Open-Innovation and Knowledge Management in Small and Medium-Sized Enterprises (SMEs): The role of External Knowledge and Internal Innovation

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Abstract

Small and medium-sized enterprises (SMEs) are the backbone of every economy worldwide. However, SMEs are not active in open innovation (OI) activities which limits the overall performance. To address this issue, this study carried out to examine the effect of external knowledge (EK), internal innovation (II) and knowledge management (KM) on firm's OI performance. This study followed the quantitative research approach and cross-sectional research design. Moreover, this study is limited to the SMEs located in Bahawalpur district, Pakistan. Data were collected from the managerial employees. Partial Least Square-Structural Equation Modeling (PLS-SEM) was used to analyze the data. Findings of the study revealed that EK and II has significant contribution to enhance OI in SMEs. Additionally, it is found that KM mediates the relationship of EK and II with OI. Thus, this study is beneficial for SMEs to increase their performance by increasing OI activities through effective KM.

Keywords: SMEs, external knowledge, internal knowledge, open innovation, Knowledge management.

1. Introduction

In an enterprise, innovation is hidden in product, services or process. Change in product, services or process based on new idea which increases the bond of innovation (Iqbal & Hameed, 2020; Rahman & Ramos, 2012).

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It plays a role of significant driving force which provides the distinctive chance to tackle the global economic pressure, unbalanced economic market, complication of technology, scientific knowledge, hope of new market and consumer related knowledge (Saguy, 2011). However, generally, innovation has two types 1) close innovation and 2) open innovation (OI).

Close innovation is a process in which scientists bring new ideas; develop new products according to the demand of customers remaining within the boundaries of the firm but they never look outside the boundaries of the firm for new idea generation (Conboy & Morgan, 2011). According to Chesbrough (2012), close innovation model explains that all the projects of research depend on the internal knowledge of the firm. Therefore, it can be further described as, close innovation is one of the isolated process in which a small group of people and certain individuals involve in an idea generation and value creation process which only depends on internal ability of this group or individuals and they do not

look outside the firm. Close innovation is shown in in Figure 1.

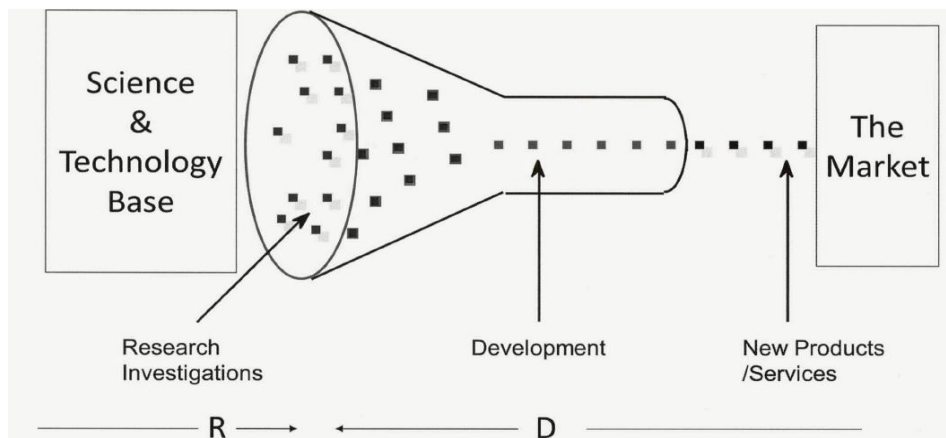Figure 1. **The Closed Innovation Model**
Source: **Chesbrough (2012, p.22)**

However, against close innovation, OI is a process in which firm use both internal as well as EK to innovate. "OI is the use of purposive inflows and outflows of knowledge to accelerate internal innovation (II), and expand the markets for external use of innovation, respectively" (Chesbrough 2006, p.1). Transfer of technology can be achieved with the help of missing knowledge from outside of the firm and the knowledge of the employees within the firm like expertise of the employees and it can approach to the market with different ways: venturing, outsourcing, with the help of company own channels, joint ventures etc. (Chesbrough, 2012).

According to the Chesbrough (2003), OI is the paradigm in which organization can and should use external and internal ideas, use external as well as internal path to the market. Further it can be explained as OI is the process in which internal knowledge as well external knowledge (EK) combine to create something new. Thus, OI is two-way procedure in which knowledge inter inside the boundaries of firm and exist from inside to outside.

Further it is defined as OI is the process in which internal knowledge and EK combine to create something new. This notion of "OI" was first proposed by the Chesbrough (2003) and has rapidly gained the attention of researchers as well as practitioners, illustrated by many special issue publications and dedicated conferences and a quickly increasing body of literature. OI procedure is shown in Figure 2.
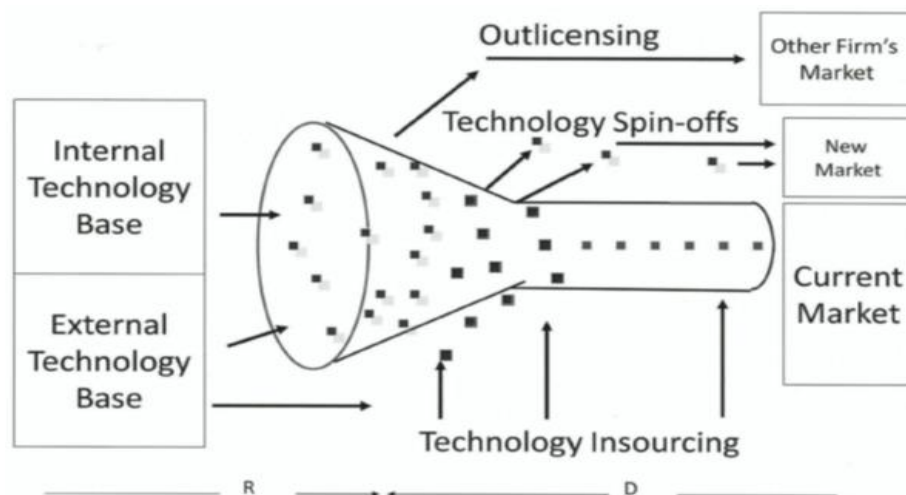

Figure 2. **The Open Innovation Model**
Source: **Chesbrough (2012, p.23)**

Recently, various studies (see, for instance, Bogers, Chesbrough, & Moedas, 2018; Bogers et al., 2017; Cassiman, & Valentini, 2016; Chesbrough, 2017; Von Krogh, Netland, & Wörter, 2018) discussed the phenomenon of OI, however, these studies missing with the role of knowledge management (KM), particularly in SMEs. As the SMEs are backbone of every nation's economy. However, Pakistani SMEs are lacking with OI activities which effects adversely on performance.

Low performance in OI is based on various challenges such as maximization of II and EK incorporation. Maximization of II and EK incorporation ae basically the major challenges of OI (West & Gallagher, 2006). However, these issues can be handled through proper KM practices. As the KM has a significant effect on firm's innovation activities (Antonelli, 1999; Carneiro, 2000; Dove, 1999; Nonaka & Takeuchi, 1995).

This study is focused on the SMEs working in Bahawalpur district, Pakistan. None of the study formally carried out the research on this area. That is the reason focus of current stud is SMEs in Bahawalpur district, Pakistan. Moreover, in rare cases any study formally documented the role of KM in OI. Thus, the objective of this study is to investigate the role of EK and II through effective KM.

2. Hypotheses Development

2.1 Incorporation of External Knowledge and Firm's Open Innovation Performance

A key barrier to open innovation is the unwillingness of employees towards extra-organizational knowledge acquisition (Chesbrough, 2006). Negative attitude of employees towards commercialization of knowledge (i.e. not-sold-here syndrome) and external knowledge utilization (i.e. not-invented-here syndrome) cause resistance in establishing these activities. The author explains that the resistance among employees in integrating external knowledge has become a key challenge in promoting open innovation. Open innovation refers to the process of combining external and internal knowledge to create something new. It is thus evident that integrating external knowledge positively relates to open innovation, however, the above-mentioned arguments suggest that open innovation process won't be completed unless external knowledge reaches inside the organizational boundaries (Pollok, Lüttgens, & Piller, 2018). Therefore, integrating external knowledge is a major issue in operationalizing open innovation. Utilizing external knowledge in an effective manner would result in yielding higher levels of open innovation performance among SMEs in Malaysia.

If a firm is incapable of sorting out relevant knowledge and incorporate only useful knowledge then external knowledge may not yield benefits to the organization (West & Gallagher, 2006). According to López-Nicolás and Meroño-Cerdán (2011), coordination problem exists when knowledge and ideas exist outside the organizational boundaries. Meanwhile, external knowledge integration can also be extended beyond the organizational activities, for instance, selecting knowledge and ideas for the innovation process, and identifying ideas etc. However, this may involve certain problems, such as, problem of networking, divergence and searching for valuable ideas. The primary issue of open innovation is searching for knowledge and ideas to bring about technological development. Contrarily, coordination incurs cost, since multiple suppliers combine and collaborate to operationalize open innovation process. The solution to this can be the effective absorption of knowledge and resolving several open innovation problems may enhance the performance of open innovation system.

EK is an imperious force to expediate OI activities. EK is the knowledge outside the boundaries of firm. This knowledge is generally based on the information as well as ideas from the suppliers, customers, external partners and any other stakeholders (Chesbrough, 2003). Management of this knowledge is most crucial in any firm. EK generally available in huge information's, that is the reason it is very difficult to sort out most important ideas and to incorporate inside the boundaries of the firm. Therefore, in this sense, KM has key role. Improper knowledge managed lead towards misutilization of resources.

EK cannot provide any benefit to the firm if the firm cannot sort out the related knowledge and cannot incorporate in the innovation activities of the firm (West & Gallagher, 2006). Coordination problem is a problem in which ideas as well as knowledge lie outside the boundaries of the firm (Rodríguez & Lorenzo, 2011). According to the author, coordination or incorporation of EK is not limited to the mechanism among activities of organization but it also includes idea searching, idea selection and various knowledge to carry out innovation process. Therefore, it includes; problem of searching of valuable ideas, networking problem and problem of divergence. Moreover, it is also explained by Rodríguez and Lorenzo (2011) that external source of idea searching and knowledge to make better technological development is very first problem of OI but on the other hand coordination requires cost because it needs corporation of

numerous suppliers (Almirall & Casadesus-Masanell, 2010). However, in all this process KM is key. Therefore, the better incorporation of EK is a solution if different OI problems and it improves the performance of OI system.

H-1: There is a significant positive relationship between incorporation of EK and firm's OI performance.

2.2 Maximization of Internal Innovation and Firm's Open Innovation Performance

The basic concern in this regard is the efficient use of development capabilities and internal research to achieve maximum benefit (Kapetaniou & Lee, 2019; West & Gallagher, 2006). Thus, feeding a company's product line is barely sufficient to obtain considerable benefits out of internal innovation, therefore, a wide range of approaches are needed in this regard. In addition, focusing mainly on product quantity and creating more products to meet market demand will less likely to ensure maximum benefits, thus, the need of this hour is to introduce methods for enhancing open innovation system and promoting internal knowledge, which seems to be a significant challenge. Previously, some industries emphasized upon internal innovation, while other emphasized on co-innovation process. Although, internal innovation can also be enhanced by venturing in SME's. According to the author, venturing refers to 'a process of launching a new organization based on internal knowledge', it also includes, obtaining support from parent institution in terms of human capital, finance, administration and valuable advice, as well as the spin-off and spin-out processes. Thus, it can be concluded that maximizing open innovation brings about improvement in the open innovation system, particularly in terms of venturing. Furthermore, venturing activities encompass extensive market activities, such as, combining the market value for all new ventures would likely be higher than their respective parent organization. It is thus evident that open innovation system can be improved by maximizing internal innovation i.e. if there is an increase in internal innovation, then open innovation system will likely to improve. In this regard, communication is a key factor in enhancing innovation among employees. Therefore, both inside and outside innovations significantly contribute to enhance employee innovation. Besides, new and innovative ideas generate only when effective communication and sharing occurs between employees. It thus explains why communication is beneficial for employees' innovation. Furthermore, different channels and strategies can be used by leaders to stimulate internal communication between the organizational employees. Cross-department meetings is an effective strategy which enables creative thinking and enhance communication between departments and employees. Besides, these meetings bring employees together to share ideas; another strategy is the informal lunch sessions in which all employees are gathered to enjoy lunch as well as communicate and share views regarding certain issues. A meeting held by chief creative officer is another significant strategy to formally discuss ideas with all the employees and take opinion from each employee one by one and then choose the best idea for further implementation. Unstructured meetings can also be used as a strategy to encourage employees. Such strategies of arranging informal meetings also incur additional cost to the organization. Although communication provides benefits to organization but it is an expensive process.

Communication is one of the key factors to increase employee innovation, both outside as well as inside communication is important for employee innovation (De Jong & Den Hartog, 2007). Furthermore, ideas only generate when employee's communication with each other and share their ideas with each other. That is why communication among employees of firm is much beneficial for innovation. However, management of knowledge/ideas from formal as well as information discussion/communication is most important.

Leaders can enhance internal communication among employees by using different strategies as well as different channels (Kengchon, 2012). According to the author strategies which increase communication among employees and generate creative thinking are "cross-department meeting" in which different department employees meet with each other and share their ideas, "informal lunch sessions hosted by a named" in which employees gather on lunch and share their views with complete freedom, "chief creative officer," in which chief creative officer of the company announces a meeting in which all employees take part and formally discuss all ideas one by one, and best idea chose to implement. The other strategy includes unstructured meetings which encourage employees to bring new ideas.

H-2: There is a significant positive relationship between maximization of II and firm's OI performance.

2.3 Knowledge Management as Mediating Variable

Additionally, according to the Zabala Martinez (2009), technological knowledge is not enough to gain competitive advantage, but it comes from EK incorporation. In this sense, EK incorporation is one

of the significant elements of OI. Moreover, Almirall and Casadesus-Masanell (2010) described that divergence is another problem related to coordination. Author argues that some selections which could have been made by the original designer are now undertaken by the different independent firms for their own interest due to the openness of system for the supplier and this loses the control of original designer but restraining of this freedom is much costly. Thus, the KM to such a way to keep in secret is also important in OI. In this way supplier and complementor maximize their own interest as compared to the interest of original designer. Hence, it can be further explained that better incorporation of EK through effective KM can resolve divergence. That is why; incorporation of EK is positively related to OI system and improves the OI system with the help of effective KM.

Furthermore, incorporation of EK leads towards higher performance in II. IIs are based on the innovation inside the boundaries of the firm. Both EK as well as internal knowledge/innovation the primary elements of OI system. How to best use internal research and development capabilities to gain maximum advantage is the central concern of OI (West & Gallagher, 2006). Like EK, II also requires communication among the employees of firm. This communication come up with valuable ideas.

Hence, form the above discussion, it is evident that both EK and internal knowledge or II are key to OI success. However, KM plays a mediating role to enhance the positive effect of EK and II. As in OI, KM is based on the effective use of information's to generate valuable ideas to leave the unproductive information's are ideas. Moreover, it is mentioned by various studies (Carneiro, 2000; Dove, 1999) that KM has positively linked with innovation activities.

H-3: There is a significant positive relationship between incorporation of EK and KM.

H-4: There is a significant positive relationship between maximization of II and KM.

H-5: There is a significant positive relationship between KM and firm's OI performance.

H-6: KM mediates the relationship between incorporation of EK and firm's OI performance.

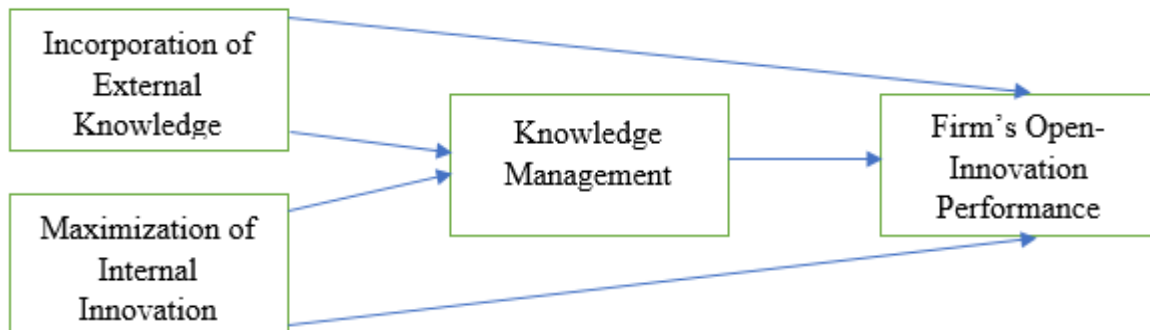**H-7:** KM mediates the relationship between maximization of II and firm's OI performance.

Figure 3. **Theoretical Framework**

3. Research Method

The current study is based on the SMEs working in Bahawalpur district, Pakistan. Managerial staff of these SMEs were selected as the respondents of this study. Only those managerial employees are selected having direct involvement in OI process. As the research methodology is one of the crucial steps which should be accordance with the problem and objectives of study (Hameed et al., 2017; Basheer et al, 2018; Hafeez et al., 2018; Muneer et al., 2019) that is the reason this study followed quantitative research and cross-sectional research design.

Convenience sampling technique was used to collect the data from SMEs located in Bahawalpur district, Pakistan. Data were collected by using 5-point Likert scale. Questionnaires were distributed through self-visit to the SMEs. First of all, the objectives of the study and questionnaire was explained to the respondents which assist respondents to fill questionnaire without any hesitation.

Moreover, Comrey and Lee (1992) provide sample in a series for inferential statistics. "Sample having less than 50 participants will observed to be a weaker sample; sample of 100 size will be weak; 200 will be adequate; sample of 300 will be considered as good; 500 very good whereas 1000 will be excellent." Thus, 300 sample size was selected for this study.

Furthermore, all the measures were adapted from previous studies. Scale items are shown in Table 1. Independent variable namely; EK was measured through 06 items. Other independent variable namely; II was measured through 05 items and mediating variable namely; KM was measured by using 05 items. However, dependent variable firm's OI performance was measured through 07 items.

4. Analysis and Findings

Two major steps were performed to analyze the data. First of all, measurement model assessed through factor loadings, Cronbach alpha, composite reliability (CR), average variance extracted (AVE), convergent validity and discriminant validity. Figure 4 shows the measurement model assessment and results are shown in Table 1. It is evident that Cronbach alpha and composite reliability both are more than satisfactory level 0.7. Factor loading is also more than 0.7. AVE achieved the convergent validity as AVE value is more than 0.5. Moreover, discriminant validity is shown in Table 2 which attained the external consistency. However, the second step of analysis was based on structural or inner model assessment which is shown in Figure 4.
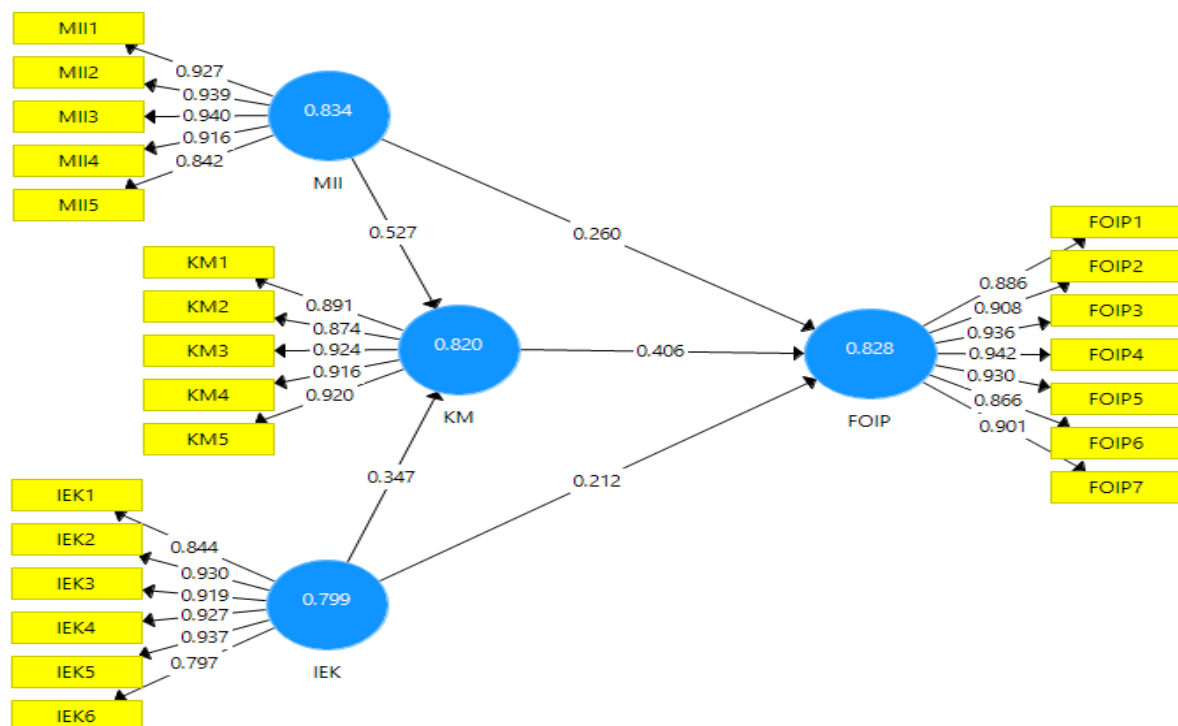

Figure 4. **Measurement Model Assessment**

Table1: **Factor loadings, Cronbach Alpha, CR, Average Variance Extracted (AVE)**

Construct		Indicators	Loadings	α	CR	AVE
Incorporation of EK (IEK)	1.	"Bringing of EK to internal system enhance OI system.	.844	.949	.960	.799
	2.	Our organization encourage employees to initiate new external collaboration practices.	.930			
	3.	Collaboration with external partners adds value to our innovation resources.	.919			
	4.	Collaboration with external partners/suppliers or customers adds value to our innovation activities.	.927			
	5.	Collaboration with external partners add value to customer relations.	.937			
	6.	Just extending the external relations with customers and suppliers are beneficial for innovation."	.797			
Maximization of II (MII)	1.	"Internal ideas are always welcomed in our organization.	.927	.950	.962	.834
	2.	Communication between partners occurs without problems.	.939			
	3.	Sufficient non-financial resources are available in our organization to achieve desired II.	.940			
	4.	Carrying out OI activities requires an internal R & D activity.	.916			
	5.	Degree of knowledge which is shared between me and my partners is sufficient to promote II."	.842			
KM (KM)	1.	"My organization has mechanisms for creating and acquiring knowledge from different sources.	.891	.945	.958	.820
	2.	My organization encourages and has processes for the exchange of ideas and knowledge between individuals and groups.	.874			
	3.	My organization rewards employees for new ideas and knowledge.	.924			
	4.	My organization does not document employee's ideas for further development.	.916			
	5.	My organization has mechanisms in place to absorb and transfer knowledge from employees."	.920			
Firm's OI Performance (FOIP)	1.	"I choose to engage in OI model, believed that it is a way to commercialize the idea.	.886	.965	.971	.828
	2.	Collaboration efforts with a number of individuals outside the organization to work on a project for mutual gain are the best description of OI.	.908			
	3.	I choose to engage in OI model believe that outsourcing of expertise would benefit.	.936			
	4.	New ideas are always welcomed for OI in our organization.	.942			
	5.	In my opinion, out-or-in licensing of intellectual property is the best description of OI.	.930			
	6.	In my opinion sharing of internal and EK enhances the OI.	.866			
	7.	In my opinion licensing of latest ideas promotes OI."	.901			

Table 2: **Discriminant Validity**

	FOIP	IEK	KM	MII
FOIP	**0.910**			
IEK	0.744	**0.894**		
KM	0.783	0.782	**0.905**	
MII	0.765	0.827	0.814	**0.913**

The results of direct effect are shown in Table 3 and Figure 5. It is evident that all the direct relationships have t-value more than 1.96. It indicates that all the direct hypotheses (H1, H2, H3, H4, H5) are accepted. It means that II and EK has significant positive relationship with OI. Increase in II and EK will automatically enhance OI in SMEs. These findings are in line with West and Gallagher (2006). Moreover, II and EK has also significant positive relationship with KM. In line with these results, KM is also positively associated with OI. Furthermore, the effective KM will enhance OI and vice versa. Moreover, effect size (f2) and R2 are also shown in Table 3. KM has moderate f2, however, all other has small f2 on firm's OI performance (Cohen, 1988). R2 shows that all the latent variables are expected to explain 67.4% variance in firm's OI performance. This variance is substantial (Chin, 1998).
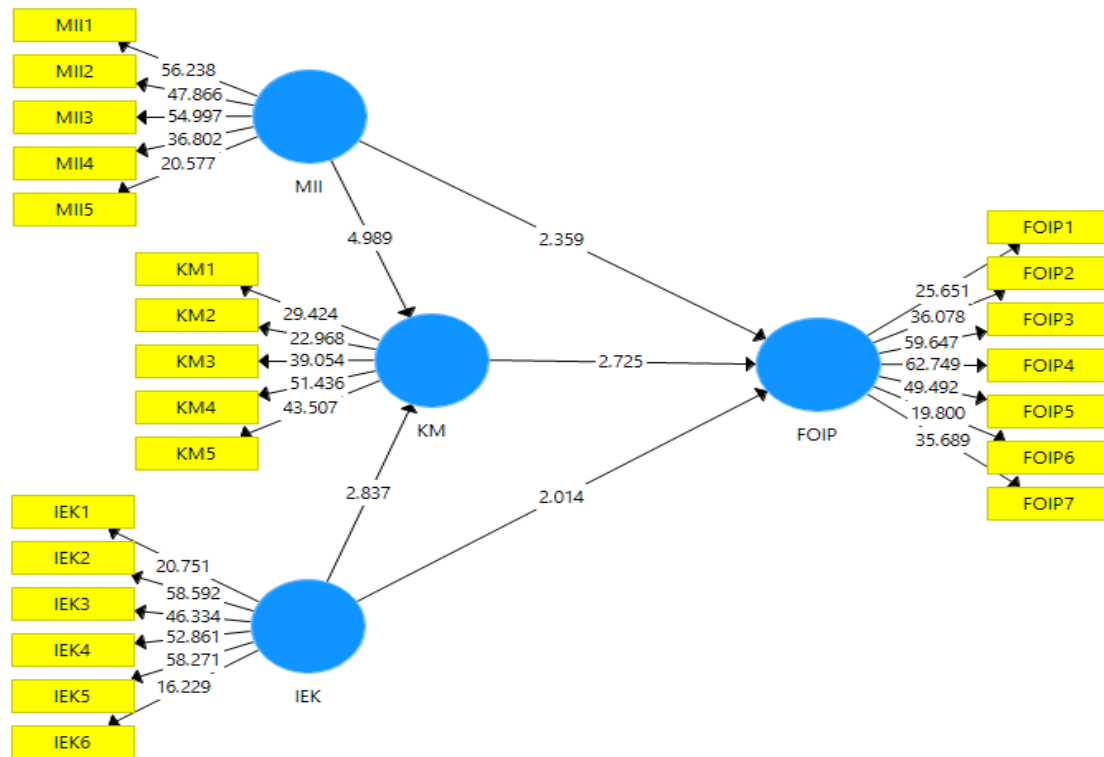

Figure 5. **Inner Model Assessment**

Table 3: **Direct Effect**

		β	M	SD	T Statistics	P Values	f²	R²	Decision
H₁	IEK -> FOIP	0.212	0.219	0.105	2.014	0.045	0.039	0.674	Accepted
H₃	IEK -> KM	0.347	0.348	0.122	2.887	0.005	0.127		Accepted
H₅	KM -> FOIP	0.406	0.399	0.149	2.725	0.007	0.152		Accepted
H₂	MII -> FOIP	0.260	0.261	0.110	2.359	0.019	0.051		Accepted
H₄	MII -> KM	0.527	0.527	0.106	4.989	0.000	0.293		Accepted

Indirect effect by using KM is shown in Table 0. In case of incorporation of EK (IEK) the t-value is 2.234. Moreover, in case of maximization of II, t-value is 1.960. In both case t-value is significant. Thus, mediation effect is significant. Hence, KM is one of the mediating variables which increase the effect of EK and IIs on OI. Below Table 0 shoes the predictive relevance (Q2). The quality of model is achieved as the Q2 is more than zero (Henseler, Ringle & Sinkovics, 2009).

Table 4. **Mediation Effect**

		β	M	SD	T Statistics	P Values	Decision
H-6	IEK -> KM -> FOIP	0.141	0.136	0.063	2.234	0.026	Mediation
H-7	MII -> KM -> FOIP	0.214	0.213	0.109	1.960	0.050	Mediation

Table 4. **Predictive Relevance (Q2)**

Total	SSO	SSE	$Q^2 = (1-SSE/SSO)$
Firm's OI Performance (FOIP)	553.000	267.047	0.517

5. Conclusion

The current study carried out to explore the effect of EK incorporation and maximization of II on firm's OI performance. This study focused on SMEs in Bahawalpur district of Pakistan. Data were collected from the managerial staff of SMEs. Only those employees were selected having direct participation in OI activities. During the study, it is revealed that both external as well as internal knowledge has a key contribution to enhance OI. II is vital to get benefit from external ideas. Both are the mandatory elements of OI system. To take maximum benefit from EK and II, effective KM is most crucial. KM has important role to sort out different ideas and to incorporate inside the boundaries of the firm. Thus, to get maximum benefit from EK and II, KM is most important factor.

5.1 Implications of the Study

5.1.1 Theoretical Implications

The current study has several implications for the literature. First, the relationship between EK incorporation, maximization of II, KM and firm's OI performance has vital role in the literature. Because this is the unique relationship which is examined by the current study. This relationship contributed significantly to the literature of OI and SMEs. Second, this is the pioneer study which examined the firm's OI performance in Pakistan SMEs. Actually, the firm's OI practices are very rare in the SMEs. Particularly, firm's OI is addressed in relation to the EK incorporation and maximization of II which is rarely addressed among Pakistan SMEs. Third, previous scholars have not addressed the firm's OI performance which is one of the unique variables and investigated in relation to the KM. Fourth, the current study is one of the pioneer studies which examined the mediating role of KM between EK incorporation and firm's OI performance. Moreover, the mediating role of KM was also examined between maximization of II and firm's OI performance.

5.1.2 Practical Implications

Theoretical implication of the current study further leads to the valuable practical implications. The relationship between EK incorporation and maximization of II, KM and firm's OI performance has several implications for the practitioners and SMEs. First, this study highlighted the EK incorporation has major role to enhance firm's OI performance. Therefore, management of SMEs can enhance the firm's OI performance by promoting EK incorporation. Second, the management of SMEs can increase the firm's OI performance with the help of II, as this study proved that maximization of II has vital role to promote firm's OI performance. Third, management of SMEs can promote KM practices by encourages the practices of EK incorporation and maximization of II. It is quite helpful for SMEs performance because KM is the key indicator of better performance. Fourth, the most important implication of the current study is connected with KM. As this study proved that KM is the key factor which has major role in firm's OI performance, more importantly, KM is the major factor which is helpful for the SMEs to promote firm's OI performance by supporting the positive role of EK incorporation and maximization of II.

6. Limitations and Future Directions

Although the current study has covered the major areas in relation to the OI and SMEs, however, the study has few limitations which could be the future directions. First, the major limitation of the current study is that; it is really tough for the SMEs to adopt OI practices. Because OI require research and development (R & D) department which is one of the most expensive process and SMEs cannot afford. Therefore, due to financial problem, the OI practices are very rare in SMEs. On the other hand, the current study covered all SMEs in Pakistan. Hence, future studies should be carried out only those SMEs which are already involved in OI. It will provide the better results in relation to the EK, II, KM and firm's OI performance. Second, this study only included EK and II, however, intellectual property management is one of the most important part of OI to protect the ideas. Future studies should also include intellectual property management in addition to the current model. Third, as the SMEs are facing financial constraint while adopting OI,

therefore, financial constraint could be used as control variable in the current model.

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