Is Artificial Intelligence Changing Knowledge Management?

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Abstract. *There is a general agreement that artificial intelligence (AI) is changing business today, as technologies required for cognitive systems such as deep learning or human-computer interaction have made exponential advances and tend to become a part of the current economy. The AI concept is tightly related to that of knowledge by its nature, as the new digital systems are or are intended to be systems that learn: as it is impossible to program all possible algorithms to successfully anticipate all potential permutations, the new digital systems are cognitive, improving with use. Including the new cognitive systems that we usually call AI in business operations rises an unprecedented challenge on knowledge management (KM) strategies, both at operational and strategical levels. One of the main aspects is the transformation of tacit knowledge into explicit knowledge, helping to more effective knowledge management that uses efficiently both human and digital knowledge, in a structured, predictive way. Our explorative paper summarizes and analyzes the recent academic discussions on the relationship between AI and KM and it points out related dilemmas regarding the use of AI explicit knowledge in business decision making and delivering value.*

Keywords: *artificial intelligence; knowledge management.*

Introduction

The concept of artificial intelligence (AI) is not a new one. The first mentions in the academic literature date from 1950 (Turing, 1950 as quoted by Armstrong & Sotala, 2012). Nevertheless, a common unanimously accepted definition of what does artificial intelligence actually represents is still not available. Davenport and Bean (2018) go as far as describing it like that technology the "is never truly here". This perspective is not unique, John McCarthy saying that once a specific AI technology or concept is proven to be functional, it is no longer classified as being artificial intelligence (as quoted in Vardi, 2012). According to IEEE (2017), artificial intelligence represents the combination of cognitive automation, machine learning, reasoning, hypothesis generation and analysis, natural language processing and intentional algorithm mutation producing insights and analytics at or above the human capabilities.

The concept of artificial intelligence is bound to be connected to that of knowledge. Therefore, knowledge management (KM) needs to consider including AI in its sphere of concern. The existing literature is not so concerned with the relationships between KM and AI. Therefore, the present paper aims to map the previous studies to have a clear picture of the state of the research and to identify key points of reference to be addressed by knowledge management when considering the AI development.

Artificial intelligence. An academic framework

Even if individuals have a relatively clear sense of what artificial intelligence is, there is a large corpus of definitions (see Legg & Hutter, 2007). Most of them are related to the ability of technological systems to achieve goals through their own cognitive abilities, in a complex environment.

One of the current difficulties of artificial intelligence is the migration from specific knowledge domains, where it has already been proven that artificial intelligence is on a comparable level with human intelligence (the so-called specialized artificial intelligence) to artificial general intelligence (AGI) which can perform at the human level in all knowledge domains. More to the point, there is already artificial intelligence capable of composing music (Bostrom, 2017), there is artificial intelligence capable of playing chess or Go better than human champions (Kasparov, 1996; Moyer, 2016), but there is no single artificial intelligence which can perform all three tasks.

How far we are from the development of Artificial General Intelligence is still under debate. Barrack Obama, quoting the position of his scientific advisors (A/N the President's Council of Advisors on Science and Technology has been established in 2001 with a mandate to advise the president on science and technology), says that we are "sufficiently far" from such a development (Dadich, 2016). A separate study by Müller and Bostrom (2016) shows that using a 50% confidence interval, artificial intelligence could be available between 2040 and 2050. On the other hand, there is the alternate hypothesis that AGI may never be achieved (Azulay, 2019) but the confidence interval for this hypothesis being true is relatively low (21%).

The impact of artificial general intelligence on general management practices is potentially very significant. However, the date when such intelligence will be available is still far away. Yet, specialized artificial intelligence (specialized AI or narrow AI) is already present, though with some divergence on how it is classified. However, under the umbrella term of artificial intelligence, a number of concepts have been introduced which do not involve intelligence and are merely automation. A study on managers (Davenport & Bean, 2018) shows that despite claims of artificial intelligence projects being implemented a good portion of them were robotic process automation (RPA), machine learning (ML) or scoring. There are researchers (Burgess, 2015) that do not agree to the inclusion of RPA for example under the umbrella of AI. This, in turn, has the effect of making the studies where the term artificial intelligence is not fully defined biased.

When we talk about the conceptual controversies regarding the understanding of AI, we have mentioned above the problem of different definitions. In this aspect, there are several studies by, for example, Schank (1987, 1991) or Murphy and Murphy (2000) from a technical perspective. Recently, Grace et al. (2018) raised the issue of exceeding human performance by AI. Indeed, the current literature seems to be more oriented towards the ethics of AI use (Bostrom & Yudkowsky, 2018) and, consequently, the profound redefinition of society, not just the economy (Makridakis, 2017). Taddeo and Floridi (2018) speak about artificial intelligence as a force of good.

The academic literature on the relationship between AI and management is quite rich, but less developed in Romania. In summary, it covers elements such as conceptual controversies and uses of AI; factors that influence the adoption of AI; perceptions regarding the adoption of AI; consequences of AI adoption.

Academic literature and the reports of consulting companies from the business environment are mainly focused on the applicability of artificial intelligence and, therefore, there are studies (more or less extended) on the usage of AI in areas as diverse as biology (Holland, 1992; Hamet & Tremblay, 2017; Webb, 2018), business and finance (Dirican, 2015; Dunis, Middleton, Karathanasopolous, & Theofilatos, 2016), even in art (Catricala et al., 2018).

The factors that lead to the adoption of AI are highly diverse, from organizational culture, appetite for risk and innovation, requirements for efficiency and performance which is visible from the studies on monitoring the adoption of the aforementioned artificial intelligence in various recent academic articles (Müller & Bostrom, 2016; Chui, 2017).

On the perception of the adoption of AI in the current activity of companies, the studies on how an AI manager is perceived show that there is a positive feedback when everything is well and there is limited need for intervention in the managerial process but the perception is changing to negative as soon as the

employees want to change or intervene in the decisional process (Ma et al., 2018). Studies in these cases have been realized on well-defined geographical regions (for example, for China, by Thomas and Liang in 2016) or only in specific areas of activity (for example, in education, by Popenici and Kerr in 2017).

What is the impact of all these technologies and concepts in the management process? Kolbjørnsrud, Amico, and Thomas (2016) suggest a set of practices for the usage of artificial intelligence in management: transfer of administrative work to AI, focus on the work which requires judgment and decision, treatment of intelligent machines as colleagues, development of design thinking.

Knowledge management concerns related to artificial intelligence

The early adoption of new technology offers organizations a competitive advantage. Nevertheless, this is limited in terms of long term sustainability; employees' competencies ensure it (Omotsyo, 2015). Nevertheless, the KM theories identify four key components: knowledge, people, processes and technology.

Many studies stress the very important role that technology plays in knowledge management (Gold, Malhotra & Segars, 2001; Lee & Hong, 2002; Butler, Feller, Pope, Emerson, & Murphy, 2008; Kuo & Lee, 2011; Sian Lee & Kelkar, 2013). The technology associated with knowledge management strategies confers facilities for knowledge storage, supports a functional knowledge architecture, facilitates effective use and transfer, could offer a multi-purpose platform or even contribute to knowledge creation. Innovation and co-creation are also stimulated by the IoT (Santoro, Vrontis, Thrassou, & Dezi, 2018). Nevertheless, knowledge management digital infrastructure does not ensure in itself the effectiveness of KM strategies, this being influenced by other factors among which organizational culture is very important (Bratianu, 2015; Zheng, Yang, & McLean, 2010).

Technological infrastructure would be only a basis for facilitating effective knowledge management strategies (Zbuchea & Vidu, 2018). Knowledge platforms should be connected to AI. The first seminal studies linking KM to AI are quite old, dating back at the beginning of the century (Becerra-Fernandez, 2000; Tsui, Garner, & Staab, 2000; Liebowitz, 2001; Nemati, Steiger, Iyer, & Herschel, 2002).

Table 1. *Relationships between artificial intelligence and knowledge management*

Study	Relationships
Becerra-Fernandez, 2000	AI helps build expert and other intelligent systems to support and enhance KM
Tsui, Garner, & Staab, 2000	For value-added, KM should use AI (Knowledge engineering).
Carneiro, 2001	AI helps KM to generate competitive advantage.
Liebowitz, 2001	AI is a facilitator for the transformation of individual knowledge to organizational knowledge.
Nemati, Steiger, Iyer, & Herschel, 2002	AI enhances KM, converts tacit knowledge into an explicit one, uncover knowledge through deep analysis, and amplifies the cognitive abilities and offer a wider explanatory framework of the decision-maker.
Fikri & Zaibon, 2003	AI permits the capturing and representation of knowledge, considering several dimensions such as people, processes, best practice and associated lessons learned.
Metaxiotis, Ergazakis, Samouilidis, & Psarras, 2003	KM operational systems offer an integrated framework for AI technologies.
Houari & Far, 2004	Optimization and enhancing decision-making processes.
Valente & Torasso, 2004	AI supports just-in-time knowledge handling and acquisition, as well as operational solutions related to daily activity.
Fenstermacher, 2005	AI helps represent and use tacit knowledge.
Metaxiotis, Ergazakis, & Psarras, 2005	AI is used in a qualitative way in KM.
Hoeschl & Barcellos, 2006	AI enables the development of selection and analysis tools to optimize databases considering open and loosely structured sources, such as the internet.
Li, 2006	Most tools used for better KM are communication-based, while AI ensures the next level of knowledge management.
Diao, Zuo, & Liu, 2009	AI offers expert systems able to ensure the induction of tacit knowledge.

Birzniece, 2011	Summarized new needs of KM that could be satisfied by AI: web knowledge acquisition, hierarchical document classification, intelligent search, and web-enabled knowledge sharing.
Gulavani & Joshi, 2011	AI facilitates the development of KM through offering various tools for knowledge acquisition, codification, and analysis, sharing and use, leading to efficiency.
Devadas & Ganesan, 2012	AI facilitates KM by allowing intelligent agents to cooperate, coordinate and collaborate among them, to create and share knowledge for process and organizational effectiveness.
Mercier-Laurent, 2015	AI ensures the design of knowledge flow from building blocks of applications that allow the successful communication of all stakeholders.
Avdeenko, Makarova, & Klavsuts, 2016	AI facilitates the knowledge spiral, between tacit and explicit knowledge.
Kingston, 2016	KM is presented as a complex collection of different approaches and models that can be pragmatically managed by means of AI.
Paschek, Mocan, Dufour, & Draghici, 2017	AI ensures prompt management of big data and integration into knowledge management systems.
Sanzogni, Guzman & Busch, 2017	AI and KM are complementary in handling tacit knowledge since AI supports human agents. This presents ethical, expertise-related as well as technological-design implications.
Anum, Lodhi, & Ahmed, 2018	AI not only helps manage heterogeneous knowledge but also generates contextual and sharable new knowledge.
Begler & Gavrilova, 2018	AI is used to improve KM in terms of data-mining and processing.
Abubakar, Behravesh, Rezapouraghdam, & Yildiz, 2019	AI can be used to spot irregularities in KM, including flaws related to the human dimension of knowledge handling.

There is a relatively large corpus of literature investigating the relationships between KM and AI, especially studies focusing on aspects of the relationship. The international conference on Artificial Intelligence for Knowledge Management is at the seventh edition this year and special tracks in the field are proposed to various academic encounters. The above review presents a selection of the most relevant articles which explicitly consider the impact of AI on KM.

Metaxiotis, Ergazakis, and Psarras (2005) point out that there are both positive and negative aspects to consider when questioning the relationships between AI and KM. The combinations between various technologies and knowledge types determine changes in the status of knowledge: from tacit go explicit, from tacit to tacit, from explicit to new knowledge, from explicit/new to tacit knowledge.

Conclusions

The previous research highlights the necessity to better understand various dimensions of AI. Also, there is a need to deepen the understanding of concepts such as knowledge management, knowledge creation, knowledge engineering, and business intelligence.

In business, in general, there is still a narrow use of AI, at least in the case of less digitally transformed economies. Nevertheless, data mining, advanced algorithms, and predictive analytics were declared to be among the highest-priority projects for enterprises adopting AI (Columbus, 2019). The current AI ecosystem consists of machine learning, robotics, and artificial neural networks, while current efforts revolve around using deep learning to train digital systems in acting with a certain degree of self-awareness (Statista Digital Market Outlook, 2019). An important indicator of the current rise of the AI is the funding of start-ups specialized in this field, at a level of more than $19 billion by 2018 (idem) – therefore, it is only a matter of time before seeing AI not only as a hype or as a feature of some industries, but as a current choice of enterprises, at least of the competitive ones.

AI and technology lead to the idea of explicit knowledge. Nevertheless, several studies show the implications of AI in relation to handling and making accessible tacit knowledge. By character, tacit knowledge is human-related and this could be one of the reasons why KM is still intuitive in some enterprises, despite the existence of abundant academic literature on the topic. Employing prediction machines is already routine in some areas such as banking and finance, and with the exponential development of technology and the simultaneous decrease of costs, we can expect to see humans replaces by AI in cases where whole decisions can be clearly defined with algorithms (Agrawal, Gans, & Goldfarb,

2018). Therefore, KM, as we know it, as a form of knowledge structuring and transfer for predictable consequences of business actions, will be soon challenged.

The next ten years will be critical in terms of changes induced by AI in human life (Winston, 2018), so AI's impact on management itself will be consistent, too. We already can see that AI impacts KM at operational levels, with the Big Data becoming an everyday presence for some enterprises, but we can also detect some other influences. KM is already transformed by AI's technical possibilities in terms of data collection, storage, organization, and transfer. The next big challenge will be the on the KM's conceptual transformation itself under the influence of AI: at present, AI is considered limited in terms of creativity and strategy definition, but some use of it could be considered at least for training creative skills. Is there a possibility that this could lead to a new form of KM in the future? For the time being, we can consider digital systems more like an opportunity to finally fix and practically introduce functional and operational KM systems in organizations, and make the transfer from tacit knowledge to explicit ones.

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