KNOWLEDGE MANAGEMENT INFRASTRUCTURE AND INNOVATION: INDIRECT EFFECTS OF KNOWLEDGE MANAGEMENT CAPABILITIES AND RESOURCE COMMITMENT

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ABSTRACT:
The knowledge management (KM) is emerging as one of the rising issues and prominent phenomenon in higher education sector of Pakistan. This study aims to examine the effect of knowledge management infrastructure (KMI) on innovation (INN), using mediating and moderating approach in education sector of Pakistan. Present study used convenience sampling technique with a sample size of 235 faculty members. Data was collected through questionnaire and analyzed through Structural Equation Modelling (SEM) technique using Smart PLS software. Findings of this study indicate that KMI has a significant positive relationship with KMC and INN. Moreover, mediation role of KMC on relationship between of KMI and INN and moderation role of resource commitment (RC) on the relationship existing between KMI and KMC were also supported by the results. Findings of this study empirically contributes to the existing KM literature by investigating the actual role of KMI & RC, by reporting high influence of KMI on INN in higher education institutions and by providing valuable insights to establish the strong KMI in order to enhance innovation processes

INTRODUCTION

KM is considered as an important factor that needs to be explored in present era, the era of globalization (Shah, Rizvi, & Jumani, 2019) as it effectively summarizes complex expressions with the intention to obtain successful results in higher educational institutes as well as to be recognized as an important system that successfully enhances their performance innovation, specifically in the context of Pakistan (Jamil & Lodhi, 2015). Implications of KM process entails global applicability such as in Spain (Muñoz-Pascual & Galende, 2017) Malaysia (Lau, McLean, Hsu, & Lien, 2017) and Jordan (Masa'deh, Shannak, Maqableh, & Tarhini, 2017). Organizations today understand that by focusing on KM, firms can succeed business competition against their competitors as system under reference successfully create, acquire, disseminate and store useful knowledge which enables them to achieve long term economic

advantages (Á. Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2014; Jamil & Lodhi, 2015).

Another distinguishing and distinctive feature of KM is that it is designed as one of the major strategies used by various industries to achieve superior performance (Gunasekaran & Ngai, 2007; Shannak, 2010) and encourage the organizations to develop unique KMC because these abilities effectively handle and organize special knowledge from different business units to enhance innovation process (Andreeva & Kianto, 2012; Masa'deh *et al.,* 2014; Obeidat & Abdallah, 2014). It has also been found as one of the significant contributors to the improved and enhanced performance of higher educational institutes by managing and combining the special knowledge through transmitting knowledge from organization to individuals and from individuals to the organization in educational sector (Fidalgo-Blanco *et al.,* 2015).

KM process supports organizations in difficult times and makes them confident to face various challenges in terms of acquiring, sharing and storing the employees' knowledge (Bisharat *et al.,* 2017; Hamoud *et al.,* 2016; Lee *et al.,* 2013). Thus, this study used KM approaches specifically in education sector of Pakistan as there is a dire need to establish proper KM infrastructure in education industry of Pakistan, to increase the efficiency and effectiveness of education through successfully utilizing employees' knowledge (Shah *et al.,* 2019).

Present study also assumes RC as strong moderator that strengthens the relationship of KMI with KMC (Mao *et al.,* 2016) as high level of RC towards IT resources and improved efficiency of KM process provides valuable contributions to increase knowledge management capabilities (Chen & Chang, 2012; Rusly *et al.,* 2014; Amayah, 2013). Therefore, this study measures RC as an integral part of KM process to achieve long term targets (Lai *et al.,* 2008) and determines that there is a need to explore RC in education sector of Pakistan in order to meet international educational standards. Furthermore, importance of RC in this context is inevitable as it plays a crucial role for consumption of the employees' knowledge, providing a platform for the successful and effective beginning of new and specialized programs and courses (Abbas *et al.,* 2017).

LITERATURE REVIEW

KMI and KMC
KM being an important technique improves and enhances the efficiency of an organization by effectively creating and managing employees knowledge from different business units (Vorakulpipat & Rezgui, 2008). Numerous researchers concluded that KM is an important factor that supports organizations to achieve long term economic advantages through efficiently utilizing employee's knowledge (Bisharat *et al.,* 2017; Hamoud *et al.,* 2016; Lee *et al.,* 2013). There are two important dimensions of KM i.e. IT based knowledge infrastructure (KM-IT) and organizational based infrastructure (KMI-OB) effecting different organizational features such as organizational creativity, learning, competitive advantages and innovation (Mao *et al.,* 2016).

IT human resource, IT resource and IT relationship resource are the main types of KMIT. IT human resource represents managerial and technical skills, IT resource symbolizes those resources that provide technological foundation and

IT relationship resource indicate those IT resources which though belong to different business units yet support an organization to share risk (Mao *et al.,* 2016). Whereas, KM organizational base infrastructure (KMI-OB) consists of culture, structure, technology and human resource that provides appropriate environment to an organization for achieving goals (Singh & Kumar, 2017). According to Teece (1998) knowledge management organizational base infrastructure (KMI-OB) assists an organization to improve their core competence because the key dimensions of organization culture and structure effectively manage employees' knowledge (Peachey, 2006).

In view of the characteristics of knowledge management-IT base infrastructure, this study found KMI as an essential factor in KM process that positively increases KMC and innovation process of the education sector. Research found knowledge management process to play an important role in the service sector (Rašula *et al.,* 2012; Wong *et al.,* 2015). According to previous researches, KM has a positive impact on KMC in sectors such as power, IT and finance (Mao *et al.,* 2016) and similar findings were previously reported by a study of comparison between two medical centers (Mills & Smith, 2011). Thus, in support of the literature presented above the present study tests the hypothesis as under:

H₁: KMI is significantly related to KMC

KMI and INN
KM system supports the organizations during the difficult times and makes them resilient to face various challenges in terms of acquiring, sharing and storing the employees knowledge (Bisharat *et al.,* 2017; Hamoud *et al.,* 2016; Lee *et al.,* 2013). As a significant predictor for improving the performance of higher educational institutes, KM permits organizations to manage and combine the special knowledge (Fidalgo-Blanco *et al.,* 2014) through transmitting knowledge from organization to individuals and from individuals to the organization in educational sector (Fidalgo-Blanco *et al.,* 2015). Past studies have also extensively acknowledged the relationship of knowledge and innovation (Chen *et al.,* 2017) and its positive impact on organizational effectiveness and cooperative and innovative performance (Chen & Huang, 2009). To be innovate, organizations need to develop new knowledge utilizing resources as a practical way for introducing new products and service (Urgal *et al.,* 2013). KM in the past studies, mostly remained confined to manufacturing and banking sectors only, however KM and its implications are also effective in education sector too (Lee & Choi, 2003; Lee & Sukoco, 2007; Soon & Zainol, 2011). Innovation process involves identification of problem, finding solution by generating of new ideas with the assistance and coalition of sponsors, implementing the novel ideas and devoting their attention toward identifying and applying novel ideas with the purpose to increase organizational performance (Scott & Bruce, 1994). Thus the present study hypothesizes that:

H₂: KMI is significantly related to INN

KMC and INN
Tanriverdi (2005) described that KMC to be an important source for gaining competitive advantage over their rivals as it is one of the complementary elements that informs an organization about product knowledge (Chuang, 2004). Moreover it enhances organizational capacity through utilization of different knowledge resources among individuals and removing all barriers

which create problems during knowledge sharing process (Chen *et al.,* 2014; Melville *et al.,* 2004). Previous studies found positive effect of KMC on INN as it effectively enhanced competence of KM that helped the organizations to introduce innovative products and services in the market (Gold *et al.,* 2001; Rašula *et al.,* 2012; Zaied, 2012). This in turn enhanced organizational capacity by utilizing different knowledge resources among individuals and removed all barriers which create problems during innovation process (Chen *et al.,* 2014; Melville *et al.,* 2004). As innovation is multi-dimensional process, it brings newness to existing product and service and supports an organization to create dominancy upon its opponents (Ortt & van der Duin, 2008). So, this study has aims to investigate hypothesis as under:

H_3:   *KMC has significance impact on INN*

Mediation Role of KMC between KMI and INN
Implications of knowledge management infrastructure are widely applicable in various domains all around the world as revealed in recent studies e.g. Spain (Muñoz-Pascual & Galende, 2017) Malaysia (Lau *et al.,* 2017) and Jordan (Masa'deh *et al.,* 2017). As organization understand that through focusing on KMI, firms can succeed in business competition against their competitors because the system under reference successfully creates, acquires, disseminates and stores useful knowledge in order to achieve long term economic advantages (Fidalgo-Blanco *et al.,* 2014; Jamil & Lodhi, 2015). However, KMC refers to the ability of an organization to acquire special knowledge from different business units and engage critical knowledge with knowledge management process to achieve long term goals (Lee & Choi, 2003; Tanriverdi, 2005). Organizations are eagerly willing to deal with KMC (Singh *et al.,* 2006) because they understand that without utilizing the knowledge management capabilities they can possibly get negative returns in form of financial losses (Tanriverdi, 2005).Therefore, there is a need to conduct an examination of the interventions between independent and dependent variables to estimate the usefulness of mediating factors. So the current study attempts to investigate and validate the mediating role of KMC between KMI and innovation by testing the following hypothesis:

H_4:   *KMC significantly mediates between KMI and INN*

Moderation Role of RC over KMI and KMC
Knowledge management needs resource commitment (RC) as it is a crucial part for establishing and efficiently utilizing the knowledge management capabilities (Tseng, 2008). In addition, RC has an important role as it is positively related to KMC particularly in the process of innovation which consequently positively enhances the process of knowledge sharing (Joshi *et al.,* 2010). Moreover, resource commitment is the process that allocates both tangible and intangible resources in order to achieve maximum output and assists an organization to design its operative knowledge management plan (Li, 2014; Mao *et al.,* 2016). The same has also been endorsed by Ying Lu & Ramamurthy 2011) and they further proposed that through spending capital on IT resources, organization can build up their unique abilities which make them capable to cope with the market changes. In view of the above, present study assumed that:

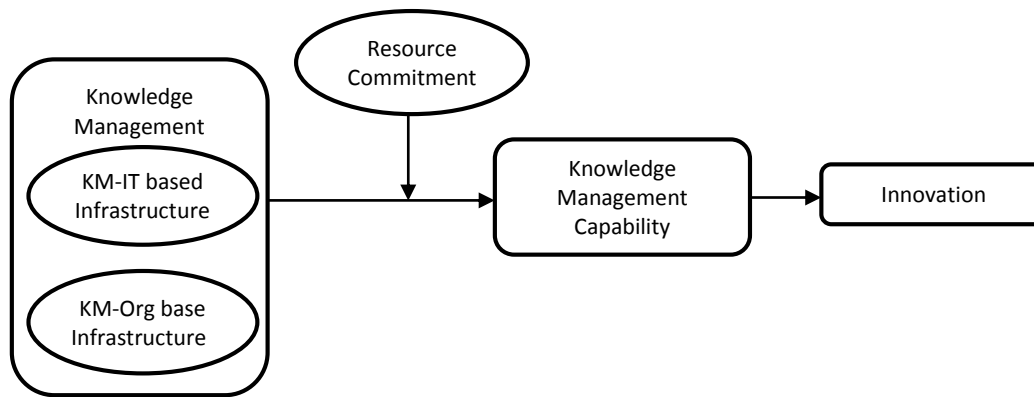*H_5:*   *RC moderates between KMI and KMC*

Figure 1. Research frame work of the present study

METHODOLOGY

Educational institutes play vital role in both economic and social development of a country and generate innovative ideas by focusing on research initiatives and activities. University stakeholders can achieve educational as well as organizational objectives by implementing the KM strategies and practices (Arouet, 2009). This calls for a need to make such sustainable and innovative education policies that not only effectively meets future educational needs of Pakistan (Abbas *et al.,* 2017) but also provide means to measure the effects of KMI on INN via adopting the moderator and mediating approaches of RC and KMC respectively. In this regard, collecting data through questionnaires is an excellent method for primarily data collection in a survey base study (Raacke & Raacke, 2012).

Population, Sample and Data Collection

This study focused the academic staff in universities as target population from a sample of private sector universities located in capital and suburbs, in Pakistan. The hypothesized relationships is analyzed using survey based questionnaire for data collection. Total number of 285 questionnaires were circulated through convenience sampling technique for data collection, however, 242 questionnaires were filled and returned, reporting 85 percent respondent rate. Out of the 285 questionnaires, 7 questionnaires were incomplete or invalid and finally 235 questionnaires were found suitable for statistical analysis which happens to be adequate and enough for use of Structural Equation Model (SEM) to investigate the complex path model.

Measures

In the present study, all 43 measurements items were adopted from existing research though slightly modified in terms of grammar and sentence structure so as to be deemed suitable and understandable to meet the needs of respondents in a university context. Five-point Likert scale questionnaire employed varying from "1" meaning "strongly disagree" to "5" meaning "strongly agree." Sources of measurement instruments are enlisted in Table I.

Table 1. Research Instrument

Factors	Items	Source
Knowledge Management Infrastructure		
KMI-IT	13	*(Lu & Ram, 2011; Bhatt & Grover, 2005)*
KMI-OB	12	*(Hung et al., 2015)*

Knowledge Management Capabilities	6	*Pérez-López & Alegre, 2012)*
Resource Commitment	3	*(Lai et al., 2008)*
Innovation	9	*(Obeidat et al., 2016)*

Data Analysis Procedure

This study follows cross-sectional research design and is quantitative in nature. Structural Equation Modeling (PLS-SEM) technique is used for evaluating the data as PLS-SEM is one of the most widely used analysis tool in management studies renowned for effectively handling small sample sizes (Hair *et al.,* 2014). Moreover, this technique is considered most appropriate for research aiming to test existing theories (Ringle *et al.,* 2018). PLS-SEM entails two stages of data analysis i.e. measurement and structural model. Measurement model is based on constructs having good indicators loading. Composite reliability, convergent and discriminant validity will be used in structural model and structural model evaluated path coefficients of variables and tested the significance through bootstrapping technique (Ringle *et al.,* 2018; Wong, 2013). Most of the recent research studies in KM have also used the PLS-SEM for doing mediating analysis e.g. (Shujahat *et al.,* 2018; Valaei *et al.,* 2017; Wang *et al.,* 2016) as it involves a more rigorous procedure to test the underlying mediating effects (Hair *et al.,* 2013).

RESULTS

Assessment of Measurement Model

First step confirmed the reliability and validity of the items (Hair *et al.,* 2006). Initially, 43 indicators were included in model to observe indicator outer loading values before elimination of all items as mentioned in Table 2. Items or indicators with low factor loading identified during the data analyses were removed as shown in Table 3. However, as per the guidelines (Hair *et al.,* 2013), particular items were theoretically important and their removal had no the effect on average variance extracted (AVE) and CR were not eliminated.

Consequently, 39 items incorporated in final measurement model and factor loadings values of all the constructs are greater than the suggested value of 0.60 are enlisted in Table 4. Similarly, CR and AVE of all the constructs are equal or go beyond the recommended values of 0.50 and 0.70, as mentioned in Table 5. Thus, both reliability and convergent validity are established. Moreover, values of discriminant validity as indicated in Table 6, also found adequate as suggested by Fornell and Larcker (1981) and in view of the authentication of validity and reliability model of the present study is sufficient for structural valuation.

Table 2. Indicator Outer Loading (Before Elimination)

Variable	INN	KMC	KMIT	KMOB
INN-35	0.837			
INN-36	0.833			
INN-37	0.799			
INN-38	0.829			

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INN-39	0.918		
INN-40	0.644		
INN-41	0.661		
INN-42	0.651		
INN-43	0.653		
KMC-26		0.645	
KMC-27		0.810	
KMC-28		0.852	
KMC-29		0.779	
KMC-30		0.784	
KMC-31		0.800	
KMIT-01			0.031
KMIT-02			-0.028
KMIT-03			0.495
KMIT-04			0.548
KMIT-05			0.513
KMIT-06			0.634
KMIT-07			0.852
KMIT-08			0.859
KMIT-09			0.842
KMIT-10			0.789
KMIT-11			0.805
KMIT-12			0.921
KMIT-13			0.647
KMOB-14			0.808
KMOB-15			0.832
KMOB-16			0.776
KMOB-17			0.029
KMOB-18			0.702
KMOB-19			0.711
KMOB-20			0.823
KMOB-21			0.727
KMOB-22			0.591
KMOB-23			0.131
KMOB-24			0.697
KMOB-25			0.110
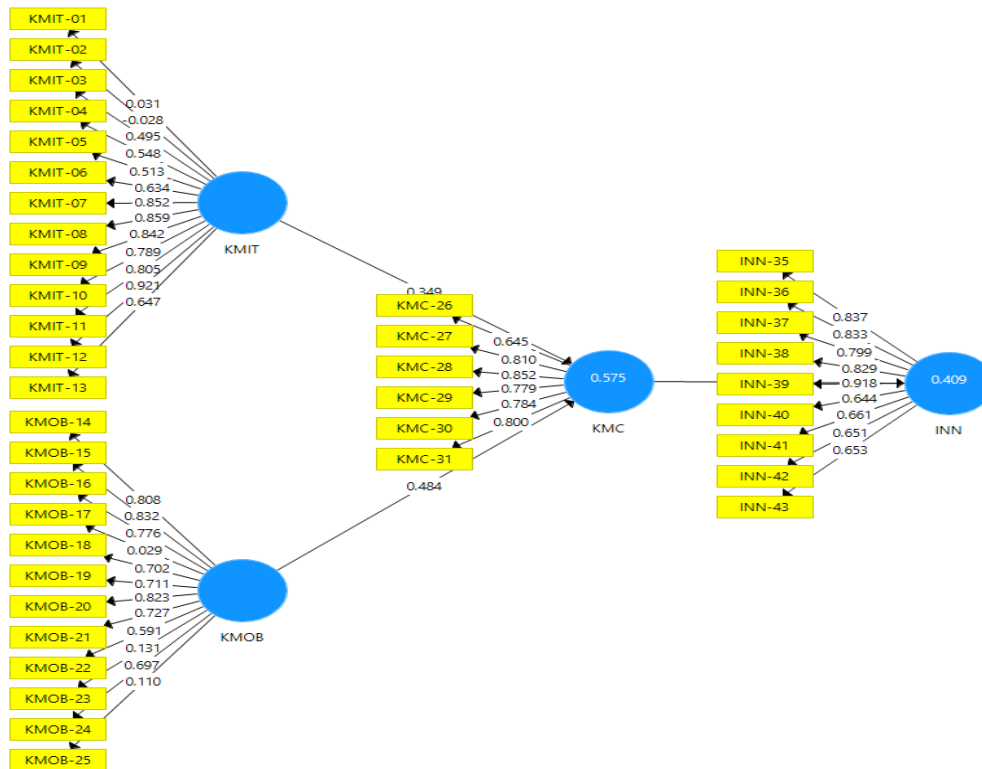
Figure No 2. Factor loading before elimination

Table 3. List of Eliminated Items

Items	Indicator Loading	AVE (before elimination)	Treatment	AVE (after elimination)
KMIT-1	0.030	0.456	*Eliminated*	0.540
KMIT-2	-0.028		*Eliminated*	
KMOB-17	0.029	0.418	*Eliminated*	0.504
KMOB-23	0.131		*Eliminated*	
KMOB-25	0.110		*Eliminated*	

Table 4. Indicator Outer Loading (After Elimination

Variables	INN	KMC	KMIT	KMOB
INN-35	0.837			
INN-36	0.833			
INN-37	0.799			
INN-38	0.829			
INN-39	0.918			
INN-40	0.644			
INN-41	0.661			
INN-42	0.651			
INN-43	0.653			
KMC-26		0.646		
KMC-27		0.810		
KMC-28		0.852		

KMC-29		0.780		
KMC-30		0.783		
KMC-31		0.800		
KMIT-03			0.504	
KMIT-04			0.548	
KMIT-05			0.520	
KMIT-06			0.635	
KMIT-07			0.853	
KMIT-08			0.858	
KMIT-09			0.845	
KMIT-10			0.788	
KMIT-11			0.805	
KMIT-12			0.921	
KMIT-13			0.650	
KMOB-14				0.810
KMOB-15				0.835
KMOB-16				0.781
KMOB-17				-0.027
KMOB-18				0.707
KMOB-19				0.708
KMOB-20				0.831
KMOB-21				0.730
KMOB-22				0.602
KMOB-24				0.697

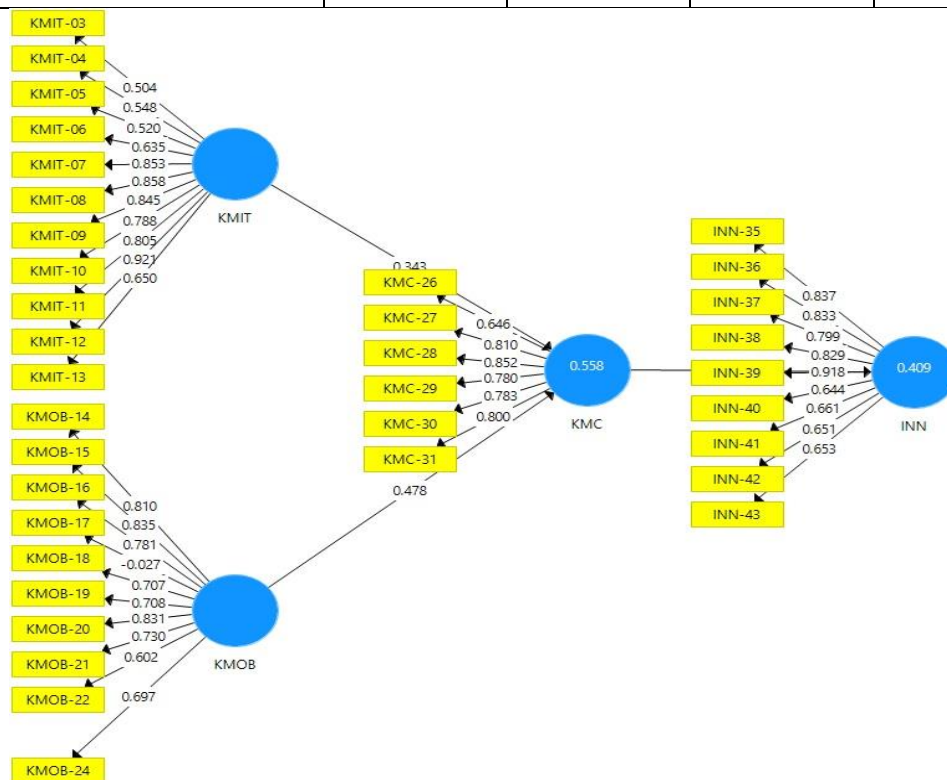**Figure 3**. Factor loading after elimination

Table 5. Composite Reliability (CR) & Average Variance Extracted (AVE)

Variable	CR	AVE
INN	0.926	0.585
KMC	0.903	0.610
KMIT	0.926	0.540
KMOB	0.900	0.504

Table 6. Discriminant Validity

Variables	INN	KMC	KMIT	KMOB
INN	0.765			
KMC	0.640	0.781		
KMIT	0.948	0.652	0.735	
KMOB	0.636	0.700	0.646	0.710

Structural Model Assessment

In this stage, analysis of structural model were performed after compulsory assessment of measurement model. In this model hypotheses were tested step by step. First step examined the direct effect of KM on KMC. Second, test direct effect of KM on INN. After that direct effect of KMC on INN was examined. Finally, effect of KM on INN was measured with the support of mediation role of KMC. In order to determine the significance of direct paths, bootstrapping method is used in this study.

According to Table 7, there is a significant positive effect of KM on KMC (β=0.743, t=21.186 and p=0.000), INN (β=0.909, t= 77.429, p=0.000). Therefore, H_1 and H_2 are supported. Similarly, there is significant positive and direct effect of KMCon INN (β=0.641, t= 14.585, p=0.000). Therefore, H_3 is accepted. In addition, Preacher and Hayes (2008) method applied to examine the mediation role of KMC between KM andinnovation. In this regard, tstatistics and p-values for evaluating the indirect effect were obtained through bootstrapping technique.Theresultsindicatethatthereissignificantindirect effect of KM on INN through the mediation of KMC (β=0.475, t= 9.508, p=0.000). This finding supports H_4.

Positive value (0.256) of moderating effect proved, RC positively strengthened the relationship of KMI and KMC that means increase in one unit standard deviation in RC, strengthen the relationship of KMI and KMC by 26 percent.

Table 7. Path Coefficients

Hypothesis	Relationship	*B*	t-Value	p-Value
H_1	*$KM^I \rightarrow KMC$*	0.743	21.186	0.000
H_2	*$KMI \rightarrow INN$*	0.909	77.429	0.000
H_3	*$KMC \rightarrow INN$*	0.641	14.585	0.000
H_4	*$KMI \rightarrow KMC \rightarrow INN$*	0.475	9.508	0.000
H_5	*$KMI \ \& \ RC \rightarrow KMC$*	0.256	2.822	0.005

Evaluation of Mediator
This study hypothesized mediation role of KMC between KM & INN (H$_4$). Mediating effect checked through indirect path effects between independent and dependent variables and evaluates significance of indirect effects by verifying the values of t-statistics, path coefficient and p value.
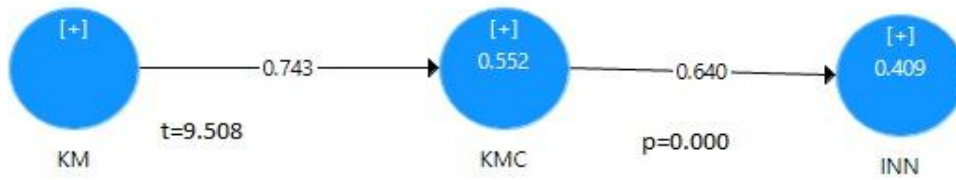

Figure 4. Mediating role of KMC between KM and INN

Preacher and Hayes (2008) method was applied to examine the mediation role of KMC between KM and innovation. In this regard, t statistics and p-values for evaluating the indirect effect were obtained through bootstrapping technique. The results indicate in Table 7, there is significant indirect effect of KM on INN through the mediation of KMC (β=0.475, t= 9.508, p=0.000), which supports the hypothesis H$_4$.

Assessment of Moderator
Present study hypothesized (H$_5$), moderation role of RC on the relationship between KM and KMC. Two stage approach was used that measures moderating effect of RC as it effectively measured continuous moderating effects among independent and dependent variables as continuous moderator variable effect relationship between two variables (independent & dependent) and changed the directions of the relationship as well (J. Hair, C. Ringle, & M. Sarstedt, 2013). Figure 5 show moderator model along with the value of variables (independent, dependent and moderator) that calculated by using two-stage approach in Smart PLS.
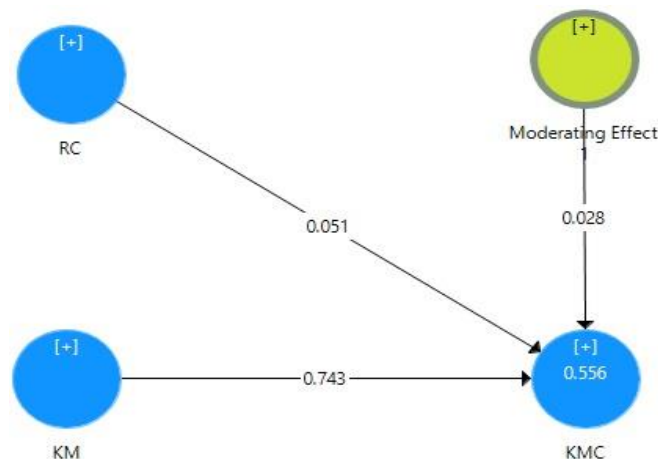

Figure 5. Moderating role of RC over KM and KMC

Value of moderating effect is tested for calculating the significance, through bootstrapping method. Table 7 above also shows moderating effect is significant as t-value= 2.822 which is bigger than 1.96 (critical value) and p-value = 0.005 that is also significant at level of confidence 0.05. Therefore, H$_5$ of present study is accepted as the values indicated in table 7, verified the significance of moderating effect of RC over KM and KMC.

DISCUSSION, CONCLUSION AND PRACTICAL IMPLICATIONS
In past, most of the research studies were carried out either in banking, telecom or IT sector. However, this study aims to examine the influence of KM on INN by using mediating and moderating role of KMC and RC respectively in higher educational institutes. The hypothesized relationships were tested using PLS-SEM technique. Findings of this research contribute to the literature by emphasizing the role KM plays to predict outcomes in educational sector i.e. innovation, as proposed by past studies to explore the effectiveness of KM in service sector (Singh & Kumar, 2017) and need for developing the efficient KM structure to enhance educational qualities of higher education institutes. Moreover there is need for organizations to utilize their resources effectively in order to obtain desired outcomes (Shah *et al.,* 2019). Findings of this research validate Mao et al. (2016) and Ferraris, Santoro, and Dezi (2017) models that demonstrate KM positively affecting innovation as these researchers found KM to be a critical factor for successfully improving the innovation processes. For instance, KM promotes KMC values and formulate robust KM strategies that assists an organization to achieve competitive advantages (Mao *et al.,* 2016).

On the other hand, existence of both knowledge management infrastructure i.e. IT base and organizational base are also positively conducive to enhance KMC along with resource commitment (Mao *et al.,* 2016) which leads to improvement of innovation process in education sector (Fidalgo-Blanco *et al.,* 2015). KM-IT base Infrastructure which contains IT resource, IT human resource and IT relationship resource, is considered as a core element that effectively improves the organizational capabilities through utilization of their resource which assist in attainment of economic advantages (Wade & Hulland, 2004). Whereas, knowledge management infrastructure (organizational base) include structure, technology, human resource and culture, which provide platform to an organization for maintaining their resources (Lattemann *et al.,* 2007).

In view of the characteristics of KM, current research found KM and RC as imperative factors for educational institution of Pakistan and highlighted that through adopting Enterprise Social Networking System (ESNS), these institutes can impart better education according to global standards and contribute maximum to economy of Pakistan. Enterprise Social Networking System (ESNS) assists an organization in effectively creating, sharing, utilizing, and retaining employees' knowledge which in turn improves innovation process of higher institution of Pakistan.

Limitations and Future Research Directions
Besides the valuable contribution this research makes to the literature, it has certain limitations, suggested and recommended as new and potential avenues of research for future studies. First, in this research the sample size is based on limited number of private sector universities which is adequate yet small. Future studies could make use of large size of sample for making results more valuable. Second, present study is cross sectional in nature including the responses and reactions of the respondents collected once to answer the research questions. For future studies, longitudinal mode of study in which the researcher studies people or phenomenon more than one point in time to answer the research question, may also be useful for greater understanding and generalizability of the findings.

Present research targeted only the teaching staff, working in private sector universities of Pakistan. However, future studies may take into account the responses and reactions of administrative staff in addition to teaching staff of both private and government universities, to get more accurate and reality based facts generating more precise and fruitful results and findings, providing a more comprehensive and thorough understanding of the organizational outcomes.

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