Organizational knowledge management with Big Data. The foundation of using artificial intelligence

Daniel PASCHEK  
Politehnica University Timisoara - Management Faculty, 300191 Timisoara, Romania  
paschi88@gmx.net

Anca MOCAN  
Politehnica University Timisoara - Management Faculty, 300191 Timisoara, Romania  
ancamocan2003@yahoo.com

Corina-Monica DUFOUR  
Politehnica University Timisoara - Management Faculty, 300191 Timisoara, Romania  
corinarusnac@gmail.com

Anca DRAGHICI  
Politehnica University Timisoara - Management Faculty, 300191 Timisoara, Romania  
anca.draghici@upt.ro

ABSTRACT

In the following paper the relevance of Knowledge Management (KM) as a foundation of Artificial Intelligence (AI) systems will be analyzed. The purpose of the work is the presentation of mandatory framework conditions for using AI with a special view on knowledge management for Big Data. Therefore the mandatory definitions of the core components will be described theoretically supported by practical examples. Based on literature, there will be done research and presentation of existing applications the relation between the knowledge management in the organization and big data as core component. To identify the relevant topics of using Big Data for knowledge management an analysis will be held up with digital companies. In addition, the main advantages and disadvantages will be depicted. The finding of the paper will be a recommendation of the developed Artificial Intelligence Knowledge Model for using Knowledge Management and Big Data for Artificial Intelligence decisions within the company.

Keywords: Knowledge Management, Big Data, Artificial Intelligence, Digital Transformation, Digitalization
INTRODUCTION

In times of digitalization, globalization and Industry 4.0 the wealth of information in every field of business arises is enormous. This can be seen by looking at the global data traffic and the degree of capacity utilization of data centres (Büst, 2016). While in the past human resources analysed these data to deviate strategic and operational business changes, computers took over these functions and evaluate the flood of data faster and more precise than any human could. While virtual and real processes are increasingly merging in the context of Industry 4.0 organizations are required to address the challenges of digital transformation through business models, technology and knowledge (Moritz, 2016). This expertise in the form of knowledge will be the production factor of the future for businesses next to energy and other commodities (Bürgel, 2013). More and more companies represent the point of view whereby the knowledge of the employees will become a sustainable competitive factor (Bürgel, 2013). Already in the past companies had to face the challenge to avoid the knowledge transfer out of the company through the retirement of staff by knowledge management systems (Awad, 2017).

Through the enormous progress by means of digitalization, information and communication technology – Knowledge Management Systems (KMS) can assist to collect, prepare and depict the known company knowledge (Awad, 2017). But without the correct actions of the company which enable and support the employees to spread and maintain their knowledge, a KMS and AI won’t be successful (Bürgel, 2013).

For this reason, the following work will analyse the relations and opportunities of using KM in Big Data in times of digitalization as a foundation for AI. The outcome will be an Artificial Intelligence Knowledge Model for the business. Furthermore the advantages and disadvantages by using KM and Big Data for AI within the company will be evaluated.

SCIENTIFIC STATUS OF THE RESEARCH

Definition of Big Data

Big Data is defined in many different ways, as can be seen in literature. The challenge is to find the distinct definition because of the wide range of the term. Big Data describes large amounts of data that can originate from a wide range of sources and are evaluated using modern computer technology (Buyya, 2016). The original type of definition is referred to Douglas Laney three dimensions, which is known as the three Vs and adapted by Gartner (2017):

1. **Volume** defines the enormous amounts of data, e.g. Companies produce data daily. Their volume is so large and so complex that it cannot be stored or even analyzed by conventional methods of data processing.
2. **Velocity**, which represents the speed at which data can be generated, evaluated and further processed,
3. **Variety** refers to the variety of data types and sources, which are, incompatible, inconsistent or unstructured.

IBM extended the 3 Vs of Laney by a fourth V. Veracity, which implies the uncertainty of data and the focus of trustworthiness of data sources (Buyya, 2016). Microsoft tries to maximise the business value by extending the 3 Vs of Laney by three further Vs (Buyya, 2016):

4. **Veracity**, which focuses on the trustworthiness and validity of data,
5. **Variability**, which refers to the complexity of data and the number of variables in data sets,
6. **Visibility**, which means you have all necessary data to do informative decisions.
In a nutshell, Big Data is about the entrepreneurial success to handle the acquisition of new information – which has to be available to a very large number of users in a very short time, with enormous volumes of data from a variety of sources and different qualities, to analyse these data in order to take informative decisions.

**Definition of Artificial Intelligence**

In the literature two different approaches to define AI can be found. On one hand humans are drawn as comparison and on the other AIs are characterized by the list of different application and work areas, for example in the following (Cleve, 2012):

- “The theory and development of computer systems able to perform tasks normally requiring human intelligence"
- “The AI examines how to capture and understand the intelligent behaviour of computers, or how to solve problems by using computers that require interoperability. “
- “AI is a subdivision of computer science, which deals with the investigation of different problem areas like robotic, speech and flow text recognition as well as image and video processing.

For the scope of this paper AI is defined as a section of informatics and applied computer science to pattern human proceedings of problem-solving and transferring them to computers in order to invent efficient and new solutions as well as new course of actions. Therefore, AI is a computer program running on any possible device or data centre with the skill to interact with its environment (Paschek, 2017).

In the literature, mainly two types of AI are distinguished as consequence of the application areas (Urwin, 2016):

- **Weak artificial intelligence** is usually used by specific application problems in which it is not logical thinking, decision making or even consciousness required. Weak AI supported mainly as information supplier, on which humans bases decisions. This includes, for example, navigation systems, voice recognition, correction suggestions when searching;
- The term of **Strong artificial intelligence** is used in the literature when a machine has the same intellectual abilities or even outperforms a human being. Urwin’s (2016) logical thinking, making decisions in case of uncertainty, plan something, learn something and the communication in natural language are capabilities of strong AI.

To set a complete definition of AI the terms of machine learning and deep learning, one has to name as foundation of AI. Deep Learning enables many practical applications of Machine Learning and by extension, the far-reaching field of AI by breaking down tasks in ways that make all kinds of machine assists seem possible (Copeland, 2016).

**Definition of Knowledge Management (KM)**

Defining KM has always been a challenge as mentioned by Girade (2015), because of the variety of concepts. After summarizing more than 100 KM definitions Girade describes the concept as “the process of creating, sharing, using and managing the knowledge and information of an organization” (Girade, 2015).

In addition, one of the primary definition of KM belong to Drucker (1999). He considered that KM is “the coordination and exploitation of organizational knowledge resources, in order to create benefit and competitive advantage” (Drucker, 1999).
Gartner synthetized the previous definition and define KM as a “business process that formalizes the management and use of an enterprise’s intellectual assets. KM promotes a collaborative and integrative approach to the creation, capture, organization, access and use of information assets, including the tacit, uncaptured knowledge of people” (Gartner, 2017).

Nevertheless, before talking about KM, the meaning of the term “knowledge” should be put into context in order to understand what constitutes knowledge and what falls under the category of information or data. These differences between the mentioned terms and the definition are shown in the following Figure 1 based on Frost’s approach (2017).

**Figure 1: Definition of Data, Information, Knowledge & Decision (own presentation).**

In the literature, knowledge is classified and characterized in different ways. The most well-known and accepted types are mention in (Mohapatra, 2016):

- **Explicit Knowledge**, is record and represent in tangible forms and available in digital format, paper format etc.;
- **Tacit Knowledge** refers to the knowledge that resides in an individual’s mind, which is usually difficult to articulate and put in words;
- **Embedded Knowledge** refers to the knowledge that is locked in processes, products, culture, routines, artefacts, or structures and applies the other two knowledge types. (Frost, 2017).

**Evaluation of scientific status**

The theory and literature shows the wide range of definitions in the fields of KM, Big Data and AI. To build a best fit system for automation with AI in the times of digitalization the data bases will build the important fundament supported by KM for organizations because:

- KM places a focus on knowledge as an actual asset and ability to protect its key knowledge and competencies from being lost or copied;
- It helps business to learn from past mistakes and successes enhances the firm's ability to innovate;
- It better exploits existing knowledge assets by re-deploying them in areas where the firm stands to gain something;
- It promotes a long-term focus on developing the right competencies and skills and removing obsolete knowledge (Frost, 2017).
THE ARTIFICIAL INTELLIGENCE KNOWLEDGE MODEL

Based on the scientific status, an Artificial Intelligence Knowledge Model was developed. It is designed on the basis of the theoretical study to provide the AI Systems with all necessary data to do the best and hopeful right decision without human interaction. Therefore the core and foundation of the approach will be the set of the available data and information’s by Big Data and the organizational KM (Figure 2).

![Figure 2: The Artificial Intelligence Knowledge Model (own presentation).](image)

On the left side of Figure 2, KM provides the necessary data of the organizational areas like Human Resource Management with Staff development data, Performance Management or Change Management as well as Organizational Learning and Information Management with organizational process development, business strategies or policies and procedures just to name a few. On the right side of the figure Big Data symbolizes the handling with the acquisition of new information in a very short time, with enormous volumes of data from a variety of sources and in different qualities. This data can be measured values, benchmark values, competitor information’s, process data and Key Performance Indicators (KPI) as well as email notifications or external environmental factors and so on. With Big Data Analytics or the support of Business Intelligence Systems (BI) the flood of structured and unstructured data will be stored, queried, evaluated, and visualized. With the preparation of these data the next level, the information is reached. This can be seen at the left side of the pyramid at the Data Performance axis. At the right side the “Descriptive” status is reached, which describes the analysis of happened incidents by a batch analysis for example. Thereby the business value of the data rises.

In order to reach the “Predictive” status of the Business value axis iterative analytics have to carry out by the system. In this way the analysed information’s with Big Data or BI has to set in relation with new data to identify possible impacts before they happen. At this stage of the Business Value axis the Predictive status affects the Knowledge status at the Data Performance axis. Already experiences as well as expert insights and contextual information are necessary to assess the information right. Knowledge and Prescriptive status supplement each other. Iterative analytics lead to well grounded information as basis for the decision of the artificial intelligence system. At this position the highest Business Data value and Data Performance exists.
By combining KM and Big Data the AI System will be able to provide the best decision at the top of the pyramid of the Artificial Intelligence Knowledge Model.

**THE RESEARCH METHODOLOGY**

To analyse the practical relevance of the model an anonymous survey method was used. The survey started with the introduction of the topic and the objective. After this, socio-demographic information about the respondent was asked e.g. the age of the person, educational background and so on. As the next part of the survey the topical main part with dichotomous questions, grouping and rating questions like the Likert Scale and open questions followed. The core of the survey was to evaluate how the respondents notice KM in their company and in which way they work with data and information as well as changes through the digitalization like Big Data. One important component were the questions about the evaluation of humans in relation to the analysis of the data and information flood with regard to decisions as well as the experiences with AI.

Target persons were mainly Chief Information Officers (CIO), Chief Technology Officers (CTO), Chief Execution Officer (CEO), Chief Digital Officer (CDO), IT process managers as well as Human Resource Managers (HRM) to make sure, the respondents will have touch points or experiences with the topic. The base line is set up by 85 valid survey replies from a total of 100 requested ones.

**Research results**

In the following, the results of the survey are presented. 85% of the requested Managers of 20 companies agree to support with answering the survey. From that 15 women and 70 men with an average age of 47 and 100% experiences with KM participated at the survey. The companies of the respondents were medium-sized enterprises with less than 1000 employees.

Regarding to the questions of KM at the company 82% mentioned that they use an internal system to collect and provide data as well as Information’s. Very interesting is that 100% of these classify the KM levels like described at the theory part of this paper in data, information and knowledge. On the other hand 18% don’t use KM or a KMS but try to establish one because of the known advantages. The results of the questioned main advantages of using KM are the acquisition of entrepreneurial knowledge over all operational and management levels with more than 42%. Second the transfer of knowledge about different employees and departments with 29% and as third the hope of lessons learned and linked knowledge development with 28%. But 68% agree with the opinion: Knowledge is the result of perception because Knowledge is fleeting. Knowledge obsolesces, Knowledge sometimes loses its truth content or Knowledge can be lost.

Especially the loss of truth is a big problem in practice. The survey shows, that 51% of executives use incorrect or outdated information at least once a week while 58% of the requested employees do not have the information they urgently need for processing their work. This shows how important a good KMS as well as application process and the living KM culture are at a company.

Considering the Artificial Intelligence Knowledge Model with the integration of Big Data the survey participants were asked about their evaluation of the model regarding the practical implementation, possible advantages, application at day-to-day business and the handling with AI. 91% of respondents would integrate and combine Big Data and KM if the tool would be able to process the data and information’s correct. It can be deducted, that the survey participants promise a lot of advantages by collecting data and information’s via Big Data. 100% agree that data without any logic or system for data organization aren’t helpful. Furthermore, it became clear that 85% are interested about using AI to operate and process the data and information’s of the KM and Big Data.
76% of the respondents recognize concrete fields of action at their business. These fields and the scored relevance can be seen at the following figure 3.

![Figure 3: Fields of Action for the Artificial Intelligence Knowledge Model.](image)

Five will be the best and zero the worst score. Especially the field’s process changes through KPIs, offers and price changes based on benchmark data and analysis of missing corporate knowledge and support of human resource processes are scored with more 4,5 and more. This means, the application of the model will be the most effects in these fields regarding the participants of the survey. At the second view at the figure all fields are scored relative high with an average score of 3.945. Derived of this value, the model promises a high additional business value in different fields of action.

All participants of the survey agree with the assumption, that the digitalization and the rising quantities of data will present the business with new challenges. 79 % of the respondents assume faster changing external environmental factors with enormous impacts to the own company. Therefore the Artificial Intelligence Knowledge Model can help to identify these changes regarding the data analysis via Big Data and the evaluation through AI immediately, respond 82% of the interviewees. The resulting approach to combine internal knowledge with Big Data from external as well as internal sources by using AI for the decision-making base and recommendations seems to be a new way to support human analytics. In addition, all respondents are appreciating that there are some big challenges to handle with. The biggest ones will be to settle the level of quality of content as well as the search ability and the reluctance to use the knowledge base. But with 56% the biggest challenge will be the identification of the best technology and algorithm for the artificial intelligence.

**CONCLUSIONS**

One important capability of the agile and flexible enterprise of the future will be the ability to deal intelligently with data as well as knowledge. The management of this data, and the collecting, selection, enrichment and transfer of knowledge are becoming more important. The main task is to analyse the abundance of data combined with individual business perspectives and experience backgrounds to transfer them into an "objective" knowledge package for a decision-making base. Therefore Knowledge Management and Big Data in conjunction with AI will be the most important tools for processing the data flow of the digital world.
REFERENCES

Awad, E.M., (2017) Knowledge Management, Dorling Kindersly, India, Pearson Education

Bürgel, H.D., (2013) Wissensmanagement: Schritte zum intelligenten Unternehmen, Berlin Heidelberg, Germany, Springer Verlag

Büst, R. Das Rechenzentrum: Die logistische Drehscheibe der Digitalisierung , (2016) Retrieved April, 29.2017 from: https://www.crisp-research.com/das-rechenzentrum-die-logistische-drehscheibe-der-digitalisierung/

Buyya, R., Calheiros, R.N., Dastjerdi, A.V., Big Data: Principles and Paradigms, Cambridge, Elsevier

Cleve, J., Lämmel, U. (2012) Künstliche Intelligenz, München, Germany, Carl Hanser Verlag

Copeland, M. (2016) What’s the Difference Between Artificial Intelligence, Machine Learning, and Deep Learning?, Retrieved April, 29.2017 from: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

Drucker, P. F. (1999), Management Challenges for the 21 Century, New York Harper Collins

Frost, A. (2017) Defining Knowledge, Information, Data, Retrieved April, 30.2017 from: http://www.knowledge-management-tools.net/knowledge-information-data.html

Gartner IT Glossary (2017) Knowledge Management (KM), Retrieved April, 30.2017 from: http://www.gartner.com/it-glossary/km-knowledge-management

Gamble, P.R., Blackwell, J. (2001), Knowledge Management: A State of the Art Guide, Kogan Page Ltd.

Girard, J.P., Girard, J.L. (2015), Defining knowledge management: Toward an applied compendium, Online Journal of Applied Knowledge Management. 3(1), 1-20

Mohapatra, S., Agrawal, A., Satpath, A., (2016) Designing Knowledge Management-Enabled Business Strategies: A Top-Down Approach, Switzerland, Springer

Moritz, E, Knowledge Management im Zeitalter der Digitalisierung, (2016) Retrieved April, 29.2017 from: https://www.financebusiness.afb.de/2016/08/23/knowledge-management-im-zeitalter-der-digitalisierung/

Paschek, D., Luminous, C. Draghici, A., (2017) Automated Business Process Management – in times of digital transformation using machine learning or artificial intelligence, 8th international conference on manufacturing Science and Education

Urwin, R. (2016), Artificial Intelligence – The quest of the ultimate thinking machine, Arcturus Holdings Limited