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A comparative analysis of machine learning systems for measuring the impact of knowledge management practices

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ABSTRACT

Knowledge management (KM) has recently emerged as a discrete area in the study of organizations and frequently cited as an antecedent of organizational performance. This study aims at investigating the impact of KM practices on organizational performance of small and medium-sized enterprises (SME) in service industry. Four popular machine learning techniques (i.e., neural networks, support vector machines, decision trees and logistic regression) along with statistical factor analysis (EFA and CFA) are used to developed predictive and explanatory models. The data for this study is obtained from 277 SMEs operating in the service industry within the greater metropolitan area of Istanbul in Turkey. The analyses indicated that there is a strong and positive relationship between the implementation level of KM practices and organizational performance related to KM. The paper summarizes the finding of the study and provides managerial implications to improve the organizational performance of SMEs through effective implementation of KM practices.

1. Introduction

As one of the contemporary management tools, knowledge management (KM) has been increasing in popularity of the tools/techniques used by large organizations and multinational companies to gain sustainable competitive advantage in the long run. Despite the growing interest and implementation initiatives, the concept of KM is still evolving, and to date there is no unifying or overarching theoretical framework that has been widely accepted.

While KM has been frequently cited as an antecedent of organizational performance, there is a paucity of empirical research regarding the impact of KM practices on organizational performance. This lack of interest is even more pronounced in the context of small and medium-sized enterprises (SMEs). While implementation of KM practices in large size firms provides immense business opportunities in terms of achieving cost efficiency and gaining competitive advantage, there is less evidence of small- and medium-sized enterprises (SMEs) implementing KM practices to capture similar benefits. The question then remains open "how well KM practices fit with the SMEs", which form the largest group of business establishments in both developed and emerging market economies from the viewpoint of generating employment and economic growth [12]. They account for more than half of the employment and value added contributions in most countries [50]. Similar trend is also observed in Turkey where SMEs constitute more than 90% of the total number of businesses and employ 61% of the workforce [53].

In view of the fact that the success of SMEs has a direct impact on the national economy, this study aims to provide two main contributions to SME research. First, based on a sample of SMEs operating in two sub-sectors of textile industry within the greater metropolitan area of Istanbul in Turkey, this study aims to examine the impact of KM practices on the organizational performance of SMEs. Second, the machine learning approach, which has been gaining growing interest in business research, is employed to identify the most important KM practices on organizational performance of SMEs.

The remainder of the paper is organized as follows. The next section provides a rather comprehensive review of the relevant literature on KM practices. Research methodology is presented in Section 3. Data analysis, results and their implications are provided in Section 4. The paper concludes with Section 5 where a summary of the findings along with future research directions are given.

2. Literature review

The field of KM has recently emerged as a new area of interest for both academic and business circles. The review of the recent literature reveals an increasing number of studies covering many different facets of KM [38]. Along with this growing interest, researchers proposed a large number of definitions of KM, most of which overlapping on common characteristics [33], while each emphasizing on a few distinct aspects of KM. Generally speaking, the existing studies in

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the field of KM have largely focused on three major streams [17]: the *philosophical nature* of KM; the *processes* of knowledge management (i.e., generation, sharing and distribution of knowledge); and the *infrastructure* of knowledge management in terms of technology and effective management of knowledge and business practices. Zaim et al. [56] classify the infrastructure further into four areas: technology, organizational culture, organizational structure and intellectual capital. Similarly they also identify four areas of processes for KM: knowledge generation and development; knowledge codification and storage; knowledge transfer and sharing; and knowledge utilization. In the forthcoming section, we will develop the concept of KM in line with the categorization purported by Zaim et al. [56], and will subsume both KM processes and related Knowledge Management Infrastructure under the general heading of KM practices.

2.1. KM practices

It has been argued that the effectiveness of KM depends on how the generation of new knowledge is organized and how existing knowledge is transferred throughout the organization. Recent studies have expressed considerable interest in knowledge sharing practices [24]. The benefits of *knowledge transfer and sharing* have also been discussed widely among the scholars and practitioners [48]. Therefore, one of the most important objectives of KM is to bring together intellectual resources and make them available across organizational boundaries. It has been suggested that organizations often waste their resources and lose a significant amount of money for repeating the same mistakes, duplicating projects and being unaware of each other's knowledge due to the lack of *knowledge transfer and sharing* throughout the organization [44].

Knowledge transfer is not a unidirectional movement. Effective knowledge transfer is more than the movement of knowledge from one location to another. Organizations can get significant learning experience through knowledge transfer between units and people. It tends to improve competency of both sides that transfer and share knowledge. It is because knowledge does not leave the owner when it has been transferred. As a result, the value of knowledge grows each time a transfer takes place and the key to value creation lies in how effective knowledge has been transferred throughout the organization.

The role and importance of information and communication technologies in knowledge transfer have been emphasized by many scholars. Clearly, technological advances bring a vast number of new opportunities to transfer and share knowledge and expertise throughout the organization within departments, plants, countries and across national borders. These technologies have a strategic role in knowledge sharing specifically for the geographically dispersed global organizations [2]. The effective use of technologies creates new ways of knowledge transfer and hold promising solutions both in transfer of explicit knowledge and tacit knowledge — in terms of experience and expertise [26]. In this respect, it is often mentioned that *technological infrastructure* has a strategic importance in knowledge transfer not only within the organization but also among different organizations [57].

As a matter of fact, all healthy organizations generate knowledge. While they are interacting with their environment, they absorb information, combine it with their experiences, values and internal rules, turn it into knowledge, and take action based on it. *Knowledge generation* can be performed in many ways. The three of the main modes among others are knowledge acquisition, knowledge generation within the firm and collaborative knowledge generation. However, *knowledge generation* process is a set of activities for the conscious and intentional generation of knowledge under specific actions and initiatives firms undertake to increase their stock of corporate knowledge [10].

Knowledge generation process does not necessitate new knowledge generation. In many circumstances, organizations may prefer to acquire knowledge from other sources and adopt it for their own use [4]. Knowledge acquisition can be used for knowledge creation, and if it is novel and useful for the organization, also be considered as a part of knowledge generation. Organizations convert information they collect from internal and external sources into knowledge through their organizational learning process by combining it with their prior knowledge, experiences, values and organizational procedures [25]. Then, the knowledge becomes a part of their organizational knowledge base. This obviously explains why the knowledge acquired through these organizational processes is new and unique for that organization [29].

Knowledge is meaningful when it is codified, classified, put in a useful format and stored. Only then, it can be used by the right person, at the right time and in the right way. *Knowledge codification and storage* is important not only for an effective use of knowledge but also for reusability of knowledge in case it is needed so that the knowledge in question can be internalized to the organization rather than the knower [39]. Therefore, considering the organization's overall objectives and priorities, many studies have been concentrating on the classification and the codification of knowledge based on its types and purposes [32], and on the storage of knowledge to let the employees be able to access knowledge any time both at present and in the future. The codification of knowledge also enables to stock the knowledge resources and to assess the potential of the organization. The most challenging feature of knowledge codification is to extract it without losing its distinctive properties which makes it valuable [10].

Despite its importance, codifying and classifying knowledge is not that simple since it relies heavily on what people know. Thus, organizational knowledge is hard to capture, clarify and express perfectly fine considering the fact that it is dispersed and scattered throughout the organization. It is found in different locations, in peoples' minds, in various organizational processes, in corporate culture embedded into different artifacts and procedures and stored into different mediums such as print, disks and optical media [5].

There is a distinction between tacit and explicit knowledge in the storage of knowledge. Explicit knowledge can be easily collected, documented, stored and retrieved quite independently of any single individual through technological means and systems. On the other hand, tacit knowledge resides in the minds of the employees and seizes a great deal of an organization's knowledge resources [14]. If the organization's knowledge resources have been described as an iceberg, the explicit knowledge is the visible part of the iceberg above the surface, whereas the tacit knowledge includes the invisible part of the iceberg beneath the surface [23]. The codification of tacit knowledge unlike explicit ones is the most cumbersome activity in the overall process because of its subjective and situational nature, and it is intimately tied to the knower's experience.

One of the most important and challenging aspects of KM is to enhance the development of a collaborative, trustworthy, emphatic and helpful *organizational culture*. The executives and scholars agree on the importance of a knowledge-friendly culture for the success of KM [21,45]. It is because knowledge is a context-dependent social concept [30] and a large part of organizational knowledge is embodied in social processes, institutional practices, traditions and values [6,15]. Therefore, no matter how powerful the tools and functions of KM are, it is of no use without willing participants and a supportive social and cultural environment [28]. While the cultural resistance is generally cited as one of the most important barriers to an effective implementation of KM [48], it is still contemplated as the neglected or underestimated side of KM practices. Therefore, it is strictly recommended for organizations to place a special emphasis on the social and cultural issues for the successful implementation of KM practices [5].

The appropriate *organizational structure* and guidelines as well as technical and non-technical expedients of which the organization has disposal constitute another building blocks of KM infrastructure [1]. Nonetheless, there is no single appropriate *organizational structure* for KM. Some scholars suggest a radical re-design for KM [35], while others