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JEL: M31, M38, O33  
DOI: 10.5937/industrija44-10036  
UDC: 004:007]:005.56  
Scientific Review

## The big Data Phenomenon – the Business and Public Impact<sup>4</sup>

*Article history:*

Received: 20 January 2016  
Sent for revision: 5 February 2016  
Received in revised form: 30 May 2016  
Accepted: 31 May 2016  
Available online: 11 July 2016

**Abstract:** *The subject of the research in this paper is the emergence of big data phenomenon and application of big data technologies for business' needs with the specific emphasis on marketing and trade. The purpose of the research is to make a comprehensive overview of different discussions about the characteristics, application possibilities, achievements, constraints and the future of big data development. Based on the relevant literature, the concept of big data is presented and the potential of large impact of big data on business activities is discussed. One of the key findings indicates that the most prominent change that big data brings to the business arena is the appearance of new business models, as well as revisions of the existing ones. Substantial part of the paper is devoted to the marketing and marketing research which are under the strong impact of big data. The most exciting outcomes of the research in this domain concerns the new abilities in profiling the customers. In addition to the vast amount of structured data which are used in marketing for a long period, big data initiatives suggest the inclusion of semi-structured and unstructured data, opening up the room for substantial improvements in customer profile analysis. Considering the usage of information communication technologies (ICT) as a prerequisite for big data project success, the concept of Networked Readiness Index (NRI) is presented and the position of Serbia and regional countries in NRI framework is analyzed. The main outcome of the analysis points out that Serbia, with its NRI score took the lowest position in the region, excluding Albania. Also,*

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<sup>4</sup> Authors gratefully acknowledge the financial support from the Ministry of Education, Science and Technology of the Republic of Serbia, Grant No. 179005.

*Serbia is lagging behind the appropriate EU mean values regarding all observed composite indicators - pillars. Further on, this analysis reveals the domains of ICT usage in Serbia, which could be focused for an improvement and where incentives can be made. These domains are: political and regulatory environment, business and innovation environment, business usage, government usage and social impacts of ICT.*

**Keywords:** *Big data, advanced analytics, the impact at scale, marketing, retail, customer data, Networked Readiness Index*

## **Fenomen “Big data” – uticaj na poslovno i javno okruženje**

**Apstrakt:** *Predmet istraživanja u ovom radu je fenomen velike količine podataka (“big data”) i primena “big data” tehnologija za potrebe preduzeća, sa posebnim akcentom na marketing i trgovinu. Cilj istraživanja je da se napravi sveobuhvatan pregled različitih rasprava o karakteristikama, mogućnostima primene, dostignućima, ograničenjima i budućnosti razvoja koncepta “big data”. Na osnovu relevantne literature u radu je predstavljen koncept i diskutovan potencijal uticaja velike količine podataka na poslovne aktivnosti. Jedan od najvažnijih zaključaka je da velika količina podataka u poslovnoj areni dovodi do pojave novih poslovnih modela, kao i izmene već postojećih modela. Značajan deo rada je posvećen marketingu i marketinškim istraživanjima koja su pod snažnim uticajem fenomena “big data”. Najinteresantniji rezultati istraživanja u ovoj oblasti odnose se na inovativne mogućnosti profiliranja kupaca. Pored ogromne količine strukturiranih podataka koji se već duže vreme koriste u marketingu, nove inicijative korišćenja velike količine podataka ukazuju na uključivanje polustrukturiranih i nestruktuiranih podataka, čime se otvara prostor za značajna poboljšanja u analizi profila kupaca. S obzirom da je korišćenje informaciono komunikacionih tehnologija (IKT) preduslov za uspeh “big data” projekata, predstavljen je koncept Indeksa spremnosti zemalja za primenu informaciono-komunikacionih tehnologija (Network Readiness Index - NRI) i analiziran je položaj Srbije i zemalja u regionu u kontekstu ovog pokazatelja. Glavni rezultat analize je da se Srbija, sa svojom vrednošću NRI indeksa pozicionirala na najniže mesto u regionu, sa izuzetkom Albanije. Isto tako, posmatrajući prosečne vrednosti NRI kompozitnih indikatora za zemlje EU, uočava se da Srbija zaostaje po svim indikatorima. Dalje, ova analiza otkriva oblasti primene IKT u Srbiji, koje bi mogle biti značajno unapređene primenom odgovarajućih podsticaja. Ove oblasti su: političko, pravno, poslovno i inovativno okruženje, poslovna upotreba IKT, upotreba IKT u javnom sektoru, kao i društveni uticaj IKT.*

**Ključne reči:** Big data, napredni analitički alati, merljiv uticaj, marketing, maloprodaja, podaci o kupcima, Indeks spremnost izemalja za primenu informaciono-komunikacionih tehnologija.

## 1. Introduction

In the last few years it has been observed the constant two-digit annual growth rate of data quantity in various domains of business and public activities and people's lives. It is considered that exabyte's i.e.  $10^{18}$  of a new data are generated every day. Just to mention the transaction information system at Wal-Mart, generating the volume of 2,5 petabytes ( $10^{15}$ ) data for only one hour, which is large as 167 times the data stored at USA Library of Congress (World Economic Forum – WEF, 2014, pp.35). According to the IBM report, 90 percent of the total data volume in the world is less than two years old and the volume of data is growing at the rate of 40% per year (IBM, n.d). The most of this data are included in IP networks (WEF 2014, pp. 43.).

One of the main reasons for this explosive increase in total data volume may be found in the general tendency of widespread computer connection of people, things, places and processes. Good examples are the expansion of various social networks, transfer of social and economic activities to the web, the widespread use of GPS systems, RFID technology, and the other manifestations of Internet of things (IoT) and Internet of Everything (IoE). Some critical drivers of massive data growth are (WEF 2014. pp.36-37):

- The process of digitization - almost 98 percent of world's stored data is digitized;
- IP protocol is becoming the dominant protocol in data communication;
- In the next few years, billions of people and things will be connected via IP protocols where business processes will be transferred and accessible online;
- The new IP version (Ipv6) –technically enables massive connection of devices ( $10^{38}$ ) to Internet;
- The cloud-based Big Data services has reached the mature phase that allows Big data initiatives to be reality for organizations of all sizes;
- The unified data platform architecture (information management, analysis and prediction) is developing so to become great enabler of big data initiatives;
- Streaming computing – enables to analyze streams of events.

In addition to the previous tendencies the environment of Information Communication Technologies (ICTs) has been rapidly changed mainly due to the two most important reasons. First, customers are different today:

statistical data show that around 80% of purchases are reached online before going to the store. In banking, over 30% of activities are finished online in western countries. In UK groceries, over 10% of customers will make the purchase online (McKinsey, 2011). Second, the costs of delivering high-end ICT solutions, as well as the time needed to develop it, steadily decline. Cheaper computing elements, such as data storage, processing and network bandwidth contribute to the more economical data processing and analytics.

At the organizational level, digitalization blurs the lines between sectors, placing fresh demand on both leadership and organizational strategy (Willmott, P. 2014). There are many examples of banks getting into the travel business or travel agents getting into the insurance business or even retailers getting into media business. Digitalization allows to the companies to connect specific areas of the value chain enabling that different services can be stitched together more cheaply and quickly. However, one of the challenges that companies are facing as a result of the digitalization, is a phenomenon of a big data. Many companies are excited about big data and advanced analytics not just because the data are big but also because the potential for impact is big (Court, D., 2015).

The subject of the research in this article is the emergence of big data phenomenon and application of big data technologies for business` needs with the specific accent on marketing and trade. The purpose of the research is to make comprehensive overview of different discussions about the characteristics, application possibilities, achievements, constraints and the future of big data development. The main result of this analysis is to delineate the areas of current development of big data technologies, as well as the directions of future expansion of its implementation.

The research of the literature was focused on two types of sources. One of them is relating to the academic articles and research papers, including the review of conceptual and theoretical stands of eminent researchers. The other type of sources are the reports realized by leading ICT development and consulting companies like IBM, SAS, SAP, Oracle, Cisco, Intel, etc., as well as consulting companies like McKinsey. In this group, there are also, reports of international organizations that are following ICT development, digitalization and an appropriate economic and social impacts, such as World Economic Forum.

The methodology of the research is based on the collection, selection and analysis of the latest literature in the field of big data and on comparative analyses of the quantitative data regarding the level of development and usage of ICT in Serbia and the countries in the region. The quantitative data presented in the article originate from numerous Harvard Business School

and European Institute of Business Administration (INSEAD) sources, which are published in World Economic Forum Report. The data origin and forms are explained in section four, as well as the structure of Networked Readiness Index (NRI), introduced by World Economic Forum at the beginning of the century. NRI is a composite index which measures the country's readiness to take advantage of a full potential of ICT usage. This index can provide a good baseline for analyzing the potential of particular economy to tackle and deal with Big data initiatives. The article is attempting to make the connection between the readiness of the business environment to accept advanced analytics and the countries' level of the ICT usage, as a key prerequisite for the big data impact.

The organization of the research in this paper is as follows. After the introduction, in the second section the big data concept is discussed. The third section, based on specialized reports, elaborates the impact of a big data on businesses, especially in marketing and marketing channels, but also in public sector. In addition, this section presents the obstacles for full big data usage. In the fourth section, the concept of Networked Readiness Index (NRI) is introduced and the comparative analysis of Serbia and regional countries in the NRI framework is presented. Finally, brief concluding remarks on the main findings of our research are made.

## **2. Big data concept**

### **2.1. Definition of the Big data phenomenon**

The term big data refers to the vast amount of data that cannot be processed and analyzed by applying the traditional computer technologies and tools. At the same time, it presents the need for a new vision and a new way of business thinking, new tools, new technology and new data management.

The main characteristics of Big data phenomenon are: *Volume*, *Variety* and *Velocity* of data, which are usually recorded in literature as „the three Vs“ (see e.g. Zikopoulos, et.al., 2012) . It has been already remarked that the data volume has substantial increased in all sphere of life and activities. Today organizations are facing with petabytes and exabytes rather than giga and terabytes of data. But, along the steadily enlargement of data volume, the percentage of data that are processed and analyzed by organizations are in constant decline. The gap between data quantity and percentage of their usage is becoming larger and larger (see more in Zikopoulos, et.al., 2012).

In addition to the data volume, the second important characteristic of Big data refers to the different forms of data which are appearing - *Variety* of data.

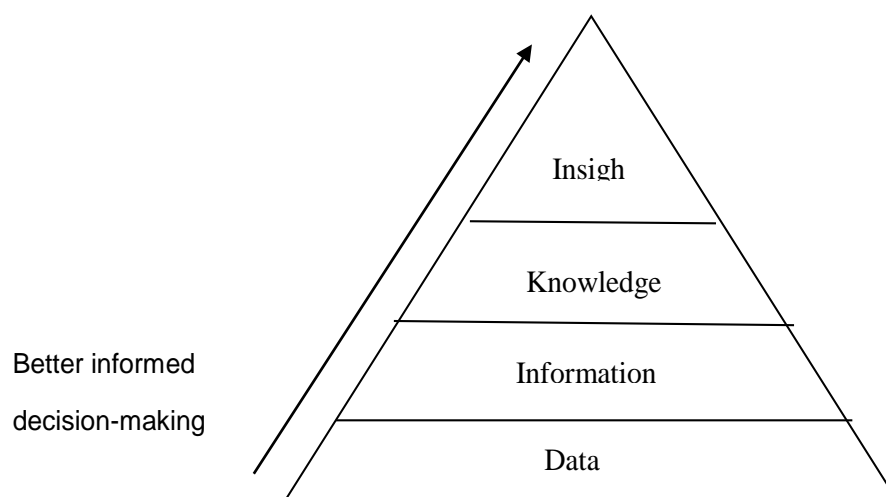
Classical data forms are well structured and stored in relation data base and similar structured forma, but the greater challenge is growing volume of unstructured and semi-structured data, such as: text, video, images, mixed content posted to social network, audio data, as well as data generated by smart devices, sensors, social network technologies, web based data, such as web pages or click-stream data, e-mails, and more. Also, enormous streams of data are provided by smartphones and the other mobile devices. The volume of these data is being increased exponentially, more rapid than the other data types, which opens the wide space of potential business usage.

One more characteristic – *Velocity* presents a specific feature of big data phenomenon. Comparing to the traditional computing systems which are mainly dealing with static data, the big data computing technology supposes the ability of processing data in motion, which is known as streams computing. Very often the processing of big data is considered to be a real-time data processing.

Besides the previous explained three Vs, it is considered that the big data description should involve the fourth V, which stands for *Value*. From the business perspective data are not much interesting and useful *per se*. What is useful is an actionable data that can change and improve business processes and provide benefits for everyday people's lives. According to some estimates, only half a percent of total volume of data are being analyzed for some knowledge and insight (Gantz, et.al., 2012, pp.4).

The figure 1 presents the knowledge pyramid. It illustrates the process of turning data into knowledge and insight that brings the value for business and society. The critical challenge for the business sector and government institutions is the process of moving up the knowledge pyramid from the bottom line, i.e. individual data to the top, where insights and knowledge are extracted. Big data can create value in different ways: making the information available more quickly; innovative uses of data to developing new products, enabling the organizations to focus on specific segments of new products and services, supporting innovations in business models, optimizing the business process and improving decision making by data-driven approach. The research conducted by McAfee et.al. (2012) demonstrates that organizations which use big data may outperform the competitors in productivity and profit gains by 5-6 percent.

Figure 1. Knowledge pyramid: from data to insight



Source: Authors modified the illustration presented in WEF Report 2014, pp.38

It is important to stress out that from historical point of view, the big data phenomenon is not something revolutionary new. It may be rather considered as the continuation of the long-lasting organizations' aspirations to create a more information based decision-making process. From the first attempts at data processing and analytics in the sixties and seventies of the last century, business decision making process have evolutionary passed through different stages of the information management journey. The most prominent stages of this journey were characterized by the dominance of the following technologies: knowledge-based information systems, intelligent decision support systems, data mining and business intelligence. All of these technologies have in common the same idea: how to transform raw data into insights and meaningful information that may contribute to the better business decision-making (for example, see more on evolution of data-driven decision making in WEF Report - 2014).

Looking at all those characteristics of big data from the perspective of their potential, the following text is analyzing how companies today are committed to realize the potential of a big data and advanced analytics in order to achieve the impact at scale or "big impact through big data" (Court, D., 2015).

## **2.2. Getting big impact from big data and adoption of a new culture model**

In order for companies to achieve “big impact through big data” or impact at scale, it is of utmost importance for data analytics to be built in the foundation of the company or the enterprise. There are successful examples of such companies like Amazon and Google (Mc Kinsey Quarterly, 2011). But for many other companies based on reputation, success from big data and data-analytics has been limited to specific parts of the business. In both cases, capturing the potential of big data and data analytics requires the strategic transformation of the company.

The successful approach towards the acceleration of the data-analysis transformation process will require from the company to take advantage of advancements in analytics on one side, and to mobilize the organization, on the other side (Soldic-Aleksic, Chroneos Krasavac, 2008). That way companies can face the inevitable challenges to realize large scale benefits and to unleash the big impact from big data and advanced analytics. An organization that is able to quickly adopt new tools and technologies and, on the other side, adapts itself to capture their potential is more likely to achieve large-scale benefits from its data-analytics efforts (Court, 2011).

But despite the fact that all investments in the new tools and technologies that will help companies to deal with the challenge of achieving scale are very useful, they are still not enough. Company needs to take few more steps forward which need to include: focus on change management, redesign of the jobs and build a foundation of analytics in companies' culture. It is stressed in the literature that crucial issue for the companies is to do the shift in culture, to put heavy emphasis on the adoption of that culture through the adaptation of the organization (Jacobs, 2014).

The old bad habit in many organizations was to make decision solely based on intuition and instincts. This should be abandoned or reconsidered as the data-driven decisions tend to be more productive and efficient decisions. In that respect Andrew McAfee and Erik Brynjolfsson (2012) stated that the phenomenon of big data brings novels in the management process, which they described as management revolution. They have conducted a practical research aiming at testing the hypothesis that data-driven companies have better economic performance. For this purpose, they have interviewed executives from 330 public companies in North American about their management practices and collected their performance data. The main findings of this research concerned to the relationship between big data and



business performance: „The more companies characterized themselves as data-driven, the better they performed on objective measures of financial and operational results. In particular, companies in the top third of their industry in the use of data-driven decision making were, on average, 5% more productive and 6% more profitable than their competitors”.

Acceptance and implementation of big data vision requires leaders to think creatively in the domain industry, to propose new business models and to articulate the positions and requirements of employees, customers, stockholders, public organizations and other stakeholders. To do so, they must rely on the professional skilled workers, who know how to deal with large quantities of data and information. Apart from traditional computer skills, data management and analytical skills, the new skills are required, which born a new profession – the profession of data scientists who possess the knowledge in domain of computer science, statistics, data analytics and business decision making (see e.g. Russom, P., 2013). In addition, companies today have a wide range of creative options on how to spur analytics engagement among the most critical employees. Some of the options include developing competitions and rewarding systems, establishing training boot camps and creating a community of power users to support end users. That will accelerate adoption, improve the ability of tools becoming more frontline friendly and create the big impact that big data are promising (Callinan, Edelman, Hieronimus, 2014).

### **3. The business impact of a big data- applying big data in marketing and trade**

From a business point of view big data analysis can provide large benefits. Just a few potential analytical tasks are mentioned here: risk modeling and management in financial sector, fraud detection, web log analytics, social media analytics, customer sentiment analysis, call center data analytics as an integral part of the Customer Relationship Management (CRM), transportation and public administration, and so on (Soldic-Aleksic, Chroneos Krasavac, 2008). Also, one of the remarkable business example is the emerging “app economy” (Briggs, Tilson, 2015) based on software applications running on smartphones which has radically changed some existing business models. Data-driven business model is essential for some companies, such as Google, Facebook, and Netflix, (Pisano, Pironti, Rieple, 2015) which have introduced new technologies for taking advantage of digital market.

According to the survey data of Economist Intelligence Unit that was published in 2013 approximately “two-thirds of executives feel that Big data

will help find new market opportunities and make better decisions” (Economist Intelligent Unit, 2013). The projects of big data implementation vary substantially across business sectors, regions and functional areas. The majority of projects are recorded in the highly digitized industries, such as telecommunications, finance industries, travel industry, retailing, and traffic sector and so on. The United States and West Europe are the leading geographical regions, while the financial management, marketing and trade are the dominant functional domains of big data usage (Dunkovic, Petkovic, 2015).

From the very beginning of the Internet development, the use of big data technologies in trade and sales has become an interesting field of application. One of the pioneers was Oren Etzioni (Mayer-Schönberger, Cukier, 2013, p.4), a participant in the creation of the first Internet search engine, MetaCrawler in 1994. The idea came when he was traveling by plane and discovered, while making the chat with other passengers, that his ticket was the most expensive one. Thinking about the solution of his problem, he realized that a vast number of price data can turn in the requested information through the process of comparing. His project was later bought by Excite, and Etzioni has continued to deal with the same problem. He treated a large amount of data on ticket prices on a single line as an on-going poll that says about the growth or decline in demand, developing an algorithm to predict the future price movement charts. This system, called "Farecast" has developed so much that it was for \$ 110 million sold to Microsoft in 2008.

This future price predictions algorithm fit later on, into the already known system of variable pricing in the airline industry (yield management). Basically, variable pricing was in response to the shooting down aircraft fares with charter carriers that have begun to sell the services of air transport to the passengers in line traffic at marginal cost (Toh, Raven, 2003). Bob Crandall, vice president of marketing for the “American airlines” was seeking a competitive response to these very low prices. Understanding that each plane, carries a huge number of empty seats, he searched for the answers: how to sell these seats, at what price, and most importantly, to which clients and how to place an offer not eroding already existing demand. Start of the Super Saver Fare program, tagged beginning of the era of selling seats to different customers in different times and through different sales channels, at different prices. Breaking the single market in many individual meetings of supply and demand, essentially led to an outcome where everyone buys at the price he was willing to pay at that moment, until the moment of complete sale of all seats (Cross, Higbie. & Cross 2011).

The system today is the basis for determining the price of plane tickets, hotel rooms, rent-a-car services and other tickets with variable demand. Marketing channel for hotel services changed, from classical reception selling, global

reservation systems, and travel agencies through the sale over the Internet reservation systems, to hotel websites, smartphones and other channels (Petkovic, Lovreta, Pindzo, 2015). This caused the inflow of huge amounts of data. It is not surprising that the survey of 500 hotel managers showed following order of top five skills to be acquired: 1. Analysis of the data; 2. Prices; 3. Sales; 4. Statistics and 5. Optimization of web pages (Kimes, 2011).

Big data emerged at the top management agenda as the problem and opportunity in the retail trade with the advent of POS cash registers. Introduced to accelerate the operational work at the cash registers and generate logistics data for inventory management, POS began to produce an enormous amount of data (Lynch, 1990) about the transaction: when, what and in which combination, where it occurred. The data generated from the POS cash registers have become the basis for segmentation, determination of beginning of promotion, variety of items on price promotion and many other important marketing decisions. All the surveyed retailers are using POS data for decision making, and even 67% of them use the other log data, generated by the different internal automated processes in business (Mercier, Richards, Shockley, 2013).

Big Data in retail evolved from the emergence of a large influx of structured data toward even stronger influx of unstructured data. The process is well-known about 4V characteristics, as it was already explained (Van Zanten, 2012). The scope and diversity of structured data coming from transactional system, or automated processes, stored in spreadsheets or relational databases is growing rapidly. An additional problem causes appetite to collect and use unstructured data in the form of video and audio, image, or semi-structured data such as XML and RSS traces (Ridge, Johnston, O'Donovan, 2015).

### **3.1. The growth of available customer data**

Development of new sources of data caused the evolution of the research of customers and their habits and behavior. Unlike the first phase (Business Intelligence 1 i.e. BI 1) when the structured data prevailed, in the second phase (BI 2) prevailing data come from the Internet and increasingly from the social networks. BI 3 phase is characterized by a growing influx of data from mobile devices like laptop computers, smartphones, tablets, etc. (Cheng Chian, Storey, 2012). SAS, one of the key suppliers of software for retail analytics, indicates the change in reporting, from market research, to the continual monitoring and permanent decision-making, based on the processed data in real time (EKN, 2013). All major software houses recognized the importance of large retailers as "big producers" of data. Study conducted by Cisco (similar to IBM), points to three new, strategically important sources of data in retailing: video cameras, mobile devices and

social networks (Van Zanten, 2012). By crossing the data with video cameras with sensors on POS and RFID scanners and mobile devices, it is possible to monitor the movement of customers through the store, length of stay in certain areas and return movement, resulting in the maps of movement and maps of customers' distribution in different parts of the store (Manyika et.al, 2011, p.92). Monitoring of customers' movement, enable retailers to identify patterns of behavior in the store, the way of their moving in order to retain them and adapt product presentation and layout of the store to the customers' expectations. The special value has possible analysis of the customers' mood, based on the analysis of digital images of facial expressions and non-verbal communication while perceiving certain products or promotional impulses (Ridge, Johnston, O'Donovan, 2015).

Mobile devices are already capable to "communicate" and warn the retailer that the potential customer is nearby store and is able to visit it. In a poll conducted by The Economist (The Economist, 2013), 78% of surveyed directors of retailers said they have collected, and 44% actively used data on geolocation of customers. In addition, these devices are associated with e-mail, profiles and history, as well as the comments on social networks and many other user activities that can "sharpen" his/her profile as the potential shopper. On the other hand, smart phones give customers significant advantages in purchasing (Shankar, Balasubramanian, 2009). Using the applications such as Red Laser to scan bar code on certain items, the shopper can easily get to the price comparison for this item, can go to the sites of other retailers in order to check the availability of offers, sales conditions and the like (Manyika et.al, 2011, P.65).

Social networks record preferences (likes and dislikes), but also activities on sites, such as retention, frequency and length of visits, and the like (Van Zanten, 2012). Intel introduced special report on the impact of social media on the demand and two important issues in retail: stock-outs and cross-selling (Intel, 2014). An interview with a well-known nutritionist in a TV program about the positive impact of raspberries on weight loss was accompanied by a significant interaction of a large number of his followers on Twitter. Two waves of viral messaging on the social network, caused two waves of growth in demand for this fruit in the shops, serviced by the on-time correction of procurement.

Vast amount of data required a change in approach to data processing. In addition to the usual reporting and forming separate queries, 67% of retailers surveyed used data mining, while 71% used tools to convert data into graphs (data visualization) and even extraordinary 67% use tools for predictive modeling, according to research IBM (Mercier, et.al. 2013). The consequence of increasing the number of data sources in modern marketing and consequently, a deluge of data, has caused a slowdown of processing.

Department store chain Sears, as a pioneer in the application of big data technology, solved the problem for too long, a minimum a three-week long preparatory period of personalized offers to loyal customers. Instead of the traditional way to centralize all data from stores in the central data warehouse, not so expensive servers were distributed in the stores, forming the cloud coordinated by the new software, Hadoop. This software allowed the processing of huge amounts of data simultaneously at the place of their origin (McAfee, Brynjolfsson, 2012).

SAP is also involved in speeding up the processing of huge amounts of data, acting according to the expectations of users accustomed to Internet search engines such as Google to get an answer to the question in a split second. To make this possible in situations of influx of a large number of market data through a variety of channels, SAP also promote a decentralized approach to data processing in the cloud computers. Of course, the fall of RAM price is the factor that allowed this change: from \$ 512mld, as much the 1 GB of memory cost in 1967, then \$ 1 these days and the expected few cents in the near future. In such circumstances, a large number of networked computers, with large RAM memory and multi-core processors have the possibility of parallel processing arrays of data without spending time on storing and then retrieving data from distant memory (SAP, 2013).

The data, particularly those from different sources, have been so far unstructured and, consequently, unsuitable for processing. However, at some point in the development of data processing algorithms, they could become structured, and therefore suitable to serve in real time to shape reactions retailers to market opportunities.

### **3.2. Some areas of big data technologies application in marketing and retail**

Various surveys suggest that implementation of big data analysis is profitable. Cisco team of experts (Van Zanten, 2012), assesses possible increase in profit after tax from the use of big data from social networks by 6%. An even greater increase in profits can be made on the basis of data coming from video systems (17%) and mobile devices (17%). Retailers that make business decisions based on data analysis have already realized a 60% increase in trading margins, are 5% more productive than their competitors and 6% more profitable than them (Intel, 2014). Better inventory management and timely sales of perishable products, as well as customization of offers to customer needs, based on the analysis of transaction data in a supermarket chain in Venezuela delivered a revenue growth of 30% (Mercier, et.al., 2013).

Big data technologies have a special role in the area of profiling customers. One of the pioneers in this field was Amazon.com (Manyika et.al, 2011, p.23),

through the development of their applications for recommendations “You may also like ...” However, a massive breakthrough in the development of customers profiling brought the concept of Customer Relationship Management, accepted by producers and traders (Etheredge, 2003, 299). Loyalty schemes of retail enterprises served as the structured data bases of individuals purchase history allowing to stores, just like the Internet-based sellers, to detect patterns of behavior of individuals, their satisfaction and loyalty (Lovreta et al., 2010, p.101). A further step in this direction was a try to achieve not only satisfaction but delight of the customers. Berman defined customer delight as the ability to “provide not only a satisfaction, as the fulfillment of expected, but also the delight as the fulfillment of an unexpected” (Berman, 2005). And, knowing the interests of customers in the store at the time of making purchase decision is certainly one of the best ways to delight your customer. In different papers and reports, there are descriptions of the advanced scenarios of future purchases (Van Zanten, 2012 and Almehairi, Bhatti, 2014).

CRM concept has evolved into a more advanced concept of Customer Knowledge Management - CKM. It answers in real time to key questions about who are and who could be our customers, what they expect and how do they behave, how they buy and eventually, when and why one can switch to another merchant (Anderson, Elf, 2015, p .41). This knowledge supports key sales strategy decisions on Customer Lifetime Value - CLV (Ness, Schoreck, Letendre, Douglas, 2001), as well as strategies for preventing the departure of customers through various loyalty schemes (Clark, 2004).

Oracle articulates the following influences of the big data on profitability in retailing: 1) higher profit margin realized on the basis of locally tailored assortments; 2) complete avoidance of a stock-outs; 3) optimization of stores (working hours, timely price-reductions, etc.). 4) the increase in the share of wallet through tracking purchase history, interests on the Internet, etc.; 5) operational ICT efficiency based on the use of ICT tools (Oracle, 2015). It seems that all these sources that increase profitability will be critical for retailers, since this sector, according to McKinsey Group analysis, suffer from declining profitability in the long term: The participation of retailers in one dollar of operating profit has dropped from \$ 0.60 in 1999 to only 0.31 \$, in 2008 year, for the benefit of producers and other (Internet) service providers (Manyika et al., 2011, p.65).

The main challenge coming with big data, definitely is related to the problem of data privacy. Photos, videos that users themselves voluntarily placed on social networks, files that are placed on public servers, comments, calendars liabilities and other information, intersecting each other, reveal much about the behavior, attitudes, and even the intentions of users. By combining these data with data generated by the security and traffic cameras and drones,

cameras that more users have on their cars and other data from a growing number of new sources, computer scientists predict the formation of so-called personal digital DNA (Michael, Miller, 2013). The issue of privacy and disclosure of personal information is intensifying in various spheres of life, including in the retail and marketing (Ridge, et.al., 2015). Specific ethical and practical legal issue (Tene, Polonetsky, 2012) is whether the trader is obliged to obtain the user's consent to collect information (opt-in), or is only obliged to comply with his request not to gather data any more (opt-out). Additional challenges of new technologies facing with the large influx of data are: tsunami data from different sources, various software that should communicate, the unwillingness of management to decide on the basis of business analytics, lack of big data experts and consultants specializing in retail and need for re-training a large number of employees (EKN, 2013).

### **3.3. Big data in public sector**

Apart from business sector, big data can bring higher performance in public sector which is generally one of the most data intensive sectors. The efficient "data-driven policymaking" requires public authorities to collect and transparently use a lot of information. To mention here the European Union's "open data" directive which proposes open access to the government data ("liquid data") for citizens and governments bodies? The government of United Kingdom, New York City and many regional-level policymakers are also launching the similar initiative of "open public data". A research conducted by Manyika and his team shows that initiative with "open data in seven sectors - education, transportation, consumer products, electricity, oil and gas, healthcare, and consumer finance - can generate more than US\$3 trillion in additional value a year" (Manyika, et. al., 2013).

Although this initiative originally was invented for the purpose of making transparent way of government decision making, it provides the boost for organizations to use big data and improve their business performance. According to the McKinsey Global Institute the governments of European Union member states can reduce their administrative costs by 15 to 20 percent by exploiting public data in full capacity (Manyika, et. al., 2011, pp. 61). But, it is worthwhile to say that governments, despite their great potential to use and generate value from big data, have not yet succeeded in fully embracing these data. Namely, there is no guarantee, nor for governments nor for business organization, that big data potential will be fully realized.

### **3.4. The obstacles for full Big data usage**

Despite the widespread interest in big data potentials and data-driven decision making, organizations face many obstacles to progress in the big

data domain (Schoenherr, Speier-Pero, 2015). The most dominant internal obstacles are: the shortage of data scientists, poor data quality (incomplete, inconsistent, obsolete and/or fragmented data across various systems) and the culture of intuitive decision making. As we have stressed out earlier in the text the most prominent external obstacle is tied to the data privacy and security considerations. It is almost usual practice that companies gather vast amount of individual's data through their own websites or browsing the social media. For example, on this way they collect specific details of individuals' buying patterns and lifestyle preferences and habits. But, actually they are doing so without person's explicit consent. Therefore, this way of data collection may cause the general public resentment regarding the big data initiative.

How to overcome the identified obstacles? To take a full potential of big data promises business organizations and public institutions must understand and accept a set of responsibilities. So policymakers should take a set of initiatives (Grimmelikhuijsen, 2009 and Bertot et al., 2014), such as: a) create political and business environment, b) formulate a general public strategy for data usage, c) provide public data as an open data formats, d) build up the appropriate infrastructure, and e) speed up the innovations in the education sector. On the other side, organizations are responsible for the internal capabilities to execute big data initiatives. Both sides should be unified in efforts of creating the general framework or landscape that give solid chances for progress of the big data visions.

#### **4. Networked Readiness Index - NRI concept**

Having in mind the broad spectrum of issues regarding the ICT usage as a prerequisite for big data project success, in this section the concept of Networked Readiness Index (NRI) is presented. This index measures the country's readiness to take advantage of a full potential of ICT applications (Soldic-Aleksic, Stankic, 2015). The index was developed at the beginning of the 21st century by the Information Technology Group at Harvard University's Center for International Development. From that period it has been published every year by the World Economic Forum in collaboration with European Institute of Business Administration (INSEAD) in the publication entitled *The Global Information Technology Report*. From the very beginning this Report was based on two theses which have remained valid until nowadays. The first one concerns to the process of constant improvement of information and communication technologies. From year to year these technologies have been more powerful, more accessible and more widespread in usage. The second thesis points to the key role of ICTs in the process of economic development, market competition and general progress at all society levels.



#### 4.1. Networked Readiness Index – structure and methodology

Networked Readiness Index (NRI) is a composite indicator derived from hierarchical structure organized at four levels. The basic NRI level is made up of 53 individual indicators - variables which are presented in table 1.

The basic variables are grouped in the first higher layer into ten subcategories – pillars. Moving up the hierarchy ten pillars are aggregated into four main categories - sub indexes: environment sub-index, readiness sub-index, usage sub-index and impact sub-index. Finally these sub-indexes create the NRI score. This score is obtained by successively aggregations (based on arithmetic mean) of values from the lowest level (indicator) to the overall NRI score. For example, environment sub-index is computed as an arithmetic mean of the first two pillars:

$$\text{Environment sub-index} = 1/2 \text{ Political and regulatory environment} + 1/2 \text{ Business and innovation Environment} \quad (1)$$

Readiness sub-index is computed as an arithmetic mean of the next three pillars:

$$\text{Readiness sub-index} = 1/3 \text{ Infrastructure} + 1/3 \text{ Affordability} + 1/3 \text{ Skills} \quad (2)$$

The other two sub-indexes are computed on similar fashion. Finally the Networked Readiness Index is derived from the four sub-indexes' values, applying the following formula:

$$\text{Networked Readiness Index} = 1/4 \text{ Environment sub-index} + 1/4 \text{ Readiness sub-index} + 1/4 \text{ Usage sub-index} + 1/4 \text{ Impact sub-index} \quad (3)$$

Table 1. Composition of the Networked Readiness Index (NRI)

ENVIRONMENT SUBINDEX	
<b>1<sup>st</sup> pillar: Political and regulatory environment</b>	<b>2<sup>nd</sup> pillar: Business and innovation environment</b>
1.01 Effectiveness of law-making bodies*	2.01 Availability of latest technologies*
1.02 Laws relating to ICT*	2.02 Venture capital availability*
1.03 Judicial independence*	2.03 Total tax rate, % profits
1.04 Efficiency of legal system in settling disputes*	2.04 Number of days to start a business
1.05 Efficiency of legal system in challenging regulations*	2.05 Number of procedures to start a business
1.06 Intellectual property protection*	2.06 Intensity of local competition*
1.07 Software piracy rate, % software installed	2.07 Tertiary education gross enrollment rate, %
1.08 Number of procedures to enforce a Contract	2.08 Quality of management schools*
1.09 Number of days to enforce a contract	2.09 Government procurement of advanced technology products*
READINESS SUBINDEX	
<b>3<sup>rd</sup> pillar: Infrastructure and digital content</b>	4.02 Fixed broadband Internet tariffs, PPP\$/month
3.01 Electricity production, kWh/per capita	4.03 Internet and telephony sectors competition index, 0–2 (best)
3.02 Mobile network coverage, % population	<b>5<sup>th</sup> pillar: Skills</b>
3.03 International Internet bandwidth, kb/s per User	5.01 Quality of educational system*
3.04 Secure Internet servers per million Population	5.02 Quality of math and science education*
<b>4<sup>th</sup> pillar: Affordability</b>	5.03 Secondary education gross enrollment rate, %
4.01 Mobile cellular tariffs, PPP \$/min	5.04 Adult literacy rate, %
USAGE SUBINDEX	
<b>6<sup>th</sup> pillar: Individual usage</b>	7.02 Capacity for innovation*
6.01 Mobile phone subscriptions per 100 Population	7.03 PCT patent applications per million population
6.02 Percentage of individuals using the Internet	7.04 Business-to-business Internet use*
6.03 Percentage of households with computer	7.05 Business-to-consumer Internet use*
6.04 Households with Internet access, %	7.06 Extent of staff training*
6.05 Fixed broadband Internet subscriptions per 100 population	<b>8<sup>th</sup> pillar: Government usage</b>
6.06 Mobile broadband Internet subscriptions per 100 population	8.01 Importance of ICT to government vision of the future*
6.07 Use of virtual social networks*	8.02 Government Online Service Index, 0 – 1 (best)
<b>7<sup>th</sup> pillar: Business usage</b>	8.03 Government success in ICT promotion*
7.01 Firm-level technology absorption*	
IMPACT SUBINDEX	
<b>9<sup>th</sup> pillar: Economic impacts</b>	<b>10<sup>th</sup> pillar: Social impacts</b>
9.01 Impact of ICT on new services and products*	10.01 Impact of ICT on access to basic services*
9.02 PCT ICT patent applications per million population	10.02 Internet access in schools*
9.03 Impact of ICT on new organizational models*	10.03 ICT use and government efficiency*
9.04 Employment in knowledge-intensive activities, % workforce	10.04 E-Participation Index, 0–1 (best)

Note: an asterisk (\*) indicates the variables coming from the World Economic Forum's Executive Opinion Survey. All the other indicators come from external sources.  
 Source: *The Global Information Technology Report 2015*, INSEAD, The Business School, World Economic Forum, 2015, pp. 29-30.

The relevant data on the NRI indicators are publicly available and can be accessed at [www.weforum.org/gitr](http://www.weforum.org/gitr). Half of the NRI indicators shows quantitative characteristics and are collected by international organizations such as the UNESCO Institute for Statistics, the UN International Telecommunication Union (ITU), the World Bank, the International Monetary Fund, and the Organization for Economic Cooperation and Development (OECD). The other half of indicators shows more qualitative aspects of national ICT networked readiness and are derived from the World Economic Forum's Executive Opinion Survey (noted with \* in the table 1). The Survey is conducted by the Forum annually. These variables are measured on a 1-to-7 point scale where 1 indicate the worst and 7 the best outcomes. The other indicators are normalized on this scale applying a max-min principle. For variables where a lower value indicates a worse outcome and a higher value indicates a better outcome, the following formula was applied:

$$6 \cdot (\text{country score} - \text{minimum}) / (\text{maximum} - \text{minimum}) + 1 \quad (4)$$

On the other side, for variables where a higher value indicates a worse outcome and, vice versa, a lower value indicates a better outcome, to ensure that 1 and 7 still indicate the worst and the best outcomes respectively, the normalization formula takes the following form:

$$- 6 \cdot (\text{country score} - \text{minimum}) / (\text{maximum} - \text{minimum}) + 7 \quad (5)$$

The minimum and the maximum in the previous two formulas are, respectively, the lowest and the highest country's scores for a particular indicator variable in the group of all observed countries.

#### **4.2. The Networked Readiness Index landscape: position of Serbia and regional countries**

The Global Information Technology Report 2015 (WEF, 2015) presents the NRI profile of 143 economies around the world. These countries account for 98.4 percent of world GDP. Singapore tops the NRI rankings in 2015 with NRI score of 5.9 on a 1-to-7 measurement scale. Among the top 10 countries 7 European countries (Finland, Sweden, the Netherlands, Norway, Switzerland, the United Kingdom and Luxembourg) are positioned. It is evident that developed economies are better than developing ones, which is illustrated with the high correlation ( $R^2=0.77$  for linear regression) between network readiness and income of the countries (The Global Information Technology Report 2015,p.7).

Table 2. Networked Readiness Index (NRI) scores on 1-to-7 scale

	Serbia	Albania	Bulgaria	Croatia	Greece
<b>Networked Readiness Index (NRI)</b>	<b>3.954</b>	<b>3.703</b>	<b>4.007</b>	<b>4.335</b>	<b>4.072</b>
<b>ENVIRONMENT SUBINDEX</b>	3.610	3.698	3.895	4.106	3.764
1 <sup>st</sup> pillar: Political and regulatory environment	3.145	3.105	3.177	3.505	3.212
2 <sup>nd</sup> pillar: Business and innovation environment	4.074	4.291	4.612	4.708	4.315
<b>READINESS SUBINDEX</b>	5.164	4.403	4.776	5.353	4.881
3 <sup>rd</sup> pillar: Infrastructure and digital content	4.830	3.529	5.239	4.664	4.978
4 <sup>th</sup> pillar: Affordability	5.516	4.492	3.821	5.893	4.379
5 <sup>th</sup> pillar: Skills	5.148	5.186	5.267	5.502	5.284
<b>USAGE SUBINDEX</b>	3.665	3.538	3.791	4.073	3.938
6 <sup>th</sup> pillar: Individual usage	4.627	3.605	4.853	5.197	4.793
7 <sup>th</sup> pillar: Business usage	3.048	3.314	3.410	3.400	3.384
8 <sup>th</sup> pillar: Government usage	3.318	3.695	3.111	3.623	3.639
<b>IMPACT SUBINDEX</b>	3.378	3.172	3.566	3.808	3.703
9 <sup>th</sup> pillar: Economic impacts	3.0838	2.525	3.329	3.686	3.149
10 <sup>th</sup> pillar: Social impacts	3.672	3.818	3.803	3.930	4.257

Source: The Global Information Technology Report 2015, INSEAD, The Business School, Johnson Cornell University, World Economic Forum, 2015, pp. 7-8 and authors' calculation

Table 2. NRI scores on 1-to-7 scale – continuation

	Macedonia, FYR	Montenegro	Romania	EU average
<b>Networked Readiness Index (NRI)</b>	<b>4.416</b>	<b>4.319</b>	<b>4.151</b>	<b>4.934</b>
<b>ENVIRONMENT SUBINDEX</b>	4.364	4.130	3.998	4.660
1 <sup>st</sup> pillar: Political and regulatory environment	3.901	3.483	3.657	4.476
2 <sup>nd</sup> pillar: Business and innovation environment	4.827	4.776	4.340	4.845
<b>READINESS SUBINDEX</b>	5.255	5.158	5.211	5.656
3 <sup>rd</sup> pillar: Infrastructure and digital content	4.429	4.697	4.560	5.645
4 <sup>th</sup> pillar: Affordability	6.134	5.180	5.545	5.614
5 <sup>th</sup> pillar: Skills	5.204	5.596	5.527	5.710
<b>USAGE SUBINDEX</b>	4.114	4.076	3.864	4.828
6 <sup>th</sup> pillar: Individual usage	4.755	4.476	4.457	5.616
7 <sup>th</sup> pillar: Business usage	3.472	3.485	3.532	4.471
8 <sup>th</sup> pillar: Government usage	4.117	4.267	3.603	4.400
<b>IMPACT SUBINDEX</b>	3.932	3.912	3.529	4.593
9 <sup>th</sup> pillar: Economic impacts	3.449	3.510	3.071	4.328
10 <sup>th</sup> pillar: Social impacts+	4.415	4.313	3.987	4.857

Source: The Global Information Technology Report 2015, INSEAD, The Business School, Johnson Cornell University, World Economic Forum, 2015, pp. 7-8 and authors' calculation

In the recent years Serbia has improved its position in the NRI ranking list. It took 87<sup>th</sup> position in 2013 (NRI value 3.7 on a 1-to-7 scale), advancing to the 80<sup>th</sup> position in 2014 (NRI value 3.88) and to the 77<sup>th</sup> place in 2015 (NRI value 3.95).

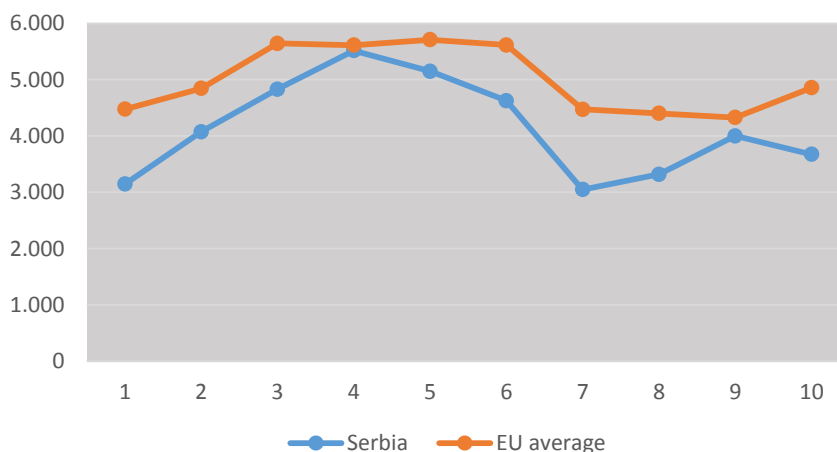
NRI scores at the pillar and subindex level for Serbia and seven regional countries, along with EU average values, are presented in table 2.

The NRI indicators' data for the individual countries were taken from NRI Report 2015, while the respective data on EU average values were calculated on the bases of individual data for EU member states.

An average NRI score for EU countries in 2015 was 4.93. Serbia, with its NRI score of 3.95 took the lowest position in the region, excluding Albania with its 3.70 NRI score.

Here we graphically present the relative difference between Serbia and the EU countries for all NRI pillars. Figure 1 compares the NRI pillar values for Serbia to the mean values of the EU member states. It indicates that Serbia is lagging behind the appropriate EU mean values regarding all pillars.

Figure 1. NRI pillar scores: Serbia vs EU average



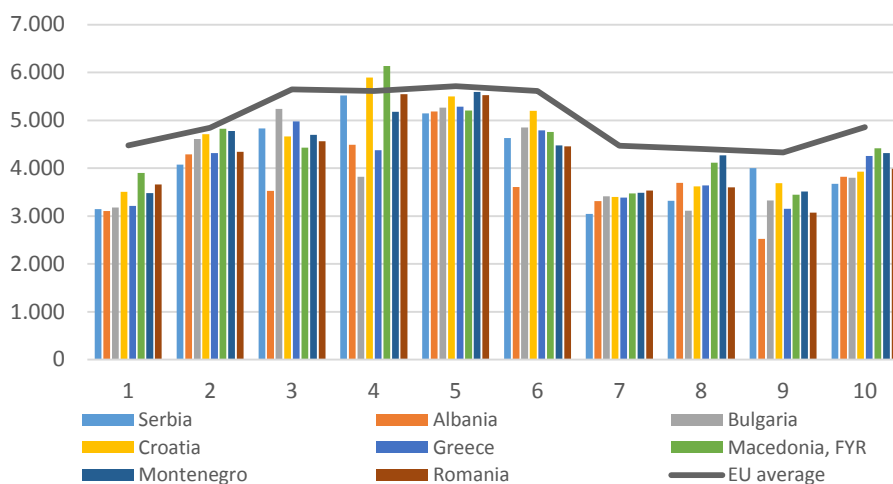
Source: Authors' calculation based on data in table 2

The most favorable performance comparing to the EU mean value Serbia showed for Readiness sub-index (3<sup>rd</sup> pillar - Infrastructure, 4<sup>th</sup> pillar - Affordability and 5<sup>th</sup> pillar - Skills). On contrary, the greatest negative deviations from the EU mean values, are recorded for the following pillars: 1<sup>st</sup>

pillar: Political and regulatory environment, 7<sup>th</sup> pillar: Business usage and 9<sup>th</sup> pillar: Economic impacts.

The Figure 2 presents the comparison of NRI pillar values between Serbia and regional countries: Albania, Bulgaria, Croatia, Greece, Macedonia FYR, Montenegro and Romania. Generally all regional countries demonstrate the poorest performance for 1<sup>st</sup> pillar: Political and regulatory environment, 7<sup>th</sup> pillar: Business usage, 8<sup>th</sup> Government usage and 9<sup>th</sup> pillar: Economic impacts. The best outcomes are observed for 3<sup>rd</sup> pillar -Infrastructure, 4<sup>th</sup> pillar – Affordability, 5<sup>th</sup> pillar – Skills and 6<sup>th</sup> pillar – Individual usage. As it can be seen at Figure 2 this pattern is not a specificity for the regional countries, but also the general (an average) tendency for the EU member states.

Figure 2. NRI pillar scores: Serbia and regional countries vs EU average



Source: Authors' calculation based on data in table 2

The table 2 and graph in figure 2 show that Serbia took the last position in the region regarding the 2<sup>nd</sup> pillar - Business and innovation environment, 7<sup>th</sup> pillar - Business usage and 10<sup>th</sup> – Social impacts, and ranked among the poorest in the region for 1<sup>st</sup> pillar - Political and regulatory environment and 8<sup>th</sup> pillar - Government usage. On the base of this analysis we see that domains which could be focused for improvement and where incentives can be made are: political and regulatory environment, business and innovation environment, business usage, government usage and social impacts of ICT.

## **5. Concluding remarks**

This paper elaborates the relevance of a big data phenomenon in a contemporary business and public environment. This phenomenon is not something revolutionary new.

It may be rather considered as the continuation of the long-lasting organizations' aspirations to create a more information based decision-making process. Many studies have demonstrated that data-driven companies and organizations which use big data may outperform the competitors in productivity and profit gains (see e.g. Mc Afee, A., 2012). Also, one of the prevailing statements in the literature regarding the big data usage points out that the greatest challenge for full acceptance of the big data concept at the company level is the potentials of the company culture model to adopt big changes and shift towards big data usage (see for example, Court, 2011, Jacobs, 2014, Calinan, et.al., 2014).

The most prominent change that big data brings to the business arena is the appearance of new business models, as well as revisions of the existing ones. Marketing and marketing research are the functions that are, among the others, under the strong impact. Big data enable to find out almost unimaginable facts about consumers. New approach forces researchers to combine data from different new sources, like social networks, smartphones and other mobile devices, video equipment, sensors with the data coming from traditional sources. One of the most exciting outcomes is new ability in new profiling of the customers. Retailing is the place where vast amount of structured data appeared even decades ago. That is why Wal-Mart was one of the first private companies that launched its own satellite (Brea-Solis et al., 2016), in order to gather all POS data in real time and use it to enhance its supply chain, category management, customer response and other business processes. Big data represents a step ahead of this, already advanced practice. It suggests involving the inflow of still unstructured data from social networks, mobile devices, video cameras etc. in order to sharpen the profiles of the customers in stores. Nowadays, big data is a big challenge, but big retailers are approaching to the stage when big data will, for sure, enable big business success.

To take a full potential of big data promises business organizations and public institutions must understand and accept a set of responsibilities. Organizations are responsible for the internal capabilities to execute big data initiatives. Governments are responsible for preparing the favorable conditions through environmental readiness (political and business) in order to support the use of big data by organizations freely and productively. This may be achieved by constant building and improving the relevant regulations, technical infrastructure and supportive human resources. In this context the

Networked Readiness Index (NRI) is presented, as a composite indicator of the country's readiness to take advantage of a full potential of ICT usage. In particular, it was analyzed the position of Serbia vs regional countries and an average of EU member states. Serbia, with its NRI score of 3.95 on the 1-to7 scale took the lowest position in the region, excluding Albania with its 3.70 NRI score. Also, Serbia is lagging behind the appropriate EU mean values regarding all observed composite indicators - pillars. This analysis reveals the domains of ICT usage in Serbia, which could be focused for an improvement and where incentives can be made. These domains are: political and regulatory environment, business and innovation environment, business usage, government usage and social impacts of ICT.

Finally, based on the findings and conclusions derived from this research a few open questions and ideas have emerged. They may be the subject of the future work with the focus on the following:

- to measure the gap between two tendencies which are elaborated in this paper: on the one side the volume of data available to organizations is on the rise while the percent of the data (structured, semi-structured and unstructured) they can manage and analyze is on the decline, on the other side. What is the role of business analytics techniques in the process of closing the gap between the two tendencies? Will the traditional tools and structured algorithms be sufficient or should they be supported by new analytical techniques and/or organizational changes?
- to investigate the relevance of big data usage in the business processes and public domain in the Serbian economy;
- also, to explore the connection between the big data usage and data-driven decision making, from one side and the organizational culture model and organization's performance on the other side in companies in Serbia.

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