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Procedia Economics and Finance 39 (2016) 605 – 611

Procedia Economics and Finance

www.elsevier.com/locate/procedia

3rd GLOBAL CONFERENCE on BUSINESS, ECONOMICS, MANAGEMENT and TOURISM, 26-28 November 2015, Rome, Italy

Application of Big Data Technology in Knowledge Transfer Process between Business and Academia

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Abstract

New data and information are being constantly produced as a result of technological development. The data and information are used by many companies as a source for creating knowledge in their sphere of business. The important part of the knowledge creating process is both adequate amount of relevant data, and an ability to transform this data to information. Various technologies are helpful, such as Big Data technology. Mostly big companies with sufficiency of money dispose of Big Data by reason of its complexity and significant expenses in terms of maintenance, specialized staff, technology infrastructure etc. Constantly changing demands of customers together with a strong competitive environment is forcing companies to innovate, for instance by designing new products, improving internal processes, or implementing new technologies. By obtaining such innovation is very helpful cooperation with research and development (R&D) institutions from academia. Universities are in a large extent dealing with R&D activities, on which companies don't have capacities, but the results from these R&D activities are for companies interesting and mostly usable in practice. The purpose of this paper is following findings obtained from analysis of the knowledge transfer and Big Data theory finding and describing the possibility of connecting these two areas in practice. The paper is focusing on knowledge transfer creation within cooperation of companies and universities through access for university to company's database during contract research with usage of Big Data. Knowledge of cooperating subjects is filling up, deepening and verifying through united access to collecting, storing, processing and interpreting available data, whereby emerging knowledge transfer between cooperating subjects.

Peer-review under responsibility of the Organizing Committee of BEMTUR- 2015

Keywords: Big Data, knowledge transfer, cooperation, technology transfer.

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Peer-review under responsibility of the Organizing Committee of BEMTUR- 2015

doi:10.1016/S2212-5671(16)30305-7

1. Introduction

The information context of the modern organization is rapidly evolving in the face of intense global competition. Decision making of managers is on the present largely depend on timely, accessible and relevant information within the context of solved problem. The most comprehensive information represent knowledge for managers. The knowledge can be obtained either from own resources of the organization or from the available data. Continuous development of information and communication technologies gave rise to new systems and platforms that are generating plenty of data every second. The data can be potentially carrier of important information necessary for the creation of subsequent knowledge related to the problem. Thanks to the openness of the Internet and its interconnection with almost all devices both at consumers or businesses, unstructured data are gaining ground. The unstructured data are such data that do not have a specific structure, and which are not stored in the relational database model. Large amounts of unstructured data have different characteristics from data generated by the own systems of organization or academia, and their database structures (e.g. data warehousing) and their tools for data management cannot efficiently process and analyze these volumes in terms of reasonable time and cost perspective (Dolak , 2011). This was the main reason why BigData technology arose. By integrating an enterprise solutions of BigData with existing information systems and the systems of the academic community, the organization can obtain new tools through which can be obtained relevant information from unstructured data. This information could essentially affect the creation of knowledge, which the scientific-research institution carries out in the given field. Creation of new knowledge is useful both for academia because it can move forward its research or be a basis for new publications, and for organizations from business because it can be helpful by creation of innovation or by solving some existing problems in the organization.

2. BigData

In terms of information and communication technologies BigData represent rapidly changing and expanding field. Large data are connected primarily with modern, trendy technologies that generate a lot of data, or use a lot of data, such as semantic technology, sound and voice processing, and the Internet of things. Therefore, it is very difficult to clearly define the term BigData. Another reason are also temporal changes in terms of rapid technological development, i.e. data which represented in the nineties large data difficult for processing, can be today processed by conventional computers or mobile devices because of technology development (Cerny, 2013). Large data are liberally defined term that describes a large amount of complex data sets, and at the same time describes innovative technologies for the collection and storage of data quantity (Kim, 2014). Nowadays BigData technology represents a modern way of working with the information, the meaning of which many organizations undervalue. The term BigData itself can be for management misleading, as evidenced by the survey of IBM, in which 18 % of managers see the BigData only as larger amounts of data, and 8 % as a new term, or the term denoting a big amount of data (Levarsky, 2013). Generally it is possible to talk about the large data in three basic meanings. First it is data too extensive for us to easily and in a reasonably short time process (e.g. data about the gravitational potential of each star, located in two galaxies that are currently exposed to precipitation). Second, the unstructured data (e.g. browsing data via text, video or audio files), and finally data by which we need information in almost real time (i.e. traffic data from thousands of cameras and satellites) (Cerny, 2013). BigData represent data with a very large size, usually to such extent that brings significant logistical challenges for handling and managing them (Oxford English Dictionary – BigData). BigData relate to data files, whose size within the current database systems is above their possibilities of capturing, storing, processing and analyzing (BigData: The next frontier for innovation, competition, and productivity). Large data relate to the large amount of data that have been collected over time, and that is difficult to analyze and handle by using common tools for a unified database service. Data in the field of market trends, manufacturing, medicine and science are being analyzed. Types of input data are business transactions, e-mail messages, photographs, camera records, reports of activities, unstructured text e.g. from blogs and social media, as well as large amounts of data, which can be generated by various sensors (Definition of: BigData). BigData is a term describing an exponential growth and availability of data, both structured and unstructured. BigData may have the same meaning for business and organizations, which has the Internet today, because this data may lead to more precise analyses (BigData. What is it & why it matters). The term BigData refers to the large amount of information

coming from different sources, such as transaction records, initialization files, social media, sensors, third parties, web applications etc. However, BigData are not only a large amount of data, they are also extremely diverse data types distributed at different speeds and frequencies (Stanimirovic, Miskovic, 2014). BigData is generated all around us in every time. It is produced by each digital process and information exchange through social media. They are also generated by various systems, sensors and mobile devices. BigData come from various sources at very high speed, in large mass and wide diversity. To be able to get from BigData such values, that will make sense, is required optimal processing power, analytical skills and abilities (What Is BigData).

According to IBM company BigData platform provides possibilities to handle large amounts of data in connection with the business opportunities of the organization. BigData platform contains traditional technology for processing structured and unstructured data with links to new technologies focusing on speed, flexibility, targeted exploration, discovery, analyzing data. According to IBM BigData are defined by following characteristics (according to: BigData for beginners and advanced):

- **Volume** represents a very large amount of data collected for analytical processing (e.g. aeroplanes Airbus are generating every half an hour 40 TB of data, Twitter generates daily 12 TB of data, Facebook 25 TB, etc.), which represents an opportunity for organizations to summary process voluminous data within a single database structure (Hrapko, 2012, Stanimirovic, Miskovic, 2014).
- **Diversity** means that the data is both in structured and structured form, i.e. data take the form of messages, images, GPS signals and other types of data generated by the Internet and telecommunications.
- **Speed** means that data must be very fast obtained and processed, i.e. in real or almost real time, which enables flexible reacting for organizations to market changes, or gaining a competitive advantage.
- **Veracity** is the possibility of obtaining a distorted outputs, because by the processing of large amounts of diverse data is at the same time processed also much data that contains rustle, or distortion (e.g. data from social networks).

Based on the similarities of understanding BigData by various authors, it is necessary to realize that the term BigData represents not only to the large amount of data. It is a complex term like Business Intelligence that defines BigData as a very large amount of data that is continuously generated from different sources (social networks, sensors, internet, text files, etc.), together with new technologies aimed at advanced collection, storage and analyze data through a variety of analytical tools. This work with data within the framework of BigData technology is characterized by high speed, whereby are processed diverse data, such as structured, unstructured, and semi-structured. The ability to process large amounts of diverse data has an essential impact on obtaining relevant information, detecting business opportunities and making operations across all processes in the organization more effective.

The problem with the ability to process large volumes of diverse data is nowadays being solved for example by a model of integrating organizational database structure with BigData technology. The integration is shown at Figure 1.

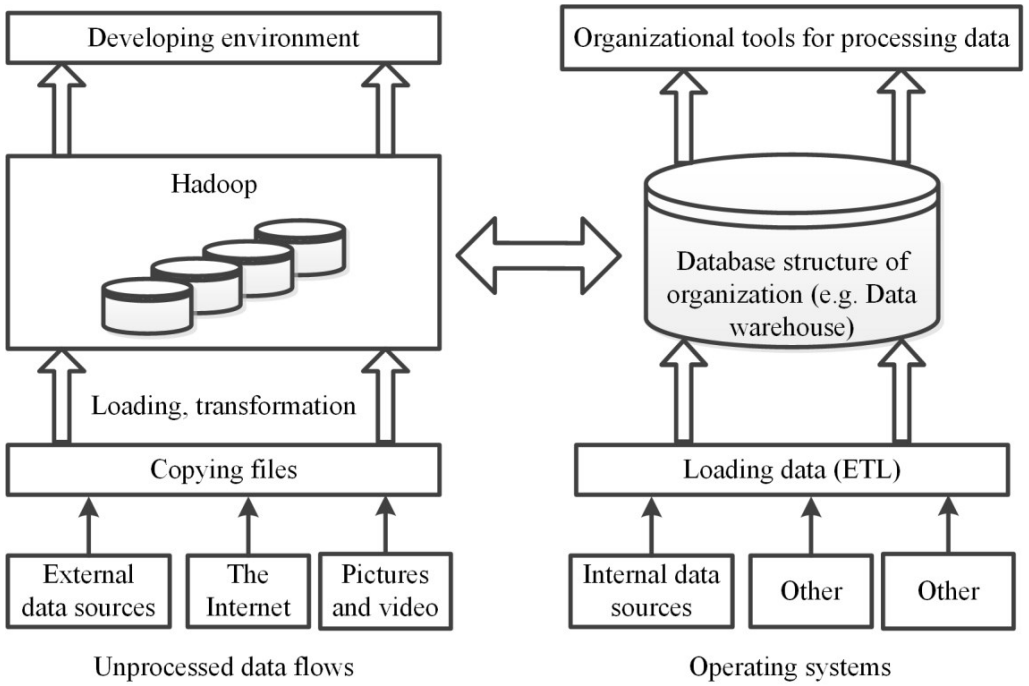

Fig. 1. Architecture of IBM BigData (Modified by Skokan, 2014)

On the basis of pictured integrations it is obvious that BigData technology providers try to integrate not only business analytical tools, but link the entire infrastructure of the organization into a single unit with the architecture of BigData. Similarly, it would be possible to solve the problem of interconnection BigData solutions of the organization with a data infrastructure of scientific-research institutions from academia.

3. Knowledge Transfer

In an information economy, organizations compete on the basis of their ability to acquire, manipulate, interpret and use information effectively (McGee and Prusak, 1993). Building competitive advantage involves creating and acquiring new knowledge, disseminating it to appropriate parts of the firm, interpreting and integrating it with the existing knowledge and ultimately using it to achieve superior performance (Turner and Makhija, 2006). Knowledge presents a deeper level of understanding than is represented by information. It is important to distinguish between particular types of knowledge, since they can have different impacts on knowledge transfer process (Reagans and McEvily, 2003). Fundamentally there are two types of knowledge: tacit and explicit. **Explicit knowledge** is easily transferred because it can be encoded in a widely recognized symbol system, and traditionally it was the backbone of formal structural approaches. On the contrary **tacit knowledge** can be transferred only under exceptional conditions, it derives its value from being inimitable so it is hard to leverage because it is difficult to codify. However, codifying it makes it imitable, producing a basic paradox that organizations must resolve (Coff, Coff, and Eastvold, 2006). There can be identified three different types of tacit knowledge in the context of developing innovation in organizations (Leonard and Sensiper, 1998):

- **A guiding concept** resides at a high level of abstraction and is often metaphorical. It also may have totemic, visual quality that is often found in the realm of product design that captures the style of a particular company.
- **Collective tacit knowledge** arises from interaction in the same group and resides in the head of each socialized group member.

- **Overlapping specific tacit knowledge** arises from groups working on common, interdependent tasks.

There is also another special form of tacit knowledge - **embedded knowledge** that resides in systematic routines such as the rites and ritual of corporate life (Blackler, 1995).

Knowledge transfer (KT) is a practical problem of transferring knowledge from one organization to another, or transferring knowledge from part of the organization to another (or all other) parts of the organization. The main aim of KT is organizing, creating, capturing or distributing knowledge and ensure its availability for future users. KT is considered to be a complex problem because knowledge resides in organizational members, tools, tasks, and their subnetworks and much knowledge in organizations is tacit or hard to articulate (Nonaka and Takeuchi, 1995). The subject has been taken up under the title of Knowledge Management.

KT can be defined as the means by which expertise, knowledge, skills and capabilities are transferred from the knowledge-base (for example, a university or college, a research center or a research technology organization) to those in need of that knowledge (for example a company, social enterprise or not-for-profit organization). Hence, KT involves the interface between universities and business, and involves the commercialization of skills and expertise possessed by higher education. The purpose of KT is also to catalyze and facilitate innovation. Examples of KT are following (according to: KES International):

- spin-off companies,
- incubators and entrepreneur schemes,
- university-industry contracts and consultancy,
- licensing of university-originated intellectual property,
- other modes of knowledge transfer and technology transfer, e.g. work-based learning projects,
- the knowledge transfer, knowledge origination and knowledge exchange process,
- innovation, open innovation and the generation of new ideas.

Cooperation between academia and business is mostly oriented in joint research and development. Organizations want to implement current technology and modern concepts but they do not have enough information about them and/or they are not able to apply them in specific conditions in their companies (Coates, Arayici and Koskela, 2010). It also often happens that companies have good ideas but they are not able to realize them primarily because of insufficiency of necessary knowledge. The cooperation between academia and business should be properly managed, so that it would be profitable from long-term perspective. The best way how to do it is by using principles of **cooperation management**, which represents effective and efficient management of relationships in a cooperation between separate and relatively independent organizations or individuals, with the goal of improving their competitiveness (Soviar et al., 2013).

The form of KT suggested by authors rests in interconnection of academic info-base with the information systems of the organization. Outcome will be in the form of enlarged amount and content of data, which will be further operated and will be the source of creating new knowledge.

4. Discussion

As the amount of data generated either by organizations or its environment is constantly enlarging and their significance is deepening, various integrations of new technologies for processing them are arising (see Figure 1). Data and information obtained from it have essential influence on managing processes in all areas of the organization. This issue can be also referred to the academia, where is data and information obtained from it an integral part of scientific and research projects, in which the processes of knowledge creation take place. Therefore it is appropriate to consider the integration of organizational BigData solution together with academia. This connection can be seen at Figure 2. It is a generalized connection of BigData technology of the organization with a database basis of academia, which is issued from a model of integrating organizational data warehouse with BigData technology by IBM. There is a bond formed between database of academia and BigData of organization. The bond represents an integration of the two databases into one comprehensive database. The main idea is that academia can

work over the data through its own tools, methods and techniques or through tools, methods and techniques of the organization, which should be accessed for academia to ensure the required and relevant outputs.

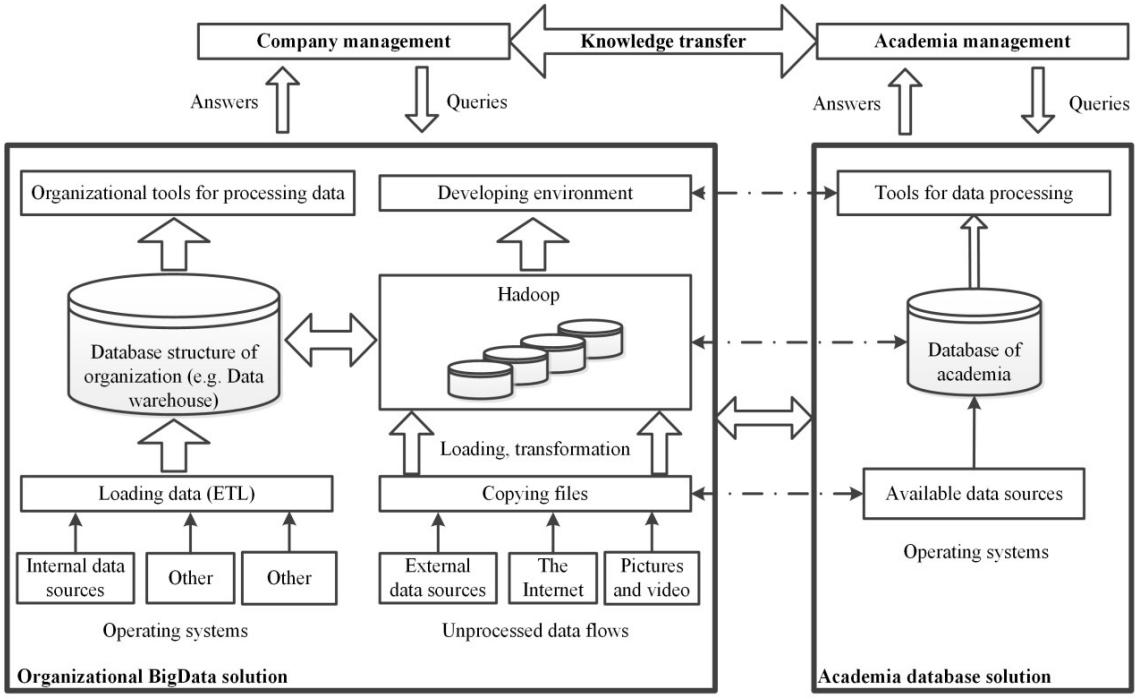

Fig. 2. Integration of organizational BigData solution with academia

Integration of organizational BigData solution with academia could have a number of benefits both for the organization and academic community. The main **benefit for organization** providing BigData is knowledge transfer in specific area, in which is the cooperating scientific-research institution form academia an expert because of daily dealing with a specific issue. The organization can use knowledge from academic institution for example in creating and implementing innovation into its business activities, which will have in the long-term perspective various positive effects specifically in obtaining a competitive advantage. Other benefits of the integration in terms of business are unloading organizational capacities, acquisition of new data sources, reducing the cost of maintaining the new data sources, becoming involved in scientific research and obtaining results from analyses that are related to the organizational activities etc.

In terms of the **academia** can be considered benefits such as gaining access to new technologies, database sources and techniques for data processing. Another benefits are creation of relevant outputs substantiated and verified by data acquired from the organization, widening the area of scientific research by finding new scientific problems and usage of available resources for its implementation. There can be also cost savings related to maintenance, licenses and securing staff for BigData technology. And last but not least academic institutions can extend their publication activities.

Despite of many mentioned benefits for both concerned parties, there could occur also some **problems**. The main problem is the issue of mutual trust. Organizations are often afraid their know-how can be stolen and are not willing to share their data and information. The possible solution is contract for using the data only for scientific and research purposes and also written conditions for academic institutions about publishing results of the research that is using data from organizations.

Acknowledgements

This paper was supported by the Slovak scientific grant VEGA 1/0621/14 Marketing management in cooperative environment – Proposal of strategic cooperation management implementation model.

This article is the outcome of the project KEGA 035ZU-4/2013 (Master degree study program: Operations Management and Logistics).

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