An integrated model of knowledge acquisition and innovation: examining the mediation effects of knowledge integration and knowledge application

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Abstract: The aim of this research is to empirically investigate the relationships among the three vital knowledge management processes of acquisition, integration and application, and their effects on organisational innovation in the pharmaceutical manufacturing industry in Jordan; a knowledge-intensive business service (KIBS) sector. Structural equation modelling findings show an excellent fit among all these processes and innovation, with positive and significant relationships. Moreover, knowledge integration and knowledge application emerged as having strong and significant mediation effects upon the relationship between knowledge acquisition and innovation. As such, an organisation’s innovation efforts would significantly benefit from the synergistic effects of properly integrating and applying externally acquired knowledge. The findings make a valuable contribution to pharmaceutical knowledge management and innovation literature, especially in an era of open innovation. Pharmaceutical companies are advised to focus on developing proficient assimilation and application capabilities in order for acquired knowledge to have notable effects on their innovation performance.

Keywords: knowledge acquisition; knowledge integration; knowledge application; innovation; knowledge management; structural equation modelling; KIBS; knowledge intensive business sector; pharmaceutical industry, Jordan.

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1 Introduction

The increasing complexity and uncertainty characterising today’s business environment have rendered old bases for achieving competitiveness as merely obsolete. World-wide encompassing phenomena reflected in globalisation, rapid knowledge and technological advances, and the pressure for differentiation and customisation, have created a context in which the onus is on continuous adaptation, change, and innovation (Brown and Eisenhardt, 1995; Gold et al., 2001; Walters and Rainbird, 2007). As such, those firms with greater innovation will be more successful in responding to changing conditions and developing new capacities to achieve better performance (Montes et al., 2004; Chen et al., 2010). These unfolding realities have led to an orientation towards innovation-based competition, as well as a deep recognition of the importance of intangible, knowledge-based resources and the way these are generated, developed and applied, in enabling firms to sustain distinctive competencies and explore innovation opportunities (Grant, 1996; Teece et al., 1997; Chen, 2004; Chen et al., 2010). Consequently, economic thought witnessed a paradigmatic shift in how value and wealth can be created, from emphasising the fundamental role of tangible, traditional factors of production, to focusing on effectively managing knowledge assets (Andriessen, 2004; Goh, 2005; Teece, 2007). This ultimately paved the way for the emergence of what has become known as ‘the post-industrial knowledge economy’, which informs the contemporary bases for building and sustaining a formidable competitive advantage (Drucker, 1993; Romer, 2004; Liao et al., 2010).

Such a transition became a major concern for industry practitioners and academicians alike, leading them to consider an organisation’s ability to effectively manage knowledge resources, through proficient acquisition, integration, absorption and application, to be instrumental in bestowing upon it an innovation-based advantage. As such, Goh (2005) argues that innovation management (IM) and knowledge management (KM) should not be viewed as two mutually exclusive concepts, but rather, KM processes are often seen as constituting a generic process through which organisations generate value-added innovations from knowledge-based resources (Jang et al., 2002). This is further supported by a growing volume of studies, which has reiterated the vital contributions of these two inherently inseparable concepts to an organisation’s competitive performance and new product success (e.g., Carneiro, 2000; Gloet and Terziowski, 2004; Darroch, 2005; Basadur and Gelade, 2006; Lundvall and Nielsen, 2007; Chen et al., 2010; Xu et al., 2010; Amalia and Nogrohu, 2011; Andreeva and Kianto, 2011; Kianto, 2011).

Despite the growing acknowledgement of knowledge management’s vital contribution to enhancing innovation, most extant studies have not provided clear guidance as to what particular knowledge processes are believed to have the most significant effects (Chapman and Magnusson, 2006; Bueno et al., 2008). Further research into the interactions among a firm’s knowledge processes, on one hand, and between these processes and innovation, on the other, is very much called for (Jantunen, 2005; du plessis, 2007; Andreeva and Kianto, 2011). This might be due to the simple, direct
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impacts proposed between a few knowledge management processes and innovation, without enriching the examination of such effects with the possibility of the existence of mediated relationships.

In particular, Liao et al. (2010) highlight the somewhat superficial and simplistic assumption of a direct, unmediated influence of knowledge acquisition on innovation capability. Although an organisation’s systematic efforts to acquire new knowledge, information, ideas and insights are believed to support its ability to develop new products, processes and know-how, however, more needs to be done to exploit the potential that such knowledge may hold. Proficient assimilation and application of acquired knowledge is needed to observe notable effects on an organisation’s innovation performance. Dahiyat and Al-Zu’bi (2012), for example, have found that an organisation’s absorptive capacity fully mediates the relationship between its knowledge acquisition efforts and involving its customers in product development, thus highlighting the complex nature of managing externally acquired knowledge so as to unlock its potential in the vein of enhancing an organisation’s innovative efforts. As such, the existing theoretical literature addressing the study of knowledge management within the context of innovation suggests that knowledge management processes are highly interrelated and overall have an important impact on organisational innovation. However, an examination of empirical literature shows that evidence in this regard is still developing and that a fair amount of discrepancy and lack of coherence as to the details of these relationships still exists (Jantunen, 2005; Subramaniam and Youndt, 2005; Andreeva and Kianto, 2011). For that reason, drawing conclusions and putting forward recommendations based on the extant literature pointing to particular knowledge practises or processes believed to clearly and significantly impact innovation efforts should be made with caution (Darroch, 2005).

In this regard, important calls have been made to focus on empirically developing integrative research frameworks and models that examine possible mediated relationships (Coombs and Hull, 1998; Lee and Choi, 2003; Lee and Lee, 2007; Xu et al., 2010; Andreeva and Kianto, 2011). Such inclusive frameworks are believed to be more useful in addressing practical issues pertaining to managing knowledge for innovation (Xu et al., 2010), especially that few previous studies have empirically examined the impact of an inclusive set of fundamental knowledge processes on innovation (Darroch and McNaughton, 2003; Darroch, 2005). In response to these calls, this research aims to develop and empirically test an integrated conceptual model that examines the interrelationships among the three knowledge management processes of knowledge acquisition, knowledge integration, and knowledge application, and innovation. This is believed to offer guidance and practical implications for managers and organisations intent on better understanding the intricacies surrounding the nature of relationships and effects among these constructs, thus clarifying the relative importance of such knowledge processes in supporting innovation.

While the interconnectedness between knowledge management processes and innovative performance is recognised in numerous industries, it is far more critical in the case of the knowledge intensive business service (KIBS) sector. As Howells and Tether (2004) have indicated, the KIBS sector is increasingly being considered as the main contributor to innovation. This is evidenced by the fact that the majority of studies examining the impact of knowledge management processes on innovation are based on empirical data obtained from knowledge-intensive firms, such as biotechnological, pharmaceutical, and Information and Communications Technologies
In essence, the concept of knowledge intensity reflects a firm’s critical dependence on the effective employment of knowledge in its value creation processes as a source of competitive advantage (Nurmi, 1998; Autio et al., 2004). As such, knowledge does not only serve as the key input into knowledge-intensive firms’ main activities, but is also reflected in the main outputs delivered by these firms (Simmie and Strambach, 2006). Another important characteristic of knowledge-intensive firms is their heavy investment in Research and Development (R&D) activities in the vein of establishing strong knowledge-based core competencies. These firms also benefit greatly from the intense interactions with other intra-industry as well as inter-industry organisations to support knowledge acquisition, development, and transfer (Simmie and Strambach, 2006; Tseng et al., 2011).

On the basis of this, the operating characteristics of such firms place a great emphasis upon the effective management of knowledge, through undertaking a number of processes aiming at creating and utilising knowledge-based resources (Nurmi, 1998; Pappa et al., 2009), in an effort designed to support value-creating activities that aim at developing new products or services (Tseng et al., 2011). Hence, it is believed that the more knowledge-intensive a company is, the more intense are its knowledge creation, acquisition, integration, and application processes (Andreeva and Kianto, 2011).

The pharmaceutical industry is considered a prime example of a KIBS sector, where continuous investment in and exploitation of knowledge-based resources is key to supporting business optimisation, innovativeness and competitiveness (Styhre et al., 2001; Ingelgård et al., 2002; Mohan et al., 2007; Pappa et al., 2009; Mehralian et al., 2013). Continuous innovation has long been the hallmark of the pharmaceutical industry, where a knowledge- and research-intensive innovation process is often considered one of its most defining characteristics. Critical conditions that firms operating in this industry need to build and sustain their competitive advantages include “Research on the forefront of science, the creation of new knowledge bases, the invention of new medicines, and the improvement of existing drugs ….” (Petrova, 2014, p.20). These explain the magnitude of the industry’s R&D activity, which – according to Petrova (2014) – accounts for a remarkable 19% of all business spending on R&D worldwide.

However, the pharmaceutical industry has recently been facing serious challenges worldwide, which are particularly reflected in a notable decline in: innovation, R&D productivity represented by cost and time of bringing new medicines to the market, as well as value added to patients and shareholders. All of these have brought into questioning the continued viability of the ‘blockbuster’ business model characterised by high investment in a few, patent-protected, high-revenue products, which has defined the operating philosophy of firms operating in the industry for decades (Senderovitz, 2009; Chesbrough, 2011; McIntyre, 2014). As Chesbrough (2011) explains, the blockbuster model is considered a closed, vertically integrated model of innovation, where all value-adding activities are performed by the firm. Despite its historic effectiveness, this model is plagued with extremely high fixed costs associated with the costly process of developing new drugs, patent expiry risks, and the fact that most pharmaceutical firms follow it.

The solutions are believed to lie in rethinking the way innovation is approached, in terms of making it more ‘open’ (Chesbrough, 2003; 2011), and less imitative and more value adding through ‘disruptive innovation’ (Christensen, 1997; Johnson et al., 2008).
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On one hand, the pharmaceutical industry has been witnessing the opening up of the innovation process, through the formation of strategic alliances, partnerships, and joint ventures. These collaborative arrangements with public and private sector partners, including companies, academic and research institutions, government, and non-governmental organisations, are quickly becoming an integral part of how the pharmaceutical industry operates, highlighting the increasingly important role of cooperative rather than competitive business strategies in enhancing the competitiveness of firms operating in such an industry (Johnson et al., 2008; Bolen et al., 2009; Senderovitz, 2009; Chesbrough, 2011; Ansell, 2013; McIntyre, 2014; Petrova, 2014). In fact, the practise of outsourcing and forging strategic alliances with partner R&D organisations, particularly contract research organisations (CROs), has been taking place in the pharmaceutical industry since the early 1980s, with outsourcing accounting for over a quarter of all pharmaceutical R&D expenditures by 2010 (Ansell, 2013).

The value of such collaboration lies in the joint sharing of cost, know-how, expertise, and intellectual property (IP), resulting in an enhanced innovation process and innovative products/technologies. Such an approach to innovation is known as ‘open innovation’ signalling the emergence of a promising business model for reinvigorating pharmaceutical innovation, thus replacing the closed, ‘one-of-a-kind, blockbuster’ approach to product innovation (Chesbrough, 2003, 2011; Chiaroni et al., 2009; Senderovitz, 2009; McIntyre, 2014).

The basic premise underlying open innovation is that external knowledge exists in abundance outside a firm’s boundaries, and is waiting to be harnessed and exploited in the vein of supporting organisational innovation (Chesbrough, 2003). However, such external knowledge does not just filter smoothly through organisational boundaries. As such, openness to and acquisition of externally generated knowledge is considered to be critical, particularly for firms operating in knowledge-intensive and/or high-technology industries (Lavie, 2006; Sirmon et al., 2007; Teece, 2007). In this sense, open innovation facilitated through external knowledge acquisition and subsequent integration and application is believed to result in performance-enhancing innovations for the firm (Van Wijk et al., 2008; Chesbrough, 2011). Such an open model of innovation is a reflection of the open system view of organisations and their intrinsic dependence on the external environment for resources, most important of which are knowledge-based ones (Jones, 2013).

Disruptive innovation, on the other hand, holds potential in enabling the pharmaceutical industry to respond to unprecedented challenges reflected in declining value delivered to patients and shareholders, through introducing innovative products/technologies that replace outdated ones. Such innovations are neither imitative nor incremental, but rather displace existing products/technologies with more useful, valuable ones that are more accessible and affordable; thereby making them available to a much larger customer segment/population previously ignored by incumbent businesses (Christensen et al., 2006; Johnson et al., 2008; Bolen et al., 2009; Wessel and Christensen, 2012). In this way, disruptive innovations are more in tune with the dynamic nature of knowledge-intensive industries, since they serve as an important force that helps create new markets and value networks, thus reinvigorating the whole industry.

On the basis of the above, this study seeks to achieve its aforementioned aim in the context of the pharmaceutical industry in Jordan, due to the innovative and knowledge-intensive nature of such an industry as highlighted above. Accordingly, this paper is structured as follows: starting with a discussion of different conceptualisations
and models of innovation and its types, section two develops the research theoretical model, by identifying and discussing the possible effects of the three KM processes of knowledge acquisition, knowledge integration, and knowledge application on organisational innovation. It then formulates the research hypotheses examining relationships among these KM processes, on one hand, and between these processes and innovation, on the other. Decisions pertaining to research methodology and design, including constructs’ operationalisation and their validity and reliability through exploratory and confirmatory factor analyses (EFA) and (CFA), are presented in section three. Section four demonstrates the empirical findings from structural equation modelling analysis. Section 5 provides discussion, contributions, and conclusions.

2 Research theoretical model and hypotheses development

2.1 Conceptualisations and models of innovation

From reviewing the extant literature, it becomes obvious that there is no dominant model or theory addressing innovation, with different efforts offering various conceptualisations and dichotomies of the concept. Some of these models were original in introducing novel concepts and terms, while others have built and elaborated upon earlier work. What is of interest to this study are those conceptualisations of innovation that emphasise the utilisation of knowledge in value creation reflected in innovative products, services, processes, know-how and managerial systems, i.e., organisational innovation. These are discussed in the following paragraphs.

One of the earliest conceptualisations of innovation is that of Schumpeter (1934), who describes it as being responsible for instigating waves of ‘creative destruction’, where the development of new products and technologies over time renders current ones obsolete. This leads to the restructuring of markets and industries in favour of those firms that are able to grasp the innovation effort, resulting in significant economic returns. Another pioneering innovation model is the Incremental-Radical Innovation Dichotomy, which is considered one of the most popular models that addressed the main types of innovation, considering them as measuring the degree of innovation. Different terminologies were used by different authors to refer to these two types. For example, while Abernathy (1978) – amongst others – distinguished between incremental and radical innovation, others, such as Porter (1986), used the terms “continuous and discontinuous technological changes”. In a similar vein, Tushman and Anderson (1986) identified two main patterns of technological change, which they called “incremental and breakthrough technological innovations”. Accordingly, technology evolves through periods of incremental changes punctuated by technological breakthroughs that either enhance or destroy the competence of firms in an industry.

Two dimensions are often used here to distinguish between an incremental (continuous) and a radical (discontinuous; breakthrough) innovation. According to the ‘internal’ dimension, an incremental innovation is one that is built upon existing knowledge, skills, and resources and, as such, is regarded as a ‘competence-enhancing innovation’. A radical innovation, on the other hand, is based on completely new knowledge, skills, and resources and will, therefore, be ‘competence-destroying’. The second dimension is an ‘external’ one that differentiates between the two types of innovation according to the extent of technological changes incurred and their impact on
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existing products and their competitiveness in the market. As such, an incremental innovation involves little technological changes that often enhance the product’s performance and competitiveness, whereas a radical one entails significant technological changes that outperform existing products and render them as obsolete and non-competitive (Garcia and Calantone, 2002; Chuang, 2005).

Henderson and Clark (1990) elaborated upon the incremental-radical innovation dichotomy, by dividing the technological knowledge required to develop new products into: knowledge of the components of the product, and knowledge of the way in which these components are integrated together to build the product itself, i.e., architectural knowledge. Accordingly, an incremental innovation builds upon existing component and architectural knowledge. A modular innovation is the result of new technological knowledge for one or more components, with architectural knowledge remaining unchanged. Architectural innovation entails significantly changing the linkage of components making up the product, without changing component knowledge. Lastly, a radical innovation revolutionises both component and architectural knowledge by significantly changing the make and build up of the product itself.

Owing to the rapid technological advancements witnessed by many industries, particularly high technology and knowledge-intensive ones, the focus shifted more towards the term: ‘technological discontinuity’, whereby an innovative technology is introduced by means of radical innovation that replaces an outdated one. The promulgation of the phenomenon of ‘technological discontinuity’ gave way to the emergence of Christensen’s (1997) ‘Disruptive Innovation’ theory, which refers to innovations that help create a new market and value network, and eventually disrupt an existing market and value network (over a few years or decades), displacing an earlier technology. In this way, disruptive innovations are an important force, in that they make useful, valuable products/services that are more accessible and affordable; thereby making them available to a much larger customer segment/population previously ignored by incumbent businesses (Christensen et al., 2006).

The above conceptualisations and dichotomies of innovation clearly focus on: the subject of innovation, whether it is the development of technologies, products/services and/or processes, and the degrees or extents of such development, ranging from incremental to radical. In this context, however, there is a need for an overall organisational approach to innovation that reflects its aforementioned aspects (scope: product, process, technology, and managerial systems; degree: incremental and radical) in enhancing value creation at the organisation’s level. Such an approach is the widely accepted ‘organisational innovation’ one (Damanpour, 1991; West and Anderson, 1996; Wang and Ahmed, 2004; Chen et al., 2010), and the one adopted in this paper. Accordingly, organisational innovation includes two main aspects: technical and administrative. Technical innovation is primarily concerned with the development and commercial exploitation of value-added outputs, processes, and technologies that are directly related to the organisation’s core activities. These include products, services, know-how, and production/service delivery process technology. As such, technical innovation includes both product/service innovation and process innovation. Administrative innovation, on the other hand, is more related to the development and introduction of new managerial philosophies, initiatives and practises and, thus, deals with the design of the organisation and its work systems, structure, and administrative activities (Damanpour and Evan, 1984; Damanpour, 1991). Both types of organisational
innovation: technical and administrative, encompass incremental and radical degrees of innovation.

2.2 Key knowledge management processes affecting innovation

The innovation process essentially requires learning, as it facilitates both: the development of new knowledge and its integration with useful existing knowledge. The effective application of the resulting knowledge is then manifested in new forms of value for the organisation and its stakeholders, including new ideas, products, processes and know-how (Calantone et al., 2002; Soo et al., 2002; Baregheh et al., 2009). In this way, the innovation process is intrinsically associated with the ability to deal with knowledge, through undertaking basic knowledge management activities reflected in knowledge acquisition, integration, and application (Luecke and Ralph, 2003; Law and Gunasekaran, 2009). Therefore, knowledge management processes stand out as critical enablers to achieving successful long-term innovation (Darroch, 2005; Jantunen, 2005; Chapman and Magnusson, 2006; Bueno et al., 2008). This becomes more evident in the context of KIBS sectors, where the process of innovation is essentially seen as a knowledge-dependent one, in which new knowledge is created, integrated with existing knowledge, and applied through a number of sequential activities starting from idea generation and passing through invention and commercialisation (Trott, 2005; Andreeva and Kianto, 2011). On the basis of this, for a firm to be able to effectively enhance its innovation performance and competitiveness, it need not only create new knowledge but it should also be able to develop a proficient ability to effectively utilise it (Johannessen et al., 1999; Abou-Zeid and Cheng, 2004). The duality of creating and utilising knowledge has come to define one of the most important tasks of the firm, according to the knowledge-based view of the firm (Grant, 1996; Teece et al., 1997; Jantunen, 2005), without which value-creating activities supporting organisational innovation would be seriously undermined. This has led academics and practitioners alike to focus on those KM processes deemed vital for both: creation and utilisation of knowledge (Lee and Lee, 2007).

An understanding of the intricacies associated with the knowledge creation process can help in explaining and clarifying the roles of knowledge acquisition, integration, and application within such a process and how they complement each other. The lack of such an understanding, as Bergman et al. (2004) point out, has contributed to problems in developing and exploiting useful knowledge, especially in knowledge-intensive organisations. Knowledge creation is often described as a complex process that involves a number of KM practises working in tandem and in a synergistic way. These often start with acquiring useful externally-generated knowledge, through valuable boundary spanning activities reflected in the formation of collaborative, inter- as well as intra-organisational knowledge sharing networks (Nonaka et al., 2000). To effectively integrate the externally acquired knowledge, firms need to be proficient at internalising it through combining the new knowledge with their existing knowledge base. Without this crucial step of knowledge integration, it becomes quite difficult to utilise externally generated knowledge (Jantunen, 2005). All of these practises are believed to significantly support the capacity of the organisation to generate and create novel forms of value that support its innovation performance (Grant, 1996; Jantunen, 2005; Aramburu et al., 2006; Nonaka et al., 2006; Bueno et al., 2008).
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As such, knowledge processes associated with communicating, sharing and integrating acquired knowledge lie at the heart of knowledge creation (Bock et al., 2005; Bueno et al., 2008; Liu and Liu, 2008). In particular, knowledge integration was found to have a significant influence on the creation of knowledge by allowing information to be assimilated and transformed into useful knowledge, thus constituting the ability to understand and take action (Kogut and Zander, 1992, 1996; Grant, 1996; Moreno-Luzon and Lloria, 2008). In the extant literature, knowledge integration has been referred to in the context of knowledge creation both: explicitly (e.g., Kogut and Zander, 1996; Grant, 1996; Teece, 1998; Bergman et al., 2004; Matusik and Heeley, 2005; Kenney and Gudergan, 2006; Ouyang, 2008), as well as implicitly. For example, Nonaka et al. (2000) mention combination and internalisation as two of four processes used for creating knowledge. While combination is concerned with combining discrete pieces of explicit knowledge held by individuals, internalisation refers to the broadening of individuals’ knowledge base by converting explicit knowledge into tacit knowledge. Zahra and George (2002) build on the notion of combination by developing the third dimension of their absorptive capacity construct. ‘Transformation’, which they explain, refers to organisational routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge. In addition, Jantunen (2005) highlights the need for firms to internalise externally generated knowledge and then combine it with the existing knowledge base, in an effort designed to prepare it for being applied in decision making and value-adding activities. The result is effectively integrated knowledge, which is described by Thomas et al. (2001) as ‘enculturated knowledge’, considering it to be an essential part of knowledge creation.

2.3 Relationships between knowledge management processes (knowledge acquisition, knowledge integration, knowledge application) and innovation

2.3.1 Knowledge acquisition and innovation

Many have acknowledged the vital role of external knowledge sources in supporting the innovation process (Cohen and Levinthal, 1990; Caloghirou et al., 2004; Jantunen, 2005; Dahiyat and Al-Zu’bi, 2012). This is mainly due to a number of imperatives characterising contemporary business environments, such as ever-changing customer needs, hyper-competitive industries and markets, and rapid technological changes. Hence, sustaining innovation activities has become extremely dependent on the organisation being continually open and exposed to various sources of external information and knowledge (du Plessis, 2007; Xu et al., 2010). This is supported by contemporary research on the sources of innovation, which found that most innovations nowadays are more dependent on borrowing (i.e., acquiring knowledge) rather than inventing (i.e., creating knowledge internally), exemplified by ‘open innovation’ (Chesbrough, 2003). Hence, collaborative arrangements and knowledge-sharing networks between an organisation and its stakeholders, particularly its value-chain partners, have proliferated encompassing customers, suppliers, strategic alliance partners, and other complementary stakeholders as initiators of product and process development and improvement (Johnson et al., 2008; Chesbrough, 2011). Since acquiring knowledge is the initiating activity in the process of knowledge creation and management, effective and purposeful acquisition of new knowledge will
significantly enhance administrative and technical innovation (Fabrizio, 2009; Liao et al., 2010). This places the emphasis upon developing proficient knowledge acquisition capabilities consisting of activities and mechanisms designed for maintaining active communication and liaison with key stakeholders and value chain partners (Gold et al., 2001). In addition, effective innovation that delivers enhanced customer value requires careful recognition of the value and relevance of new external information and knowledge before actually getting involved in their capture (Cohen and Levinthal, 1990; Zahra and George, 2002). Coupled with the need to target valuable and relevant external knowledge is to ascertain that organisational members are able to assimilate and understand information and knowledge obtained from external sources. These two aspects have led to the adoption of the absorptive capacity concept earlier mentioned so as to guide the organisation’s knowledge acquisition effort in support of an organisation’s innovation activities (Cohen and Levinthal, 1990; Thomas et al., 2001; Zahra and George, 2002; Dahiyat and Al-Zu’bi, 2012).

On the basis of the above discussion, to the extent that an organisation develops a broad and active network of collaborative relationships and arrangements, it is expected to have wider exposure to best practises and complementary knowledge. This, in turn, would enhance both: the effectiveness and efficiency of its knowledge acquisition processes, and its individuals’ absorptive capacities, thus significantly supporting organisational innovation (Gold et al., 2001; Zahra and George, 2002; du Plessis, 2007). The reason being that organisations proficient at acquiring external knowledge from a variety of sources are believed to accumulate richer and higher quality knowledge bases (Cohen and Levinthal, 1990; Fabrizio, 2009; Andreeva and Kianto, 2011). On the basis of this, it is hypothesised that:

\[ H1: \text{There is a positive and significant relationship between knowledge acquisition and innovation.} \]

2.3.2 Knowledge integration and innovation

Although knowledge acquisition capability is considered crucial for creating and managing knowledge, supporting organisational innovation requires additional complementary knowledge-related activities and processes. Acquired and captured knowledge is often in raw form and is need of assimilation and integration for it to be properly absorbed and incorporated into organisational capabilities and competencies. This requires the conversion of newly-acquired information and knowledge into a transferable form and sharing it among organisational members so that it can be effectively combined with existing knowledge. Such an ability to combine and integrate existing and new knowledge into a useful form is essential for the effective undertaking of innovation activities (Kogut and Zander, 1992; Grant, 1996; Zahra and George, 2002; Jantunen, 2005; Xu et al., 2010).

The fundamental role of knowledge integration in building and renewing an organisation’s innovative capabilities has been particularly addressed by Grant’s (1996) “Knowledge-Based Theory of Organisational Capability”. The theory is based on the premise that knowledge embedded in individual organisational members in specialised forms, such as skills, expertise and know-how, is the foundation of capabilities and competencies. However, for organisational capability to be formed and built, such collective specialised knowledge residing in individuals must be integrated. When
knowledge, particularly tacit knowledge, is effectively shared and exchanged among those organisational members who possess it, it becomes internalised in the organisation’s existing repository of knowledge through the resulting collective learning and synergistic benefits, thus significantly enriching the organisation’s collective knowledge stock and capital (Nonaka and Takeuchi, 1995; Youndt et al., 2004; Wu et al., 2008; Elsetouhi and Elbeltagi, 2011; Seleim and Khalil, 2011). In this way, innovation is generated in an interactive social communication process, in which a variety of specialised knowledge-based resources are shared, combined, and absorbed within an organisational setting (Kogut and Zander, 1992; Tsai et al., 2001; Autio et al., 2004; Brachos et al., 2007; Chen et al., 2010).

The sharing of tacit knowledge for innovation is especially important in knowledge-intensive industries, such as biotechnology and pharmaceuticals, as du Plessis (2007) points out, where not a lot of explicit knowledge exists. In this context, knowledge, both partially codified and tacit, is effectively exchanged, shared, combined, evolved, and refined via cross-functional project teams, which allow for dialogue, cross-fertilisation of ideas and insights, reflection, and sense making (Gold et al., 2001; Bergman et al., 2004; Darroch, 2005; Matusik and Heeley, 2005). Ultimately, this is expected to significantly support innovation capabilities and lead to the development of value-added products (du Plessis, 2007).

Moreover, continuous regeneration of organisational capabilities, through active knowledge integration and reconfiguration, has paved the way for the emergence of the concept of ‘Dynamic Capabilities’, further highlighting the vital contribution made by knowledge integration and re-integration in sustaining an organisation’s innovation-based advantage (Teece et al., 1997; Eisenhardt and Martin, 2000). Building on that, organisational innovation heavily derives from the organisation’s proficient ability to integrate knowledge through both: developing new combinations of and associations among existing knowledge resources, or what is known as ‘reconfiguring existing knowledge’, as well as combining newly acquired knowledge with existing knowledge (Kogut and Zander, 1992; Grant, 1996). Integrating knowledge through these two main mechanisms enhances the value and relevance of created knowledge, which stimulates the generation of new ideas for new products, services, and processes (Tsai, 2001). On the basis of this, it is hypothesised that:

**H2: There is a positive and significant relationship between knowledge integration and innovation.**

2.3.3 Knowledge application and innovation

Effective utilisation and application of knowledge represents the cornerstone behind the success of organisational innovation, as innovation is essentially seen as the process through which the organisation follows a set of activities designed to enable it to utilise and apply created and learned knowledge to: develop new products/services, managerial systems, technologies, and processes; solve new problems; improve overall performance and productivity; and modify any aspects of its business (Damanpour, 1991; Ibarra, 1993; Almeida, 1996; Gold et al., 2001; Jantunen, 2005; Chen et al., 2010; Xu et al., 2010).

It is a mistake to assume that merely acquiring and creating knowledge is sufficient for effective innovation to ensue. In other words, an organisation’s effective ability to acquire and create knowledge does not necessarily mean that one can assume that such knowledge will be applied effectively in the vein of supporting organisational innovation.
activities (Nonaka and Takeuchi, 1995; Gold et al., 2001). In fact, a pertinent theme in
the innovation literature is the emphasis placed upon the importance of developing
processes specifically designed to utilise external knowledge sources in innovation
activities (Chesbrough, 2003). Innovation, as Gold et al. (2001) point out, is the result of
application-based processes that are oriented toward the actual use of newly created
knowledge. A firm that lacks the necessary capabilities to effectively exploit acquired
and created knowledge and incorporate it into valuable new or improved products,
processes, and technological know-how, will not be able to sustain a high degree of
innovation (Cavusgil et al., 2003; du Plessis, 2007). In fact, firms would not be able to
sustain their competitiveness if they failed to harness and apply their knowledge-based
resources in value-creating activities.

As such, one of the most important tasks of the firm, according to the
knowledge-based view, is the duality of knowledge creation and utilisation (Grant, 1996;
Teece et al., 1997; Jantunen, 2005; Tseng et al., 2011), as today’s hyper competitive
environment has compelled business firms to make full use of their knowledge-based
resources so as to support innovative activities (Jantunen, 2005; Brachos et al., 2007).
Particular emphasis is placed here upon how firms apply rather than create knowledge, as
knowledge creation provides the potential for value creation, but knowledge usage
realises it. On the basis of this, it is hypothesised that:

$H3$: There is a positive and significant relationship between knowledge application
and innovation.

2.4 Mediation effects of knowledge integration and knowledge application
on the relationship between knowledge acquisition and innovation

On the basis of the hypothesised relationships between the three knowledge management
processes of acquisition, integration, and application, and innovation, discussed in detail
in Section 2.3, and in response to important calls in the literature to focus on developing
integrative research models that empirically delineate the relationships among key
knowledge processes in the vein of facilitating innovation, particularly the examination of
possible mediated relationships (Coombs and Hull, 1998; Lee and Choi, 2003; Lee and
Lee, 2007; Xu et al., 2010; Andreeva and Kianto, 2011), this research proposes positive
and significant mediation effects of knowledge integration and knowledge application on
the relationship between knowledge acquisition and innovation. Although the role of
knowledge acquisition in supporting innovation activities is necessary and important,
nevertheless, it is not considered to be alone sufficient for knowledge creation and
organisational learning to take place (Argote and Ingram, 2000), as acquired knowledge
needs to be assimilated and integrated with existing organisational knowledge and
capabilities for tangible benefits to be realised (Grant, 1996; Zahra and George, 2002;
Ethiraj et al., 2005; Kotabe et al., 2011). Externally acquired knowledge may not increase
new product market performance if such knowledge is not integrated and transformed
into valuable useful form. As such, it is believed to have a more indirect than direct role
in enhancing innovation and new product performance (Darroch and McNaughton, 2003;
Jantunen, 2005). Other processes and structures are also needed in innovation activities.

In essence, innovation is seen as an organisation-wide endeavour whose purpose is to
enable the organisation to generate value through critical processes primarily concerned
with creating and utilising knowledge. A firm that is active and proficient at accessing a
A variety of knowledge sources and bases, as well as acquiring knowledge that is vital and relevant to its operations from such sources, will be able to enrich and support its knowledge integration activities with focused and relevant newly-acquired knowledge. This is believed to significantly enhance the relevance, value, and quality of the newly created knowledge, which results from combining and integrating existing knowledge with recently acquired one, as well as reconfiguring existing organisational capabilities. The resulting knowledge, in turn, will serve as the input to the knowledge application process in the form of ready-to-be-used assimilated knowledge. Knowledge application is responsible for the optimal utilisation and exploitation of organisational knowledge-based resources in developing new products/services, processes, know-how and/or modifying existing ones. Therefore, based on a cause-and-effect logic, the value of the forms in which the knowledge will be utilised and applied (i.e., products/services, technologies, processes, managerial decisions) will be inherently determined by the effectiveness and outcomes of both: the knowledge integration as well as the knowledge acquisition processes (Grant, 1996; Argote, 1999; Zahra and George, 2002; Liao et al., 2010; Kotabe et al., 2011; Dahiyat and Al-Zu’bi, 2012).

Given the aforementioned discussion, organisations with proficiency in acquiring, integrating, and applying knowledge are expected to be more capable of enhancing and sustaining their innovation than those that lack effective knowledge processing capabilities. On the basis of this, it is hypothesised that:

- **H4**: There is a positive and significant relationship between knowledge acquisition and knowledge integration.
- **H5**: There is a positive and significant relationship between knowledge acquisition and knowledge application.
- **H6**: There is a positive and significant relationship between knowledge integration and knowledge application.
- **H7**: The relationship between knowledge acquisition and firm innovation is mediated by knowledge integration and knowledge application.

On the basis of the aforementioned discussion concerning the development of the research model and its hypotheses (Section 2), Figure 1 depicts the proposed research model.

**Figure 1** The research model
3 Research methodology

3.1 Research design and population

This research is designed to investigate the relationships among three key knowledge management processes and organisational innovation. Accordingly, a KIBS sector was chosen as the population for this study, which mainly consisted of all the twenty-six (26) pharmaceutical manufacturing companies operating in Jordan. Each of the 26 pharmaceutical manufacturing companies was invited to participate in the research questionnaire-based survey, through contacting the human resources department in each of these companies. Twenty-one (21) out of twenty-six (26) companies agreed to participate, which represented 80.7% of the whole population. The unit of analysis consisted of knowledge workers who held managerial positions in each of the participating companies, including those in the top management level (i.e., executive managers), the middle management level (i.e., managers of main divisions), the lower management level (i.e., heads of departments and supervisors), as well as employees. Consequently, multiple respondents at different managerial levels within each pharmaceutical manufacturing company were targeted by the survey since knowledge management functions, in terms of knowledge acquisition, integration, sharing, dissemination, and application, are undertaken collectively through ‘organisation-wide’ efforts rather than being the sole or individual responsibility of a specific work unit or person. The same rationale applies in the case of organisational innovation, whether it is related to products/services, managerial systems, processes, and/or technologies. In this way, including multiple respondents in the survey would ensure higher representativeness and reduce bias.

3.2 Research constructs operationalisation

After developing the research model and hypotheses, there is a need to measure the main variables under investigation in order to gather primary data for the purpose of testing the research model and hypotheses. After reviewing relevant studies, a number of items were developed to measure the research constructs and their respective dimensions. Table 1 shows constructs’ measurement items and their sources of operationalisation.

3.2.1 Knowledge acquisition

Knowledge acquisition refers to the capacity of the organisation to obtain externally-generated knowledge that is available outside its boundaries. Key dimensions of such capacity include: Maintaining active communication and liaison with external environmental parties, nurturing multiple ties and contacts with them, and ensuring access to new ideas and information from diverse external sources. These emanating from the consideration of organisations as open systems that are in a continuous state of interaction with their external environments, acquiring knowledge from external sources is emphasised as a primary means for knowledge creation (Sirmon et al., 2007; López-Sáez et al., 2010; Dahiyat and Al-Zu’bi, 2012). The knowledge and expertise of an organisation’s stakeholders and value chain partners (i.e., customers, suppliers, competitors, and partners) can well complement its knowledge resources and compensate for any gaps or shortages (Yli-Renko et al., 2001; Kotabe et al., 2011). Moreover, the
emergence of the concept of absorptive capacity has complemented organisational knowledge acquisition efforts and enhanced their effectiveness, through emphasising the importance of assessing the value and relevance of externally acquired knowledge, as well as facilitating its assimilation and interpretation, on the part of organisational members covering diverse functional backgrounds (Cohen and Levinthal, 1990; Zahra and George, 2002). On the basis of this, six items (KA1–KA6) were developed in order to measure the ‘knowledge acquisition’ construct after a review of relevant literature (Cohen and Levinthal, 1990; Thomas et al., 2001; Zahra and George, 2002; Jantunen, 2005; Moreno-Luzon and Lloria, 2008; Ouyang, 2008) (see Table 1).

<table>
<thead>
<tr>
<th>Knowledge acquisition: KA1–KA6</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA1 The organisation is keen on facilitating knowledge flows between itself and the external business environment, by actively communicating with its most influential stakeholders</td>
<td>Cohen and Levinthal (1990), Thomas et al. (2001), Zahra and George (2002), Jantunen (2005), Moreno-Luzon and Lloria (2008) and Ouyang (2008)</td>
</tr>
<tr>
<td>KA2 Core team members are selected for their multiple ties and contacts, which enable them to access diverse and remote sources of information and knowledge</td>
<td></td>
</tr>
<tr>
<td>KA3 The organisation accesses, collects, and acquires new ideas and information from diverse external sources in its business environment, including its customers, suppliers, competitors, and partners</td>
<td></td>
</tr>
<tr>
<td>KA4 The organisation has in place internal routines and processes that allow its individuals to analyse, process, interpret, and understand the information obtained from external sources</td>
<td></td>
</tr>
<tr>
<td>KA5 Individual members of the organisation from different subunits hold discussions, interact, and communicate together, whenever there is a need to understand and comprehend certain information and knowledge acquired from outside the organisation</td>
<td></td>
</tr>
<tr>
<td>KA6 The organisation is keen on seeking assistance from its highly skilled individuals to enrich its learning experience</td>
<td></td>
</tr>
</tbody>
</table>

| Knowledge integration: KI1–KI5 | |
|-------------------------------| |
| KI1 Our organisation is efficient in accessing and benefiting from the specialist knowledge held by individual organisational members, through facilitating interaction and mutual cooperation amongst them | Grant (1996), Bergman et al. (2004), Matusik and Heeley (2005), Kenney and Gudergan (2006) and Ouyang (2008) |
| KI2 Our organisation is proficient at combining and integrating new knowledge with existing knowledge | |
| KI3 The organisation focuses on integrating the various functional experiences and backgrounds through establishing cross-functional teams that link its different departments and divisions | |
| KI4 The organisation is keen on eliminating barriers to interaction among its different functional departments and divisions, in order to support the sharing and exchange of knowledge within the firm | |
| KI5 The organisation is capable of modifying existing capabilities and building new ones for future needs | |
Table 1  Measurement of the research constructs (continued)

<table>
<thead>
<tr>
<th>Knowledge application: KAPP1–KAPP8</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAP1 My organisation depends on its past experience in modifying its products, strategies, and behaviours</td>
<td>Gold et al. (2001), Almeida (1996), and Jantunen (2005)</td>
</tr>
<tr>
<td>KAP2 My organisation undertakes a set of activities designed for using the available knowledge in the development of new products</td>
<td></td>
</tr>
<tr>
<td>KAP3 My organisation undertakes a set of activities designed for using the available knowledge to solve new problems</td>
<td></td>
</tr>
<tr>
<td>KAP4 My organisation uses the available knowledge to improve its productivity</td>
<td></td>
</tr>
<tr>
<td>KAP5 My organisation develops mechanisms for storing and retrieving the available knowledge</td>
<td>Gold et al. (2001), Almeida (1996), and Jantunen (2005)</td>
</tr>
<tr>
<td>KAP6 The organisation is keen on exploiting newly developed ideas in order to improve its managerial systems</td>
<td></td>
</tr>
<tr>
<td>KAP7 The organisation is effective at exploiting acquired knowledge in improving its performance</td>
<td></td>
</tr>
<tr>
<td>KAP8 The organisation is proficient at converting acquired knowledge and expertise into new and/or improved products, services, and strategies</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Innovation: INNOV1–INNOV3</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>INNOV1 The organisation develops new products/services</td>
<td>Chen et al. (2010), Damanpour (1991), and Ibarra (1993)</td>
</tr>
<tr>
<td>INNOV2 The organisation develops its managerial systems</td>
<td></td>
</tr>
<tr>
<td>INNOV3 The organisation develops the technology that it uses (equipment, information systems, processes, know-how)</td>
<td></td>
</tr>
</tbody>
</table>

3.2.2 Knowledge integration

Following a strategic perspective, knowledge integration is derived from Grant’s (1996) “knowledge-based theory of organisational capability”, which emphasises the importance of an organisation’s capacity to integrate the diverse knowledge bases and skills held by its individual members in building and renewing organisational capability. Such an integrative capacity of knowledge consists of three main aspects, which are: the efficiency of integration, which represents the extent to which the organisation is capable of accessing and utilising the specialist knowledge held by its individual members; the scope of integration, which refers to the ability to combine and integrate new knowledge with existing knowledge bases; and the flexibility of integration, which refers to the extent to which an organisation can modify existing capabilities and build new ones through accessing and integrating additional knowledge.

In this way, knowledge integration is linked to the creation of knowledge, through facilitating the communication, exchange, sharing, and eventual integration of specialised knowledge and expertise among individuals belonging to diverse functional backgrounds (Kogut and Zander, 1992, 1996; Darroch, 2005; Matusik and Heeley, 2005; Kenney and Gudergan, 2006; Liu and Liu, 2008). Particular inference is made in this context to cross-functional coordination and integration mechanisms (Bergman et al., 2004; Moreno-Luzon and Lloria, 2008; Ouyang, 2008), especially teams that are interdisciplinary in nature. Based on the aforementioned discussion, five items (KII–K15)
were developed in order to measure the ‘knowledge acquisition’ construct after a review of relevant literature (Grant, 1996; Bergman et al., 2004; Matusik and Heeley, 2005; Kenney and Gudergan, 2006; Ouyang, 2008) (see Table 1).

3.2.3 Knowledge application

Knowledge application refers to organisational processes concerned with facilitating the actual use of available knowledge-based resources and capabilities in order to take advantage of emerging business opportunities, as well as improve certain aspects of product-market performance (Davenport et al., 1998; Gold et al., 2001). Examples include harnessing ideas, expertise, and know-how to modify and/or develop new products, services, processes, and strategies, enhance the quality of the decision-making process, and sustain overall competitive performance. Accordingly, eight items (KAP1-KAP8) were developed in order to measure the ‘knowledge application’ construct based on a review of relevant literature (Almeida, 1996; Gold et al., 2001; Jantunen, 2005) (see Table 1).

3.2.4 Innovation

Innovation in this study refers to organisational innovation, which refers to an overall organisational approach to enhancing value creation (Damanpour, 1991; West and Anderson, 1996; Wang and Ahmed, 2004; Chen et al., 2010), through the generation, development and exploitation of new ideas in the forms of new products/services, processes (technologies, know-how, equipment, information systems), and managerial systems (Damanpour, 1991; Ibarra, 1993; Liao et al., 2007; Chen et al., 2010). On the basis of this, a three-item scale (INNOV1–INNOV3) was developed to measure the extent to which the firm is capable of effectively developing innovations in terms of new products, new processes, and new management systems and procedures (see Table 1).

3.3 Research instrument design and primary data collection

After developing measurement items for the research constructs, a research instrument in the form of a structured self-completion questionnaire was developed and delivered to the pharmaceutical manufacturing companies in order to gather primary data to test the research model and hypotheses. All the research constructs were measured on five-point Likert-type scale ranging from ‘never’ to ‘rarely’, ‘sometimes’, ‘mostly’, and ‘always’. A small section was also included to study the respondents’ and companies’ characteristics. Next, the questionnaire underwent rigorous refereeing as part of a pilot stage, in order to ensure its face and content validity and to examine the appropriateness of the developed items in measuring the research constructs. This was done by referring to five experienced academics in two reputable business schools in Jordan specialised in the areas of knowledge management, strategic management, and innovation management. The pilot stage was insightful, in that a number of amendments were carried out on the first draft of the questionnaire concerning content, wording, repetition of meaning, design, and layout. After that, the questionnaire was translated from English to Arabic, and the translation was reviewed by the same academics to ascertain that both copies conveyed the same meanings and were accurate translations of each other. The objective
here was to ensure that all participants understood the intended meaning accurately in their native language.

The questionnaires were personally delivered to a total of two hundred and forty-five (245) respondents. Each respondent was asked to indicate the extent to which the content of each questionnaire item is practised in their respective companies. The respondents were reminded several times via telephone calls and emails to ensure that as many respondents participated in the study as possible. Overall, primary data collection spanned a time period of seven weeks. Questionnaires were then collected by the researcher and a number of assistants by hand. Out of two hundred and forty-five (245) questionnaires delivered, two hundred and three (203) valid and useable questionnaires were returned; thus resulting in a response rate of 82.8%.

3.4 Respondents’ characteristics

As evident in Table 2, the majority of the surveyed pharmaceutical manufacturing companies are both: well established in their field of operation (57.6% have at least 20 years of experience), and are of relatively large size (68% employing at least 100 employees). This is believed to add value and insight to the responses provided, reflecting wide managerial and operational experiences, particularly since experience plays a vital role in accumulating knowledge management-related capabilities and skills associated with the capturing and translation of knowledge into innovative products/services and know-how. Furthermore, nearly half of the respondents (49.8%) enjoy relatively high levels of experience, with a minimum number of 10 years reaching to more than 20 years. The distribution of respondents according to their managerial positions was proportional to the relative sizes of the three managerial levels (8.8% occupied positions in the top management level; 11.8% in the middle level; 59.7% in the lower level; and 19.7% non-managerial employees). Also, most respondents are well educated holding undergraduate and postgraduate degrees (65.5% with a bachelor’s degree; 21.2% with either a master’s or a doctoral degree).

3.5 Validity and reliability

The face and content validity of the research instrument were assessed through a pilot study phase, which included five academics in two reputable business schools in Jordan specialised in the areas of knowledge management and strategic management. Additionally, the opinions of four managers working in two pharmaceutical manufacturing companies operating in Jordan were sought to evaluate the clarity and relevance of the questionnaire items. The content validity of the developed questionnaire was assured by thoroughly examining relevant empirical and theoretical studies related to the main research variables (see Table 1).

With regard to construct validity, as recommended by Hair et al. (1998), exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to assess construct validity. Thus, EFA was performed to test components of the knowledge acquisition, knowledge integration, knowledge application and innovation constructs, in terms of identifying patterns among the items used to measure these constructs. Moreover, CFA, derived from structural equation modelling (SEM), was also utilised to confirm or refine the unidimensionality of measurements that resulted from the EFA, since it is a more rigorous test of unidimensionality (Garver and Mentzer, 1999, p.40).
To assess the EFA, four commonly used assumptions were followed (Hair et al., 1998; Field, 2009):

- sampling adequacy (Kaiser–Meyer–Olkin measure >0.5)
- the minimum eigenvalue for each factor to be one
- considering the sample size, factor loading of 0.40 for each item was considered as the threshold for retaining items to ensure greater confidence
- varimax rotation was used since it is a good general approach that simplifies the interpretations of factors (Field, 2009, p.449).

To assess the CFA, goodness of measurement model fit using SEM were followed (Chau, 1997, p.318): Chi-square \( \chi^2 \) \((P \geq 0.05)\); goodness-of-fit index (GFI ≥ 0.90); adjusted goodness-of-fit index (AGFI ≥ 0.80); normed fit index (NFI ≥ 0.90); non-normed fit index (NNFI ≥ 0.90); comparative fit index (CFI ≥ 0.90); standardised root mean-square residual (SRMR ≤ 0.08); and root mean square error of approximation (RMSEA < 0.10). Factor loadings are the correlations of the variables with the factor, the weighted combination of variables which best explains the variance. Higher values (e.g., more than 0.40) make the variable representative of the factor (Hair et al., 1998, p.106).

Table 3 shows the results of EFA for the components of knowledge acquisition, knowledge integration, knowledge application, innovation. An index of Kaiser’s measure of sampling adequacy (overall MSA = 0.703) and Bartlett’s test of Sphericity Chi-square \((P \leq 0.000)\) suggested that factor analysis is appropriate for analysing the data. On the basis of the eigenvalue greater than 1, a four-factor model emerged that explains 68.414% of the total variance. After examining the pattern matrix of the EFA, all items had loadings greater than 0.4 and communalities greater than 0.5. The first factor, with 52.176% of the total variance, was labelled ‘Knowledge Integration’ and includes eight items (KA4, KA5, KA6, KI1–KI5). As earlier indicated in sub-Section 4.2, items KA4, KA5, KA6 were not among those items originally developed to be as part of the measurement of that factor but rather as part of ‘Knowledge Acquisition’, and have unexpectedly loaded onto factor one. However, it is such incidents that warrant the conducting of further analysis in the form of CFA, which was also undertaken in this study since it provides a more rigorous test of unidimensionality (Garver and Mentzer, 1999, p.40). Discussion of CFA results will follow after discussing EFA results. The second factor, with 6.718% of the total variance, was labelled ‘Knowledge Application’ and includes seven items (KAP1-KAP7), thus excluding one of the items originally developed to measure this construct, which is KAP8. The third factor holds 4.921% of the total variance, and was labelled ‘Knowledge Acquisition’ and includes four items (KA1–KA3, and KAP8). As evident in Table 3, items KA4-KA6, which were among those items originally developed to measure ‘Knowledge Acquisition’, were excluded and have loaded onto factor one labelled ‘Knowledge Integration’. Also, one of the items originally developed to measure ‘Knowledge Application’ (KAP8) has loaded onto this factor ‘Knowledge Acquisition’. Lastly, a fourth factor resulted from EFA with 4.598% of the total variance, and was labelled ‘Innovation’ and includes the three items originally developed to measure this construct without any additions or deletions (INNOV1–INNOV3).
Table 2  Research respondents’ characteristics

<table>
<thead>
<tr>
<th>Respondents’ characteristics</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company size – number of employees</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 40 employees</td>
<td>13</td>
<td>6.4</td>
</tr>
<tr>
<td>40 – less than 70 employees</td>
<td>22</td>
<td>10.8</td>
</tr>
<tr>
<td>70 – less than 100 employees</td>
<td>30</td>
<td>14.8</td>
</tr>
<tr>
<td>100 – less than 130 employees</td>
<td>17</td>
<td>8.4</td>
</tr>
<tr>
<td>130 employees and above</td>
<td>121</td>
<td>59.6</td>
</tr>
<tr>
<td><strong>Company experience – number of years in the pharmaceutical industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>5 – less than 10 years</td>
<td>14</td>
<td>6.9</td>
</tr>
<tr>
<td>10 – less than 15 years</td>
<td>26</td>
<td>12.8</td>
</tr>
<tr>
<td>15 – less than 20 years</td>
<td>43</td>
<td>21.2</td>
</tr>
<tr>
<td>20 – less than 25 years</td>
<td>38</td>
<td>18.7</td>
</tr>
<tr>
<td>25 years and above</td>
<td>79</td>
<td>38.9</td>
</tr>
<tr>
<td><strong>Respondent’s managerial position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior managers</td>
<td>18</td>
<td>8.8</td>
</tr>
<tr>
<td>Divisional managers</td>
<td>24</td>
<td>11.8</td>
</tr>
<tr>
<td>Heads of departments</td>
<td>90</td>
<td>44.4</td>
</tr>
<tr>
<td>Supervisors</td>
<td>31</td>
<td>15.3</td>
</tr>
<tr>
<td>Employees</td>
<td>40</td>
<td>19.7</td>
</tr>
<tr>
<td><strong>Respondent’s educational level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td>Two years diploma</td>
<td>23</td>
<td>11.3</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>133</td>
<td>65.5</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>39</td>
<td>19.2</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Respondent’s experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>51</td>
<td>25.1</td>
</tr>
<tr>
<td>5 – less than 10 years</td>
<td>51</td>
<td>25.1</td>
</tr>
<tr>
<td>10 – less than 15 years</td>
<td>52</td>
<td>25.6</td>
</tr>
<tr>
<td>15 – less than 20 years</td>
<td>29</td>
<td>14.3</td>
</tr>
<tr>
<td>20 years and above</td>
<td>20</td>
<td>9.9</td>
</tr>
<tr>
<td>Total</td>
<td>203</td>
<td>100</td>
</tr>
</tbody>
</table>

To confirm and validate the findings that emerged from using EFA, the four-factor model components were evaluated by CFA using EQS 6.1 software. Table 3 shows the four-factor model and a summary of the model goodness-of-fit, which were all met. As shown in Table 3, all items loadings emerging from CFA well exceeded the cut-off point value; 0.60. Items with non-significant factor loadings, high measurement errors and low factor loadings when compared with the suggested 0.60 threshold were deleted.
An integrated model of knowledge acquisition and innovation

(Hair et al., 1998). Also, certain items were deleted since this significantly improved the model’s goodness-of-fit, and was also sound theoretically. Consequently, three items (KA4–KA6) were deleted during CFA from ‘Knowledge Integration’, two items (KAP6, KAP7) were deleted from ‘Knowledge Application’, one item (KAP8) was deleted from ‘Knowledge Acquisition’, and all three items measuring ‘Innovation’ (INNOV1–INNOV3) have loaded onto one factor without any additions or deletions.

Convergent validity is examined by using the Bentler–Bonett normed fit index (NFI) (Bentler and Bonett, 1990). As shown in Table 3, the four-factor CFA model has an NFI value that equals 0.90. Furthermore, indication of the measures’ convergent validity is provided by the fact that all factor loadings are significant and that the scales exhibit high levels of internal consistency (Gerbing and Anderson, 1988). Also, as shown in Table 3, the values of composite reliability and average variance extracted (AVE) for each construct are all above the threshold: 0.70 and 0.50, respectively.

**Table 3**

<table>
<thead>
<tr>
<th>Knowledge integration</th>
<th>EFA results</th>
<th>CFA results</th>
<th>Average variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KA4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The organisation has in place internal routines and processes that allow its individuals to analyse, process, interpret, and understand the information obtained from external sources</td>
<td>0.564</td>
<td>11.479</td>
<td>Deleted</td>
</tr>
<tr>
<td><strong>KA5</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual members of the organisation from different subunits hold discussions, interact, and communicate together, whenever there is a need to understand and comprehend certain information and knowledge acquired from outside the organisation</td>
<td>0.695</td>
<td>Deleted</td>
<td>0.84*</td>
</tr>
<tr>
<td><strong>KA6</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The organisation is keen on seeking assistance from its highly skilled individuals to enrich its learning experience</td>
<td>0.755</td>
<td>Deleted</td>
<td>0.84*</td>
</tr>
<tr>
<td><strong>KI1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our organisation is efficient in accessing and benefiting from the specialist knowledge held by individual organisational members, through facilitating interaction and mutual cooperation amongst them</td>
<td>0.574</td>
<td>0.77</td>
<td>0.84*</td>
</tr>
<tr>
<td><strong>KI2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our organisation is proficient at combining and integrating new knowledge with existing knowledge</td>
<td>0.689</td>
<td>0.78*</td>
<td></td>
</tr>
<tr>
<td><strong>KI3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The organisation focuses on integrating the various functional experiences and backgrounds through establishing cross-functional teams that link its different departments and divisions</td>
<td>0.666</td>
<td>0.78*</td>
<td></td>
</tr>
</tbody>
</table>
Table 3  
Exploratory (EFA) and confirmatory factor analyses (CFA) for the research constructs (continued)

<table>
<thead>
<tr>
<th>Knowledge integration</th>
<th>EFA results</th>
<th>CFA results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor loadings</td>
<td>Eigen value</td>
</tr>
<tr>
<td><strong>Knowledge integration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KI4 The organisation is keen on eliminating barriers to interaction among its different functional departments and divisions, in order to support the sharing and exchange of knowledge within the firm</td>
<td>0.704</td>
<td>0.74*</td>
</tr>
<tr>
<td>KI5 The organisation is capable of modifying existing capabilities and building new ones for future needs</td>
<td>0.698</td>
<td>0.84*</td>
</tr>
<tr>
<td><strong>Knowledge application</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KAP1 My organisation modifies its products, strategies, and behaviours in the light of its past experience</td>
<td>0.634</td>
<td>1.478</td>
</tr>
<tr>
<td>KAP2 My organisation uses a set of activities designed for using the available knowledge in development of new products</td>
<td>0.520</td>
<td>0.73*</td>
</tr>
<tr>
<td>KAP3 My organisation uses a set of activities designed for using the available knowledge to solve new problems</td>
<td>0.722</td>
<td>0.80*</td>
</tr>
<tr>
<td>KAP4 My organisation uses the available knowledge to improve its productivity</td>
<td>0.702</td>
<td>0.79*</td>
</tr>
<tr>
<td>KAP5 My organisation stores and retrieves the available knowledge</td>
<td>0.733</td>
<td>0.69*</td>
</tr>
<tr>
<td>KAP6 The organisation is keen on exploiting newly developed ideas in order to improve its managerial systems</td>
<td>0.499</td>
<td>Deleted</td>
</tr>
<tr>
<td>KAP7 The organisation is effective at exploiting acquired knowledge in improving its performance</td>
<td>0.535</td>
<td>Deleted</td>
</tr>
<tr>
<td><strong>Knowledge acquisition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA1 The organisation is keen on facilitating knowledge flows between itself and the external business environment, by actively communicating with its most influential stakeholders</td>
<td>0.722</td>
<td>0.79</td>
</tr>
<tr>
<td>KA2 Core team members are selected for their multiple ties and contacts, which enable them to access diverse and remote sources of information and knowledge</td>
<td>0.577</td>
<td>0.78*</td>
</tr>
</tbody>
</table>
Table 3  Exploratory (EFA) and confirmatory factor analyses (CFA) for the research constructs (continued)

<table>
<thead>
<tr>
<th>Knowledge acquisition</th>
<th>EFA results</th>
<th>CFA results</th>
<th>Average variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor loadings</td>
<td>Eigen value</td>
<td>Factor loadings</td>
</tr>
<tr>
<td>KA3 The organisation accesses, collects, and acquires new ideas and information from diverse external sources in its business environment, including its customers, suppliers, competitors, and partners</td>
<td>0.787</td>
<td>0.77*</td>
<td>0.77</td>
</tr>
<tr>
<td>KAP8 The organisation is proficient at converting acquired knowledge and expertise into new and/or improved products, services, and strategies</td>
<td>0.511</td>
<td>Deleted</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Innovation

<table>
<thead>
<tr>
<th>Innovation</th>
<th>EFA results</th>
<th>CFA results</th>
<th>Average variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>INNOV1 The organisation develops new products/services</td>
<td>0.844</td>
<td>1.012</td>
<td>0.74</td>
</tr>
<tr>
<td>INNOV2 The organisation develops its managerial systems</td>
<td>0.709</td>
<td>0.83*</td>
<td>0.77</td>
</tr>
<tr>
<td>INNOV3 The organisation develops the technology that it uses (equipment, information systems, know-how)</td>
<td>0.785</td>
<td>0.85*</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Sampling adequacy (Kaiser-Meyer-Olkin measure greater than 0.5):

Model goodness of fit indices results

<table>
<thead>
<tr>
<th>$\chi^2$</th>
<th>GFI</th>
<th>AGFI</th>
<th>NFI</th>
<th>CFI</th>
<th>NNFI</th>
<th>SRMR</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>219.289</td>
<td>0.900</td>
<td>0.812</td>
<td>0.900</td>
<td>0.935</td>
<td>0.920</td>
<td>0.050</td>
<td>0.081</td>
</tr>
</tbody>
</table>

4 Structural model, hypotheses testing, and findings

The analysis began by running a structural equation model depicting the structural paths proposed among the research main constructs, in order to test the research main hypotheses ($H1–H7$) (see Figure 2). The analysis began by creating a direct path from knowledge acquisition to innovation, knowledge integration to innovation, and knowledge application to innovation. Then, a direct path was created from knowledge acquisition to knowledge integration as well as knowledge application. Finally, a direct path was created from knowledge integration to knowledge application. The maximum likelihood method in the EQS 6.1 program was used to examine the structural model. A number of fit indices were used to assess the goodness of measurement model fit (Chau, 1997, p.318; Hu and Bentler, 1999; Martens, 2005): Chi-square ($P \geq 0.05$); goodness-of-fit index (GFI $\geq 0.90$); adjusted goodness-of-fit index (AGFI $\geq 0.80$); normed fit index (NFI $\geq 0.90$); non-normed fit index (NNFI $\geq 0.90$); comparative fit index (CFI $\geq 0.90$); standardised root mean-square residual (SRMR $\leq 0.08$); and root mean square error of approximation (RMSEA $< 0.10$). Table 4 shows that the
model has an excellent fit to the data, where the normed fit index NFI (NFI ≥ 0.90) equals 1.00.

Figure 2 The empirical research model (see online version for colours)

Moreover, the structural results show that all the research hypotheses are supported $H_1 - H_6$ (see Figure 2 and Table 4). The results showed that each of the three KM processes of Knowledge Acquisition, Knowledge Integration, and Knowledge Application has a positive and significant relationship with Innovation (knowledge acquisition $\rightarrow$ innovation: $\beta = 0.23$, $t = 2.930$; knowledge integration $\rightarrow$ innovation: $\beta = 0.20$, $t = 2.245$; knowledge application $\rightarrow$ innovation: $\beta = 0.27$, $t = 3.030$), providing support for $H_1$, $H_2$, and $H_3$, respectively. Knowledge Acquisition also has a strong positive and significant relationship with Knowledge Integration ($\beta = 0.67$, $t = 12.581$), and a positive and significant relationship with Knowledge Application ($\beta = 0.31$, $t = 5.125$), providing support for $H_4$ and $H_5$, respectively. The structural results also show a strong positive and significant relationship between knowledge integration and knowledge application ($\beta = 0.54$, $t = 9.053$), providing support for $H_6$.

In addition, the results show that the strongest significant path in the structural equation model is Knowledge Acquisition $\rightarrow$ Knowledge Integration $\rightarrow$ Knowledge Application, in which the value of $R^2$ is 0.607. The two other significant paths are:
- Knowledge Acquisition $\rightarrow$ Knowledge Integration, in which the value of $R^2$ is 0.444.
- Knowledge Acquisition $\rightarrow$ Knowledge Integration $\rightarrow$ Knowledge Application $\rightarrow$ Innovation, in which the value of $R^2$ is 0.393.

Taken together, these structural findings clearly and strongly provide support for $H_7$, in that although there is a positive and significant relationship between knowledge acquisition and innovation, nevertheless, knowledge integration and knowledge application emerged as having strong and significant mediation effects on the relationship between knowledge acquisition and innovation. In fact, the path linking all of the three KM processes together emerged as the strongest path in the structural model, with an $R^2$ value of 0.607, and was followed by a path linking knowledge acquisition and knowledge integration ($R^2 = 0.444$). The path linking all of the KM processes with innovation followed a similar sequence, beginning with knowledge acquisition, and progressing to integration then application and ending with innovation, with a significant and fairly strong $R^2$ value of 0.393. Furthermore, the Normed Fit Index NFI (NFI ≥ 0.90) score of
1.00 indicates that the model, encompassing the aforementioned paths/relationships, represents the best fit to the data compared with any alternative model. Therefore, these findings clearly and strongly indicate that an organisation’s innovation efforts would significantly benefit from the synergistic effects of properly integrating and applying externally-acquired knowledge.

**Table 4** Summary of structural path model results

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Variables in the paths model</th>
<th>β*</th>
<th>T-Value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Knowledge acquisition → Innovation</td>
<td>0.23</td>
<td>2.930</td>
</tr>
<tr>
<td>H2</td>
<td>Knowledge integration → Innovation</td>
<td>0.20</td>
<td>2.295</td>
</tr>
<tr>
<td>H3</td>
<td>Knowledge application → Innovation</td>
<td>0.27</td>
<td>3.030</td>
</tr>
<tr>
<td>H4</td>
<td>Knowledge acquisition → Knowledge integration</td>
<td>0.67</td>
<td>12.581</td>
</tr>
<tr>
<td>H5</td>
<td>Knowledge acquisition → Knowledge application</td>
<td>0.31</td>
<td>5.125</td>
</tr>
<tr>
<td>H6</td>
<td>Knowledge integration → Knowledge application</td>
<td>0.54</td>
<td>9.053</td>
</tr>
</tbody>
</table>

*Standardised beta coefficients. ** Significant at P < 0.05

Model goodness of fit indices:

<table>
<thead>
<tr>
<th>Desired level</th>
<th>χ²</th>
<th>P</th>
<th>NFI</th>
<th>NNFI</th>
<th>CFI</th>
<th>GFI</th>
<th>AGFI</th>
<th>SRMR</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>P ≥ 0.05</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.80</td>
<td>0.08</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model indices results: Excellent model fit; NFI is 1.00

- Significant paths at the 0.05 level
  - Knowledge acquisition → Knowledge integration
  - Knowledge acquisition → Knowledge application
  - Knowledge acquisition → Knowledge integration → Knowledge application

5 Discussion, contributions, and conclusions

The premise of this study essentially derives from the pre-eminence of the knowledge economy as a contemporary paradigm of economic wealth creation. In light of such a pervasive environmental reality, value is created and sustained through the effective management of knowledge-based resources in the vein of building and sustaining an innovation-based advantage. As such, modern business organisations are compelled to adapt their operating philosophies and set new ‘theories-in-use’ that place the emphasis upon building and sustaining ‘innovation-based’ advantages. In this context, this study has developed and empirically validated a research model that depicts the relationships among three essential knowledge management processes concerned with acquiring, integrating, and applying knowledge, on one hand, and organisational innovation, on the other.

More specifically, structural equation modelling (SEM) results reveal significant positive relationships between:

- each of the three KM processes of acquisition, integration, and application, and innovation
knowledge acquisition on one hand, and each of knowledge integration and knowledge application, on the other, as well as between knowledge integration and knowledge application.

Moreover, knowledge integration and knowledge application emerged as having strong and significant mediation effects upon the relationship between knowledge acquisition and innovation. This is evidenced by the finding that a significant and positive path emerged linking the three aforementioned KM processes and innovation, beginning with knowledge acquisition and ending with innovation, with knowledge integration and application lying at the heart of such a path. This is further supported by the finding that these three KM processes constituted a strong and significant path among them, beginning with knowledge acquisition and ending with knowledge application.

Moreover, the results have shown that the strongest significant relationships are those between knowledge acquisition and knowledge integration, and between knowledge integration and knowledge application. They have also shown that the strongest significant path in the structural model is that linking knowledge acquisition with knowledge integration and knowledge application. These findings strongly support the sequential effects that exist among these three key KM processes. Another strong and significant path emerging from the structural model is the one linking the three KM processes with innovation, thus providing valuable empirical evidence that supports the crucial roles of these processes in enhancing organisational innovation.

A number of conclusions are derived from the aforementioned findings. First, although an organisation’s systematic efforts to acquire new knowledge, information, ideas, and insights support its ability to develop new products, processes, and know-how, more needs to be done to exploit the potential that such knowledge may hold. Proficient assimilation and application of acquired knowledge is needed to observe notable effects on an organisation’s innovation performance. This finding is a clear response to Liao et al. (2010), who highlight the superficial and simplistic assumption that acquiring externally generated knowledge has a direct, unmediated influence on supporting an organisation’s innovation capability. It also highlights the complex nature of managing externally acquired knowledge. As a result, the absorptive capacity concept has emerged due to the realisation that it is not merely sufficient to acquire ready knowledge from outside the firm, but rather, organisational members must be able to assimilate and understand such information and knowledge obtained from external sources. This is believed to significantly facilitate combining existing knowledge and the newly acquired and assimilated knowledge into value-adding activities (Cohen and Levinthal, 1990; Zahra and George, 2002; Dahiyat and Al-Zu’bi, 2012).

These key findings provide strong empirical support to the important and closely associated roles of absorptive capacity and knowledge integration in truly benefiting from externally-generated knowledge and unlocking its potential. More specifically, the literature on absorptive capacity stresses an organisation’s learning capabilities that facilitate the purposeful targeting, communication, sharing, and assimilation of externally acquired knowledge, thus transforming it into useful knowledge that can be successfully integrated for subsequent effective utilisation (Cohen and Levinthal, 1990; Zahra and George, 2002; Chang and Lee, 2008; Moreno-Luzon and Lloria, 2008).

The results also clearly demonstrate the relevance of Grant’s (1996) “knowledge-based theory of organisational capability” and the vital role of knowledge integration in building such capability. In particular, and from an innovation perspective, knowledge
An integrated model of knowledge acquisition and innovation

provides firms with the raw material for innovation, and knowledge integration enables combining shared, but previously disparate, ideas, insights and information conducive to the creation of new products, services, and processes (Cohen and Levinthal, 1990; Kogut and Zander, 1992; Moreno-Luzon and Lloria, 2008). As such, knowledge integration in the vein of building new organisational capabilities and competencies and the modification of existing ones has become one of the fundamental tasks of firms operating in today’s ‘knowledge economy’ (Kogut and Zander, 1992, 1996; Grant, 1996; Teece et al., 1997; Eisenhardt and Martin, 2000), as knowledge without proper integration will not be considered as actionable knowledge that can be later used and exploited. It is the sharing, exchanging, and subsequent integration of knowledge that readies the diverse and often dispersed sets of knowledge bases, which have been acquired, and prepares them for subsequent exploitation and application (Tsai et al., 2001; Brachos et al., 2007; Chen et al., 2010). This important conclusion emanating from the study’s key findings also supports the roles of Nonaka and Takeuchi’s (1995) two processes of combination and internalisation in creating knowledge in firms.

One of the key contributions of this study is the building and empirical validation of an integrated model that illustrates intricate relationships between key knowledge management processes and innovation, which include strong and significant mediation effects as well as direct impacts. As such, this study has significantly contributed to the extant literature where numerous calls have been made urging scholars to build rigorous integrative models that explain important insightful relationships among key knowledge management practises and stipulate how these impact organisational innovation (e.g., Lee and Choi, 2003; Lee and Lee, 2007; Xu et al., 2010; Andreeva and Kianto, 2011). The empirical model has provided further evidence in support of the contention that Knowledge Management and Innovation Management should not be viewed as two mutually-exclusive concepts. Instead, innovation was shown to be a knowledge-based process driven by three key knowledge practises, namely: knowledge acquisition, knowledge integration, and knowledge application. This is in congruence with recent studies that have sought to examine innovation from a knowledge-based view (Darroch and McNaughton, 2003; Darroch, 2005; Jantunen, 2005; Subramaniam and Youndt, 2005; Chang and Lee, 2008; Fabrizio, 2009; Chen et al., 2010; Andreeva and Kianto, 2011; Tseng et al., 2011).

This study provides practical implications to firms intent on enhancing their innovation. Although there is wide agreement among academicians and practitioners alike on the essential role, which knowledge and the way it is managed, plays in supporting the development and improvement of products/services, processes, and know-how, this study specifies the dynamics involved in such management. In particular, and with the abundance of externally-generated knowledge in an era of open innovation, pharmaceutical companies should focus more on how to harness such widely available know-how through developing proficient assimilation and application capabilities in order for acquired knowledge to have notable effects on their innovation performance. In other words, an organisation’s innovation efforts would significantly benefit from the synergistic effects of properly integrating and applying externally-acquired knowledge. In this way, managers working in pharmaceutical manufacturing companies are provided with clear guidance concerning how to better exploit externally acquired knowledge, in the vein of enhancing overall pharmaceutical innovation.

This study has developed an integrated model depicting the relationships among key knowledge processes and organisational innovation, based on data collected from the
pharmaceutical manufacturing industry in Jordan. As such, the findings reached may be subject to limitations since they have been derived from a particular industry in a particular country context. Although the industry surveyed is considered a Knowledge Intensive Business Sector (KIBS) deemed relevant for studies of this type, and that it has in fact been conducted in a developing country context that is in great need for building a knowledge-based economy, as indicated by Bontis (2004), further future studies can be undertaken in other contexts so as to provide necessary validation, whether in terms of other industries (KIBS and non-KIBS), or in different economic contexts.

Acknowledgements

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**Bibliography**


