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# The Role of IT and Knowledge Management Capabilities in Generating Innovation Knowledge in Telecom Companies

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## **Abstract**

Telecom companies face a fierce competition from innovation based start-up companies, particularly those that are using internet networks to offer communication services through the voice and video over internet protocol technologies. Understanding why and how telecom companies innovate in the market is very crucial in order to predict the future of this business sector. In this paper, we argue that telecom companies are utilising their capabilities that have a significantly important role in fostering innovation, namely information technology (IT) capability and knowledge management (KM) capability. IT capabilities have changed dramatically in the last few years with the introduction of intelligent systems, big data analytics, the Internet of Things and the wide use of mobile apps and sensors. It is not clear how these technologies play a role in telecom companies' innovation and it is not clear whether IT impacts innovation directly or if KM capability has a mediation role in utilising technology to support innovation. We outline the methodology of this investigation as a qualitative study with stakeholders from multiple telecom companies and we expect at the end of the study to be able to offer a holistic view on the way these companies innovate in regard to their products and services.

**Keywords:** Information technology capabilities, knowledge management capabilities, innovation, dynamic capability.

## 1. INTRODUCTION

Public and private organizations in every industry encounter increased environmental uncertainty and rapid changes in their external environment and the telecom sector is no exception. They are exposed to pressures to improve product or service quality which is presented to the customers in addition to reducing the cost and to compete against other products of high quality. Innovation has been seen as a key to a firm's competitiveness, especially in a dynamic business environment that is characterized by the globalization of the markets, increasingly complex business problems, dynamics of user needs, and new technology. One of the most dramatic evolutions in the business world over the past decade has been the dawn of the new economy that is the knowledge based economy. Increasing global competition and growth of marketplaces have created a competitive incentive among many companies to consolidate and reconcile their knowledge assets as a means of creating value that is sustainable over time. Business organizations view knowledge as their most valuable and strategic resources for achieving sustainable competitive advantage (Davenport and Prusak 1998). While countless studies in innovation research have identified many factors that might influence innovation success, research results consistently indicate that the knowledge held by a firm and its capabilities to manage it are the main driving forces (Hult et al. 2004). The abilities which enable a firm to manage knowledge resources across its business units, effectively through a series of processes including creation, transfer, integration and application have been termed "knowledge management capability (KMC)" (Gold et al. 2001; Tanriverdi 2005). Organizations depend on their KMC to continuously innovate (Cohen and Levinthal 1990). Another stream of research related to knowledge deals with the role of information technology (IT). IT is enabling and enhancing diverse knowledge management processes (KMPs) such as creation, transfer, and the application of knowledge, making firms more productive and competitive (Alavi and Leidner 2001; Davenport and Prusak 1998). Thus, IT is greatly enabling firms' KMC (which we refer to in this paper as IT-based knowledge management capability (IT-based KMC)), which will lead to generating new ideas within the organization resulting in new products, services or processes. Previous studies have recognized that IT contributes to enhancing, building and augmenting firms' KMC (Alavi and Leidner 2001; Sambamurthy et al. 2003; Tanriverdi 2005). The link between KMC and a firm's innovation has been emphasized (Moos et al. 2013; Yayavaram and Chen 2015). Yet, limited research has been done to examine theoretically and empirically the link between IT-based KMC and firms' innovation. As more companies turn to IT in an attempt to enhance a firm's competitiveness through innovation, this gap must be addressed by examining the relationship between IT-based KMC and different innovation outcomes (product or process) along the innovation pathway.

Information systems (IS) literature shows mixed findings in establishing a relationship between IT and a firm's performance. Several researchers found a positive direct relationship between IT and firm's performance (Bharadwaj 2000; Bhatt and Grover 2005), whereas others have reported that there is no direct relationship between IT and firm's performance (Kohli and Deraj 2003; Tippins and Sohi 2003). However, previous research on the business value of IT seems to have explained this relationship through the so-called IT-enabled organizational capabilities perspective (Rai et al. 2006). From this perspective, IT has an indirect impact on a firm's performance through higher-order process capabilities. Thus, IT plays a key role in enabling other organizational capabilities that increase a firm's performance, such as agility (Sambamurthy et al. 2003), knowledge management (Tanriverdi 2005) and supply chain integration capabilities (Rai et al. 2006). The existing literature provides evidence that IT- capability (ITC) is a necessary component for firms which aim to achieve competitive advantage in terms of innovativeness, and they have used organizational resources or capabilities as a mediator to examine the link between ITC and innovation (Chen et al. 2015; Wang et al. 2013). Moreover, Huang and Li (2009) showed that ITC has an indirect effect on a firm's innovativeness through information synergy. Wang et al. (2013) suggested that for the impact of ITC at the firm level, outcomes should be examined by taking into account other organizational resources or capabilities, and they called for more research to investigate the possible effects of other organizational capabilities, such as knowledge management (KM) on the relationship between ITC and innovation performance. Thus, to extract the business value of IT, firms need to apply ITC to harness and exploit their KMC to continually innovate their business products, services and processes so as to enhance the firm's performance.

Several pieces of research have tried to investigate the relation between IT and KM using different theoretical stands. For example, based on the resource based view (RBV), IT is considered as a rare, valuable and appropriable organizational resource, which can lead to a greater breadth and depth of knowledge creation, storage, transfer and application in the organization (Alavi and Leidner 2001;

Wade and Hulland 2004). Many scholars argue that IT applications have affected the KMC of organizations (Joshi et al. 2010; Tanriverdi 2005). As IT has become more powerful, many organizations invest more on the technical aspect to manage its KMPs (Lyengar et al. 2015). Different kinds of ITC have different characteristics and attributes, which can lead to different outcomes and effectiveness (Wade and Hulland 2004). For instance, the levels of the appropriability, imitability and mobility attributes for IT infrastructure resource are high, while the levels of these three characteristics in the IT business relationship are low-medium. Therefore, the different kinds of ITC may affect KMC on different levels. The Telecom sector has a particularity in how ITC is deployed (both IT and telecom infrastructure), how knowledge is generated and how it is used to support innovation. This paper blends the dynamic capability (DC) theory and RBV to identify the factors that might better explain the innovation performance at the firm level. Companies need to understand how to build their ITC and KMC necessary for innovation and use them to support rather than hinder that innovation. The aim of this study is to understand how an organization's IT and KM capabilities can affect innovation (products or services) within the Jordanian telecom sector and in particular, exploring how ITC can capture knowledge that is used in KMPs to aid innovation. In this paper, IT-based KMC is proposed as an accumulation of both IT and KM capabilities after which we aim to examine the status of this capability and how it enhances a firm's innovation by introduction of new products or services into the market.

The remainder of this research paper is organized into the following sections: First, a literature review with a more detailed explanation around IT capabilities enabling firms' innovation, KM capabilities enabling firms' innovation and IT capabilities enabling KM capabilities. Then, the research focus and questions, followed by a description of the methodology of the present study. Finally, we conclude the paper with the anticipated theoretical and practical contribution(s).

## 2. LITERATURE REVIEW

### 2.1 Information Technology Capabilities Enabling Firms' Innovation

IT is a key source for obtaining KMC, innovation, and competitive advantage (Bharadwaj 2000; Chen et al. 2015; Tanriverdi 2005; Wang et al. 2013). According to Bharadwaj (2000), ITC refers to the "abilities to mobilize and deploy IT-based resources in combination or co-presence with other resources and capabilities". Wade and Hulland (2004) indicated the characteristics of ITC which could help a firm to achieve superior performance. These characteristics are rarity, appropriability, and non-substitutability. Firms need significant investment in IT resources to develop the capability of innovativeness. IS researchers identified sets of IT-based capabilities from different angles for diverse purposes. For a comprehensive understanding of the role of IT in enhancing innovation performance, tangible and intangible ITC are discussed (Chen et al. 2015; Wang et al. 2013). Chen et al. (2015), using data collected from manufacturing firms in China, identified an indirect effect of ITC (IT infrastructure flexibility, IT integration, IT business alignment, IT management) and product innovation performance through corporate entrepreneurship and competitive intensity. Similarly, using a survey from data collected in China, Wang et al. (2013), found that market orientation mediates the relationship between ITC and innovation performance. Furthermore, IT resources have been discussed as a driving force in a firm's innovation, in terms of both product and process innovation (Tarafdar and Gordon 2007). Consistent with previous studies, the present study selected three kinds of ITC, namely: IT- infrastructure, IT- human and IT- business relationship and focuses on how these three kinds of ITC affect innovation indirectly through the development and enablement of the knowledge flows among business units. Previous studies have shown that collaboration among team members significantly enhances team creativity (Tushman and O'Reilly 1997). It fosters exchange of information, and opinions and allows team members to progressively and actively build upon each other's understanding. Creative teams can rapidly process and assimilate knowledge from many different sources and apply it to the ideation process. IT is a critical enabler of collaboration capability in organization. Particularly, internet-based technologies such as portals, wikis, communication applications (e.g., e-mail), forums, blogs, and social networking sites are instrumental that allow users to share knowledge irrespective of time, distance or geography (Kleis et al. 2012). The more knowledge exchange and collaboration between people in the firm, newer ideas, products and processes will be developed. Moreover, in the context of data-rich environment, technological infrastructure can help firms to extract new ideas or understanding about their products, customers, and markets which are crucial to innovation (Tan et al. 2015). Technologies that are required for data analytics include data warehouse, online analytical processing tools, Hadoop, and MapReduce (Chaudhuri et al. 2011). IT-human skills are not only better equipped to anticipate and address future business needs of the firm,

but also are better able to innovate valuable new product features before competitors and achieve intangible benefits such as customer satisfaction (Bharadwaj 2000).

## 2.2 Knowledge Management Capabilities Enabling Firms' Innovation

Knowledge has been considered a source of competitive and sustainable advantage in organizations (Ruggles 1998). However, Grant (1991) argued that organizational resources by their own are not productive, they require the cooperation and coordination of teams of resources. Thus, the capacity of a group of resources to perform some tasks or activities is considered a capability that can result in competitive and sustainable advantages (Grant 1991). A firm's KMC refers to the ability of the company to identify, mobilize, deploy, and leverage knowledge resources with other capabilities or resources across functional boundaries (Chuang 2004). KMC can help companies in promoting innovation, improving market responsiveness, reducing information and knowledge redundancy, all leading to improving a firm's performance (Liao et al. 2011). A review of previous studies has identified different dimensions of KMC. Two categorizations are noteworthy; on the one hand, Gold et al. (2001) categorized KMC from the infrastructure view and developed three dimensions of capabilities, namely: technology, culture and structure. On the other hand, Gold et al. (2001) categorized KMC from the process view. They categorized KMC into four dimensions, namely: knowledge acquisition, conversion, application, and protection. KMPs are defined as the degree to which the firm creates, shares, and utilizes knowledge resources across functional boundaries. KMPs complement and support each other. KMPs enable organizations to capture external knowledge, leverage existing knowledge to create new knowledge and make them valuable (Alavi and Leidner. 2001; Gold et al. 2001), which will lead to the development of new products or processes. Focusing on knowledge flows among organizational units, knowledge management also enables organizations to create and leverage cross-unit knowledge synergies, which are critical for innovation and performance (Alavi and Leidner 2001; Tanriverdi 2005). Table 1 describes the four dimensions of knowledge processes that taken into account in this study.

| <b>Variables</b>   | <b>Definition</b>   | <b>Author(s)</b>                          |
|--------------------|---|---|
| <b>Creation</b>    | Refers to the activities for developing new content or replacing existing content within the interactions of tacit and explicit knowledge. There are four modes of knowledge creation through the interactions of tacit and explicit knowledge: 1) socialization, 2) externalization, 3) internalization, and 4) combination. | Alavi and Leidner. (2001); Nonaka (1991). |
| <b>Storage</b>     | Is a process of structuring and storage of knowledge.   | Alavi and Leidner (2001).                 |
| <b>Transfer</b>    | Refers to disseminate knowledge throughout a firm to foster productivity and innovation.  | Lee et al. (2013)                         |
| <b>Application</b> | Refers to the process of the actual use of knowledge. The application of knowledge enables organizations to continuously translate their organizational expertise into embodied products.   | Gold et al. (2001); Alavi and Leidner.    |

*Table 1. Knowledge management processes*

The existing literature suggests that knowledge processes have an impact on innovation. For example, Nonaka (1991) report that companies that score high in knowledge creation or in revealing already existing knowledge, have also been successful, in the creation of new markets, rapid development of new products, quick response to their customers and domination in emergent technologies, which in turn culminates in innovation. Moreover, intra-organizational knowledge sharing, refers to the moving of existing knowledge between different organizational actors, both within and between departments and hierarchical levels (Bhatt 2001). Knowledge sharing is considered as a critical factor in an organization's ability to respond quickly to change, innovate and achieve successful competitive advantage (Cohen and Levinthal 1990; Taminian et al. 2009). All the knowledge that has been acquired, created and shared needs to be stored and documented, otherwise an organization will be in danger of losing the acquired knowledge. Bhatt (2001) states that an organization will struggle to retain its competitive advantage, innovativeness, and creativity if the needed knowledge has not been made easily available in the right kind of format.

## 2.3 IT Capabilities Enabling KM Capabilities

Researchers have associated KMC with the development of IT (Tanriverdi 2005). IT can support KMC in sundry ways. IT provides effective search and retrieval of knowledge and information within the organization and facilitates collaboration, coordination and communication among functional areas or

departments, thereby leading to effective knowledge transfer (Alavi and Leidner 2001; Lyengar et al. 2015). Thus, there is influence by the different types of ITC on KMC. Each dimension of ITC is briefly described below.

IT infrastructure capability refers to the computer and related digital communication technology foundation of an organization and can support KMC in various ways. Firstly, a high level of IT infrastructure resource enables creation of a wider breadth and depth of knowledge flows along the KMPs (Alavi and Leidner 2001). New knowledge is crucial in developing innovative ideas for new products and services. Knowledge management systems are information systems supporting and enhancing the creation, transfer and use of knowledge, and nurturing innovation (Alavi and Leidner 2001). Technology can enhance the integration and application of knowledge by embedding two dimensions of knowledge, which are tacit and explicit knowledge, into organizational routines. Secondly, Tanriverdi (2005) showed that IT infrastructure enhances the knowledge exchange between business units in an organization. A shareable technical platform and database could guarantee accurate, real-time and comprehensive knowledge and information for communication between organizational members, which facilitates the process of knowledge acquisition, transfer and use of information (Bharadwaj 2000; Ross et al. 1996). Thirdly, the development of IT infrastructure resources changes the traditional technology base for knowledge management. For instance, the penetration of cloud computing and Web 2.0 technologies offer a flexible infrastructure for organizational members to share knowledge and information across different business units and gain the appropriate amount of knowledge and information that is stored in the system very quickly and in an efficient way, which then increases the firm's ability to respond quickly in a rapidly changing environment (Bhatt and Grover 2005; Sultan 2013). Furthermore, the advent and extensive use of IT, especially the communication networks, the internet, extranet and intranet have brought a fast, agile and convenient method of acquisition, sharing, and storing of knowledge (Mohamed et al. 2006).

IT human capability means the technical and managerial IT skills of the organizational members (Bharadwaj 2000). With a valuable IT human resource, organizational members can address business problems and maximize opportunities through IT (Ross et al. 1996). The technical IT skills of organizational members allows firms to design and develop reliable applications that support the business needs for effective and efficient knowledge flows (Melville et al. 2004). The ability to integrate and maintain multiple systems guarantees a wide breadth and depth of knowledge flows and thereby leads to effective knowledge creation, storage, transfer and application in the organization. Managerial IT skills involves the ability to identify and manage IT functions towards success (Bharadwaj 2000). With a high level of managerial IT skills, organizations could obtain a high business understanding of IT functions and coordinate activities associated with knowledge processes efficiently (Ross et al. 1996; Tseng 2008). Therefore, with a high level of IT human resource, organizations are able to integrate IT and knowledge management strategies, thereby increasing competitive advantage (Bhatt and Grover 2005). Previous research concluded that innovation is a critical component for firms to create value and sustain competitive advantage (Subramaniam and Youndat 2005).

IT business relationship capability refers to the relationship between the IT function and other functional areas or departments of the organization, which reflects the level of mutual respect and willingness to share risk and responsibility for the effective application of IT in the firm (Ross et al. 1996). A strong IT business relationship capability indicates that the members of the IT staff communicate, coordinate, negotiate, collaborate and share with competitors, customers, suppliers, and other business partners. This relationship allows all the business units from the possible effective use of IT. Bhatt and Grover (2005) concluded that the interaction between IT groups and other functional groups allows for knowledge diffusion and flow throughout the organization. During collaboration, coordination and communication, organizations can easily create, share, and use knowledge from customers, suppliers and other business partners, thus creating new ideas within the organization that leads to new products or services.

### **3. RESEARCH FOCUS**

From the review of previous literature, IT contribution and assistance in supporting and building a firm's knowledge capabilities has been recognized (Alavi and Leidner 2001; Tanriverdi 2005). The link between KMCs and a firm's innovation has been emphasized (Moos et al. 2013; Yayavaram and Chen 2015). Yet, limited research has been done on the link between IT and innovation, mainly the impact of a particular technology on a particular category of innovation. Each mobile operator in Jordan uses different IT tools for supporting and enhancing the organizational processes of knowledge creation,

storage/retrieval, transfer and application, which would foster innovation at their organizations. For example, they are using knowledge maps, query software and search engines that can help identify, collect and extract useful knowledge from a wide variety of knowledge resources, databases and data warehouses to help them to store various forms of data, information and knowledge. Business intelligence tools such as data mining and analytical software allow them to transform existing data to gain new insights and knowledge, while also using groupware can support internal networks to help enhance the knowledge flows among the organizational units, such as research and development (R&D) and marketing units to develop innovation. Thus, our study will attempt to fill the gap in literature between IT and innovation by exploring the different IT tools that are used to support KMPs, which would improve or foster different levels of innovation (products or services) for different organizations within the same sector. Moreover, the foundation for generating any IT business value is the link among the three core dimensions: IT infrastructure, IT human, and IT business relationship (Melville et al. 2004). However, most prior works focused on the IT infrastructure angle, neglecting the other IT capabilities. In the present study, our focus will be not just on the IT infrastructure aspects but rather the other capabilities of IT, such as IT human, and IT business relationship, which have received less attention in the IS literature. The main objective of this research paper is to investigate the interrelationships between different ITC and innovation in the Jordanian telecom industry. Furthermore, the mediating effects of KMC on the relationships are another objective as described in Figure 1.

In this research, we address the gaps in knowledge mentioned above by answering the following research questions. The general research question is: Can IT capabilities support innovation in the Jordanian telecom industry directly or indirectly through knowledge management capability? Below are the specific research questions:

1. What is the impact of IT capabilities on a firm's innovation in the Jordanian telecom sector?
2. How do different types of IT capabilities affect knowledge management capability?
3. How does knowledge management capability improve innovation for the Jordanian telecom industry?
4. Does knowledge management capability have a mediating role in the relationship between IT capability and innovation?

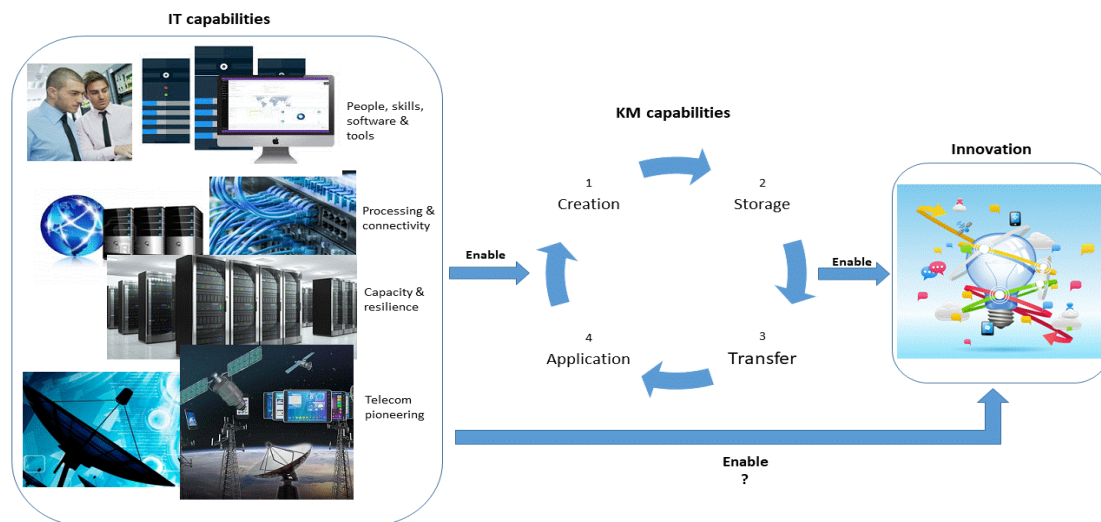


Figure 1: Research conceptual model

## 4. RESEARCH METHODOLOGY

This research uses an empirical method of investigating the role of IT-based KMC in fostering innovation in the Jordanian telecom sector. The approach of this investigation involves using a qualitative method. The qualitative method is rooted in interpretive methodological principles. This study will use a multiple case studies approach, which enables researchers to closely examine the data within a specific context. It is suitable for understanding in-depth how telecom companies use IT and KM capabilities, and how their use enhances a firm's innovation. We used the multiple case study

method because, in order to understand the possible relationships between IT-based KMC and innovation, we need to describe specific organizational contexts of innovation (product or process) and analyse the role of IT in them. Accordingly, we used a multiple case study methodology that will help us to identify common patterns from multiple innovation instances from more than one organization. The targeted population of this study consisted of all mobile telecommunication companies in Jordan. The mobile telecommunication industry in Jordan has shown immense growth in recent years and it is considered as one of the most competitive markets in the Middle East. According to the Competition Intensity Index (2014) released by Arab Advisors Group, Jordan's mobile market is the second most competitive in the region after Saudi Arabia. According to the official statistical sources of the Ministry of Communication and Information Technology (2011), there are three licensed mobile operators in Jordan: Zain, Umniah, and Orange. According to a recent index produced by Arab Advisors Group (2014), Zain Jordan has the largest market share with 40% of the market, followed by Orange Jordan with 31%. Then there's Umniah, the latest entrant that has 29% of the market share.

The present study will involve in-depth interviews with key staff working in Jordanian mobile telecommunication companies within the IT, R&D and marketing departments. The job titles for these staff will include the chief technology officer (CTO), IT-director, IT-manager, middle manager of IT, senior manager of IT, R&D director and marketing manager in order to collect the required qualitative data. Business executives from these telecom companies were identified as ideal subjects, because they are familiar with the situation regarding innovation in their firms and are also in a good position to report upon ITC and KMC. Interviews are one of the most extensively used methods of data collection (Bryman and Robert 1999). The individual in-depth interviews that will be conducted in this present study will be of a face-to-face, semi-structured nature, which is one of the most common approaches in qualitative research. The aim of this study is to seek information from the most influential and knowledgeable participants. Qualitative research enables the researcher to consider people's attitudes towards the research topic. Using ITC for generating knowledge to enhance innovation requires an understanding of the perceptions and attitudes of participants who have experienced the phenomenon. Each interview is expected to last between 60 minutes and 120 minutes and it will be recorded. After the complete set of study data has been collected, each transcript will be read line by line and sentence by sentence several times in order to be coded to analyse the responses of the interviewees. Word processing software will be used to organize and manage the collected data from the interview transcripts. We will apply the ideas of NVivo, a computer software package, to sort and organize data using word software. The coding processes consist of creating word files for each code and collecting all excerpts related to each code in the relevant word file, then creating folders for each category and grouping all the related code files under each category folder and so on.

## 5. EXPECTED THEORETICAL AND PRACTICAL CONTRIBUTIONS

This paper tests the effects of ITC on innovation, and considers the mediating role played by KMC on innovation. By answering the research questions, we expect that this study makes several significant contributions to the foregoing literature in a number of ways. First, this research will show how ITC along with other organizational capabilities, such as knowledge management, can enhance a firm's innovation, and this will fill the gap in the literature on the possible effect of other organizational capabilities or resources on the relationship between ITC and innovation (Wang et al. 2013). Second, in terms of the research object selection, past ITC and KMC related studies chose cases from finance and manufacturing firms in the context of advanced Western countries or newly industrialized Asian countries such as USA, Canada, Taiwan, Hong Kong, and Korea (Gold et al. 2001; Lee and Choi 2003). The telecommunication industry is a major part of Jordan's emerging economy. The industry is witnessing considerable growth and is characterized by fierce competition which makes it a suitable locale for research to investigate the influence of IT-based KMC on innovation within the Jordanian telecom sector. We are hoping to expand the scope of relevant studies on ITC, KMC, and innovation to fill this important gap and serve as a reference to scholars in this area in the future. Third, this research will apply DC theory. This research will highlight that the use of IT alone is not sufficient to gain value, but firms also need dynamic capabilities to continuously reconfigure resources and to integrate IT resources for decision making and to enhance firms' innovation. The results of the present study also have important implications for managers. It will help managers build the right ITC that will facilitate the process of knowledge generation, transfer and use, and which would foster innovation at their organizations.

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