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Aligning enterprise knowledge and knowledge management systems to improve efficiency and effectiveness performance: A three-dimensional Fuzzy-based decision support system

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ABSTRACT

The purpose of this paper is to propose a three-dimensional fuzzy logic approach to evaluate the level of alignment between the knowledge an enterprise possesses and the knowledge management systems (KMSs) it adopts. The study also aims to propose the KMSs best suited to reducing misalignment and improving operational performance in terms of efficiency and effectiveness, analysing the level of alignment between an enterprise's knowledge and its KMSs from both the ontological and epistemological points of view. The authors have used the proposed methodology to develop a software-based Knowledge Management Decision Support System (KM-DSS), which was tested on a small and medium enterprise (SME) operating in the high-tech industry. The results highlight that the proposed DSS allows managers to evaluate knowledge management processes and identify which KMSs to adopt to improve alignment with the nature of the knowledge their enterprise possesses as well as to increase their level of efficiency and effectiveness.

1. Introduction

The scientific community has long been attentive to the issue of strategic, organisational and management alignment, and various perspectives have been examined (Chan & Reich, 2007). Chandler (1962) investigated the relationship between strategy and structure in large industrial companies in the United States and pointed out the importance of alignment between structure and strategy. He also showed that economic performance is directly related to the ability of management to create strategic alignment between the position of an enterprise in the competitive product-market arena and the design of an appropriate administrative structure to support its implementation. Waterman, Peters, and Phillips (1980) supported Chandler's point of view, showing that an enterprise is a complex and adaptive system characterised not only by dynamic alignment between strategy and structure, but by a set of seven factors: strategy, structure, systems, style, staff, skills, and goals. They proposed the '7S Model', which is still widely used in the literature today.

Henderson and Venkatraman (1993) analysed strategic alignment between information systems and business organisation, stressing that alignment must be both within and outside the enterprise. Internal alignment is the ability of an enterprise to align organisational and Information and Communication Technology (ICT) processes with the infrastructure. Conversely, external alignment refers to business and ICT strategies. In one of the most commonly cited alignment models – the strategic alignment model (SAM) – Henderson and Venkatraman (1993) stated that enterprises need to integrate the business and ICT domains on three levels: strategies (i.e., external integration), infrastructures (i.e., internal integration), and both strategies and infrastructures (i.e., cross-domain integration). Reich and Benbasat (2000) investigated the influence of various factors on the social dimension of alignment between business and information technology objectives. Chan, Sabherwal, and Thatcher (2006) investigated how alignment between business and ICT strategies allows an enterprise to create value from ICT investments. Alignment leads to a more focused and strategic use of ICTs, which in turn allows enterprises to improve performance.

The issue of alignment between enterprises and ICTs has been analysed in a number case studies (e.g., Chan, Huff, Barclay, & Copeland, 1997; de Leede, Looise, & Alders, 2002; Irani, 2002; Kearns & Lederer, 2000; Tallon, 2007; Weiss & Anderson, 2004).

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The findings support the hypothesis that enterprises successfully aligning their business strategy with their ICT strategy outperform those that do not. In other words, good alignment means the enterprise is applying appropriate ICTs in specific situations in a way that is suited to their business strategy, goals, and needs (Luftman & Brier, 1999). Shih and Chiang (2005), on the other hand, examined alignment between corporate strategy, human resource management strategy, and knowledge management strategy as well as their influence on knowledge management effectiveness.

In the literature on knowledge management (KM), the concept of alignment was first analysed by Carayannis (1999), who assumed that KM plays a pivotal role in achieving a synergistic symbiosis between the ICTs and organisational practices used by an enterprise. In line with Carayannis, Bhatt (2001) introduced the concept of triadic alignment. Bhatt investigated how alignment between technologies (tools), techniques (organisational practices), and people (knowledge) allows an organisation to manage its knowledge effectively. Tseng (2008) stated that an enterprise should align its knowledge management systems (KMSs) with the nature of its knowledge if it is to be efficient and effective. Indeed, the use of efficient and effective KMSs leads to correct alignment between the nature of an enterprise's knowledge and the KMSs used, which is itself a factor that could have a positive impact on the adoption of KM (or else be a barrier to it).

All these contributions highlight the importance of investigating alignment between knowledge and KMSs. Despite they only develop conceptual frameworks to analyse interaction between technologies, techniques, and people, they do pave the way for further practical implications regarding the development of Decision Support Systems (DSSs) driving enterprises in the process of alignment between their knowledge and knowledge management systems. This issue has also been underlined in two literature reviews on the topic of knowledge management (Cerchione & Esposito, 2016; Durst & Edvardsson, 2012).

In the light of the foregoing, this paper proposes a three-dimensional (3D) fuzzy-based decision support system that:

1- Evaluates alignment between an enterprise's knowledge and its knowledge management systems
2- Suggests specific KMSs to reduce misalignment and improve the operational performance of an enterprise in terms of the efficiency and effectiveness of its KMSs.

The issue of alignment between the nature of an enterprise's knowledge and the knowledge management systems used to support the process of knowledge management is extremely important for the following three reasons: (1) an alignment between the nature of the knowledge and the KMSs used is a critical success factor in supporting the different phases of the KM development process (i.e., knowledge creation, storage, transfer/sharing, and application); (2) misalignment between the nature of the knowledge and the KMSs used leads to inefficiency and ineffective use; and (3) over the last twenty years, ICT has been offering new opportunities in terms of new, low cost, and easy to use knowledge management tools with a high performance/price ratio.

Furthermore, although this topic is crucial to large companies, it is even more important to small and medium enterprises (SMEs), as they usually have few resources to monitor innovation in the KMS sphere. It is precisely for this reason that the proposed DSS is specifically geared towards use in SMEs.

The remainder of the paper is organised as follows. After this introduction, the framework on Knowledge Management Decision Support Systems is presented in Section 2. Section 3 introduces the conceptual schema. Section 4 discusses the proposed approach to KM alignment. Section 5 reports the details of the Knowledge Management Decision Support System developed in the study, and Section 6 illustrates how the proposed DSS was implemented in an SME. Some discussion and conclusions bring the paper to a close.

2. Knowledge management decision support systems

This section presents an overview of the role of management information systems (MISs) and decision support systems (DSSs) in the field of knowledge management. More specifically, the review focuses on papers addressing the design of information systems focusing on knowledge management in enterprises.

A systematic study of the existing state of the art on the topic was conducted in three main phases, bringing together the contributions of Easterby-Smith, Thorpe, and Jackson (2012); Petticrew and Roberts (2006); Pittaway, Robertson, Munir, Denyer, and Neely (2004), and Cerchione and Esposito (2016), namely (1) paper search, (2) paper selection, and (3) paper analysis.

The purpose of the paper search phase was to identify all the relevant papers focusing on designing decision support systems for knowledge management. The search was carried out using the academic database Scopus, which guarantees a broad range of scientific papers as it includes more than 8000 peer-reviewed journals. This phase spans the period from 1960 to the present and was carried out using the keywords 'decision support system*' and 'management information system*' in combination with 'knowledge management' and 'performance'.

The paper selection phase consisted in selecting papers on the topic under investigation. During this phase, three criteria for the inclusion/exclusion of research products were defined. The first criterion relates to the focus of the abstract, in line with the approach proposed by Pittaway et al. (2004). This criterion made it possible to include only papers whose abstracts address the development of support systems for knowledge management. The abstracts were read simultaneously by two different readers, and a third one was consulted in the event of uncertainty as to whether to include a paper or not. The second criterion related to the focus of the paper as a whole. Also in this case, the papers were read by two readers, and a third researcher was consulted in the event of uncertainty. The third criterion, i.e., cross-referencing, allowed some additional papers that had not been found in the selected databases despite being cited in the literature to be included in the final sample. The third criterion ensures that all the main contributions on the topic were included in the final sample. The paper analysis phase provides both a descriptive and content analysis of papers focusing on the development of decision support systems for knowledge management.

In accordance with Power's (2001, 2002, 2004) classification, the papers were grouped into descriptions of data-driven, model-driven, document-driven, communication-driven, and knowledge-driven DSSs (Table 1). Wang, Ding, Liu, and Li (2016) developed a Decision Support System to evaluate KM performance using triangular fuzzy numbers. They identified four categories of indices to assess knowledge management performance (i.e., the process of knowledge management, the structure of organisational knowledge, economic benefits, and efficiency), comprising 31 indices overall. Patil and Kant (2014) identified several barriers to KM adoption in the context of the supply chain (i.e., strategic, organisational, technological, cultural and individual barriers), and twenty-one solutions to overcome them. They thus proposed a DSS to identify the priorities of the most serious barriers and obtained a ranking of the most efficient actions to overcome them. Ivarsson and Gorschek (2012) developed a system for storing and sharing the knowledge acquired from practical experience of managing projects. Their system makes it possible to assess the quality of organisational practices and to share and improve on them. It also allows practitioners to search for practices appropriate to their specific situation. Hong, Suh, Lee, and Lee (2011) developed a DSS