The mediation effect of innovativeness on knowledge application and organizational innovation: Case of Tunisian companies

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ABSTRACT

Today, the company is becoming more and more aware of the immense power of knowledge, the stakes of which are becoming more and more crucial. However, acquiring, developing and maintaining competitive advantage from internal resources and skills remains the overarching goal for every organization. It is for this reason that it is necessary to put in place a strategic plan for the application of knowledge. This research focuses on the efforts made by companies in terms of knowledge management processes in order to implement innovative solutions. The objective of this research is part of this perspective and aims to examine the relationship between the application of knowledge and organizational innovation by highlighting the mediating effect of innovative capabilities. In order to determine this relationship, a quantitative method was adopted using a total of 252 Tunisian senior managers. The results of the structural equation analysis reveal the existence of a significant influence of knowledge management on both types of technical and administrative organizational innovation.

A B S T R A C T

Today, the company is becoming more and more aware of the immense power of knowledge, the stakes of which are becoming more and more crucial. However, acquiring, developing and maintaining competitive advantage from internal resources and skills remains the overarching goal for every organization. It is for this reason that it is necessary to put in place a strategic plan for the application of knowledge. This research focuses on the efforts made by companies in terms of knowledge management processes in order to implement innovative solutions. The objective of this research is part of this perspective and aims to examine the relationship between the application of knowledge and organizational innovation by highlighting the mediating effect of innovative capabilities. In order to determine this relationship, a quantitative method was adopted using a total of 252 Tunisian senior managers. The results of the structural equation analysis reveal the existence of a significant influence of knowledge management on both types of technical and administrative organizational innovation.

Introduction

The reality of the evolution of new information and communication technologies ((N)ICT) in recent decades has had a profound influence on the progression and modes of organization. A number of researchers from the social world have presented this period at the end of the millennium as the information society. This period is indicated as: “a period of history in which information and information technologies played a primordial role, precursor of a new order, of a major upheaval on the social, economic, and cultural”. (Source: Great Terminological Dictionary, GTD). As a result, in the face of this unpredictable and uncertain environment, businesses are increasingly facing severe challenges in the global environment. This evolution of economies has transformed the true wealth of businesses from the tangible to the intangible. According to Ricardo et al. (2021), it is important to improve the efficiency and sustainability of the organization in order to acquire skills and capabilities of rare and non-imitable value. Mostafa Al-Emran et al. (2020) considered organizations as dynamic processes supported by the interactions of their members for the creation, accumulation and use of knowledge for the improvement of organizational performance.

Marques and Simon (2006) assert that knowledge is the main wealth of an organization which is observed as capital with a recoverable and evaluable economic value. The loss of this knowledge or its poor exploitation potentially leads to organizational failure. This is why knowledge management in companies has become a major issue. For many organizations, achieving a better level of performance depends not only on the successful deployment of tangible assets and natural resources, but also on the effectiveness of knowledge management (Lee and Sukoco, 2007). Thus, among the main reasons why companies invest in knowledge management is the construction of a knowledge base to facilitate the flow of information and knowledge within the company. This is all the more difficult for companies established in developing countries like Tunisia which are increasingly exposed to competition and local and international requirements in terms of competitiveness and innovation. Innovative organizations are subject to pressure from external
factors such as competition, resource shortages and customer demands, or from internal organizational choice, such as obtaining distinctive skills, and increasing the extent and quality of services. In one way or another, the adoption of innovation aims to ensure adaptive behavior to maintain or improve performance. For organizational effectiveness, the organization emphasizes the heterogeneity of rare, valuable, non-substitutable, and inimitable resources and capabilities in the development of distinctive competencies. Thus, the ability of companies to innovate makes it possible to develop different learning habits and innovative skills.

However, there are very few studies in the literature that examine the effects of knowledge translation on the technical and administrative innovation of organizations, and there is no clear model to test the magnitude of this influence (Kör & Maden, 2013). It is in this context that the challenge is to provide an answer to the following central question: What is the impact of the application of knowledge on organizational innovation in Tunisian companies?

It is therefore necessary to answer the subsidiary questions which arise from this, namely:

i. What is the influence of knowledge application on organizational innovativeness? And to what extent does innovativeness influence both types of innovation?

ii. What is the influence of innovativeness on the relationship between the application of knowledge and the two types of innovation (technical and administrative) within Tunisian companies?

This research aims to explain the appropriate use of organizational initiatives, and more particularly knowledge management. For this reason, it is useful to study and define the links that exist between the application of knowledge and the main types of innovations (technical and administrative). It is therefore necessary to study the effect of knowledge application as an independent variable, innovativeness as a mediating variable and organizational innovation as a dependent variable. Accordingly, the main objective of our research is to analyze the influence of knowledge application on technical and administrative innovation with the mediating effect “Organizational innovativeness”.

In order to achieve this objective, it allows us to understand to what extent the application of knowledge can provide added value for any innovative company.

**Literature Review**

**Theoretical and Conceptual Background**

**The application processes**

According to Nonaka and Takeuchi (1998), organizational capacity is defined as the ability to create knowledge so that it can be applied effectively and thus ensure the sustainability of any business. In the literature, the processes associated with the application of knowledge are: storage, retrieval, application, contribution and sharing. Efficient storage and retrieval mechanisms allow the organization rapid access to knowledge. To be competitive, organizations must be able to create, capture and localize organizational knowledge. Additionally, organizational knowledge and expertise must be shared. The most significant example of the importance of knowledge sharing comes from the operating system (Linux) for product development. As a result of this knowledge sharing, functionality grew rapidly and adoption became widespread.

In a discussion, Gold asserted that effective application of knowledge helps businesses improve efficiency and reduce costs. Knowledge application is therefore a central element for the knowledge management process. From a knowledge perspective, the value of individual and organizational knowledge depends primarily on its application due to the rigidity and tacit nature of knowledge. Effective application of knowledge allows individuals to make fewer errors, improve efficiency, and reduce redundancy (Chen and Huang, 2009).

**Adoption of innovation**

Innovation is an important source of growth and a key driver of competitive advantage for many organizations. Thus, achieving innovation requires coordinated efforts of many actors and integration of activities across specialized functions, domains and contexts of knowledge application. Thus, creativity within the organization is fundamental to the innovation process (Van de Ven et al., 1999). The organization's ability to innovate is a prerequisite for the successful use of inventive activity of resources and new technologies. Conversely, the introduction of new technologies presents complex opportunities and challenges for organizations, leading to changes in management practices and the emergence of new organizational forms.

Organizational and technological innovations are intertwined. Schumpeter (1950) saw organizational changes, alongside new products and processes, as well as new markets as drivers of “creative destruction”. Innovation researchers have introduced numerous conceptual typologies of innovation. For example, Zaltman et al. (1973) identified approximately 20 types of innovation grouped according to the state of the organization. Within this variety of types of innovations, the best known and most studied of the typologies of innovation is the distinction between product and process innovations (Kotabe and Murray, 1990).

Another widely recognized but less researched typology is the distinction between technological innovation (also called “technical”) and administrative innovation (also called “organization” and “management”) (Birkinshaw et al., 2008). Edquist and his colleagues
(Edquist et al., 2001; Meeus and Edquist, 2006) suggested that these two typologies offered a taxonomy that distinguishes between two types of product innovations (“into goods” and “into services”) and two types of procedural innovations (“technological” and “organizational”). Gary Hamel (2006) distinguished between two types of process innovations that resemble Meeus and Edquist’s distinction: innovation in operational processes (such as customer services, logistics, and procurement) and innovations in management processes (such as strategic planning, management project and employee evaluation). According to Edquist et al. (2006), there are four types of innovations that apply to service organizations: service innovations, technological process innovations, and administrative process innovations.

**Technical innovation:** (IT) is composed of product innovation and process innovation. Indeed, product innovation is defined as the development and commercialization of new products for value creation and to meet external user needs or market needs (Damanpour&Gopalakrishnan, 2001). Product innovation is a systematic work process drawing on existing knowledge from research and practical experiments directed towards the production of new materials, products and equipment, including prototypes.

On the other hand, process innovation is considered as a creation of new processes or improvement of existing processes (Leonard & Waldman, 2007). Process innovation involves the implementation of a new production or improved delivery method which includes the evolution of techniques, hardware and/or software (Zheng et al., 2010).

**Administrative innovation:** (AI) is considered as performance arising from changes to the organizational structure and administrative processes, reward and information system. It encompasses core work activities within the organization that are directly related to management (Chew, 2000; Damanpour & Evan, 1984). Administrative innovation allows organizations to have procedures in place for designing, manufacturing and delivering products. In short, industrial enterprises operate in a very complex environment on the basis of efficiency and effectiveness of internal operations, product innovation, process innovation and administrative innovation which are considered as sources of articulation of competitive advantage.

**Organizational innovation**

For Avlonitis et al. (2001), innovativeness refers to “novelty,” and they defined the latter as “the various dimensions of novelty for both the firm and the market.” In addition, the notion of novelty and the desire for novelty are respected (Midgley and Dowling, 1978; Roehrich, 2004). Wang and Ahmed (2004) characterize “Organizational innovativeness as the overall innovative capacity of a firm to introduce new products to markets, and the opening of new markets, by combining strategic orientation with behavioral and innovative processes. Slater and Narver (1994) consider innovativeness to be one of the key value-creating capabilities that drive organizational performance. Similarly, Hwang et al., (2020) considers innovativeness as the development of new competitive strategies for the creation of value for the company. Amabile (1997) aligns innovativeness with the concept of organizational creativity. Menguc and Auch, (2006) relate to innovativeness as the usual way of business development. Similarly, Markides (2001) conceptualizes innovativeness as a firm’s tendency to engage and support new ideas, to experiment, and to be creative. In addition to creativity and resource-based design, the concept of risk is incorporated into some definitions (Hwang et al., 2020), as well as the idea of uncertainty, ambiguity and difficulty. Siguaw et al. (2006) discuss “organizational innovation orientation”, which they understand to be a holistic approach, an organization-wide knowledge structure that facilitates innovativeness. Midgley and Dowling (1978) and Hirschman (1980) argue that the level of innovativeness influences whether a consumer adopts a new product or not, as well as influencing the speed of innovation after introduction. of the product or service on the market (Hwang et al., 2020). Based on the above, the level of innovativeness (i.e. high, moderate or low) acts as a precursor for the timing of adoption of innovations (i.e. early, late, or not at all), creating the necessary preconditions for innovative behavior in a specific area.

Most definitions refer to the orientation of organizational innovativeness, which appears to act as an umbrella term in the innovation literature for several variables. For example, Siguaw et al. (2006) discuss the overall knowledge structure of the firm that produces the specific set of capabilities for producing innovations. Atuahene-Gima and Ko (2001) view innovation orientation as human resource practices that promote support for innovative and risky behaviors that enable employees to keep up with changing technologies. Nyström et al. (2002) studied organizational size, limited resources, and organizational age as factors impacting innovativeness. Finally, all these definitions share the view that interaction in innovation networks offers companies with some of the necessary conditions for innovation, namely information transfer, learning and coordination of production and product business development (Dyer and Singh, 1998).

**The relationship between knowledge translation and organizational innovation:**

Belkassem Amamou and Salah Koubaa (2013) asserted in their article titled: ‘Communities of practice and knowledge absorption capacity in an inter-organizational context’ that the application process is linked to the actual use of current knowledge for resolve existing problems. In addition, it makes knowledge more active and more relevant in creating value for organizations. Furthermore, they define knowledge translation as the management process through which optimal storage and retrieval mechanisms enable a company to easily access knowledge. By effectively applying knowledge, organizations must improve their capabilities to manage different sources of knowledge effectively. This is done by using the best knowledge in the most suitable form. In this way we obtain a reduction in errors, and the conversion of collective knowledge to obtain advantages for organizations.
For these reasons, knowledge application plays an important role in improving administrative and technical innovation in organizations. Thus, the knowledge application process is positively related to organizational innovation. In accordance with the previous discussions, the following hypotheses are formulated.

H1: The knowledge application process is positively related to administrative innovation.

H2: The knowledge application process is positively related to technical innovation.

The relationship between knowledge application, innovativeness and organizational innovation

Dobni (2008) asserts that innovativeness is a multidimensional context that includes several characteristics: the intention to be innovative, the infrastructure to support innovation, the operational-level behaviors necessary to influence the market, and the environment for the implementation of innovation.

Garcia and Calantone (2003) and Muffatto (1998) define innovativeness as the capacity and climate for innovation having a deep relationship between technological resources, skills, knowledge, capabilities or strategies existing in the company. Additionally, innovativeness enables the creation of core values, assumptions and beliefs within the organization.

Quoted in their article ‘The Relationship between Knowledge Management and Innovation in Turkish Service and High-Tech Firms’, Burcu Kör and Ceyda Maden (2013) suggested that Creativity pushes employees to transform new knowledge into new products, services, processes, technology as well as administrative systems or structures, policies, plans and programs. Thus, the application of knowledge between the functional areas of an organization makes it possible to create conditions conducive to pushing the members of the organization to participate in innovation activities. Knowledge translation can foster close contacts and interactions that support innovativeness within the organization.

When knowledge is applied by organizations, organizational learning takes place because there is a positive impact on innovation. Furthermore, effective knowledge management develops the infrastructure to support innovation and increase an organization’s innovative capacity. Indeed, Burcu Kör and Ceyda Maden (2013) suggest that innovativeness applies to culture where the generation, acceptance and implementation of new ideas, processes, products and services are the norms. Thus, knowledge application has a positive effect on organizational innovativeness. Therefore, the following hypothesis is developed:

H3: Knowledge application process is positively related to innovativeness.

Through innovativeness, employees are socialized to engage in innovation activities and to shape the environment to be more innovative. Furthermore, the understanding and perceptions of organizational members about the environment are considered as a guide for engaging in innovation activities (Burcu Kör et Ceyda Maden (2013)). These innovation activities have significant value in the technical and administrative core of the organization. Thus, innovation can be considered as a cultural element that precedes technical and administrative innovations in organizations. In light of the above, the following hypotheses are proposed:

H4: Innovativeness is positively related to administrative innovation

H5: Innovativeness is positively related to technical innovation

As indicated previously, we will study the relationships that exist between the application of knowledge, types of innovation and innovativeness. The previous hypotheses relate knowledge management processes, innovativeness and types of innovation. Furthermore, knowledge management processes influence innovativeness, which in turn, have an impact on both types of innovations (i.e., administrative and technical). Therefore, this study proposes that innovativeness plays a mediating role in the relationship between knowledge application and innovation types. Thus, we made the following hypotheses:

H6: Innovativeness mediates the relationship between knowledge application and administrative innovation.

H7: Innovativeness mediates the relationship between knowledge application and technical innovation

Research & Methodology

The question sheet

The development of quantitative research in the social sciences tends to operationalize concepts, instruments, perceptions and opinions (Bryman, 1984). The questionnaire is developed either by adapting a pre-existing tool or by creating a new questionnaire. However, as a first step in developing a personalized instrument in this research, several other questionnaires are considered as possible research instruments (Boumarafi and Jabnoun, 2008, Al-Alawi and al, 2007, Zaim et al., 2007, SyedIkhsan and Rowland, 2004). The survey questionnaire is designed based on an extensive literature review and a series of questionnaires designed based on well-established documents. It is developed to first understand the status of the organization, thereby confirming the similarity and uniqueness of the organization’s culture.

To evaluate the validity of our research model, item measures are generally adopted for the improvement of confidence that the constructs of interest have accurately assessed and thus the measurement of the variable will be more consistent. Multiple item
measures are used for most variables to improve the reliability and validity of the measures. Additionally, variables are measured with Likert scales which provides the benefit of standardization and determination of relative effect amounts.

In the four items (App1, App2, App3, and App4), respondents indicate the extent to which knowledge is applied by their customers, partners, and employees.

After distinguishing previous research (Damanpour, 1991; Ibarra, 1993), the present study adopts two dimensions of innovation, including technical innovation and administrative innovation. A five-point Likert scale (Strongly Disagree, Slightly Disagree, Neutral, Slightly Agree, and Strongly Agree), based on the work of Ibarra (1993), and reflects the extent to which companies are satisfied with the development of innovation activities.

This study examines the dimensionality of our measures by performing a principal components factor analysis with varimax rotation (Hair et al., 1998). The administrative innovation factor includes four items (adm1, adm2, adm3, adm4) to measure the extent of responsiveness to environmental changes and the degree of administrative innovation in terms of planning procedures and process control systems.

The technical innovation factor consists of four items (tech1, tech2, tech3, tech4) to the extent that the company develops new technologies, incorporates technologies into new products and facilitates the development of new processes to improve the quality and reduce costs.

Sampling

The preliminary investigation is adopted in order to purify the measuring instruments and check their dimensionality. It ensures the implementation of stages 3 and 4 of Churchill's paradigm (1979). Therefore, we chose a sample consisting of 252 individuals. This number is largely sufficient because it favors the establishment of appropriate exploratory analyzes (PCA and Cronbach's Alpha).

The data collection

We distributed approximately 450 questionnaires in total and received 260 completed ones, representing a response rate of 58%. After the verification, we retained 252 usable questionnaires. This analysis presents a description of the structure of the sample according to certain characteristics, on the one hand, the profile of the respondents, their age and the number of years of experience and, on the other hand, the companies selected, namely: the sector, the date of creation, the location, the number of employees, the level of education and, finally, the training expenses.

Descriptive analysis

After using the questionnaires, we found that most of our interlocutors are managers (48%), human resources managers (30%), marketing managers (12%), quality managers (5%) and financial managers (5%). This high rate of responses from managers is explained by the interest they place in the purpose of the research which directly affects senior managers.

Most of the companies included in this study are moderately old (71.42%) created between 1980 and 2010. The oldest company has been established for 54 years, while the youngest was created in 2010. Thus, 33.33 % of the companies surveyed are located in Monastir, 57% in Tunis and Sousse, and, finally, 10% of the companies are located in Mahdia. We note that the majority of respondents work in medium-sized companies to the extent that 47.61% of companies have a workforce of between 50 and 200 employees. In fact, 33.33% of companies have a workforce of more than 50 employees. In addition, 19.04% of companies have a workforce of fewer than 50 employees. In addition, 60% of respondents obtained their bachelor's degree (or master's degree) and 31% of respondents obtained their master's degrees (bac+5) in which 9% of staff have a doctoral degree. We also note that most respondents are aged between 30 and 40 years old and 30% of respondents are over 40 years old. Also, 65% of respondents have more than five years of experience.

The distribution according to sector of activity indicates that the sample is represented by a set of companies operating in the industrial and agri-food sector (48%), the commercial sector (17%). In addition, we observe that the service sector represents (32%) as well as that of buildings only occupies small proportions in the entire sample (8.31%).
Analysis of the results

Factor analysis: “knowledge application” scale

Table 1: KMO index and Bartlett test of the “Application” construct

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin index for measuring sampling quality.</th>
<th>.763</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's test of sphericity</td>
<td>Chi-square approx.</td>
</tr>
<tr>
<td>dd</td>
<td>6</td>
</tr>
<tr>
<td>Meaning</td>
<td>.000</td>
</tr>
</tbody>
</table>

The KMO index of 76% can be described as excellent or meritorious. It tells us that the correlations between the items are of good quality. Then, the result of Bartlett's test of sphericity is significant (p < 0.0005). This leads us to conclude that the PCA carried out on the knowledge application scale produces relevant results. The PCA is therefore acceptable and the quality of representation of the items is better. We also notice the absence of weak anti-image correlations.

Table 2: Representational qualities of the construct “Application of knowledge”

<table>
<thead>
<tr>
<th></th>
<th>Initials</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>App1</td>
<td>1,000</td>
<td>.720</td>
</tr>
<tr>
<td>App2</td>
<td>1,000</td>
<td>.885</td>
</tr>
<tr>
<td>App3</td>
<td>1,000</td>
<td>.812</td>
</tr>
<tr>
<td>App4</td>
<td>1,000</td>
<td>.669</td>
</tr>
</tbody>
</table>

Extraction method: Principal component analysis.

The factors retained for this PCA make it possible to extract more than 67% of initial information from each item. We also note that the minimum information extracted in the first item is 67% and is considered acceptable.

Table 3: The total explained variance of the construct “Application of knowledge”

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial eigenvalues</th>
<th>Sums extracted from the square of loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of variance</td>
</tr>
<tr>
<td>1</td>
<td>2.441</td>
<td>61.018</td>
</tr>
<tr>
<td>2</td>
<td>1.645</td>
<td>16.127</td>
</tr>
<tr>
<td>3</td>
<td>1.503</td>
<td>12.579</td>
</tr>
<tr>
<td>4</td>
<td>.411</td>
<td>10.276</td>
</tr>
</tbody>
</table>

Based on the table above, we see that the first two axes have an acceptable eigenvalue which is greater than 1, which corresponds to 70%. This axis explains 77.145% of the total information.

According to the Kaiser criterion, we only retain the axes having an eigenvalue greater than 1 and in our case there are two axes which represent the variable “Application” with a quality of representation equal to 77%. This axis is now called “application”.

Table 4: Rotation of the matrix of components of the construct “Application of knowledge”

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>App1</td>
<td>0.881</td>
<td></td>
</tr>
<tr>
<td>App2</td>
<td>0.790</td>
<td></td>
</tr>
<tr>
<td>App3</td>
<td>0.925</td>
<td></td>
</tr>
<tr>
<td>App4</td>
<td>0.661</td>
<td></td>
</tr>
</tbody>
</table>

Extraction method: Principal component analysis; Rotation method: Varimax with Kaiser normalization; Convergence of the rotation in 3 iterations.
Reliability analysis of the “application” scale:

The scale measuring the application of knowledge obtains a Cronbach's alpha equal to 0.787 which attests to its good internal consistency. That is to say, the “Application of knowledge” scale has satisfactory reliability.

Table 5: Reliability statistics

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's alpha based on standardized elements</th>
<th>Number of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>.787</td>
<td>.787</td>
<td>4</td>
</tr>
</tbody>
</table>

Organizational innovation: technical and administrative:

The KMO value of the technical innovation variable is equal to 0.758, as well as the KMO value of the administrative variable which is equal to 0.707. This therefore shows the possibility of factoring these eight items. It tells us that the correlations between the items are of good quality. The quality of representation of the items is also satisfactory with communities greater than (0.5). It follows from these values that the conditions for applying the PCA are verified. The unidimensionality test shows the number of factors needed to recover up to 74% of the information from these eight factors. The Cronbach alpha coefficient of the technical innovation variable is equal to 0.764 and the Cronbach alpha coefficient of the administrative variable is equal to 0.713 which attests to their good internal consistency. That is, the organizational innovation scale has satisfactory reliability. This is an acceptable rate validating the two factors of organizational innovation. All of these results are illustrated in the table below.

Table 6: Summary of the factor analysis and reliability of the construct “Organizational innovation”

<table>
<thead>
<tr>
<th>The variables</th>
<th>The items</th>
<th>The quality of representation</th>
<th>The variance explained</th>
<th>KMO</th>
<th>Cronbach's Alpha</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>Tech1</td>
<td>0.747</td>
<td>74.35%</td>
<td>0.758</td>
<td>0.764</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Tech2</td>
<td>0.795</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tech3</td>
<td>0.704</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tech4</td>
<td>0.728</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>Adm1</td>
<td>0.836</td>
<td>74.21%</td>
<td>0.707</td>
<td>0.713</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Adm2</td>
<td>0.709</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adm3</td>
<td>0.670</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adm4</td>
<td>0.753</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Innovativeness:

The exploratory factor analysis carried out on the data shows that these items can be factorized (KMO = 0.782 and Bartlett significant p ≤ .000) and underlines that organizational innovativeness is indeed a unidimensional factor, and that together, the four items retained explain 76.77% of the variance of the construct. Finally, the reliability coefficient is considered good with a Cronbach's alpha equal to 0.794. All these results are illustrated in the table below.

Table 7: Summary of the factor analysis and reliability of the “Organizational innovativeness” construct

<table>
<thead>
<tr>
<th>The variables</th>
<th>The items</th>
<th>The quality of representation</th>
<th>The variance explained</th>
<th>KMO</th>
<th>Cronbach's Alpha</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovativeness</td>
<td>Innova1</td>
<td>0.688</td>
<td>76.77%</td>
<td>0.782</td>
<td>0.794</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Innova2</td>
<td>0.747</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Innova3</td>
<td>0.820</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Innova4</td>
<td>0.815</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Organizational innovativeness

The impact of one latent variable on another is not necessarily direct. AMOS software allows testing of complicated models with mediation relationships by measuring total effects composed of direct and indirect effects (Akrout, 2010). The presence of an intermediary relationship in the context of our analysis justifies, once again, our use of the structural equation method.

The relationship between knowledge management processes and the two types of organizational innovation is mediated by organizational innovativeness, so we will verify the significance of this indirect causal link.
Based on the data displayed in this table, we calculated the indirect effects as shown in the table below.

**Table 9:** Summary of standardized indirect effects of knowledge application on organizational innovation

<table>
<thead>
<tr>
<th></th>
<th>Innovativeness</th>
<th>Technical Innovation</th>
<th>Administrative Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct</strong></td>
<td>.716</td>
<td>.748</td>
<td>.648</td>
</tr>
<tr>
<td><strong>Indirect</strong></td>
<td></td>
<td>.716 * .748 = .535</td>
<td>.716 * .648 = .463</td>
</tr>
</tbody>
</table>

Organizational innovativeness reveals positive and significant impacts on both types of organizational innovation. After having verified the measures of indirect effects, we will move on to validating the significance of these effects. One thing, moreover, that the AMOS software does not do, hence our use of the Sobel method. The presence of a mediation effect is proven with a value significantly different from zero, according to this test. (Akrout, 2010).

Indices relating to the indirect links between knowledge application and organizational innovation are presented in the following table.

**Table 10:** Application of the Sobel method: Indirect effect of knowledge management processes on administrative innovation

<table>
<thead>
<tr>
<th>Mediating variable: Organizational innovativeness</th>
<th>Application / Administrative innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect</td>
<td>Z-score</td>
</tr>
<tr>
<td>0.463</td>
<td>3.52330487</td>
</tr>
<tr>
<td>One-tailed probability: 0.02003810</td>
<td></td>
</tr>
<tr>
<td>Two-tailed probability: 0.04007621</td>
<td></td>
</tr>
</tbody>
</table>

**Table 11:** Application of the Sobel method: Indirect effect of application processes on technical innovation

<table>
<thead>
<tr>
<th>Mediating variable: Organizational innovativeness</th>
<th>Application / Technical innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect</td>
<td>Z-score</td>
</tr>
<tr>
<td>0.535</td>
<td>4.57380936</td>
</tr>
<tr>
<td>One-tailed probability: 0.02430484</td>
<td></td>
</tr>
<tr>
<td>Two-tailed probability: 0.04860968</td>
<td></td>
</tr>
</tbody>
</table>
As shown in Table 11, the Sobel Z statistic becomes significant when Sobel's Z is greater than 1.96 and P<0.05 (Preacher and Hayes, 2004, 2008). This allows us to conclude that the application of knowledge positively influences administrative innovation in a direct manner (like 3.52 which is greater than 1.96) but that the processes of knowledge management indirectly influence administrative innovation for the dyad through organizational innovativeness. However, innovativeness is indeed a partial mediator of the link between knowledge application and administrative innovation.

This table (11) displays significant indirect effects between application processes and technical innovation with “P” less than 0.05, and a significant value when Z is greater than 1.96 (like 4.57). Hence the validation of the hypothesis relating to the mediating role of organizational innovativeness. However, innovativeness is indeed a partial mediator of the link between knowledge application and technical innovation.

**Discussion**

The empirical research was accomplished through a quantitative method. This methodological approach made it possible to support elements of response to the problem set out in this article.

After carrying out the statistical processing and presenting the results of testing all the hypotheses, using structural equation methods, this part aims to present, discuss and interpret the results obtained.

**Testing the direct effect of knowledge application on technical and administrative innovation:**

The direct effect of knowledge application on technical and administrative innovation is formulated by the following two hypotheses:

H1: Knowledge application has a positive effect on administrative innovation

We hypothesized that knowledge application has a direct and positive impact on administrative innovation. The results of structural equation modeling carried out to test this direct effect show that “knowledge application” has a direct and positive impact on “administrative innovation” (CR=2.675>1.96; p=0.025<0.05). Thus, the structural link between these two variables is equal to 0.667. Our results are similar to those of Gloet and Samson (2012), Sedighi and Zand (2012), Karami et al. (2015), who suggest that knowledge application has a positive effect on administrative innovation. As a result, “knowledge application” has an indirect and positive impact on “administrative innovation”.

H2: Knowledge application has a positive effect on technical innovation

In this hypothesis, we admit that the application of knowledge has a positive influence on technical innovation. The results show that (CR=2.459>1.96, p=0.010<0.05). These results are consistent with those obtained by ôöf and Heshmati (2002), Griffith et al. (2006), Robin and Mairesse (2008). They showed that knowledge application has a positive effect on technical innovation. Likewise, within the framework of our research, this relationship between knowledge application and technical innovation is confirmed with a structural link equal to 0.785.

H3: The knowledge application process is positively related to organizational innovativeness.

We hypothesized that “knowledge application” has a positive impact on “organizational innovativeness”. Indeed, the structural link is 0.716, the critical ratio is acceptable (CR=2.589>1.96; p=0.010<0.05). This hypothesis is validated. Therefore “knowledge application” has a direct and positive effect on “organizational innovativeness”.

H4: Innovativeness is positively related to administrative innovation.

This hypothesis proposes that organizational innovativeness has a positive direct effect on administrative innovation. The results indicate that the structural link is equal to 0.648 (CR=7.422>1.96; p=0.015<0.05). These indications show that there is a positive and significant link between these two variables. It appears from these results that hypothesis H3.a is validated. Thus, organizational innovativeness has a positive and significant direct influence on administrative innovation.

H5: Innovativeness is positively related to technical innovation.

Based on the literature, we assume that “organizational innovativeness” has a positive influence on “technical innovation”. This hypothesis H3.b is validated. Indeed, the table of results shows a significant CR equal to 10.353>1.96 and p=0.001<0.05). Thus, “organizational innovativeness” has a direct positive influence on “technical innovation” with a structural link 0.748.

According to Abdellatif, Slama and Mokni (2017), organizational innovation is notably developed through the concepts of innovativeness. Through it (innovativeness), employees become socialized to engage in innovation activities and to shape the environment to be more innovative.

**The mediating effect of innovativeness between knowledge management and organizational innovation:**

To verify the mediating effect of organizational innovativeness, we follow the procedure recommended by Baron & Kenny (1986) relating to the analysis of the mediating effect of a variable in the process of impact of the independent variable on the dependent variable in four steps:
i. The first step focuses on examining the relationship between the independent variable: knowledge application and the dependent variable: organizational innovation (Technical and Administrative Innovation). This constituted the subject of the first and second hypotheses.

ii. The second step is to verify the relationships between the independent variable: knowledge application and the mediating variable (organizational innovativeness). This is our third hypothesis.

iii. The third step is to verify the relationships between the mediating variables and the dependent variable (Organizational innovation); this is our fourth and fifth hypothesis.

iv. The fourth step is to include the mediating variables in the model and check whether they affect the direct relationships. According to Kenny et al. (1998, p 260), the four steps must be successively ensured in order to show the existence of an integral mediating role of a variable. If only the first three steps are verified, the mediating role is only partial. According to some authors (MacKinnon et al. 1995; MacKinnon et al. 2002), the first step is not necessary, however the second and third steps are essential to ensure the existence of the mediating role.

To be confirmed, this mediation effect of innovativeness must be tested by the Sobel test. This test indicates that the Sobel Z statistic takes on a significant value when it is greater than 1.96 (Preacher and Hayes, 2004, 2008).

**The mediating effect of innovativeness between knowledge application and administrative innovation:**

We will now test the mediating effect of the “Innovativeness” variable between the acquisition of knowledge and administrative innovation. The results show that the effect of knowledge application on innovativeness is significant since (CR = 2.589 > 1.96 and p = 0.010 < 0.05). Our results also show that the relationship between innovativeness and administrative innovation is significant (CR = 7.422 > 1.96 and p = 0.015 < 0.05).

Finally, the relationship between the knowledge application variable and administrative innovation is significant (CR = 2.675 > 1.96 and p = 0.025 < 0.05).

We can also note that with the presence of the “Innovativeness” variable, the relationship between the application of knowledge and administrative innovation is still significant since we have Z = 3.523 > 1.96 and P < 0.05. We thus conclude that the mediating effect of the “Organizational innovativeness” variable between these two variables is verified.

**Innovativeness mediates the relationship between knowledge application and technical innovation.**

We now move on to test the mediating effect of the “Innovativeness” variable between the application of knowledge and technical innovation. The results show that the relationship between the variable “Application of knowledge” and “technical innovation” is significant (XY) (CR = 2.459 > 1.96 and p = 0.010 < 0.05).

Our results also show that the relationship between organizational innovativeness and technical innovation (MY) is significant (CR = 10.353 > 1.96 and p = 0.001 < 0.05).

We also note that with the presence of the “Innovativeness” variable, the relationship between the application of knowledge and technical innovation is still significant since we have: Z = 4.573 > 1.96 and P < 0.05. We thus conclude that the mediating effect of the “Organizational innovativeness” variable between these two variables is verified.

Thus, leaders can influence innovation in different ways, by developing a climate conducive to innovation and supporting innovativeness (Mumford, MD, & Hunter, S. T, 2005). This influence can have a direct effect on innovation; it is also likely that innovativeness can interact positively with knowledge application to enhance organizational innovation.

**Conclusion**

In the context of a business environment, which is characterized by rapid and continuous changes, the empirical analysis of knowledge application, innovativeness and innovation concepts is essential for the creation of competitive advantages. Thus, in this research, the importance of knowledge application, innovativeness and multidimensional approach to innovation, including administrative and technical innovation, is demonstrated. Through effective knowledge application, organizations can promote not only the development of organizational innovation, but also the improvement of all types of innovation. Therefore, the application of knowledge management through effective means facilitates the implementation of different types of innovation in organizations. Furthermore, mediation shows the importance of innovativeness in explaining the relationship between knowledge management processes and technical innovations.

This work offers a practical contribution in that the influence of knowledge management on organizational innovation practices helps explain the role of knowledge management in the development of innovation within the organization. Moreover, little previous research has focused on knowledge management practice initiatives leading to organizational innovation. This contribution reinforces the in-depth dialogue that is certainly important to the organization's community in times of economic instability. Within any company, the application of knowledge is a real lever for growth because it allows you to take advantage of opportunities that open the way to organizational development. Therefore, the application of knowledge is an essential step for any firm. We have previously
outlined the various advantages of adopting such an approach. This integrates with efforts to create a culture of learning, change management, continuous process improvement and organizational self-actualization.

Pursuing this area of study helps take into account development and success factors, such as competitiveness, innovation capacity, organizational learning, knowledge capture capabilities, what differentiates a sector from another. This research helps practitioners create new knowledge needed by managers on the key determinants of organizational innovativeness.

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Conflicts of Interest: The authors declare no conflict of interest.

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