BIG DATA ADOPTION IN SELECTED COMPANIES OF THE RETAIL SECTOR IN THE REPUBLIC OF MACEDONIA

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Abstract: In a highly digitalized world, big data and analytics are among major trends companies worldwide are facing. As companies generate data across different sources (information systems), which is increasing rapidly in volume, variety and velocity, big data analytics becomes essential. Big data is a term that describes the large volume of data (both structured and unstructured), that overwhelms a business on a day-to-day basis. But the importance of big data doesn't revolve around how much data one organization has, but what organizations do with the data that matters. Big data and analytics, provide organizations with the opportunity to analyze data generated from any source and to find answers that enable cost reductions, time reductions, new product development and optimized offerings, and smart decision making.

Big data is affecting companies from different size and in almost every industry, and has the potential not only to transform the business world, but the society as well at large extent. Emerging literature and the empirical evidence suggest that companies from the retail sector can gain competitive advantage from data if they adopt big data analytics technologies. In spite of that, companies in the country are still in the early stages of adoption of big data analytics technologies. Hence, the goal of this paper is to determine factors affecting the big data analytics adoption in selected companies in the Republic of Macedonia from the retail sector. This is a pilot study and as such represents the first attempt to assess the level of big data analytics adoption in the country. This small scale preliminary study will provide evaluation of the feasibility of the key steps of the proposed research model (methodology) in order to conduct future research in larger extent and sample.

There have been several theoretical models that explain technology acceptance. The research model in this study is based on Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990). The TOE framework explains that adoption of technological innovations is influenced by a range of factors in the context of the technology, organization and external environment. The framework explains that these three factors stimulate and influence the technology innovation adoption-decision in companies. It is considered as multi-perspective framework and an integrative model that is developed for studying factors affecting adoption of innovative technologies and has been used to assess organizations' adoption of big data analytics technologies mostly in telecommunications, e- commerce and other.

The proposed research model specifies the following technological characteristics (technical capacity, relative advantage and complexity), intra-organizational factors (top management support, organizational culture, organizational size and IT expertise/ technological competence), and inter-organizational factors (competitive pressure, external support, and regulatory /government policy as well as data security and privacy) as determinants of big data analytics adoption. The preliminary results of this pilot study support the research model and the methodology. The significance of the proposed determinants/factors can help managers formulate their analytics strategies and increase the use of big data technology in order to fulfil organizational goals and achieve better organizational performance.

Keywords: Big data, adoption, the Technology-Organization-Environment Framework (TOE), retail sector, Republic of Macedonia

1.INTRODUCTION

Data science has already proved itself and its values are realized and appreciated across many different sectors and industries such as in high tech, media, telecom, retail, banking, financial services, security, healthcare, shipping and many others (McKinsey, 2016). There is no doubt that more companies will attempt to drive value and revenue from their data (Forester, 2017).

In a highly digitalized world, big data and analytics are among major trends companies worldwide are facing. As companies generate data across different sources (information systems), which is increasing rapidly in volume, variety and velocity, big data analytics technology becomes essential. Big data is a term that describes the large

volume of data (both structured and unstructured), that overwhelms a business on a day-to-day basis. But the importance of big data doesn't revolve around how much data one organization has, but what organizations do with the data that matters. Big data and analytics, provide organizations with the opportunity to analyze data generated from any source and to find answers that enable cost reductions, time reductions, new product development and optimized offerings, and smart decision making (Watson, 2014).

The era of big data has resulted in the development and applications of technologies and methods aimed at effectively using massive amounts of data to support decision-making and knowledge discovery activities. But, big data is not a single product rather a complex set of technologies and techniques for data gathering, data store, data processing, data access, data analytics and data visualisation. Each layer of the big data technology stack adds significant level of complexity that challenges organisational resources and capabilities (Khan, 2017). Big data is considered a strategic technology which is perceived as a source of competitive advantage for various businesses regardless of its industry by many researchers. Big data empowers data analysts to make sense of exabyte's of diverse data sets and transforms them into useful information and new knowledge (Khan, 2017). The benefits of big data in the business environment are indeed numerous as this new technology allows high-performance analytics from multiple structures and non-structured sources.

Big data creates value in several ways. Simply making big data more easily accessible to relevant stakeholders in a timely manner can create tremendous value. As they create and store more transactional data in digital form, organizations can collect more accurate and detailed performance data (in real or near real time) on everything from product inventories to personnel sick days. Big data allows organizations to create highly specific segmentations and to tailor products and services precisely to meet those needs. Sophisticated analytics can substantially improve decision making, minimize risks, and unearth valuable insights that would otherwise remain hidden. Big data enables companies to create new products and services, enhance existing ones, and invent entirely new business models.

According to IDC (2015) big data market is growing over 23% per year during 2014-2019 period with annual spending reaching 48.6 billion in 2019. The IDC (2015) projected annual big data market growth in three areas consisting of infrastructure at 21.7%; software at 26.2%; and services at 22.7%. According to Gartner research (2015) "more than three-quarters of companies are investing or planning to invest in big data in the next two years".

There is no doubt that big data is affecting companies from different size and in almost every industry, and has the potential not only to transform the business world, but society as well at large extent. In spite of that, companies in the country are still in the early stages of making use of big data technology. Hence, the goal of this paper is to determine factors affecting the big data analytics adoption in selected companies in the Republic of Macedonia in the retail sector. This is a pilot study and as such represents the first attempt to assess the level of big data adoption in the country. This small scale preliminary study will provide evaluation of the feasibility of the key steps of the proposed methodology in order to conduct future research in larger extent and sample.

2. METHODOLOGY AND RESULTS

In the literature, there have been several theoretical models that explain technology acceptance. The phenomenon of acceptance of new technologies is relatively widely elaborated especially in the last two decades. The interest of the researchers towards understanding the factors that influence organizational and individual acceptance of new technologies is nowadays not only general, but also industry or product focused. These models have their origins in the disciplines of psychology, information systems and sociology and are intended to predict and understand people's intention, behaviour and attitude towards use of a technology. Each theory provides significant insights about the antecedents for the adoption of information systems and technologies. Davis's technology acceptance model (TAM) is one of the most influential approaches to explain and predict user acceptance of information systems (Davis, 1989). TAM model is based on the Theory of Reasoned Action (TRA) and to some point on the Theory of Planned Behavior as an extension of the TRA proposed by Ajzen (Ajzen and Fishbein, 1980). These studies both support the Framework of Tornatzky and Fleischer (1990). The Technology – Organization – Environment (TOE) framework suggests that the technological context, organizational context and environment context are the three important determinants that influence the process by which organizations adopt and implement innovations (Tornatzky and Fleischer, 1990). Further, the TOE framework is consistent with the Diffusion of Innovation Theory (Rogers, 1995) which emphasized that technological characteristics and both internal and external characteristics of the organization are the drivers for technology diffusion. However, TOE framework and DOI theory have been used to assess organization adoption of big data technologies adoption mostly in telecommunications, e – commerce and enterprise systems (Oghuma, 2013, Awa et al., 2012). Literature and

empirical evidence suggest that companies from the retail sector can gain competitive advantage from data if they adopt big data analytics technologies as well (McKinsey, 2016).

In general, big data is recognised as the innovation engine driving new digital transformations of businesses. There are many challenges for promoting the business value and the diffusion of big data technologies across companies from different sectors. In spite that, the number of companies implementing and utilizing big data, however, is not high in the country. Therefore, the goal of this paper is to identify factors influencing the big data adoption and usage in companies in the Republic of Macedonia from technology-organization-environment (TOE) perspective. This is a pilot study with focus on companies form the retail sector in the country. The research model proposed in this study is based on Technology-Organization-Environment (TOE) framework and is presented in Figure 1 below.

Figure 1: The research model (TOE based)
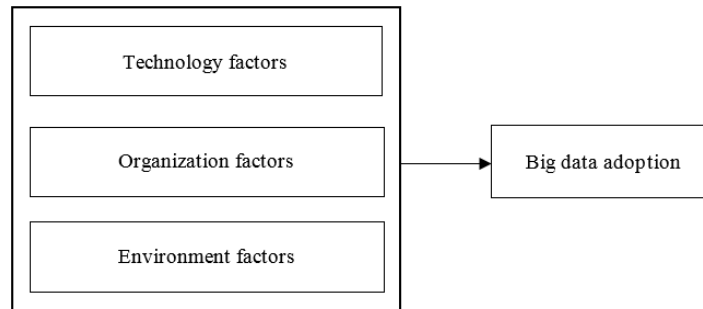
The TOE framework developed by Tornatzky and Fleischer (1990) explains that adoption of technological innovations is influenced by a range of factors in the context of the technology, organization, and external environment (Tornatzky and Fleischer, 1990). Recognized as organizational-level framework, the TOE explains that these three elements of an organization's context stimulate and influence the technology innovation adoption-decision. This multi-perspective framework is an integrative model that is developed for studying factors affecting adoption of big data technology in three aggregated stages of assimilation: initiation, adoption-decision, and implementation. The model specifies three technological characteristics (relative advantage, complexity, and security), three intra-organizational factors (organizational size, top management support, and IT expertise), and three inter-organizational factors (competitive pressure, external support, and privacy) as determinants of assimilation. Technology-Organisation-Environment (TOE) framework of Tornatzky and Fleischer (1990) has been tested and validated by many studies and used to determine factors that influence the adoption of new technology by companies, in this sense big data technologies as well (Scot, 2007, Awa, et al., 2012, Oghuma, 2013, and others). The studies confirmed that various technological, organizational and environmental factors facilitate or inhibit adoption of new technology in companies. The perception of benefits from big data and technological capability are identified as the critical determinants of the big data adoption. The compatibility with existing system, data quality and integration, and security and privacy are ranked highly in technology context. Management support and financial investment competence for the implementation and utilization of big data technologies, and the government support and policy are identified as the adoption and usage factors from organization and environment aspects, respectively.

The proposed research model specifies the following technological characteristics (technological competence technical capacity and complexity), intra-organizational factors (organizational size, top management support, management culture and IT expertise), and inter-organizational factors (competitive pressure, external support, and regulatory /government policy as well as data security and privacy) as determinants of big data analytics adoption. For the purpose of this pilot study, data was collected through an interview conducted with senior level managers, middle level managers and lower level staff of the retail companies in the country randomly chosen. The interview was guided based on a defined questionnaire. The total number of analysed questionnaires is 24. Based on the job title/position held in the company, the structure of the sample is presented in table 1 below.

Table 1. Profile of the respondents

Job title/position held in the company	Frequency
Executive manager	1
Sales manager	6
IT Manager	7
Marketing manager	3
Customer Care Manager	2
Other (Supervisor, Sales Person, Team Leader, Asst. Manager, Accountant)	5
Total	**24**

From the total number of respondents, more than half (15) answered that their companies had adopted big data analytics, while the remaining 9 respondents answered that had not adopted big data analytics or was not sure whether their company had adopted big data analytics yet.

The first group of questions refers to the technological group of factors and include questions measuring technical capacity, relative advantage and complexity as determinants of big data analytics adoption. When asked to indicate the software and hardware items related to big data analytics technology which were being used in their company in order to show the extent of adoption, the preliminary results indicate that most of the analysed companies has already put in place the hardware necessary for hosting big data analytics software and also use relational databases, business intelligence tools, NoSQL databases and other as means of collecting, storing and processing raw data. 5 of the respondents answered that they are not sure of the software or technology being used in their company.

Regarding the data type collected and analysed, more than a half of the respondents answered that their companies collect mostly transactional data. The other half of the respondents answered that they collect most of the data listed in the question i.e. beside transactional data, multimedia data, mobile data and archived/historical data. These findings lead to the conclusion that analysed companies have seen the importance of collecting and analysing different data type to gain insight about the business and the customers even though quite a significant number are still relying on traditional data only. Most of the respondents (75%), rate the computer usage in their company as being at large extent, 3 respondents has rate it as medium extent, and 3 declare as not competent for making this type of conclusions. Regarding the relative advantage of implementing the big data technology, most of the respondents, 83% confirmed that usage of big data analytics provides many benefits to the organization. For the complexity of the implementation of big data technologies and the amount of data in terms of volume, variety and velocity, the answers are as follows: more than a half of the respondents answered that implementation of big data technologies is very complex. The complexity of data is ranked as very high by 87.5% of the respondents. The rest of the respondents (3) specify complexity with moderate extent.

The second group of questions refers to the intra-organizational group of factors (top management support, organization culture, organizational size, and IT expertise/ technological competence) as determinants of big data analytics adoption. In this group the following questions were asked and measured on 5 point Likert scale. The results are as follows: Top management support of implementation of big data analytics technologies as a source of competitive advantage is very important (average score 4.38); Organization culture is supportive for the development and implementation of big data analytics technologies (average score 3.29); IT expertise and the technological competence of the staff is sufficient in the company (average score 3.08). The company size as factor that determines big data adoption according to the respondents is very important in sense that larger organizations in parallel have higher need and higher possibilities and capabilities to implement it (average score 4.46). In this section respondents pointed out that digitization of operations made it necessary (and possible) to implement big data analytics to narrow internal coordination and operational costs.

The third group of questions refers to the inter-organizational group of factors (competitive pressure, external support, and regulatory /government policy as well as data security and privacy) as determinants of big data

analytics adoption. Competitive pressure is ranked as very high by most of the respondents, since competition in the industry pressures organizations to innovative ways of conducting business. Government encouragement and support is considered very important according to 87.5% of the respondents. According to respondents this governmental support should reflect in provision of access to different type of data as well as a creation of enabling environment for technology innovation adoption, in this sense big data analytics as well. The privacy and security of obtained data (especially customer data) as major barrier of big data adoption was recognised by more than 2/3 of the respondents.

It can be concluded that the level of big data analytics adoption in the analysed companies is still on a low level. Although the benefits of big data analytics adoption is recognized by most of the respondents, the internal resistance to adopting it as a new way of doing business is very high. Data security and privacy laws, lack of skills and expertise, lack of trained analytical staff, as well as lack of capacity to store non-traditional data types are also rated high as obstacles/challenges of big data analytics adoption. At the end, it is determined as too costly to host and maintain the technological infrastructure. The main obstacles that hold back the big data adoption by the companies in the retail sector are dispersed in all three group of factors: technological, organizational and environmental. Only with synergic effort in all this domains the level of big data adoption can be improved and companies can gain the recognised benefits of the technology.

The preliminary results of the study showed that though many respondents indicated moderate to high adoption of big data analytics. But, it was obvious that the meaning of big data, big data analytics and big data analytics technogy/ies was not very clear to most of the respondents, judging from the obtained responses in terms of infrastructure, required skills, expertise, and relative advantage of the technology. This study also revealed that there were a number of challenges that obstruct the adoption of big analytics technology in the country. The overall implications of these preliminary findings are that the adoption of big data analytics in companies from the sample is still at an early stage. This is a pilot study and the sample is small in order to generalise conclusions. The limitation of the research methodology is the subjectivity that is expected in estimations given by the managers-respondents. Overestimation or underestimation of the real situation is possible. However, this bias is present in every methodology of this type.

3. CONCLUSION

Organizations are increasingly turning to data analytics as a way to gain business insights, and strategic advantage, from their data. Big data is not only challenging the actual organisational landscape but also challenging the theories that aim to explain the technology usage and acceptance. Many studies done so far, rely on the TAM framework (Davis, 1989) and its variations (Venkatesh et al., 2003) in order to understand the technology adoption. This pilot study investigates factors influencing technology adoption in broader context – technological, organizational and environmental (TOE perspective). The preliminary results of this pilot study support the proposed model and the challenges that were addressed by the respondents can help managers formulate their analytics strategies and increase the use of big data technologies in order to fulfil organizational goals and achieve better organizational performance. The preliminary results of the study confirmed that analysed companies need to address considerable challenges if they are to capture the full potential of big data. A shortage of the analytical and managerial talent necessary to make the most of big data is a one of the most important challenges companies in the country are facing.

In general, big data is recognised as the innovation engine driving new digital transformations of businesses. There are many challenges for promoting the business value and the diffusion of big data technologies across companies from different sectors. This counts for companies in the country as well.

Turning a world full of data into a data-driven world is an idea that many companies have found difficult to pull off in practice, Macedonian companies are not exception. That's why, knowing the factors that affect the adoption of big data technologies is important.

This research represents the first study in this field in the country and one of a few in the region. Hence it could be used as a good base for further research in this scientific area and as a guideline for managers to improve big data analytics adoption.

REFERENCES

[1] Awa, H.O., Ukoha, O. and Emecheta, B.C. (2012). Integrating TAM and TOE frameworks and expanding their characteristic constructs for E-Commerce adoption by SMEs. Proceedings of Informing Science & IT Education Conference (InSITE 2012), June 22-27, Montreal, Canada.

[2] Bughin, J. (2016), Big data, big bang? Journal of Big Data, 3(2), pp. 1-14.

[3] Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. Management Science, 35(8), pp.982-1003.

[4] Khan, H. U. (2017), Are enterprises ready for big data analytics? A survey-based approach, International Journal of Business Information Systems, Inderscience Enterprises Ltd., 25, (2).

[5] McKinsey Global Institute, (2012). Big data: The next frontier for innovation, competition, and productivity, Retrieved from: https://www.mckinsey.com.

[6] McKinsey Global Institute, (2016). The Age of Analytics: Competing in a Data-Driven World, Retrieved from: https://www.mckinsey.com.

[7] Morabito, V. (2015). Big Data and Analytics: Strategic and Organizational Impacts, Springer.

[8] Oghuma, P. (2013). Big Data Analytics Adoption in Telecommunications Industry: The Korean Telcos Perspectives.

[9] Rogers, E.M. (1995). Diffusion of Innovations. Free Press; New York; USA.

[10] Scott, J.E. (2007). An e – Transformation Study Using the Technology-Organization –Environment Framework, University of Colorado.

[11] Tornatzky, L.G. and Fleischer, M. (1990). The Processes of Technological Innovation. Lexington Books, Lexington.

[12] Watson, H. J. (2014). Tutorial: Big Data Analytics: Concepts, Technologies, and Applications, Communications of the Association for Information Systems, 34 (65), pp. 1247-1268.