

At present, open innovation (OI) practices have gained traction in all industries, particularly in small and medium-sized enterprises (SMEs). However, only a few Malaysian SMEs practice OI and there is limited literature available on OI practices in Malaysian SMEs. To address this issue, the main objective of the current study is to reveal the challenges of OI and the role of financial constraints in Malaysian SMEs. To achieve this objective, this study implemented the quantitative approach and adopted the cross-sectional research design. Questionnaires were used to collect data from three hundred (300) data managerial staff of Malaysian SMEs. Cluster sampling was used to collect the data. It was found that Malaysian SMEs faced various challenges during the implementation of the OI system. These challenges included motivating spillovers, maximizing internal innovation, and incorporation of external knowledge and intellectual property (IP) management. Moreover, it was found that sufficient finance is needed to resolve these challenges. Hence, this study contributes in the body of knowledge by developing a framework for SMEs to facilitate OI and by identifying the constraints in this framework. Therefore, the current study can be used for Malaysian SMEs to improve their OI system.

Keywords: Malaysia, open innovation, SMEs

1. Introduction

In recent years, open innovation (OI) has gained wide traction in the field of innovation management (Popa, Soto, & Martinez, 2017). OI is grounded in

[1] School of Economics, Finance and Banking, University Utara Malaysia, Malaysia;
[2] UCP Business School, University of Central Punjab, Lahore, Pakistan;
[3] UCP Business School, University of Central Punjab, Lahore, Pakistan.
Correspondence concerning this article should be addressed to Mohsin Altaf, UCP Business School, University of Central Punjab, Lahore, Pakistan. E-mail: mohsin.iltaf@gmail.com

the idea that businesses should utilize internal as well as external sources to generate innovation, rather than depending on a company's internal research and development (R & D) only as in the close innovation model (Freel & Robson, 2016). OI is based on the generation of new ideas through both external knowledge and internal R & D efforts.

In the current decade, OI activities are increasing in SMEs, particularly in Malaysia. However, in rare cases any study formally documented the issues/challenges of OI in Malaysian SMEs. In this regard, Gassmann, Enkel, and Chesbrough (2010) observed that every economy contains a large number of SMEs but the number of studies on OI application by SMEs are still limited (see, for example, Wynarczyk, Piperopoulos, & McAdam, 2013). Freel and Robson (2016) argued that prior studies on OI have focused primarily on large-sized high-tech firms and it is broadly acknowledged that OI practices depend largely on firm size (Popa et al., 2017). Therefore, the adoption of OI in SMEs may differ from high-tech firms and consequently few studies have investigated OI in the definite setting of SMEs (Lee, Park, Yoon, & Park, 2010; Van de Vrande, De Jong, Vanhaverbeke, & De Rochemont, 2009). It is also claimed that such studies have largely discussed the differences between small and large firms rather than focusing on SMEs.

OI has many benefits, however, various prior studies show that companies are unwilling to adopt strategies related to innovation (De Wit, Dankbaar, & Vissers, 2007; Lichtenthaler & Ernst, 2009). In this direction, Not-Invented-Here (NIH) syndrome has been mentioned as a crucial determinant that may discourage SMEs from implementing OI practices (Chesbrough & Crowther, 2006; Spithoven, Vanhaverbeke, & Roijakkers, 2013). Therefore, Malaysian SMEs need to be open about adopting new strategies to enhance performance.

Apart from the issues mentioned above, SMEs are also facing various challenges in adopting OI practices. According to prior studies, these include maximizing internal innovations (West & Gallagher, 2006), incorporating external knowledge (Rodríguez & Lorenzo, 2011), motivating spillovers (Güngör, 2011; West & Gallagher, 2006), and intellectual property handling (Hagedoorn & Ridder, 2012). These four challenges are most important in the success of OI practices. All of them have a direct relationship with OI. However, a high cost is needed to use the elements to ensure the smooth running of the OI system.

Based on the literature, this study comes up with two major questions. The first question is what are the major challenges of OI in Malaysian

SMEs? The second question is what is the role of financial constraints in Malaysian SMEs? Hence, the major objective of this study is to identify the challenges of OI and the role of financial constraints in Malaysian SMEs. It is believed that SMEs have a central importance for the economy of every country. SMEs in Malaysia contribute to the economic development of the country by virtue of their sheer number and an increasing share in both employment and Gross Domestic Product (GDP) (Aris, 2006). Their role in the Malaysia strengthens economic activities. SMEs have made a significant contribution in Malaysian economy (Anuar & Yusuff, 2011). Indeed, they are the backbone of the economy (Normah, 2006). Therefore, SMEs are selected for this study after considering the importance of SMEs for the Malaysian economy. These selected SMEs are based in services, manufacturing, mining, construction and agriculture.

2. Literature Review

Open Innovation is different from close innovation. In close innovation, organizations produce their own innovative ideas and then build, distribute, market, finance and support them with the help of their own internal applications (Huizingh, 2011). As described by experts, internal research and development has proposed the OI concept to enhance the traditional innovation model or closed innovation model (Chesbrough, 2003; Gassmann, 2006; Lichtenthaler, 2009).

The review of literature has shown that there are many studies conducted on OI all over the world. Many researchers have explored the challenges of OI and observed that managing these challenges is crucial. These challenges include maximizing internal innovations (West & Gallagher, 2006), motivating spillovers (Güngör, 2011), incorporating external knowledge (Rodríguez & Lorenzo, 2011) and intellectual property (IP) Management (Hagedoorn & Ridder, 2012). At the same time, researchers have also considered the effects of financial constraints on the management of OI challenges (Van de Vrande et al., 2009) indicating a gap in their management. In this regard, there are few studies on the combined effect of these challenges. Thus, this study will identify the combined effects of the above mentioned challenges along with the role of financial constraints in OI, particularly among SMEs, as they are facing various financial constraints that could become a hindrance in OI adoption.

2.1 Hypothesis Development

Motivating spillovers comprise factors that enhance OI. These factors could be internal, such as employees as well as external, such as suppliers.

According to Taylor's theory, a reward is one of the tools which enhance employee motivation and an enhanced employee motivation increases performance. Furthermore, Vroom's expectancy theory explains that motivation is only attained when there is a relationship between performance and outcome. Therefore, there is a need to motivate different factors which enhance OI practices (West & Gallagher, 2006).

On the other hand, the process of motivation increases the overall expense and SMEs face a challenging situation of handling expenses, since the reward and incentive system could be a costly one. Moreover, according to Almirall and Casadesus (2010), coordination cost also increases when incentives are not aligned. Hence, finance is an important aspect which affects various factors. Therefore, it is hypothesized that

H_1: There is a significant relationship between motivating spillovers and OI system.

H_2: There is a significant relationship between motivating spillovers and financial constraints.

OI is one of the main areas affecting the innovation capability of firms based on mutual interaction between organizations. Interaction outside the boundaries of an organization shows valuable outcomes in the form of OI. This external interaction follows two diverse directions (Chesbrough et al., 2006; Huizingh, 2011). Firstly, inbound OI (outside-in process) which denotes the internal utilization of external knowledge from customers, universities, external partners, research related organizations, and secondly, outbound OI (inside-out process) which denotes the external use of internal knowledge with the help of licensing or by any other means. Hence, external knowledge from outside the firm is one of the key elements of OI. According to the resource-based view (RBV), company resources lead towards success (Umrani, 2016) and external knowledge is one of the resources of SMEs.

Hameed, Basheer, Iqbal, Anwar, and Ahmad (2018) investigated whether external knowledge is a key to OI and found that the incorporation of external knowledge enhances OI practices. In this regard, coordination with external partners such as suppliers can generate new ideas (Rodríguez & Lorenzo, 2011). Hence, external knowledge has a positive relationship with OI. However, coordination is a costly process (Almirall & Casadesus, 2010). According to Chesbrough (2012), coordination with external partners is one of the expensive processes. Therefore, finance creates a challenge for SMEs. According to Hameed et al. (2018), external knowledge is a very valuable element which improves OI; however, it

increases the overall cost since OI activities require the R & D department which is costly. Thus, external knowledge has a significant relationship with OI and financial constraints. Based on this argument, it is hypothesized that:

H_3: There is a significant relationship between the incorporation of external knowledge and OI system.

H_4: There is a significant relationship between the incorporation of external knowledge and financial constraints.

Intellectual property (IP) defines the firm's degree of assurance or commitment with outbound OI (Hsu & Fang, 2009). IP management is an asset which protects the commercial success of innovation (Von Zedtwitz, Gassmann, & Boutellier, 2004). Teece (1986, p. 1124), as cited by Pisano (2006), mentioned that "innovators require market knowledge to work effectively". Consequently, it requires an innovation network which depends on IP regimes. A well-managed IP regime can support OI activities and could positively impact the OI system. Well-managed IP is based on the capability of firms which is in line with the resource-based view (RBV).

IP limits the scope for disagreement (Arundel, 2001) and strengthens the process of OI. It serves as a protection mechanism linked to openness (Laursen & Salter, 2014) and it protects companies when they practice openness (Parida, Westerberg, & Frishammar, 2012). However, for SMEs the patenting process of IP could be costly and this could increase the overhead cost for Malaysian SMEs. According to Chesbrough (2006), the protection of OI ideas requires patents and copyrights which increases the overall innovation expense. Hence, it is hypothesized that

H_5: There is a significant relationship between intellectual property (IP) management and OI system.

H_6: There is a significant relationship between intellectual property (IP) management and financial constraints.

West and Gallagher (2006) explained that the maximization of internal innovation is vital for OI system. Various characteristics shown by a company's employees have a significant effect on the implementation of OI (Huizingh, 2011), such as employee resistance and deficiency of internal commitment have been declared as major barriers for the adoption of OI by SMEs (Van de Vrande et al., 2009). Therefore, communication among employees has considerable importance as it is associated with OI performance in SMEs, particularly in Malaysia.

Resource-based view (RBV) demonstrates that success of a SME is largely determined by its internal resources, such as assets and competencies (Umrani, 2016). Assets or resources of the firm could be tangible and

intangible (Collis, 1994). Competencies are intangible, such as skills and knowledge (Teece, Pisano, & Shuen, 1997). The maximization of internal innovation is also based on internal skills and capabilities which are resources of SMEs. Thus, the relationship between internal innovation and OI system is well justified on the basis of RBV.

Internal ideas flow out of the company with the help of licensing, contractual agreements and patenting or to gain monetary as well as non-monetary assistance (Hung & Chou, 2013; Lichtenthaler, 2009). The degree of openness strategies is generally based on firm internal factors (Drechsler & Natter, 2012). Therefore, internal innovation is an important element of OI. However, it requires employees to communicate with each other during meetings and seminars where all employees contribute and discuss various ideas. However, organizing meetings and seminars is costly and could increase the total cost of the OI system (Kengchon, 2012), thus creating financial constraints for the company. According to Van de Vrande et al. (2009), innovation in SMEs is hampered by the lack of financial resources. Furthermore, this process requires the existence of R & D department which needs to be funded internally. Thus, maximizing internal innovation requires R & D department which is costly (Hameed et al., 2018) and discourages OI activities. Therefore, the maximization of internal innovation has a significant relationship with OI and financial constraints.

H_7: There is a significant relationship between the maximization of internal innovation and OI system.

H_8: There is a significant relationship between the maximization of internal innovation and financial constraints.

Additionally,

H_9: There is a significant relationship between financial constraints and OI system.

From the above discussion, it is evident that motivating spillovers, incorporation of external knowledge, intellectual property (IP) management and maximization of internal innovation have a significant relationship with OI. Moreover, it is evident that these variables also have a significant relationship with financial constraints and financial constraints in turn have a significant relationship with OI. Thus, these findings from the previous literature lead towards the incorporation of financial constraints as the mediating variable following the instructions of Baron and Kenny (1986). Hence, the following hypotheses are proposed.

H_{10}: Financial constraints mediate the relationship between motivating spillovers and OI system.

H_{11}: Financial constraints mediate the relationship between the incorporation of external knowledge and OI system.

H_{12}: Financial constraints mediate the relationship between intellectual property (IP) management and OI system.

H_{13}: Financial constraints mediate the relationship between maximization of internal innovation and OI system.

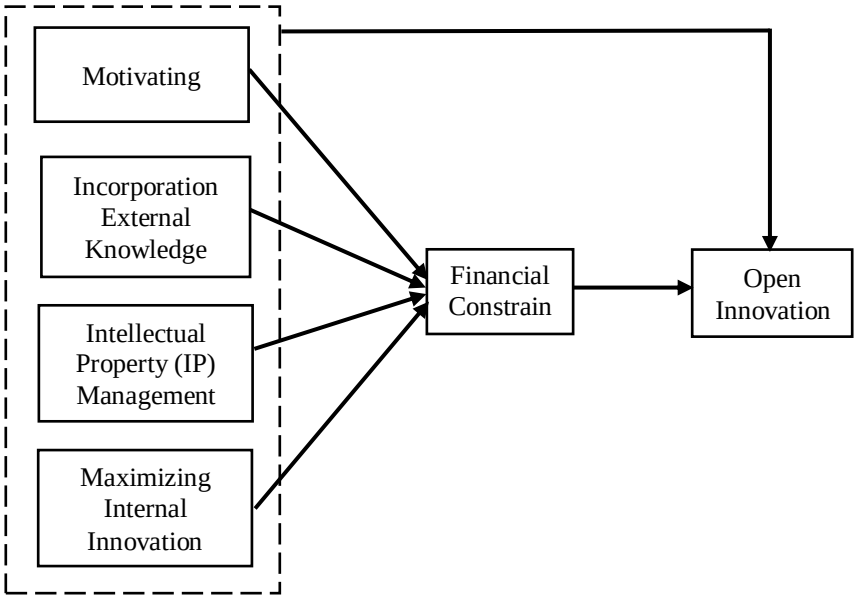

Figure 1. Theoretical Framework

3. Research Methodology

The current study adopted the cross-sectional research design. The quantitative research approach was deemed as the most appropriate procedure for this study based on its objectives, nature of population and research design (Burns & Grove, 1987). Malaysian SMEs were selected as the target population of the current study. The managerial staff members of Malaysian SMEs directly involved in OI activities were selected as respondents. Malaysian SMEs are generally divided into five sectors, namely services, manufacturing, mining, construction and agriculture. All these SMEs were selected for the current study.

Comrey and Lee (1992) presented a rule of thumb to determine the size of sample for inferential statistics; a sample size below 50 is considered the weakest sample size, a sample size of 100 is considered as weak, a sample

size of 200 is satisfactory, a sample size of 300 is good, a sample size of 500 is very good and a sample size of 1000 is outstanding. Moreover, according to Hair, Black, Babin, Anderson, and Tatham (2006), sample size should depend on the number of items developed for some specific characteristics. It was suggested that each item should be represented by using 5 samples. Since the current study has 31 attributes, therefore, the sample size should be 155. However, by following the recommendations of previous studies, a sample size of 300 was selected for this study. Moreover, area cluster sampling was chosen as it is the most suitable technique when the population is spread over a wide area (Hameed et al., 2018). Area cluster sampling is probability sampling which does not require a sampling frame (Sekaran & Bougie, 2016). The current study does not have a sampling frame which is one of the reasons to select area cluster sampling.

Area cluster sampling is based on three major steps recommended by Sekaran and Bougie (2016). The first step is based on the formation of clusters. In the current study, formation of the clusters was based on Malaysian states. Malaysia has a total of sixteen states and in each state SMEs are working. The proportion of SMEs in each state as the proportion of total number of SMEs is as follows; Selangor 19.8%, Perak 8.3%, Pinang 7.4%, Kuala Lumpur 14.7%, Johor 10.8%, Kedah 5.4%, Kelantan 5.1%, Pahang 4.1%, Negeri Sembilan 3.6%, Malacca 3.5%, Terengganu 3.2%, Perlis 0.8%, Labuan 0.3%, and Putrajaya 0.1%. However, this study did not include the states of Sabah and Sarawak due to various limitations such as time and financial cost. Each state is considered as one cluster. Thus, the current study focused on 14 clusters. The second step of cluster sampling is the selection of clusters randomly. By following the second step, 08 clusters (Pinang, Kuala Lumpur, Kedah, Terengganu, Selangor, Perlis, Putrajaya, Johor) were selected. Finally, following the third step of cluster sampling, respondents were selected randomly from each selected cluster.

Data were collected by using mail survey and a 5-point Likert scale was used. Three hundred (300) questionnaires were distributed to the managerial staff of SMEs in Malaysia. Out of this number, 117 questionnaires were returned, resulting in a response rate of 39%. According to Sekaran (2003), 30% response rate is sufficient for a mail survey.

3.1 Measures

All the measures are adapted by using the variables uncovered in the study conducted by Hameed et al. (2018), de Rochemont (2010), Meulenbroeks (2011) and Mahrous (2011). Motivating spillover is measured through 04

items, maximization of internal innovation is measured through 05 items, incorporation of external knowledge is measured through 06 items, intellectual property (IP) management is measured through 04 items, the variable financial constraints is measured through 05 items and OI is measured through 07 items.

3.2 Statistical Tool

The current study used Partial Least Square-Structural Equation Modeling (PLS-SEM) to analyze the data. It is one of the prominent techniques recommended by various prominent studies (Hair, Babin, & Krey, 2017; Henseler, Ringle, & Sinkovics, 2009). Generally, it is based on two major steps including measurement model assessment and structural model assessment. All the steps of PLS-SEM are shown in Figure 2.

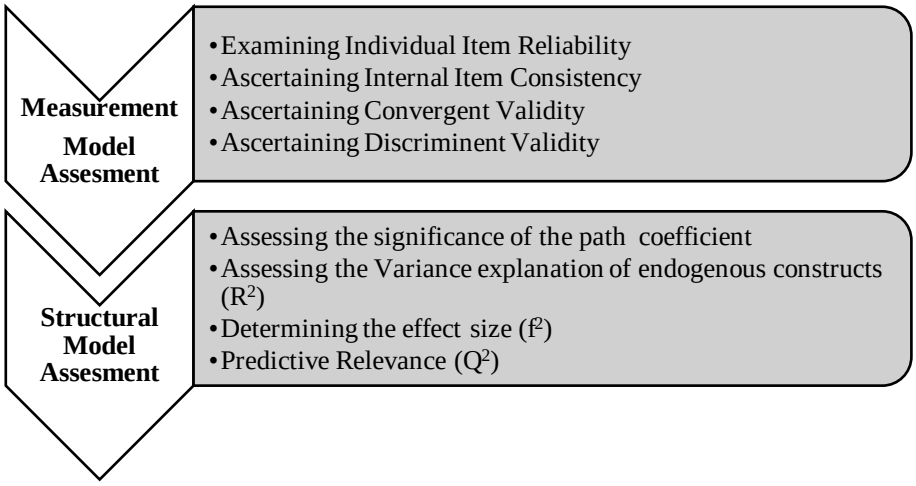

Figure 2. Two Step of PLS-SEM
Source: Hameed et al., (2018)

4. Analysis and Results

Before testing the hypotheses, the current study performed preliminary analysis. All the preliminary analysis are shown in Table 1. In this analysis, missing value, outlier and normality was examined. It was found that the collected data had no missing value and remains free from outlier. Moreover, normality was examined by following the recommendations of Meyer, Becker, and Van Dick (2006).

Table 1
Preliminary Analysis

Coding	Mean	SD	Kurtosis	Skewness
MS1	4.06	0.936	0.708	-0.943
MS2	3.966	0.987	-0.302	-0.688
MS3	3.829	1.112	-0.524	-0.638
MS4	4.231	0.928	2.339	-1.454
IEK1	4.299	0.754	2.263	-1.168
IEK2	4.077	1.031	0.162	-0.963
IEK3	4.034	1.154	0.181	-1.047
IEK4	3.915	1.059	-0.512	-0.615
IEK5	3.966	1.086	0.152	-0.906
IEK6	4.043	0.982	-0.384	-0.69
IPM1	4.017	0.978	0.528	-0.867
IPM2	4.077	0.818	2.21	-1.093
IPM3	4.06	1.015	-0.386	-0.767
IPM4	4.179	0.966	0.471	-1.003
MII1	4.145	0.936	0.077	-0.866
MII2	4.179	0.921	0.575	-1.032
MII3	3.803	1.015	-0.371	-0.539
MII4	3.957	0.982	0.157	-0.792
MII5	3.991	1.008	0.092	-0.844
OI1	3.906	1.07	-0.191	-0.743
OI2	4.043	0.964	1.461	-1.129
OI3	4.103	0.841	2.117	-1.158
OI4	4.239	0.883	0.873	-1.095
OI5	3.949	0.968	0.742	-0.926
OI6	3.957	0.955	0.348	-0.807
OI7	4	0.857	0.323	-0.659
FC1	3.991	0.822	0.323	-0.546
FC2	3.872	1.017	0.492	-0.873
FC3	4	0.857	1.512	-0.989
FC4	3.949	0.914	1.306	-0.987
FC5	4.017	0.806	0.614	-0.627

Data is said to be normally distributed if the range of skewness and kurtosis lies within ± 1.0 and ± 3.00, respectively. However, data was

slightly non-normal. That is why the current study used partial least square (PLS) to handle this issue. PLS has the ability to get accurate results in case of non-normal data. As stated in prior studies, PLS-SEM delivers precise model estimations if the data is extremely non-normal (Reinartz, Haenlein, & Henseler, 2009; Wetzels, Odekerken, & Van Oppen, 2009).

Moreover, Variance Inflation Factor (VIF) value of under 5.0 shows no multicollinearity (Hair et al., 2006). However, Meyers, Gamst, and Guarino (2016) described that the non-existence of collinearity will be determined if the VIF value is under 10.0. This study followed the recommendations of Hair et al. (2006). Table 2, shows the VIF values in this study which are within the acceptable range (5.0).

Table 2
Multicollinearity Test

Construct	VIF
Financial Constraint (FC)	1.603
Incorporation of External Knowledge (IEK)	3.998
Intellectual Property (IP) Management (IPM)	2.778
Maximization of Internal Innovation (MII)	3.155
Motivating Spillovers (MS)	3.164

After completing the preliminary analysis, data were analyzed through PLS-SEM. First of all, the measurement model was assessed to examine the reliability and validity of data. Figure 3 shows the measurement model assessment. Factor loadings is shown in Table 3 and Figure 3, where all the values are above 0.5 (Hair, Black, Babin, Anderson, & Tatham, 2010). All items have factor loadings above the minimum threshold level. Thus, all items were retained. Moreover, Cronbach alpha and composite reliability is also above 0.7 (Fornell & Larcker, 1981). Furthermore, average variance extracted (AVE) is above 0.5, which confirms the convergent validity (Hair & Lukas, 2014). Additionally, discriminant validity is achieved through AVE square root by following the criteria of Fornell and Larcker (1981). It is shown in Table 5.

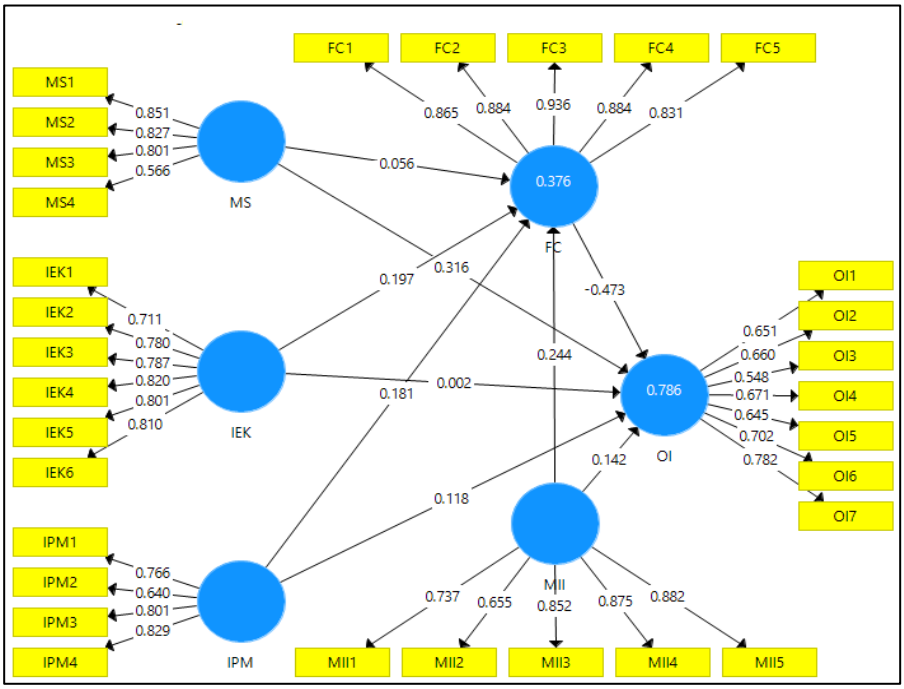

Figure 3. Measurement Model Assessment

The analysis revealed that the variable motivating spillovers has a significant positive relationship with OI, having t-value 3.075 and β-value 0.316. The relationship between the incorporation of external knowledge and OI was also found to be positive with t-value 2.021 and β-value 0.002. Similar results were found in case of IP management and maximization of internal innovation with t-values 2.13 and 2.547 and β-values 0.118 and 0.142, respectively. Therefore, motivating spillovers, incorporation of external knowledge, intellectual property (IP) management and maximization of internal innovation have a positive effect on OI system. These factors increase OI system.

Table 3
Factor Loadings

	FC	IEK	IPM	MII	MS	OI
FC1	0.865					
FC2	0.884					
FC3	0.936					
FC4	0.884					
FC5	0.831					
IEK1		0.711				
IEK2		0.78				
IEK3		0.787				
IEK4		0.82				
IEK5		0.801				
IEK6		0.81				
IPM1			0.766			
IPM2			0.64			
IPM3			0.801			
IPM4			0.829			
MII1				0.737		
MII2				0.655		
MII3				0.852		
MII4				0.875		
MII5				0.882		
MS1					0.851	
MS2					0.827	
MS3					0.801	
MS4					0.566	
OI1						0.651
OI2						0.66
OI3						0.548
OI4						0.671
OI5						0.645
OI6						0.702
OI7						0.782

Table 4
Reliability and Convergent Validity

	Cronbach's Alpha	rho_A	Composite Reliability	(AVE)
FC	0.927	0.928	0.945	0.775
IEK	0.875	0.876	0.906	0.617
IPM	0.756	0.764	0.846	0.581
MII	0.859	0.862	0.901	0.648
MS	0.761	0.783	0.851	0.593
OI	0.792	0.799	0.849	0.502

Table 5
Discriminant Validity

	FC	IEK	IPM	MII	MS	OI
FC	***0.88***					
IEK	0.566	***0.786***				
IPM	0.543	0.775	***0.762***			
MII	0.564	0.757	0.705	***0.805***		
MS	0.516	0.784	0.655	0.765	***0.77***	
OI	0.779	0.712	0.68	0.732	0.744	***0.669***

In the same vein, the relationship of these four factors with the variable financial constraints was also examined. It was found that motivating spillovers, incorporation of external knowledge, IP management and maximization of internal innovation have a significant positive relationship with financial constraints with t-values 2.408, 3.195, 3.533, 2.079 and β-value 0.056, 0.197, 0.181, 0.244, respectively. Moreover, an increase in financial constraints decreases the OI as the relationship between financial constraint and OI was found to be significant but negative with t-value 6.983 and β-value -0.473. These results support H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8 and H_9. All these results are shown in Table 6.

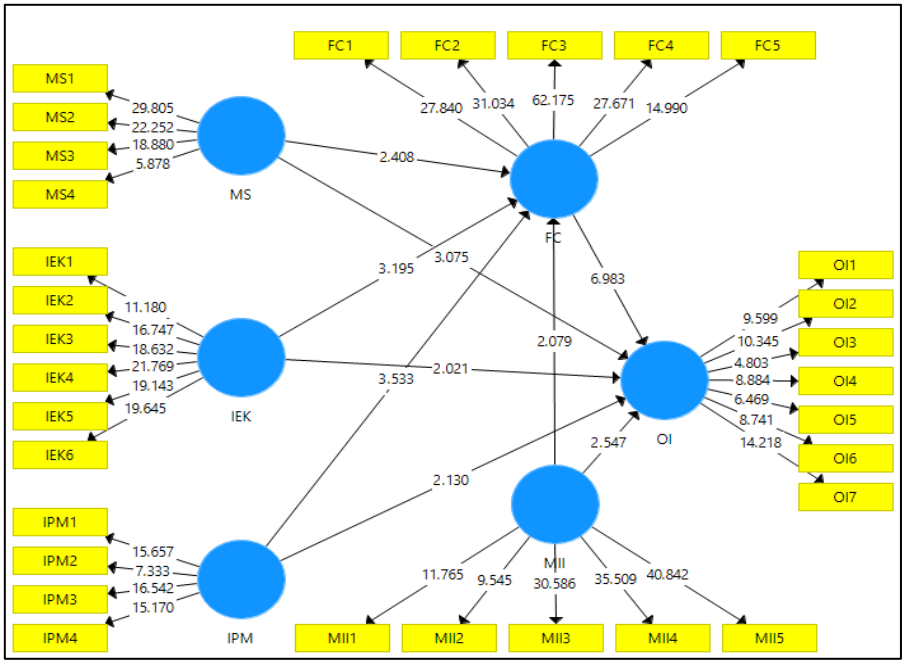

Figure 4. Structural Model Assessment

Mediation effect is also examined by considering the t-value. It was found that the mediation effect of the variable financial constraints between motivating spillovers and OI was significant with t-value 2.449 and β-value -0.027, respectively. Similar results were found in case of mediation effect between incorporation of external knowledge and OI with t-value 2.631 and β-value -0.093, respectively. Moreover, the mediation effect between maximization of internal innovation and OI was also found to be significant with t-value 2.023 and β-value -0.115, respectively. However, the mediation effect between IP management and OI was found to be insignificant with t-value 1.439 and β-value -0.086, respectively. It was found that all significant mediation effects are negative. All mediation results are shown in Table 7. These findings support H_{10}, H_{11} and H_{13}. However, the results do not support H_{12}.

Table 6
Direct Effect

Paths	Beta	S.E	t-value	f^2	Decision
FC -> OI	-0.471	0.068	6.983	0.652	Supported
IEK -> FC	0.196	0.165	3.195	0.026	Supported
IEK -> OI	0.007	0.001	2.021	0.003	Supported
IPM -> FC	0.186	0.058	3.533	0.058	Supported
IPM -> OI	0.122	0.056	2.13	0.023	Supported
MII -> FC	0.234	0.117	2.079	0.038	Supported
MII -> OI	0.145	0.056	2.547	0.172	Supported
MS -> FC	0.065	0.021	2.408	0.065	Supported
MS -> OI	0.317	0.103	3.075	0.022	Supported

Table 7
In-Direct Effect

Paths	Beta	S.E	t-value	Decision
IEK -> FC -> OI	-0.092	0.035	2.631	Mediation
IPM -> FC -> OI	-0.088	0.059	1.439	No Mediation
MII -> FC -> OI	-0.109	0.057	2.023	Mediation
MS -> FC -> OI	-0.031	0.011	2.449	Mediation

According to Chin (1998), the R-squared value of 0.60 is considered as substantial and 0.19 is considered as weak, while 0.33 is considered as moderate. Table 8 below shows the R-Square value of the current study. All the exogenous latent variables are expected to explain 78.6% variance in endogenous latent variable which is strong. Additionally, the current study assessed the quality of model through predictive relevance (Q^2). The Q^2 value must be above zero to achieve a certain level of model quality (Chin, 1998). Table 9 shows that Q2 value is above zero.

Table 8
Variance Explained

Latent Variables	R^2	Variance Explained
Open Innovation	0.786	Strong
Financial Constraint	0.376	Moderate

Table 9
Predictive Relevance (Q^2)

	SSO	SSE	Q^2 (=1-SSE/SSO)
FC	585	428.918	0.267
OI	819	568.723	0.306

Finally, the effect of size (f^2) is shown in Table 6. It shows the effect of each variable on dependent variables. Cohen (1988) described that the f-squared values 0.02, 0.15, and 0.35 considered as weak, moderate and strong effects, respectively. In the current study, the variable financial constraints have a strong effect in case of OI and maximization of internal innovation has a moderate effect on OI. All other variables have a weak effect. However, incorporation of external knowledge has no effect at all on OI.

5. Findings and Discussion

The findings have helped to answer the research questions. The current study posed two research questions. The first research question was 'what

are the major challenges of OI in Malaysian SMEs?' Studies have documented the challenges faced by SMEs in developing their OI system. These challenges include motivating spillovers, maximizing internal innovation, incorporation of external knowledge and IP management. West and Gallagher (2006) carried out a study on software houses and found that the above mentioned variables are the major challenges for OI. Apart from these challenges, financial constraints influence on OI practices. As described by Van de Vrande et al. (2009), innovation in SMEs is hampered by the lack of financial resources. The relationship of these four challenges (motivating spillovers, maximizing internal innovation, incorporation external knowledge, intellectual property (IP) management) was found significant with OI. Hammed et al. (2018) also found that external knowledge and internal innovation have a significant effect on OI in Malaysian SMEs. This shows that the direct relationship between OI and other independent variables is significant which is consistent with previous studies.

The second research question was 'what is the role of financial constraints on OI practices in Malaysian SMEs?' The current study found that financial constraints play a mediating role between OI challenges and OI system. The current study also found that financial constraints have a negative effect on OI system. An increase in financial constraints decreases OI practices. As described by Van de Vrande et al. (2009), insufficient financial resources decrease OI performance in SMEs. An increase in internal innovation, external knowledge incorporation, motivating spillovers and IP management increases financial constraints which decreases OI. Internal innovation requires R & D department which is costly (Hameed et al., 2018). IP management through patents and copyrights increases the overall cost to manage OI (Chesbrough, 2003). Moreover, extraction of external knowledge requires coordination with external stakeholders which increases the cost (Chesbrough, 2012). Additionally, the provision of incentives is always expensive for any organization. Thus, the variable financial constraints plays a mediating role between OI challenges and OI system. To sum up the discussion, motivating spillovers, maximizing internal innovation, incorporation of external knowledge and IP management are the major challenges of OI. Effective management of these challenges will lead towards OI success. However, SMEs are unable to resolve these challenges due to financial constraints.

6. Conclusion

In this research, it was observed that Malaysian SMEs are facing different challenges in the implementation of OI system. These challenges include motivating spillovers, maximizing internal innovation, incorporation of external knowledge and IP management. It was observed that there are different factors which enhance OI practices. Thus, there is a need to drive these factors to develop an OI system, which is one of the challenges faced by OI. Another challenge is that OI is a two-way process which requires the enhancement of internal innovations and introduction of external knowledge inside the boundaries of the firm. This study also observed that new ideas need to be protected against misuse by external parties, as well as from the employees of the firm itself. Meanwhile, if SMEs overcome these challenges then these challenges can become strengths as all of them are significantly and positively related to OI. In this case, better motivation system, internal innovation, incorporation of external knowledge and IP management will warrant a better OI system.

At the same time, financial constraints is another major challenge for OI in SMEs as it makes it difficult for SMEs to try to solve these four challenges. In addressing motivating spillovers, an incentive system is needed to encourage the factors that enhance OI practices; therefore, it needs sufficient finance to generate incentives. Moreover, maximizing internal innovation is also an expensive process which requires communication among SME employees and the input of experts to generate new ideas. With regard to the next challenge, which is incorporation of external knowledge, establishing communication with external partners is also an expensive process which could be a possible hindrance. For the last challenge which is IP management, a higher cost is borne by SMEs in order to file for intellectual property right to protect new ideas generated by them. The innovation process also requires research and development (R & D) which is not easy for SMEs.

Future research could examine the constraints identified in this framework to improve it. Future research should be carried out to find out various ways to overcome the challenges of OI. Particularly, research should be conducted to examine the role of joint ventures in reducing financial constraints. As joint ventures between various SMEs can help to strengthen the financial resources.

6.1 Implications of Study

This study explored the major challenges for OI in SMEs and examined the combined relationship of four factors, namely motivating spillovers, maximizing internal innovation, incorporation of external knowledge and IP management, regarding OI. This study developed a framework for SMEs to facilitate OI which could contribute to the field. It also developed a survey-based instrument and explored various OI challenges, including financial constraints.

The current study is a significant contribution with valuable practical implications. Since this study focused on SMEs which are the backbone of the economy and highlighted the issues/challenges in OI. The OI system is not well established in SMEs and they are unable to adopt OI practices. This study highlighted the reasons SMEs are unable to adopt OI and also highlighted financial constraints as a major reason. Thus, this study is valuable for SMEs to overcome the major challenges highlighted and to adopt OI practices which will automatically improve SMEs' performance and will ultimately contribute to Malaysian economy. Therefore, the study is highly beneficial for practitioners making the strategies to overcome the challenges in adopting OI practices.

References

Almirall, E., & Casadesus, R. M. (2010). Open versus closed innovation: A model of discovery and divergence. *Academy of Management Review, 35*(1), 27–47.

Anuar, A., & Yusuff, M. R. (2011). Manufacturing best practices in Malaysian small and medium enterprises (SMEs). *Benchmarking: An International Journal, 18*(3), 324–341.

Aris, N. M. (2006). SMEs: Building blocks for economic growth. Paper presented at the *National Statistical Conference, Kuala Lumpur, Department of National Statistics, Malaysia*.

Arundel, A. (2001). The relative effectiveness of patents and secrecy for appropriation. *Research Policy, 30*(4), 611–624.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Burns, N., & Grove, S. K. (1987). *The practice of nursing research: Conduct, critique & utilization*. Philadelphia, PA: Saunders.

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.

Chesbrough, H. (2012). Open innovation: Where we've been and where we're going. *Research-Technology Management, 55*(4), 20-27.

Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: Early adopters of open innovation in other industries. *R&D Management, 36*(3), 229–236.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern Methods for Business Research, 295*(2), 295–336.

Cohen, J. (1988). *Statisticalpower analysis for the behavioral sciences (2'EU.).* HilIsUale, NJ: Lawrence Eribaum Associates.

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.

de Rochemont, M. H. (2010). *Opening up for innovation: The antecedents of multi partner alliance performance* (Ph. D. thesis, Eindhoven University of Technology, The Netherlands).

De Wit, J., Dankbaar, B., & Vissers, G. (2007). Open innovation: The new way of knowledge transfer? *Journal of Business Chemistry, 4*(1), 11–19.

Drechsler, W., & Natter, M. (2012). Understanding a firm's openness decisions in innovation. *Journal of Business Research*, 65(3), 438–445.

Freel, M., & Robson, P. J. (2016). Appropriation strategies and open innovation in SMEs. *International Small Business Journal: Researching Enterprenureship, 35(5),* 578–596.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Gassmann, O. (2006). Opening up the innovation process: Towards an agenda. *R & D Management, 36*(3), 223-228.

Gassmann, O., Enkel, E., & Chesbrough, H. (2010). The future of open innovation. *R & D Management, 40*(3), 213–221.

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*, 1510–1520.

Hagedoorn, J., & Ridder, A. K. (2012). *Open innovation, contracts, and intellectual property rights: An exploratory empirical study.* (UNU-MERIT Working Papers; No. 025). Maastricht: UNU-MERIT, Maastricht Economic and Social Research and Training Centre on Innovation and Technology.

Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate data analysis.* Upper Saddle River, NJ: Pearson Prentice Hall.

Hair, J. F., & Lukas, B. (2014). *Marketing research.* Australia: McGraw-Hill Education.

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.

Hameed, W. U., Basheer, M. F., Iqbal, J., Anwar, A., & Ahmad, H. K. (2018). Determinants of firm's open innovation performance and the role of R & D department: An empirical evidence from Malaysian SME's. *Journal of Global Entrepreneurship Research, 8*(1), 29.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In Rudolf R. Sinkovics, & Pervez N. Ghauri (Eds.), *New challenges to international marketing* (pp. 277–319). Colombia: Emerald Group Publishing.

Hsu, Y. H., & Fang, W. (2009). Intellectual capital and new product development performance: the mediating role of organizational learning capability. *Technological Forecasting and Social Change, 76*(5), 664-677.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2–9.

Hung, K. P., & Chou, C. (2013). The impact of open innovation on firm performance: The moderating effects of internal R & D and environmental turbulence. *Technovation, 33*(10), 368–380.

Kengchon, S. (2012). The ODI impact of a strategic management planning process on employee motivation, satisfaction, engagement, and innovative behaviors: A case study of a family-owned SME in Thailand. *Social Research Reports, 21*, 47-66.

Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy, 43*, 867–878.

Lee, S., Park, G., Yoon, B., & Park, J. (2010). Open innovation in SMEs: An intermediated network model. *Research Policy, 39*(2), 290–300.

Lichtenthaler, U. (2009). Outbound open innovation and its effect on firm performance: Examining environmental influences. *R & D Management, 39*(4), 317–330.

Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. *Journal of Management Studies, 46*(8), 1315–1338.

Meulenbroeks, E. (2011). *Integrating business model and open innovation thinking: How collaboration with external partners adds value to the business models of lsobionics, Arachidonic Acid,(r) claryl picture glass and Dyneema (r) Personal Protection* (Master's thesis, Open Universiteit, The Nethearland).

Meyer, J. P., Becker, T. E., & Van Dick, R. (2006). Social identities and commitments at work: Toward an integrative model. *Journal of Organizational Behavior, 27* (5), 665–683.

Normah, M. A. (2006, September 4-5). SMEs: Building blocks for economic growth. Paper presented at *the National Statistics Conference, National Statistics Departments, Kuala Lumpur*.

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. (2006). Profiting from innovation and the intellectual property revolution. *Research Policy, 35*(8), 1122–1130.

Popa, S., Soto, P. A., & Martinez, I. C. (2017). Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs. *Technological Forecasting and Social Change, 118*, 134–142.

Reinartz, W., 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.

Rodríguez, J. L., & Lorenzo, A. G. (2011). Open innovation: Organizational challenges of a new paradigm of innovation management. *European Research Studies, 14*(1), 75.

Sekaran, U. (2003). *Research method for business: A skill-building approach* (4th ed.). New York: John Wiley.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. New York: John 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. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy, 15*(6), 285–305.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.

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 Zedtwitz, M., Gassmann, O., & Boutellier, R. (2004). Organizing global R & D: Challenges and dilemmas. *Journal of International Management, 10*(1), 21–49.

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.

Wetzels, M., Odekerken, G. S., & Van Oppen, C. (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. *MIS Quarterly, 33*(1), 177–195.

Wynarczyk, P., Piperopoulos, P., & McAdam, M. (2013). Open innovation in small and medium-sized enterprises: An overview. *International Small Business Journal, 31(3)*, 240–255.