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Innovativeness of IT Entrepreneurial Firms: The Roles of Knowledge Management and Dynamic Innovation Capabilities

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Abstract

The present study explores the mediating role of dynamic innovation capabilities, focusing on the relationship between knowledge management and innovativeness in IT entrepreneurial firms. A mixed method approach was used where quantitative data was collected from 200 IT entrepreneurial firms and an in-depth case study was conducted for the qualitative study. The quantitative analysis indicated that dynamic innovation capabilities fully mediate the relationship between knowledge management and innovativeness and it was sorted in case studies. While contributing to the ongoing attempt at explaining how knowledge management practices lead to innovations, the study suggests that managers should pioneer in building dynamic innovation capabilities in order to gain a competitive advantage through innovativeness in a dynamic environment.

Keywords: Dynamic innovation capabilities, Innovations, IT entrepreneurs, Knowledge exploration, Knowledge exploitation, Resource based view.

Introduction

In the knowledge management literature, knowledge has been identified as an important source of innovations (Donate & Guadamillas, 2011; Johannessen & Olsen, 2011; Koch, 2011; Monferrer, Blesa, & Ripolles, 2014; Nonaka, Toyama, & Konno, 2000; Yesil, Koska, & Buyukbese, 2013; Zheng, Zhang, Wu, & Du, 2011).

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The rest of the paper is structured as follows: In the following section, the theoretical domains of the study, namely, knowledge management, innovativeness and dynamic innovation capabilities are discussed and hypotheses are formulated. In the third section, the methodology of the study is outlined along with the findings. The subsequent section deals with the discussion of the findings, theoretical and managerial implications, limitations and directions for future research. Finally, a brief conclusion is given.

Literature Review

Knowledge Management – Knowledge Exploration and Exploitation Practices

Witnessing globalization, technological advances, knowledge-intensive businesses, accelerated product life cycles and rapid changes in customer needs, it is apparent that we are living in a knowledge economy (Martin-de Castro et al., 2011). In a knowledge economy the importance of managing knowledge is far more pertinent than any other aspect. Therefore, over the past years knowledge management has been developing as a research discipline (Moustaghfir & Schiuma, 2013). Donate and Guadamillas (2011, p.892) defined knowledge management as “a set of processes through which knowledge is acquired, developed, gathered, shared, applied and protected by the firm in order to improve organizational performance.” As highlighted in this definition, there are various aspects of knowledge management and scholars have explored these aspects in different ways and to different extents.

Nonaka and Takeuchi (1995) are leading scholars in the knowledge management arena, and from their perspective knowledge management is basically managing the organizational knowledge creation process. They developed the SECI process (Socialization, Externalization, Combination and Internalization) which has evolved around the conversions of tacit knowledge and explicit knowledge. However, Grant (1996) argued that knowledge creation is an individual activity, and hence organizations can only apply that existing knowledge to its production of goods and services. Therefore, the primary role of an organization is knowledge application rather than knowledge creation. Nonaka et al., (2000) stated that such an argument is valid only when knowledge and human beings are considered as static and inhuman. They further emphasized that “knowledge is created through the interactions amongst individuals or between individuals and their environments, rather than by

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an individual operating alone” (p.15). Demarest (1997) stressed that to build a robust body of knowledge, a firm needs to ‘construct’ knowledge. Therefore, organizations do have a role in creating knowledge. It is true that individuals possess knowledge, but by adopting proper mechanisms, organizations can generate or create knowledge (for example, through research and development activities) which is useful in developing new products or processes.

Yesil et al., (2013) highlighted the fact that knowledge creation, transferring and sharing are the key activities of knowledge management. Their focus was on knowledge sharing, which was considered the behaviour of individuals dispersing knowledge among themselves. Knowledge sharing can also be referred to as knowledge dissemination. Demarest (1997) focused on knowledge creation and dissemination in knowledge management. While Nonaka focused more on knowledge creation, most of the other authors (Demarest, 1997; Donate & Guadamillas, 2011; Koch, 2011; Wickramasinghe, 2015; Yesil et al., 2013) focused primarily on knowledge application processes.

All these perspectives emphasize that knowledge creation and application are the two key dimensions in knowledge management. Strengthening these views, Donate and Guadamillas (2011) stressed that knowledge management activities can be grouped into two broad areas – exploration and exploitation. Knowledge exploration is related to the “obtaining of new knowledge for generating new processes or products”, whereas knowledge exploitation is related to “practices as those utilized to leverage existing knowledge (Donate & Guadamillas, 2011, p.891).” In brief, these two aspects talk about knowledge generation and application. In this study, knowledge exploration and exploitation are considered as two separate constructs which are mutually exclusive and it is assumed that firms adopt ambidextrous strategies in developing both exploration and exploitation within the firm (Gupta, Smith, & Shalley, 2006).

Innovations and Innovativeness

Joseph Schumpeter is an iconic researcher in innovation literature and pioneered the discussions on innovation in the 1930's. Innovations are no longer activities which happen inside a laboratory. They are organizational wide processes where many stakeholders such as customers, suppliers, employees, etc. would take part in developing innovations (Bessant & Phillips, 2013). Schumpeter defined innovations

as the introduction of a new product or a new production method, opening up a new market or new source of raw materials, or creation of a new organizational structure in the industry (as cited in Sundbo, 1998, p.1). In these innovations discussed by Schumpeter, the entrepreneur played a central role as he was the innovator (Prodan, 2007; Sundbo, 1998). In Schumpeter's point of view, entrepreneurs are the creative force which distorts the market equilibrium by introducing innovations.

In the literature, it is difficult to find a consensus definition of innovation due to the complex nature of the construct (Gracia & Calantone, 2002; Quintane et al., 2011). Despite having various definitions, the simplest definition of innovation is 'newness' (Oke, Burke, & Myers, 2007; Rogers, 1998; Varis & Littunen, 2010). This novel component can vary to different degrees such as radical or incremental (Lin, Chen, & Chiu, 2009). In radical innovations newness is very high (for example, a totally new product/ process) and incremental innovations are minor improvements. However, organizational success depends on both since radical innovations are essential for long-term success and incremental innovations are required to make customers satisfied (Plessis, 2007).

Since there is a high rate of change in technological development, the life span of technological products is short (Prodan, 2007), and owing to product obsolescence tech firms need to continuously introduce new products to the market. "The capacity of an organization to produce innovations continuously" is identified as innovativeness (Quintane et al., 2011, p.928). Further, Damanpour defines innovativeness as "the rate of adoption of innovations" (as cited in Kilic, Ulusoy, Gunday, & Alpkhan, 2014, p.2). Both these definitions have operationalized innovativeness as the number of innovations adopted within a given period of time.

Dynamic Innovation Capabilities

Dynamic capabilities are "the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997, p.516). Ambrosini, Bowman and Collier (2009) stressed that dynamic capabilities are basically organizational processes and Teece et al., (1997, p.510) mentioned the dynamic capabilities approach as that which "emphasizes the development of managerial capabilities, and difficult-to-imitate combinations of organizational, functional and technological skills." These organizational processes and managerial capabilities are a well managed cluster of activities (Feiler & Teece,

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2014). Hence, firms can develop dynamic capabilities in the areas they wish to develop. Poppelbub et al., (2011) highlighted the necessity of developing dynamic service innovative capabilities to deliver continuously improved or completely new services to customers. Zheng et al., (2011) recognized the importance of developing knowledge based dynamic capabilities such as knowledge acquisition capabilities, knowledge generating capabilities and knowledge combination capabilities to foster the innovative performance of the firm. Further, Cheng and Chen (2013) identified the positive effects of dynamic innovation capabilities on breakthrough innovations. Therefore, if a firm wishes to enhance its innovativeness, it needs to develop dynamic capabilities in the respective areas. As this study focuses on the innovativeness of IT entrepreneurial firms, dynamic innovation capabilities are explored in depth.

Each and every firm has a unique way of developing innovations based on their past learning such as experiential, vicarious, individual and organizational learning (Teece, 2007). The same happens with their capabilities. The nature of these dynamic innovation capabilities are unique to each firm, as firms have their own ways of transforming knowledge into new products and processes (Breznik, 2014; Cheng & Chen, 2013). When a firm develops its own dynamic innovation capabilities, those become “hard-to-transfer and hard-to-imitate innovation capabilities that firms use to develop, integrate, and reconfigure existing and new resources and operational capabilities” (Cheng & Chen, 2013, p.445). These dynamic capabilities are capabilities that firms have developed to manage their innovative process.

Hypotheses and Conceptual Model

The Relationship between knowledge management (exploration and exploitation) practices and innovativeness

A firm’s innovativeness depends almost entirely on the knowledge it possesses and its ability to deploy them (Martin-de Castro et al., 2011). Studies which have explored the knowledge management field, agree that knowledge management practices lead to the better performance of the firm (Nonaka & Takeuchi, 1995; Grant, 1996; Donate & Guadamillas 2011). Demarest (1997, p.381) mentioned that “... the most obvious link between knowledge management and enhanced economic performance is in the area of innovation.” Hence, knowledge can be identified as a pre-requisite of the innovation process (Quintane et al., 2011). Considering a broader view of knowledge

management practices, several scholars have explored the relationship between knowledge exploration and exploitation practices and innovations as follows.

Nonaka and Takeuchi (1995) examined the success of Japanese companies and stated that their knowledge creation activities enabled them to continuously innovate. They further highlighted the fact that knowledge creation leads to continuous innovation, which in turn leads to a competitive advantage. In the Sri Lankan context, Wickramasinghe (2015) studied the impact of knowledge sharing on innovativeness in offshore outsourced software development firms. The empirical findings supported the notion that knowledge sharing practices impact positively on innovativeness. Further, she emphasized that knowledge sharing enables the dissemination of innovative ideas such as improvements in work methods and identification of new business opportunities.

Koch (2011) examined how knowledge integration mechanisms can support a firm's innovative process in order to achieve an innovative outcome. She further emphasized that knowledge integration mechanisms help the firm to utilize its heterogeneous knowledge for innovation. Tsai (2001) identified that knowledge transfer among organizational members enhances the firm's ability to innovate, as it provides an opportunity for mutual learning. Transfer of existing knowledge stimulates the creation of new knowledge, enabling innovation. Despite of all these practices, the application of knowledge is vital for new product developments (Song, Van Der Bij, & Weggeman, 2005). Knowledge application is about the utilization of knowledge to generate new products and processes to respond to environmental changes.

Creation and sharing of new knowledge – which is at the core of exploration activities for innovation – and integration, transfer and application of knowledge – which is essential for exploitation activities connected to innovation – enable a firm to manage its innovation process successfully. Strengthening this argument, Xu, Houssin, Caillaud and Gardoni (2010) developed a meta-model of knowledge management and continuous innovation. Using that model, they argued that knowledge generation and application processes create new knowledge for continuous innovation. Finally, Donate and Guadamillas (2011) explored the relationship between knowledge exploration and exploitation activities and innovation while focusing on the moderating roles of culture, leadership and HR practices. Using empirical data, they found that both exploration and exploitation activities have a positive and significant effect on innovation results. In line with previous research, it is suggested that there

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is a relationship between knowledge management practices – exploration and exploitation – and innovativeness. The following hypotheses were thus proposed:

H1: A firm's knowledge exploration practices have an impact on the innovativeness of the firm

H2: A firm's knowledge exploitation practices have an impact on the innovativeness of the firm.

The relationship between knowledge management (exploration and exploitation) practices and dynamic innovation capabilities

Teece (2007), a leading scholar who contributed to the advancement of the dynamic capabilities view, identified knowledge management as one of the micro-foundations of dynamic capability. According to his study, the key pillars of knowledge management are learning, knowledge transfer, knowledge integration and knowledge application. Learning is imperative to create new knowledge and is enhanced through research and development activities. Further, the ability to integrate and combine assets including knowledge is a core skill in building dynamic capabilities. When a firm possesses the ability to integrate the know-how from outside as well as within the firm and apply that knowledge in new product developments, the firm can develop hard-to-transfer and hard-to-imitate dynamic innovation capabilities (Teece, 2007). Aligning with this view, Eisenhardt and Martin (2000) identified knowledge creation and transfer as important elements of dynamic capability. Several scholars highlighted the fact that knowledge sharing activities have a significant positive impact on innovation capability (Lin, 2007; Saenz, Aramburu, & Rivera, 2009; Yesil et al., 2013). When firms build these innovation capabilities in a dynamic environment to develop, integrate, and reconfigure resources and operational capabilities, those become dynamic innovation capabilities (Cheng & Chen, 2013).

A firm's ability to encourage learning and knowledge sharing – which is at the core of knowledge exploration activities for innovation – and knowledge integration, transfer and application – which is essential for knowledge exploration – allows the firm to develop dynamic innovation capabilities. Bearing in mind these premises, the authors propose that knowledge exploration and exploitation practices have an impact on dynamic innovation capabilities. The following hypotheses were thus proposed:

H3: A firm's knowledge exploration practices have an impact on the dynamic innovation capabilities of the firm

H4: A firm's knowledge exploitation practices have an impact on the dynamic innovation capabilities of the firm.

Relationship between dynamic innovation capabilities and innovativeness

This study focuses on IT entrepreneurs and Wu (2007) revealed that in the high-tech sector, products have short life cycles, and the demand for customized products is high. Therefore, for these high-tech firms, innovations are more essential than for any other firms owing to the dynamic nature of the industry. In that context, firms should develop dynamic innovative capabilities which can adapt, integrate and reconfigure knowledge management practices (exploration and exploitation) in order to innovate continuously. Saenz, Aramburu and Blanco (2012, p.920) emphasized that "actually, innovation lies at the core of what is known as 'dynamic capabilities'." This statement highlights the fact that dynamic capabilities are essential in the innovative process.

Several scholars have emphasized that dynamic capabilities lead to the innovative performance of a firm (Cheng & Chen, 2013; Poppelbub et al., 2011; Simatupang & Widjaja, 2012; Teece et al., 1997; Teece, 2007; Yesil et al., 2013). In the study conducted by Chen and Chen (2013), the positive effects of dynamic innovation capabilities on breakthrough innovations were investigated. According to their study, dynamic innovation capabilities help increase absorptive capacity, enabling the firm to explore new information and develop breakthrough innovations. Poppelbub et al., (2011) proposed the dynamic service innovation capabilities model to implement new or improved service offerings (service innovations) in service organizations. Simatupang and Widjaja (2012) conducted an exploratory study in the digital content industry and identified that innovative capability leads to the innovation success of the firms studied. Han and Li (2015) studied knowledge-based dynamic capabilities in the Chinese context and highlighted that they have a positive impact on the innovative performance of the firms. Therefore, based on these findings, it is clear that in order to gain a competitive advantage through innovation, a firm needs to build dynamic innovation capabilities (Cheng & Chen, 2013; Simatupang & Widjaja, 2012). Therefore, the authors propose that:

H5: A firm's dynamic innovation capabilities have an impact on the innovativeness of the firm.

The mediating role of dynamic innovation capabilities

A knowledge resource is identified as an imperative asset for organizational performance and the management of this knowledge resource is critical in order to gain a competitive advantage (Grant, 1996; Nonaka & Takeuchi, 1995; Peteraf, 1993). Martin-de Castro et al., (2011, pp.871-872) stated that "in this new competitive arena, one of the best ways for reaching a firm competitive advantage position comes directly from continuous technological innovation." A firm's ability to produce innovations largely depends on the knowledge it possesses and its capacity to deploy it (Martin-de Castro et al., 2011). This phenomenon is very relevant for IT entrepreneurs, as technology is the core of their business and competitive advantage depends largely on how well they manage the knowledge resource to build innovations.

This is the fundamental concept in the resource based view. That is, firms comprising of distinctive resources can gain a competitive advantage by developing value creating strategies using their valuable, rare, inimitable and non-substitutable resources (Eisenhardt & Martin, 2000). One underlying condition of the resource based view is the heterogeneity of resources (Peteraf, 1993). That is, resources differ from firm to firm and thereby firms can earn superior rents from those resources. However, owing to the heterogeneous nature of resources, they are sticky in the short run (Teece et al., 1997). That is, a firm cannot change its resource base in the short run. Ambrosini et al., (2009) supported this view, highlighting the static nature of the resource based view. Wu (2007) questioned the straightforward application of the resource based view in evolving markets, as it can furnish misleading conclusions about the relationship between start-up resources and performance. Furthermore, the resource based view has failed to explain how and why some firms have achieved a competitive advantage in rapidly changing, unpredictable markets (Eisenhardt & Martin, 2000; Gnizy, Baker and Grinstein, 2014; Teece et al., 1997). These views highlight the inapplicability of the resource based view to IT firms operating in dynamic environments.

Overcoming the weaknesses of the resource based view, the dynamic capabilities view was developed and it states that in order to survive in a rapidly changing environment, firms need to build dynamic capabilities to achieve and maintain a

competitive advantage (Teece et al., 1997; Teece, 2007). Firms which have developed dynamic capabilities show timely responsiveness to the changing environment while being innovative (Feiler & Teece, 2014; Teece et al., 1997). Dynamic capabilities are organizational processes and managerial capabilities which enable a firm to adapt, integrate and reconfigure its skills, resources and competencies to the changing environment (Ambrosini et al., 2009; Teece et al., 1997). Therefore, the dynamic capabilities view has been able to go beyond the resource based view and explains how firms change their processes and resources to achieve a competitive advantage in changing markets. In a stable environment, a firm can gain a competitive advantage by only having distinctive resources, but in a dynamic environment having only distinctive resources will not be adequate. Therefore, a firm should have a distinctive resource base along with dynamic capabilities to alter the way they manage this resource base in order to gain a competitive advantage.

Summing up the argument so far, the resource based view explains how firms can achieve a competitive advantage by having a distinctive resource base (Peteraf, 1993; Wernerfelt, 1985) and knowledge has been identified as one of the strategic resources which can generate a competitive advantage (Grant, 1996; Nonaka & Takeuchi, 1995; Peteraf, 1993). Hence, firms are keen to have proper knowledge management practices in order to extract the maximum use from their knowledge resource. The explosion in the knowledge economy, global competition and technological advancements have made the environment dynamic and made innovations central to the gaining of a competitive advantage (Lawson & Samson, 2001). The resource based view has failed to explain how a competitive advantage is achieved through innovations in such dynamic environments (Ambrosini et al., 2009; Eisenhardt & Martin, 2000; Lawson & Samson, 2001; Teece et al., 1997; Wu, 2007). In other words, having knowledge management practices alone are not sufficient to innovate. There should also be managerial capabilities which can alter these processes and resources according to the dynamics of the environment. Such managerial capabilities can be identified as dynamic innovation capabilities (Ambrosini et al., 2009; Bessant & Phillips, 2013; Teece et al., 1997). Hence, based on the above argument, the following hypotheses were developed:

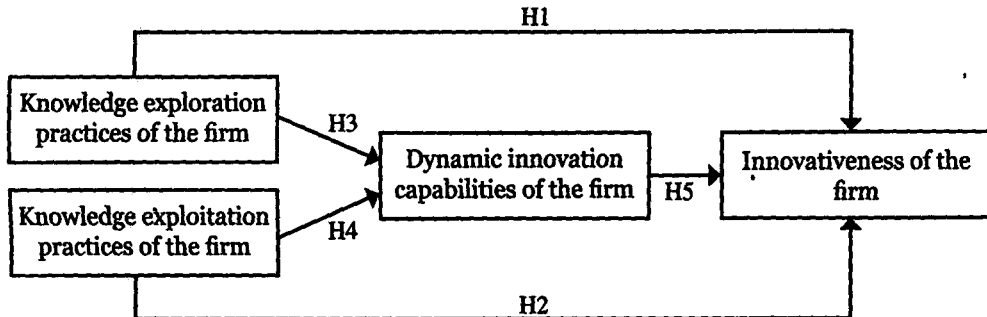
H6: Dynamic innovation capabilities mediate the relationship between knowledge exploration practices and the innovativeness of the firm

H7: Dynamic innovation capabilities mediate the relationship between knowledge exploitation practices and the innovativeness of the firm.

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The relationships suggested in the above hypotheses are illustrated in Figure 1. As is shown there, knowledge exploration and exploitation practices of the firm lead to its innovativeness. Moreover, dynamic innovation capabilities mediate the relationship between knowledge management practices (both exploration and exploitation) and the innovativeness of the firm.

Figure 1: Conceptual Model



Methodology

To recap, the purpose of this study is to explore how IT entrepreneurial firms use dynamic capabilities to convert knowledge into innovations required in order to understand the innovative processes undertaken by IT entrepreneurial firms in Sri Lanka. A deductive approach is used to construct the knowledge management practices, dynamic capabilities and innovativeness of the firms in order to test and establish a causal relationship among the variables. This led the researchers to employ a quantitative analysis for this study. After the verification of the aforementioned causal factors that influence the innovativeness of IT entrepreneurial firms, the researchers next utilized a qualitative method to uncover how dynamic capabilities convert knowledge management practices into innovations. Thus, a mixed method design was adopted to collect data on four constructs: knowledge exploration, knowledge exploitation, dynamic innovation capabilities and innovativeness. This method is useful in order to extract a better understanding of the research problem by combining the strengths of both quantitative and qualitative research (Creswell, 2014).

Quantitative Design

Measures

Survey items were adopted from existing instruments used in past research. Measures assessing knowledge exploration, exploitation, and innovativeness were adopted from Donate and Guadamillas (2011). Knowledge exploration and knowledge exploitation activities were measured using four and eleven items respectively. Eight items were used to measure innovativeness. Items used to measure dynamic innovation capabilities were adopted from Cheng and Chen (2013). All the constructs were operationalized as one-dimensional constructs. The original questions were used and minor modifications (such as changing the order of questions, correcting grammatical mistakes, etc.) were done when required, and the original scale (7 point Likert-type scale) ranging from 1 ('strongly disagree'/'very low'/'much worse) to 7 ('strongly agree'/'very high'/'much better') was used as it is.

Sample and data collection

The unit of analysis in this study is the firm, and therefore responses were collected from multiple layers of the firm (Zheng, Yang & McLean, 2010). In organizational research, the multiple respondents approach provides superior quality response data and is suitable for both intra-organizational and inter-organizational phenomena (Van Bruggen, Lilien, & Kacker, 2002). When response data on organizational variables is collected from multiple respondents', the measurement error can be reduced (Van Bruggen et al., 2002) and the validity and reliability of the study increase (Kumar, Stern, & Anderson, 1993).

A mix of an online and offline mail survey was carried out on the sample. A total of 200 responses were received, but only 197 were usable. Among the usable responses, 70 were online responses (35.5%) and 127 were offline responses (64.5%). A MANOVA test (see Table 1) was conducted on the online and offline survey results and no statistical differences were detected between the two groups (Wilks' lambda = 0.997, $p = 0.959$). Further, data were collected from multiple respondents including entrepreneurs (59.9%), senior managers (13.7%), middle level managers (10.2%) and tech leads (16.2%). Another MANOVA test (see Table 1) was performed and the results indicated that there were no statistical differences between the four groups (Wilks' lambda = 0.935, $p = 0.381$). Thus, the data were treated as responses of one group representing the unit of analysis, which is the entrepreneurial firm.

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Table 1: MANOVA Test Results

	Effect	Value	F	df	Error df	Sig.
Respondent	Wilks' Lambda	0.935	1.073	12.000	502.984	0.381
Mode	Wilks' Lambda	0.997	0.159	4.000	192.000	0.959

Qualitative Design

Selection of the cases and data collection

Yin (2009) highlighted that there are five ways of selecting a single-case design. Among those a representative case was used for this study to explore knowledge management practices, dynamic innovation capabilities and innovativeness. The researcher selected a leading, innovative IT firm¹ as the case to study. In selecting the firm, innovative performance, ownership and expert judgments were taken into consideration. ABC firm has been identified as one of the top five local IT firms which designs innovative products (A.T. Kearney, 2012). They have footholds in Human Resources software, radio stations and mobiles which are locally and internationally recognized. The firm is a school start-up which created its identity through continuous innovations. Further, they have pioneered in introducing several new-to-the-market innovations in Sri Lanka. The firm has been operating for nearly 20 years with more than 100 employees.

Data for the qualitative study was collected mainly from two sources. Firstly, structured interviews were conducted and secondly, documentary information related to the firm – especially articles appearing in the newspapers and exposure in other mass media – were used to support the findings. The interview guide was designed based on the conceptual model and the questionnaire. However, interviews were open to any new insights. The entrepreneur, two Chief Operating Officers and the Head of the Research and Development unit took part in this study. Further, a focus group study was conducted to confirm and strengthen the findings of the interviews. Five junior engineers participated in the focus group discussion.

¹ Hereinafter referred to as ABC firm

Results

Quantitative Data Analysis

The quantitative data was analyzed using Structural Equation Modeling (SEM) as it allows the estimation of complex relationships, especially when the mediating effect exists (Hair, Black, Babin, Anderson, and Tatham, 2006; Zheng et al., 2011). SPSS 20 and AMOS 20 packages were used for the analysis.

Measurement model

The measurement model “specifies the indicators for each construct, and enables an assessment of construct validity” (Hair et al., 2006, p.733). Based on the conceptual model, there are four latent variables, namely, knowledge exploration (EX), knowledge exploitation (EI), dynamic innovation capability (DIC) and innovativeness (INV). The final measurement model was obtained after removing two items (er3 and ei2) which had regression weights less than 0.5 at two stages. The third question of the exploration variable (er3) was about the usage of proprietary technology to develop or improve products/services/processes and was removed at stage one. The second question of the exploitation variable (ei2) referred to the availability of phone or e-mail directories within the firm to find experts in specific areas and was removed at stage two. Goodness of Fit (GOF) measures of chi-square, goodness-of-fit index (GFI), comparative fit index (CFI) and root mean square error of approximation (RMSEA) were used to evaluate the measurement model. The final measurement model achieved a good level of fit having a chi-square = 534.5, CMIN/df = 1.864, GFI = 0.840, CFI = 0.911 and RMSEA = 0.066.

Reliability was measured using Cronbach’s alpha (alpha values > 0.7) and composite reliability (values > 0.6). Convergent and discriminant validity were assessed using Average Variance Extracted (AVE) (values > 0.5) and Squared Multiple Correlation (SMC) and the AVE matrix respectively. As shown in Table 2, except the AVE of EI and DIC, all other values are above the agreed upon lower limit. EI (0.49) and DIC (0.48) have lower convergent validity (AVE) but they maintain satisfactory levels of composite reliability. Hence, the reliability and validity of the measurement model is assured.

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Table 2: Reliability and Validity Summary

Variable	Mean	Cronbach's alpha	CR	AVE	ER	EI	DIC	INV
ER	4.90	0.708	0.84	0.52	0.52			
EI	4.75	0.896	0.94	0.49	0.059	0.49		
DIC	5.30	0.808	0.87	0.48	0.049	0.038	0.48	
INV	5.40	0.906	0.94	0.57	0.014	0.008	0.054	0.57

Structural model

The structural model indicates the hypothesized relationships among the latent variables. Three structural models were drawn to test the direct relationships (H1 to H5) and to test the effect of the mediators (H6 and H7). Except for two direct relationships (H1 and H2) all other hypotheses were supported by the statistical analysis. Table 3 gives the findings of the hypotheses testing along with the GOF measures of the structural models.

Table 3: Path Analysis

Path	Hypotheses		GOF Measures of the Structural Model				
	β	P	Chi-square	CMIN/df	GFI	CFI	RMSEA
(H1) ER→INV	0.113	0.081	351.968	1.977	0.865	0.926	0.071
(H2) EI→INV	0.078	0.306					
(H3) ER→DIC	0.153	0.045					
(H4) EI→DIC	0.221	0.006					
(H5) DIC→INV	0.247	0.002					
(H6) ER→INV	0.104	0.162	211.335	2.113	0.891	0.929	0.075
ER→DIC	0.189	0.014					
DIC→INV	0.207	0.009					
(H7) EI→INV	0.051	0.510	407.943	1.863	0.856	0.925	0.066
EI→DIC	0.255	0.001					
DIC→INV	0.206	0.011					

H1 and H2 measured the direct relationships between knowledge management practices (exploration and exploitation) and the firm's innovativeness. The findings did not support these relationships. The rest of the direct relationships were

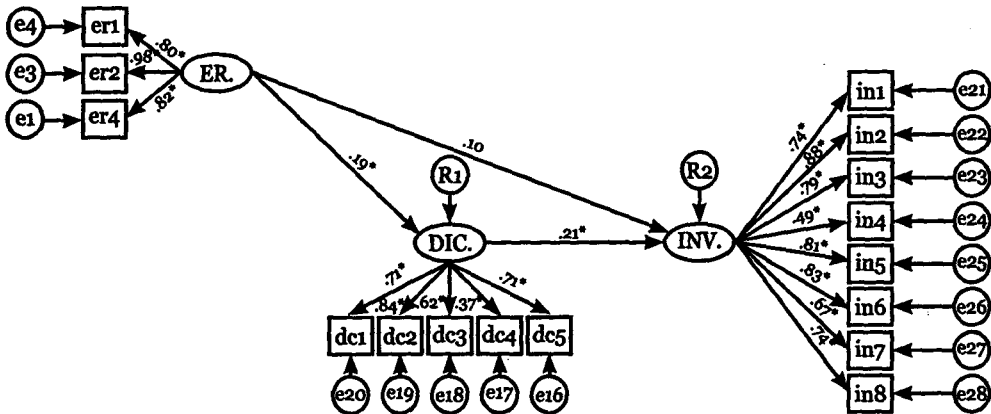
measured by H3 (ER→DIC), H4 (EI→DIC) and H5 (DIC→INV), and the findings supported those relationships. More importantly, the mediating effect of dynamic innovation capabilities (H6 and H7) was supported by the statistical analysis (the structural models are given in Figure 2 and 3). To further investigate the mediating effect, a bootstrap analysis was performed. The findings are given in Table 4. These findings indicate that the relationships between knowledge exploration and exploitation practices and innovativeness are fully mediated by the dynamic innovation capabilities of the firm.

Table 4: Findings of the Mediator Effect

	Direct effect		Indirect effect		Mediation		
	β	P	β	P	Upper bound	Lower bound	
ER→DIC→INV	0.041	0.358	0.010	0.018	0.040	-0.004	Full
EI→DIC→INV	0.024	0.671	0.032	0.007	0.088	0.006	Full

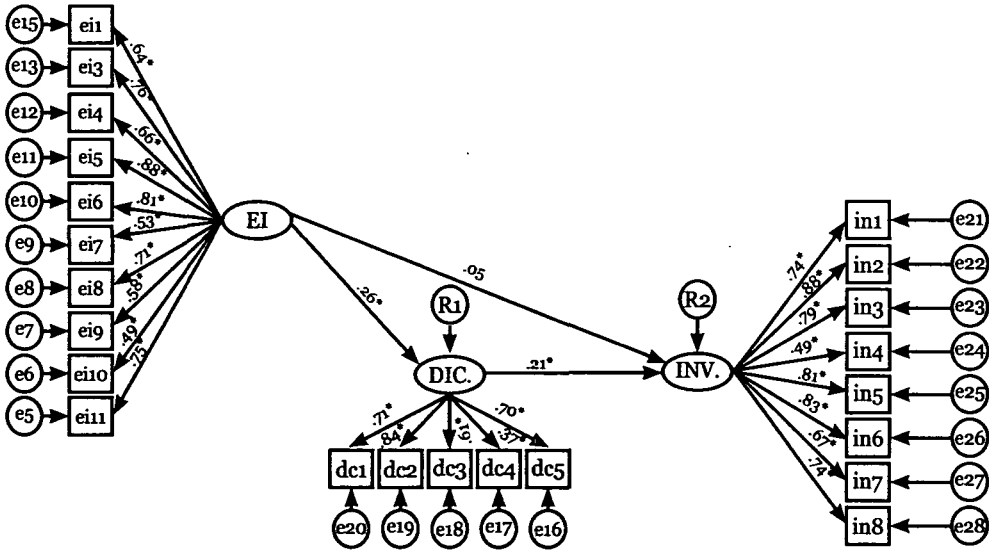
Three control variables, namely, R&D expenditure, firm size and age were introduced to a structural model with four variables, and the model was significant with a chi-square value of 1234.869 and a degrees of freedom value of 461. GOF indices were also satisfactory. However, only R&D expenditure showed a significant positive impact ($\beta - 0.174$, $P - 0.022$) on innovativeness. The impact of the other two controlling variables (that is age and size) on innovativeness was not significant. Summing up, only R&D expenditure had a positive impact on innovativeness, and not the age and size of the firm.

Figure 2: Structural Model for Moderation (ER→DIC→INV)



* Significant at 5% level

Figure 3: Structural Model for Moderation (EI→DIC→INV)



* Significant at 5% level

Qualitative Data Analysis

The qualitative data was analyzed using the thematic analysis developed by Braun and Clarke (2006). The data obtained through interviews was recorded and transcribed verbatim. The data set was read a couple of times to increase familiarity with it and then coded for analysis using the NVivo software.

Internal research and development (R&D) activities, proprietary technology and the internal R&D unit were the focal aspects of knowledge exploration. The entrepreneur stressed the importance of R&D activities for innovations. The notable fact is that the firm conducts research activities for each and every new project because the firm wants to gather as much knowledge as possible for innovations. The entrepreneur said:

“... then we realized, oh my God, we have to do research on so many things. Then one of the things we did was, we formed a small team and assigned them to do just that.”

ABC firm has their own R&D unit and none of the participants believed in proprietary technology. The reason was that in the IT industry, where technology changes

rapidly, having a proprietorship won't necessarily ensure success. One of the COOs mentioned that success depends on exploring the market, the speed of execution and the reiteration of products to suit the clients.

Key knowledge exploration practices are developing knowledge repositories, allowing employees to access to those repositories, sharing best practices, and obtaining suggestions from the customers and employees. ABC firm has a digital knowledge repository/database to which employees have access anytime. They have an e-learning platform to share knowledge as well. Further, they share best practices with all the employees during the technical sessions, quarterly meetings and annual meetings. The Head of the R&D unit mentioned how they are committed to obtaining customer suggestions. According to him, "we used to send them feedback every six months. And recently we have opened up Google forms and we share with them." Not only customer suggestions, but employee suggestions are also encouraged at these two firms. One of the COOs mentioned that:

"It is part of the embedment that we have gone through our firm's culture where we encourage people to speak up, tell us in whatever way new products can be developed, how even the existing products can be developed and also allowing people to experiment around it."

Further, the employees who participated in the focus group supported the COO's view, saying that the top managers are always ready to listen to their ideas and if they come up with really good ideas, the top managers incorporate those into products and processes. These views highlighted the fact that the firm has easily accessible knowledge repositories, formal and informal mechanisms to share knowledge and means of capturing employee and customer suggestions. These practices have enabled them to leverage on existing knowledge to develop innovations continuously.

Focusing on the dynamic innovation capabilities, the entrepreneur stated that they have the ability to change their processes according to the changing requirements. He explained how they had obtained support from other institutes such as LIRNEasia, the University of Moratuwa, etc. in developing innovative products (e.g. the Disaster and Early Warning Network – DEWN). The Head of R&D unit stressed that such need is born of the dynamic nature of the environment. The entrepreneur mentioned that empowering managers and having continuous communication with them are essential factors to build dynamic capabilities. In order to facilitate communication, organizational structure should be flexible.

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A COO mentioned that;

“we help people to engage in very direct communication. It is super important, so that there is no hierarchy or bureaucracy that gets in the way.”

Therefore, flexible organizational structure, empowerment and communication are essential factors for dynamic innovation capabilities.

Innovativeness is the firm’s ability to innovate continuously. These innovations can be radical or incremental. At the ABC firm both these types of innovation can be seen. As one of the COOs mentioned;

“In particular, when you look at our history, once in 04 years we have done major releases. But in between, there are short term kinds of releases, intermediary releases that we have done once in 06 or 10 months. But our major releases are done once in 04 years, continuously.”

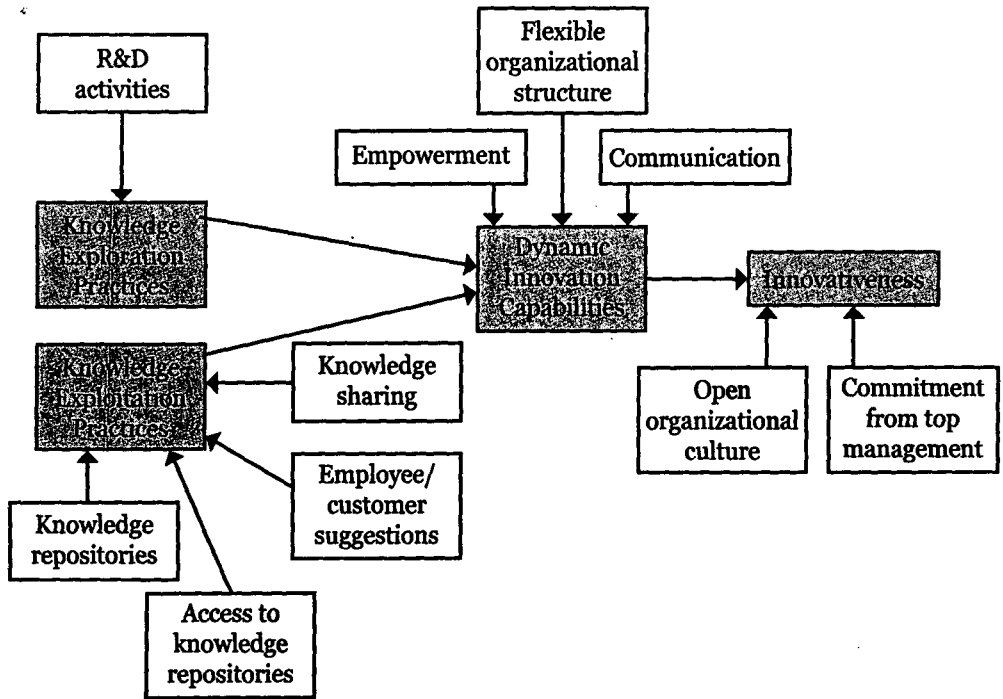
The firm continuously innovates, but most of these are incremental innovations. When analyzing the innovativeness, it is apparent that it is the open culture that pervades the firm that has enabled it to come this far. Such cultures are developed by the founders. Their commitment is highly important in driving an innovative culture. Therefore, commitment from the top management and an open culture are essential factors for continuous innovations.

Through these interviews it was evident that firms alter their knowledge management practices to suit the innovation project. The entrepreneur stated:

“So if you really look at ABC, we don’t have well defined processes per say for knowledge generation and knowledge application. I mean for me knowledge is out there... When it comes to building something innovative, it is about how you get whatever knowledge is required and make it useful in building something new.”

His statement highlights the fact that the firm possesses the ability to adapt, which is its dynamic capability. Therefore, the mediating role of dynamic innovation capabilities is visible through the case studies as well. Finally, based on the analysis of qualitative data the researcher developed a thematic map, illustrated in Figure 3.

Figure 4: Thematic map



Discussion

Drawing from the resource based view and the dynamic capabilities view, this study examined the mediating role of dynamic innovation capabilities in the relationship between knowledge management and innovativeness. Both quantitative and qualitative analyses indicated the mediating role of dynamic innovation capabilities. Further, it was revealed that when firms allocate adequate funds towards R&D activities, their innovativeness increases. However, the size or years of operation had no influence on the innovation activities. It is the firm's ability to generate and apply knowledge to develop innovations aligning with the dynamics of the environment that was important.

Even though previous studies have supported the relationship between knowledge management activities and innovations (Donate & Guadamillas, 2011; Koch, 2011; Nonaka & Takeuchi, 1995; Song et al., 2005; Tsai, 2001; Wickramasinghe, 2015; Xu et al., 2010), the present study failed to confirm this relationship. This may be because of the contextual differences as the original scale was developed by collecting data from Spanish technological firms operating in the electrical materials

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and equipment industry, the electronic materials industry, the office equipment industry, and the medical, surgical and optical materials industry. Further, these firms were not entrepreneurial firms. Moreover, the smaller size of the sample could be a possible reason as well. Therefore, future studies need to be carried out in this regard.

Theoretical Contributions

The findings of the study contribute to the existing literature in several ways. Firstly, this study used the dynamic capability view to overview the theoretical manifestation of the impact of knowledge management practices on innovativeness. As a result, the role of dynamic innovation capabilities was found to be the mediator between knowledge management and innovativeness. Thus, it is verified that knowledge management practices alone could not result in innovations, but that firms that have dynamic capabilities could transfer those practices into innovations. More precisely, this study expanded the existing theoretical domain by introducing the intervening mechanism of dynamic capabilities for knowledge management practices that lead to innovations. Secondly, most earlier studies isolated the impact of either exploration practices (e.g. creation, sharing, etc.) or exploitation practices (e.g. transfer, integration, application, etc.) on innovativeness, but this study integrated both these aspects in a single model to obtain a more holistic perspective. As the third contribution of the study, the mediating role of dynamic capabilities on the relationship between both knowledge exploration and exploitation practices and innovativeness is emphasized. Finally, knowledge management as an aggregated or fragmented construct could not result in innovations if there is no required dynamic capability. Thus, this study empirically verified the findings of Donate & Guadamillas (2011), Koch (2011), Nonaka & Takeuchi (1995), Song et al. (2005), Tsai (2001), Wickramasinghe (2015) and Xu et al. (2010) while making the explanation of the impact of knowledge management practices on innovations mediated through dynamic capabilities, more comprehensive.

Managerial Implications

The findings have certain implications for managers in entrepreneurial firms. It was empirically verified that entrepreneurial firms should have knowledge management practices for innovations which is in line with Song et al., (2005), Tsai (2001), Wickramasinghe (2015) and Xu et al., (2010). Especially, in order to continuously innovate, managers should commit themselves to the practice, and invest more on

internal research and development activities to generate new knowledge. This study also recommended that managers in entrepreneurial firms should pay a great deal of attention to developing knowledge repositories and allow easy access to them. This facilitates the firms to better utilize their existing knowledge base, as knowledge sharing has been identified as one of the predominant knowledge management practices. It is also advisable for the firm to share its best practices among its employees to prevent the reinvention of the wheel. Next, managers who wish to continue with the innovation process need to welcome suggestions from employees and customers. At the same time, by maintaining a flexible organizational structure with an open culture, managers can encourage bottom-up innovations as employees can freely communicate their ideas to the management.

More importantly, managers in entrepreneurial firms have to recognize the value of capabilities which should necessarily be dynamic. Those are the capabilities which alter the existing processes and even resources to suit the current requirements. As revealed in the qualitative study, the dynamic capabilities of organizations require empowering and communication at the implementation stage. However, if managers are expecting to increase the innovations of the firm by having knowledge management practices, it requires an incorporation of dynamic capabilities. Surviving in an industry with immense competition is a great challenge for most IT entrepreneurial firms. In this context, by adopting the above practices and developing dynamic capabilities, firms can easily adjust to the changing environment, and thereby gain an advantage over their competitors.

Limitations and Directions for Future Research

The researcher has identified the following as the limitations of this study. Firstly, the study is limited to the Sri Lankan context, but local literature was not adequate to build the arguments in the study. Secondly, information on many IT entrepreneurial firms was not on record at any authorized government or private institute. The lack of precise information about the population limited the researcher's ability to collect data from a representative sample of IT entrepreneurs.

The relationship between knowledge management and innovation is a well established phenomenon in the literature. However, the findings of this study did not support that relationship. Therefore, future studies can explore the subject in this regard. Furthermore, future studies can adopt the qualitative methodology to

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discover factors other than knowledge management which affect innovations, and to explore the nature of dynamic capabilities in the IT sector.

Conclusion

In today's dynamic environment, innovations are vital for a firm to gain an advantage over its competitors. Thus, the impact of knowledge management on the innovativeness of entrepreneurial firms was examined through the dynamic innovation capability perspective. The literature survey revealed that firms pay a great deal of attention to managing their resource base which is dynamic. The empirical investigation of this study supported the notion that, firms need to develop dynamic capabilities which enable them to adapt, integrate and reconfigure their knowledge resources to suit their innovative activities.

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