

Big Data: Opportunities and Challenges

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Abstract—The concept of Big Data has become a reality due to our capability to create and collect digital data at an extraordinary rate. Despite its significance, the concept of Big Data is still largely overlooked and underestimated. Drawing on seven case studies of service providers and customers from different countries, this study contributes to the existing body of knowledge by comprehensively addressing the opportunities and challenges of Big Data.

Keywords-Big Data; Innovations; Technology; Challenges and Opportunities; Jordan.

I. INTRODUCTION

The rapid emergence, prevalence and potential impact of Big Data has sparked a significant amount of interest amongst Information Systems/Information Technology (IS/IT) industry and research. The concept of Big Data has come true due to the inescapable significance of our capability to create and collect digital data at an extraordinary scale. Big Data has been around since 2005, when the term Big Data has been adopted from O'Reilly media. The increasing number of people, devices, and sensors that are now connected by digital networks (i.e., Internet of Things) has generated a vast amount of data. Data is generated from online transactions, social networking interactions, emails, clickstream, logs, search queries, sensors, global positioning satellites, roads and bridges, and mobile phones [16]. The amount of data that is produced each day already exceeds 2.5 Exabyte [11]. In addition, the bidirectional telecommunications capacity is growing by almost 30% per year and the globally stored information is increasing by more than about 20% per year [7][27]. Accordingly, the great potential of Big Data for both academics and practitioners has become clear. In the business world, companies are leveraging Big Data technologies for effective decision making, efficient business operations, and maximum business impact [10][26]. For example, business could use Big Data to improve their offers, manage risks, and know their customers better [5]. According to McKinsey report [10], government administration in developed economies could save more than \$149 billion in operational efficiency improvements alone by using Big Data. In short, Big Data solutions provide managers with the ability to make informed decisions that are based on evidences rather than making

arbitrary decisions which are largely dependent on their intuitions and subjective judgments.

Although there is currently no single universally accepted definition of the term, Manyika et al. [10] define Big Data as “datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze data”. In other words, Big Data is an advanced information technology that allows users to capture, communicate, aggregate, store and analyze massive amounts of data. However, the value of Big Data largely depends on what types of software tools are available, what sizes of datasets are common in a particular industry, and their use in general (i.e., the way one is using it along with purposes).

Despite the rapid emergence of Big Data technologies, empirical research in this domain is still quite limited [1]. In addition, many organizations are still not aware about Big Data analytics along with their capabilities, benefits, and also challenges. An empirical research conducted by Russom [15] showed that only 28% of respondents understand the concept of Big Data and have name it, most of them (around 85%) being from developed countries. Moreover, despite the numerous advantages of Big Data, its implementation and adoption in developing economies is still very limited and surrounded by a variety of challenges. Therefore, the main objective of this research is to examine and shed light on the current state and the future prospects of Big Data in developing countries.

The rest of the paper is structured as follows. In section two, we provide a comprehensive theoretical background and literature review of the Big Data concept. Thereafter in section three, the research methodology including data collection and analysis methods are discussed. In section four, the results of the study are presented and discussed. Finally in section five, the research conclusions are presented and recommendations for theory and practice are offered.

II. BACKGROUND

There has not been a commonly accepted definition in regards to Big Data. However, as mentioned earlier, the literature usually reports that Big Data should include datasets with sizes beyond the ability of commonly used software tools to capture, manage, and process the data

within a tolerable elapsed time. Many researchers have defined Big Data via its three main characteristics and aspects that go beyond the capability of the current database management systems. These characteristics are Volume, Velocity and Variety, also known as 3Vs [4][9][11][15]. Volume refers to the size of the data such as terabytes (TB), petabytes (PB), and zettabytes (ZB), Velocity means how frequently the data is generated, and Variety represents the different types of data sources; for example, data could be unstructured social networking data, web logs data, sensor readings, streamed video and audio, or mobile generated data [11]. Recently, Kaisler et al. [8] added “Value” as a fourth characteristic of Big Data. Value measures the usefulness of Big Data in decisions-making [2].

Although Big Data was a serious problem just a few years ago, now it is considered as business opportunity. Using Big Data gives organizations a competitive advantage to differentiate themselves from others, and this can help them uncover people’s hidden behavioral patterns and even emphasis on their intentions [15]. It can also eliminate the gap between what people want to do and what they actually do in addition to how they interact with others and their environment, which helps directly in decision-making. Previous research also showed that data-driven decision making is associated with higher productivity, profitability and market value. Indeed, companies that use data-driven decision making may enjoy 4% higher productivity, 6% greater profitability, and 50% higher market value [20]. In addition, Big Data analytics can positively impact product development, market development, operational efficiency, customer experience, and market demand predictions [3][15]. With the rapid explosion of data, governments can also benefit from Big Data by creating a system that collects and analyzes vast amount of data coming from different sources to help them in tracking criminals, preventing money laundering as well as improving homeland security [1]. McKinsey Global Institute [10] argued that five new kinds of value might come from Big Data:

- 1- Creating transparency in organizational activities that can be used to increase efficiency.
- 2- Enabling more experimentation to discover needs, expose variability, and improve performance.
- 3- Segmenting populations in order to customize actions.
- 4- Replacing/supporting human decision making with automated algorithms.
- 5- Innovating new business models, products, and services.

However, while Big Data can yield extremely useful information, it also presents new challenges with respect to how much data to store, how much this will cost, whether the data will be secure, and how long it must be maintained. Big data also presents new ethical concerns. In fact, one of the major challenges of Big Data is preserving individual privacy [12][16]. In their study, Agrawal et al. [1] also identified many technical challenges associated with Big Data. These technical challenges include scalability (i.e., data volume is scaling faster than compute resources),

heterogeneity (i.e., data comes from different sources), lack of structure (i.e., data must be carefully structured as a first step in -or prior to- data analysis), error-handling (i.e., data cleansing and error correction), timeliness (i.e., the larger the data set to be processed, the longer it will take to analyze), and visualization (i.e., present results in powerful visualizations that assist interpretation). Big Data adoption is also facing several other managerial and organizational challenges. These managerial and organizational challenges include inadequate staffing skills, lack of business support [15], organization culture, and resistance to change [11].

III. METHODOLOGY

The present section explains the methodology used in collecting and analyzing data for the purpose of achieving the objectives of the current study. Given the scarcity of empirical research in the area of Big Data adoption and the need to obtain rich data, the study was considered exploratory in nature, and therefore, a case study approach was considered appropriate [17]. Case studies are useful for exploring areas where existing knowledge is limited [6] and are also valuable in generating an understanding of a particular situation [17]. Our research method involves seven case studies representing Big Data solution providers (i.e., Informatica, Huawei, Rabaie Analytics Group) and Big Data potential customers (i.e., EMP, A leading e-commerce startup company in Jordan, Aramex, E-Arabia) (see Table 1). The decision to use the perspectives of these two different groups was based on the belief that service providers could offer a better understanding of the benefits and challenges of adopting Big Data based on their own interaction with, and feedback from their clients, while customers that had adopted Big Data solutions could provide us with information regarding benefits and challenges they experienced. Interviewees were senior decision-makers with adequate experience in assessing Big Data solutions.

TABLE I. A LIST OF INTERVIEWEES

Interviewee	Position and institution	Time
Interviewee 1	Senior Software Developer at Informatica	45 min
Interviewee 2	Chief Marketing Officer (CMO) of Huawei Technologies	45 min
Interviewee 3	Manager at Data Aurora Rebai Analytics Group	30 min
Interviewee 4	Senior Consultant at E-Arabia	45 min
Interviewee 5	Computer Engineer at warehousing department in Aramex	40 min
Interviewee 6	Engineering Program Director a leading startup e-commerce company located in Jordan.	50 min
Interviewee 7	CIO at Emerging Market Payments (EMP).	35 min

A. Case Studies Description

- *Big Data Solution Providers*

Informatica: Located in the heart of Silicon Valley, Informatica provides data integration software and services that enable organizations to gain a competitive advantage in today's global information economy by empowering them with timely, relevant and trustworthy data for their top business imperatives. We interviewed a senior software developer at Informatica to provide us with insights about the uses of Big Data in developed countries as well as the opportunities and challenges facing the implementation of that technology in the region.

Huawei Technologies: Huawei is a leading global Information and Communication Technology (ICT) solutions provider. Through its dedication to customer-centric innovation and strong partnerships, it has established end-to-end capabilities and strengths across the carrier networks, enterprise, consumer, and cloud computing fields. They are committed to creating maximum value for telecom carriers, enterprises and consumers by providing competitive ICT solutions and services. Its products and solutions have been deployed in over 170 countries and regions, serving more than one third of the world's population.

Rabaie Analytics Group: Rebaie Analytics group is a boutique "data" consultancy organization which provides a range of services for vendors, companies, civil society organization, governments and citizens to make their "data" an aurora of innovation, competition and productivity. They help vendors on their product and marketing direction and messaging and they help clients in vendor-neutral selection of Big Data technologies and advise on Big Data strategy and architecture. They also build data auroras that focus on data visualization, analysis, crowdsourcing, and collaboration. Data auroras aid organizations in harnessing various information streams in real time, analyzing their data seamlessly and their sharing their story to the world.

- *Big Data Solution Customers*

Emerging Market Payments (EMP): EMP Middle East, previously Visa Jordan Card Services, was founded in 1991 by Visa and a group of Jordanian banks to ensure high quality Visa acceptance and processing in the country. Based in Amman, Jordan, EMP Middle East is run by a highly experienced management team and more than 70 employees. The company serves more than 20 banks and 18,000 merchants in Jordan and the surrounding region. EMP Middle East also operates Jordan's national ATM switch, JoNET, and a state-of-the-art card personalization facility.

A leading e-commerce startup company: The Company was established by experts at leading firms in the fashion and e-commerce industry. Seasoned shoppers and experienced ecommerce engineers joined forces to bring their passion, expertise and the latest offerings to fashion

lovers in the Middle East. The Jordan based company claims to use the most advanced technologies in the industry to offer their customers a comfortable, enjoyable and secure shopping experience anyplace/anytime. Their back office harnesses the latest innovations in the industry, allowing them to customize and personalize their offers to best suit the needs of their customers.

Aramex: Aramex is a leading global provider of comprehensive logistics and transportation solutions. Established in 1982 as an express operator, the company rapidly evolved into a global brand recognized for its customized services and innovative multiproduct offering. In January 1997, Aramex became the first Arab-based international company to trade its shares on the NASDAQ stock exchange. After five years of successful trading, Aramex returned to private ownership in February 2002 and continued to expand and excel as a privately owned company, establishing global alliances and gaining stronger brand recognition. In June 2005, Aramex went public on the Dubai Financial Market (DFM) as Arab International Logistics (Aramex) with its shares traded under ARMX. Today, Aramex employs more than 13,900 people in over 354 locations across 60 countries, and has a strong alliance network providing worldwide presence. The range of services offered by Aramex includes international and domestic express delivery, freight forwarding, logistics and warehousing, records and information Management solutions, e-business solutions, and online shopping services.

E-Arabia: E-Arabia is a startup e-commerce company. It is a platform that helps start-up e-commerce companies in hosting their e-commerce solutions as well as integrating their solutions with online payment companies, and logistical companies (e.g., Aramex, DHL, FedEx).

B. Data Collection and Analysis

Data collection took place between April 2014 and June 2014 and was primarily personal face-to-face semi-structured interviews, a technique well suited to exploratory research. This is because it allows expansive discussions to illuminate factors of importance [17]. Seven direct face-to-face semi-structured interviews have been conducted. Face-to-face interviewing may be appropriate where depth of meaning is important and where a research is primarily focused on gaining insight and understanding. A set of research questions were formulated in an attempt to meet the main objectives of this research. Questions were compiled from validated instruments in the literature to represent each construct and wording was modified to fit the Big Data context. Major questions directed to interviewees were related to the concept and role of Big Data and its impacts on businesses. The interviews were recorded, transcribed, edited and qualitatively analyzed. Data were consolidated through brainstorming sessions, informal conversations, discussions and field notes of daily observations. Accordingly, a picture of the current situation

concerning the opportunities and challenges of Big Data can be formed.

The length of each interview was approximately 45 minutes. Participants were freely expressing their opinions, seeking answers and suggesting solutions. On the other hand, other sources of secondary data such as brainstorming sessions, informal conversations, and reports have been also combined altogether to supplement data. The compelling reason for using an interview as the main methodology was completely based on the qualitative nature of the theories and their complexity related to represent a suitable research analysis. The interview questions count to 25 questions as a net total count. The 25 questions were distributed in a maneuver that accommodates for covering almost all the ideas concerning the study's main objectives. Having all interviews in hands, the transcribed data of the seven interviews went through preparation and editing processes to make it ready for the analysis. The resulted textual data was then aggregated with the hand notes of the researchers and the combined content was qualitatively analyzed. The analysis procedure has been performed using NVIVO 10.0 software. NVIVO is a computer assisted qualitative data analysis package, settled by QSR International [21]. This software offers a set of functions that support the coding and recovery of text. Another remarkable privilege is that it assists researches to write down memos during the analysis process [22]. In an attempt to conquer reliable and informative knowledge out of the interviews, each single interview has skilfully created a transcript that was saved in a distinct word processor document. This has enabled sustaining fertility of the interviews data. Afterwards, all documents were imported in NVIVO for reading, analysis and coding. The main objective of the analysis was to transform data into findings, but more importantly was to make a sense out of it. During the analysis, recurring ideas, patterns of beliefs, and salient themes were extracted with relevant quotations that demonstrated support for these themes. The emerging themes were then examined based on their intensity, depth, and specificity with the phenomenon of interest, with additional emphasis given to comments that were frequently repeated or refuted by the interviewees [23].

IV. RESULTS AND DISCUSSION

Big opportunities can be considered as an essential factor in influencing the decision of adopting Big Data [3][5]. In recent years, Big Data has become a major topic in the field of ICT. Novel digital technologies such as Big Data are transforming the ICT industry and the way companies can operate. It is evident that Big Data generates business opportunities. By analyzing Big Data, organizations can capture new facts about their customers, partners, products, services, and operations and then use that information for business advantage [15]. For example, businesses can use such information to develop new products and services, improve decision making, optimize operations, and reduce costs [10]. However, businesses and policy makers need to

address considerable issues in order to realize the full potential of Big Data. This section covers the extracted themes that were derived from the analyses of data; each theme converses an issue related to Big Data adoption.

A. *Underestimating the Value of Big Data*

Over the past two decades, Big Data analytics and technologies have become increasingly important in both the academic and the business communities [24]. Findings of this study revealed that Big Data and business analytics exploitations by Jordanian companies are still at the very infancy stage. According to the interviewees, both start-up and leading enterprises are not fully aware of Big Data and business analytics technologies along with their benefits and outcomes. Despite their general lack of awareness, we have observed that some organizations in Jordan have implemented some sort of business analytics including Database Management Systems (DBMS) and Google analytics. The value that can be derived from Big Data analytics differs from what traditional data analytics can offer. Some of the leading Jordanian companies are using traditional data analytics. According to the interviewee 4, "We are currently using Google analytics, because it is familiar and gets the job done." While interviewee 5 stated, "we use Structured Query Language (SQL) server analysis services to build statistical and analytical reports and dashboards for the business owners in order to help them in the management process". Accordingly, it seems that most of Jordanian companies do underestimate the value derive from unstructured data.

What can be established from our interviews with well-established enterprises as well as startup companies based here in Jordan that there are no serious steps or plans for fully utilizing Big Data technologies in the near future. Most of Jordanian companies are still using traditional technologies mainly for automating business processes. Generally speaking, we have realized that there is a lack of interest in implementing business analytics in general and Big Data in particular. Interviewee 6 stated that "there is no need to implement Big Data to start-up enterprises since most of the data we use is structured and we barely use unstructured data". The aforementioned statement by Interviewee 6 also indicates that they are some sort of misunderstanding and misconception about big data technologies.

B. *Misconception About Big Data and its Actual Size*

In an IBM study [15], it has been discovered that over half of all defendants contemplate their datasets that are between one terabyte and one petabyte to be Big Data. This includes more than three-quarters of midsize companies. However, it has been established that size alone does not matter; Big Data is also about an extraordinary diversity of data types, delivered at various speeds and frequencies [15]. Big Data is defined as "any dataset that cannot be managed

by traditional processes and tools, any line that outlines “big” and “small” data is arbitrary because the key characteristic is that the data has a greater volume than the current data ecosystem can manage” [13]. This theme has a wide misapprehension, the Jordanian interviewees believed that “Big Data” refers to having “large datasets” and almost all argued that “they do not have large amounts of information nor they deal with large amounts of unstructured data”. Interviewee 2 further commented that Big Data refers to “Any company with lots of information and questions.” Interviewee 1 referred to it as “Applications that require data analysis with large volumes on continuous stream of data.” Indeed, the aforementioned statements clearly highlight the misunderstanding concerning the size of data required for Big Data. On the other hand, interviewee 3 who clearly illustrates the issue of size in Big Data stated that, “when it comes to size of the data, we often tell our clients that it is not about the size of data you have, rather it is about the value that can be extracted from your data. Even with few megabytes, organizations now mash-up datasets and tell interesting stories with data. Some clients have terabytes of data and others have megabytes. You can start small and start playing with the tools and move on”.

C. Corporate Culture is Critical

Novel technologies (e.g., social media, cloud computing, mobile computing and Big Data) are transforming the ICT industry and the way companies across all markets and industries can operate (European Commission, 2013). Previous research on IS/IT indicated that culture is one of the critical factors for implementing new innovations [1][14][25]. This research also finds that corporate culture is a significant organizational factor that impacts the adoption and implementation of Big Data. This issue has been explicitly expressed by the majority of interviewees. For example, interviewee 2 argued that “corporate culture influences are significant! The industry expression is “we don’t know what we don’t know” is all too true. Many, marketing professionals in particular, see Big Data as a “Harry-Potter like” magic solution. However, at an average cost of \$10m USD, the CEO and board expect to see a return.” Interviewee 1 also explained that, “The corporate culture has huge influence not only on Big Data adoption but also on any novel IT initiatives. Chances are significantly higher to succeed in adopting Big Data in a given company if it enjoys a culture that supports technological innovations”. Similarly, interviewee 7 stated that, “the technology is there and available and many leading organizations have the capabilities to impersonate all these new technologies. To me the big challenge comes in the people and culture. So we humans became major players in the data-driven plan”.

D. Security, Privacy and Ethical Concerns

Security has been emphasized as one of the main issues in Big Data adoption literature [16][19]. What can be

derived from all the interviews is that security is the number one concern when implementing Big Data. Privacy is another huge concern, and one that increases in the context of Big Data [1]. Another literature perspective adds, “We, however, face many challenges, such as legal, privacy, and technical issues regarding scalable data collection and storage and scalable analytics platforms for security” [19]. Thus, securing both data and communication is really vital for Big Data providers and consumer. Our investigation exposed that there are huge concerns about data privacy and security risks. This presents many challenges for widespread adoption of Big Data in Jordan and in developed countries. There are many remarks in respects to this theme came from our interviewees. For example, interviewee 3 clarified that, “Big questions to be asked when it comes to Big Data revolve around privacy and security. Do you know how your data is being used? Do you trade-off your data in order to get a better experience and have more fun?”. Interviewee 1 also explained that “security and privacy are the main priorities”, interviewee 1 agreed with interviewee 3 by saying “Security and privacy are part of the main challenges when implementing Big Data”.

Policy makers have long struggled to draw the line for ethical data use, the discussion has historically revolved around the definition of “sensitive data.” Yet, any attempt to exhaustively define categories of sensitivity typically failed, given the highly contextual nature of personal information [16]. With the rise of Big Data technologies, business innovators are thrilled about the prospective benefits they are able to generate from the design and development of a wide range of new products and services based on the size, variety, and velocity of information available raises new questions [18]. Some of those questions are about the implications of the acquisition, storage, and use of large quantities of data about people’s attributes, behavior, preferences, relationships, and locations [18]. Ethical concern is the most sensitive topic, when we discussed with interviewee 2 about his thoughts about the risk of unauthorized use of data by Big Data providers, he commented, “It is a big risk...providers may sell your data to advertisers. This may result in an unwanted intrusion to your life by others; a one big reason I advocate “permission-based marketing.” Interviewee 3 commented, “Unfortunately, there are no clear ethical standards in the world of Big Data although this is much needed now.”

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Around the world today, there is an overwhelming demand for tools that could help organizations in accessing, analyzing, governing, and sharing information. This study is concentrating on understanding the current state of Big Data in developing countries, particularly Jordan in comparison to developed world. Drawing on seven case studies of service providers and customers from different countries around the

globe, this study contributed to the existing Big Data literature by addressing the complex and multidimensional nature of innovation adoption. Findings of this study indicated that there are many promised benefits of Big Data technologies such as better decisions making and hence improve every aspect of businesses, for example those related to cost reduction, sales improvement, gaining competitive edge, and ultimately improving business profit margins. However, many technical, organizational and environmental challenges described in this study must be addressed before this potential can be fully realized. These challenges include security, privacy and ethical concerns, lack of awareness and misconceptions about Big Data amongst Jordanian leading enterprises, lack of experts in the field, corporate culture, resistance to change, and other technological issues, such as complexity in data modeling and integration approaches.

B. Recommendations and Implications

- Awareness and Literacy

The lack of awareness about Big Data in Jordan exposed an important need for extensive workshops and conferences to fulfil this significant gap as well as to emphasize on the benefits and the importance of riding the Big Data wave as it is the way to future. Furthermore, the need to stress on the importance of pursuing the study of data sciences and analytics amongst high school students and undergraduates considering continuing their education since data scientists are huge assets to any developing country as well as the need to include Big Data courses in business and ICT majors in Jordanian universities to ensure the planting of seeds to a fruitful future of Big Data in Jordan.

- Integration

There is a deep need for an intermediary to facilitate and assist in the implementation of Big Data in organizations and integrating Big Data with the rest of the business processes and technologies. There should be more motivation for Big Data startups to be established to help in this aspect so more companies would adopt Big Data.

- Security, Privacy and Ethical issues

Big Data environment should be aligned with organizational security and privacy requirements. Security measures need to be implemented so as to ensure the privacy of information.

- Customer Alignment in Strategic Plans of Jordanian Companies

The lack of focus on the customer needs and desires in Jordanian companies has been noticeable where the use of Customer Relationship Management (CRM) tools were limited and performance was mainly measured strictly by revenue figures, whereas the core of successful Big Data implementation is always keeping the customer in mind and always caring for what is best for the customer. The need for the customer alignment with business models and

strategic plans is crucial to the success of Big Data in companies.

- Need For More Data-Driven Decision Making in Jordanian Companies.

For IT experts, data is a valuable currency or resource like gold or money that will open opportunities that no one has ever thought of, due to the fact that the insight you can get from your market through data are immeasurable. The stress of the need for more data-driven decision-making cannot be stated enough as it will revolutionize the direction and future of companies.

Our future plan is to conduct further studies supported with more interviews and surveys in the area of Big Data so we can keep up to date with the latest improvement regarding Big Data technologies. In addition, with the help of our MIS department, we are planning to organize the first Big Data workshop or conference that will gather professionals from the Jordanian market with IT specialists from around the world to help us in raising awareness about Big Data in the Jordanian market.

REFERENCES

- [1] D. Agrawal, P. Bernstein, E. Bertino, S. Davidson, U. Dayal, M. Franklin and J. Widom, "Challenges and opportunities with big data", 2012, CRA white paper, available on: https://hpcforge.cineca.it/files/CoursesDev/public/2014/Tools_Techniques_Data_Analysis/papers/p2032-labrinidis.pdf
- [2] A.T. Chatfield and O. Al-Hujran, E-government evaluation: a user-centric perspective for public value proposition, *International Conference on E-Learning, E-Business, Enterprise Information Systems, and E-Government*, IEEE 2007, pp. 53-59.
- [3] J. Bughin, M. Chui and J. Manyika, "Clouds, big data, and smart assets: Ten tech-enabled business trends to watch". *McKinsey Quarterly*, 56(1), 2010, pp. 75-86.
- [4] J. Chen, Y. Chen, X. Du, C. Li, J. Lu, S. Zhao and X. Zhou, Big data challenge: a data management perspective. *Frontiers of Computer Science*, 7(2), 2013, pp. 157-164.
- [5] S. Dutta and B. Bilbao-Osorio, "The Global information technology report 2012: Living in a hyperconnected world". *World Economic Forum*, 2012.
- [6] K.M. Eisenhardt, "Building Theories from Case Study Research". *Academy of Management Review*, 14(4), 1989, pp. 532-550.
- [7] M. Hilbert and P. López, "The world's technological capacity to store, communicate, and compute information. *Science*". 332(6025), 2011, pp. 60-65.
- [8] S. Kaisler, F. Armour, J. A. Espinosa and W. Monev. Big data: Issues and challenges moving forward. In *System Sciences (HICSS), 2013 46th Hawaii International Conference on* (pp. 995-1004), 2013, IEEE.
- [9] D. Lanev, 3D data management: Controlling data volume, velocity and variety. *META Group Research Note*, 6, 2001.
- [10] J. Manyika, M. Chui, B. Brown, J. Bughin, R. Dobbs, C. Roxburgh and A.H. Bvers, Big data: The next frontier for innovation, competition, and productivity, 2011.
- [11] A. McAfee, E. Brynjolfsson, T.H. Davenport, D.J. Patil and D. Barton, "Big Data. The Management Revolution". *Harvard Bus Rev*, 90(10), 2012, pp. 61-67.
- [12] K. Michael and K.W. Miller, Big data: New opportunities and new challenges [guest editors' introduction]. *Computer*, 46(6), 2013, pp. 22-24.

- [13] S. Miele and R. Shockley, Analytics: A blueprint for value in midmarket organizations: Converting big data and analytics insights into results. IBM Institute for Business Value. *IBM Global Business Services Strategy and Analytics*, 2012.
- [14] L. Morgan and K. Conboy, "Factors Affecting the Adoption of Cloud Computing: An Exploratory Study". *proceeding of 21st European Conference on Information Systems*, 2013, Utrecht, Netherlands.
- [15] P. Russom. Big data analytics. *TDWI Best Practices Report, Fourth Quarter*, 2011.
- [16] O. Tene and J. Polonetsky, Big data for all: Privacy and user control in the age of analytics, *Northwestern Journal of Technology and Intellectual Property*, 11(5), 2013, pp. 239-247.
- [17] R. Yin, *Case Study Research: Design and Methods*, London, Sage, 2003.
- [18] K. Davis, *Ethics of Big Data: Balancing Risk and Innovation*, CA, O'Reilly Media, Inc, 2012.
- [19] P.K. Manadhata. Big data for security: challenges, opportunities, and examples. In *Proceedings of the 2012 ACM Workshop on Building analysis datasets and gathering experience returns for security*, 2012, (pp. 3-4). ACM.
- [20] E. Brvnjolfsson. L.M. Hitt and H.H. Kim. Strength in Numbers: How Does Data-Driven Decisionmaking Affect Firm Performance?. 2011. [Online]. Available from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1819486.
- [21] P. Bazeley and L. Richards, *The Nvivo Qualitative Project Book*, Sage Publications, London, 2000.
- [22] G. Gibbs (2002) *Qualitative Data Analysis: Explorations with Nvivo*, Open University Press, London.
- [23] C. Marshall and G. Rossman, *Designing Qualitative Research*, Sage, London, 1999.
- [24] H. Chen, R.H. Chiang and V.C. Storey, Business Intelligence and Analytics: From Big Data to Big Impact. *MIS quarterly*, 36(4), 2012, pp. 1165-1188.
- [25] M. Al-Debei and E. Al-Lozi, Explaining and predicting the adoption intention of mobile data services: A value-based approach. *Computers in Human Behaviour*, 35(2014), 2014, pp. 326-338.
- [26] M. Al-Debei, Data Warehouse as a Backbone for Business Intelligence: Issues and Challenges. *European Journal of Economics, Finance and Administrative Sciences*, 33, 2011, pp. 153-166.
- [27] M. Al-Debei, R. El-Haddadeh and D. Avison, Towards a business model for cellular networks and telecommunication operators: a theoretical framework. In *Proceedings of the 13th Conference of the UK Academy for Information Systems UKAIS'08*, Bournemouth, UK, 2008, pp 1-15.