Big Data Analytics: Applications, Prospects and Challenges

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Abstract In the era of the fourth industrial revolution (Industry 4.0), big data has major impact on businesses, since the revolution of networks, platforms, people and digital technology have changed the determinants of firms' innovation and competitiveness. An ongoing huge hype for big data has been gained from academics and professionals, since big data analytics leads to valuable knowledge and promotion of innovative activity of enterprises and organizations, transforming economies in local, national and international level. In that context, data science is defined as the collection of fundamental principles that promote information and knowledge gaining from data. The techniques and applications that are used help to analyze critical data to support organizations in understanding their environment and in taking better decisions on time. Nowadays, the tremendous increase of data through the Internet of Things (continuous increase of connected devices, sensors and smartphones) has contributed to the rise of a "data-driven" era, where big data analytics are used in every sector (agriculture, health, energy and infrastructure, economics and insurance, sports, food and transportation) and every world economy. The growing expansion of available data is a recognized trend worldwide, while valuable knowledge arising from the information come from data analysis processes. In that context, the bulk of organizations are collecting, storing and analyzing data for strategic business decisions leading to valuable knowledge. The ability to manage, analyze and act on data ("data-driven decision systems") is very important to organizations and is characterized as a significant asset. The prospects of big data analytics are important and the benefits for data-driven organizations are

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significant determinants for competitiveness and innovation performance. However, there are considerable obstacles to adopt data-driven approach and get valuable knowledge through big data.

Keywords Big data · Big data analytics · Performance · Enterprises Knowledge management · Internet of things (IoT)

1 Introduction

Data is characterized as the *lifeblood of decision-making and the raw material for accountability. Without high-quality data providing the right information on the right things at the right time, designing, monitoring and evaluating effective policies becomes almost impossible* [1]. In that context, an ongoing attention to data and data-driven approaches from academics and professionals exists, since the knowledge arising from data analysis processes leads to the promotion of innovative activity, transforming organizations, enterprises and national economies.

Nowadays, in the 4th Industrial revolution era, organizations and governments focus on the development of capabilities that provide knowledge extracted from large and complex data sets, commonly known as "big data". Big data is a buzzword in the last years in the business and economics fields, since it plays an essential role in economic activity and has strengthened its role in creating economic value by enabling new ways to spur innovation and productivity growth. Hence, the ability of management, analysis and acting is significant under the context of knowledge-based capital (KBC) that is associated with digital information, innovative capacity and economic aspects [2].

In that era, many enterprises independent size, from start-ups to large organizations, attempt to obtain data-driven culture struggling for competitive advantage against rivals. Enterprises aim to leverage data generated within organizations through their operations to gain valuable insights for better, faster and more accurate decisions in crucial business issues.

The advent of the Web 2.0 allows users interacting with each other on social media platforms, enabled companies getting access to big amounts of data easier and cheaper. In addition, the appearance of Web 3.0 provides considerably increased opportunities for external data collection. Mobile devices (smart phones and tablets) that facilitate companies to measure even more precisely, since those devices, both Internet and mobile-enabled, have the capability to promote e.g. highly mobile, location-aware and person-centered processes and transactions. This capability will continue offering unique research challenges and opportunities through the years [3].

Digital enterprises like Google, Amazon and Facebook highlight the significance of big data, indicating the various ways that can be used from supply chain to customer satisfaction highlighting the benefits of enterprises. Many enterprises started to benefit from those opportunities offered by the immense development of big data technologies. Today, enterprises in every industry sector and not limited to

ICT sector, are focused on data exploitation to gain a competitive advantage, while managerial decisions rely on data-based analytics and less on the leader's experience [4]. Nonetheless, exploitation of big data needs people with skills and expertise who will able to capture value from data insights providing significant knowledge to managers and decision-makers.

1.1 Defining Big Data

The tremendous generation of data, expected to reach 180 ZB in 2025, give data a leading role in change and growth of the 21st-century shaping a new "digital universe" with the transformation of markets and businesses [5]. Digital information from complex and heterogeneous data coming from anywhere and at any time introducing a new era, the era of "Big Data" [6].

Big data refers to large datasets that are not able to be captured, stored, managed and analyzed by typical software tools [7]. These data sets that are huge -not only in size- but also in heterogeneity and complexity (structured, semi-structured and unstructured data) including operational, transactional, sales, marketing and other data. In addition, big data includes data that comes in several formats including text, sound, video, image and more. This unstructured data is growing faster than structured and have captured the 90% of all the data [8]. Therefore, new forms of processing capabilities are required for getting data insights that lead to better decision making.

On the data life cycle the challenges can be divided into three categories: data, process and management challenges (Fig. 1) [6]. Data challenges refer to characteristics of big data including volume, velocity, variety and veracity. Process challenges are related with the techniques needed for big data acquisition, integration, transformation and analysis in order to gain insights from the big data. The data management challenges include challenges regarding data security, privacy, governance and cost/operational expenditures.

Big data can be characterized by the seven Vs: volume, variety, veracity, velocity, variability, visualization and value.

Volume refers to the large size of the datasets. It is fact that Internet of Things (IoT) through the development and increase of connected smartphones, sensors and other devices, in combination with the rapidly developing Information and Communication Technologies (ICTs) including Artificial Intelligence (AI) have contributed to the tremendous generation of data (counting records, transactions, tables, files etc.). The speed of data is surpassing Moore's law and the volume of data generation introduced new measures for data storage i.e. exabytes, zettabytes and yottabytes.

Variety represents the increasing diversity of data generation sources and data formats. Web 3.0 leads to growth of web and social media networks leading to the generation of different types of data. From messages, updates, photos and videos that are posted in social media networks like Facebook or Twitter, SMS, GPS

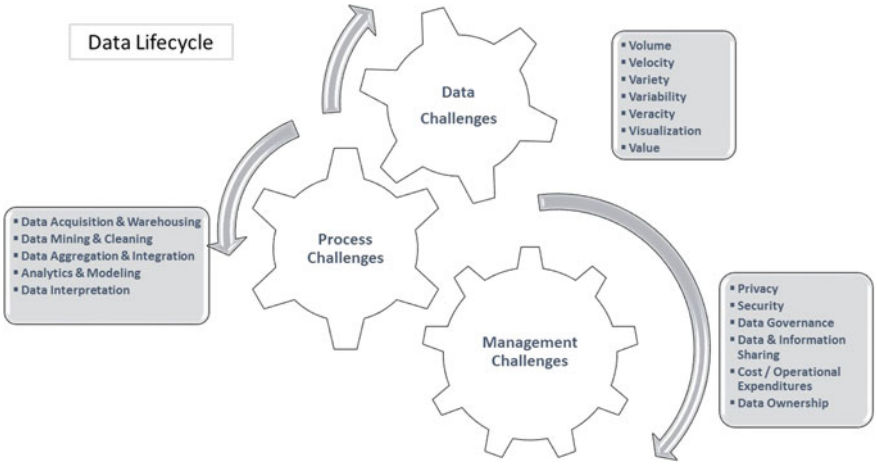

Fig. 1 Challenges in data lifecycle

signals from smartphones, customers transactions in banking, e-business and retail, voice data in call centers etc. Many of the crucial sources of big data are comparatively novel, including mobile devices that supply huge streams of data that are connected with human behavior through their activities and locations; or web sources supplying data through comprising logs, click-streams and social media actions. Additionally, big data also differs in data types that are generated, thus big data consists on structured data (tables, records), unstructured data (text and voice), semi-structured data (XML, RSS feeds) and other data that is difficult to classify like data deriving from audio, video and other appliances.

Variability is often confused with variety, but variability is related with rapid change of meaning. For instance, words in a text can have a different meaning according to context of a text, thus for an accurate sentiment analysis, algorithms need to find out the meaning (sentiment) of a word taking into account the whole context.

Velocity. Big data is characterized by the high speed of data generation. Data generated by connected devices and web arriving in enterprises in real-time. This speed is extremely significant for enterprises in taking various actions that enable them to be more agile, gaining competitive advantage against competitors. Despite the fact that some enterprises have already exploited big data (click-streams data) to offer their customers purchase recommendations, nowadays enterprises though big data analytics have the ability to analyze and understand data taking actions in real-time.

Veracity of data refers to data reliability and accuracy. The data collection has data that are not clean and accurate, thus data veracity refers to the data uncertainty and the level of reliability correlated with some type of data.

Visualization. Data visualization is the science of visual representation of data and information. It presents quantitative and qualitative information in some schematic form, indicating patterns, trends, anomalies, constancy, variation, in ways that cannot be presented in other forms like text and tables [9].

The leverage of big data can provide valuable knowledge and thus the value offered by the data analysis process can benefit enterprises, organizations, communities and consumers.

Enterprises that overcome challenges and exploit big data efficiently have more precise information and are able to create new knowledge by which they can improve their strategy and business operations regarding well-defined targets like productivity, financial performance and market value [10], while big data plays a major role in digital transformation of enterprises introducing innovations. Therefore, an increasing interest in exploitation of big data among enterprises and organizations exists (Fig. 2).

The economic benefits of big data in UK private and public-sector businesses will increase from £25.1 billion in 2011 to £216 billion in 2017 [11]. Big data can provide more value in enterprises in various ways and is able to enhance productivity and competitiveness of enterprises. Big data is referred to the continuous growth of data and technologies that are necessary for collection, storage, management and analysis of data. The way of thinking about businesses has changed with big data, since it changes major elements of organizations and not only management. Big data can be a key resource for enterprises obtaining new knowledge, added value and fostering new products, processes and markets, thus data is characterized as an asset from enterprises' executives indicating the significance of data-driven approach within enterprises [12]. Enterprises gathered data for ages, however, nowadays more and more enterprises are actually analyzing the data instead of just keeping them. Hence, data-driven enterprises perform better in financial and operational terms, 5% more productive and 6% more profitable than no data-driven, gaining significant competitive precedence against their competitors [13].

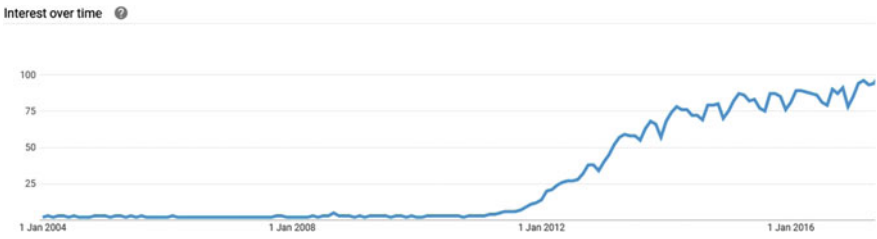

Fig. 2 Big data trend https://trends.google.com/trends/explore?date=all&q=%2Fm%2F0bs2j8q

1.2 Big Data Analytics

The analysis of large data-sets in enterprises, the term of big data analytics is associated with data science, business intelligence and business analytics. Data science is defined as a collection of fundamental principles that promotes taking information and knowledge from data [4]. Over the last years, data-driven approaches like Business Intelligence (BI) and Business Analytics are characterized indispensable to operating enterprises. BI is defined as the methodologies, systems and applications for collecting, preparing and analyzing data to provide information helping decision makers. In other words, BI systems are data-driven decision making systems [14], while Business Analytics are the techniques, technologies, systems and applications that are used to analyze critical business data for supporting them to understand their business environment and take business decisions on time. The power of Business Analytics is to streamline vast amounts of data to enhance its value, while BI mainly concentrates historical data in graphs and data table reports as a way to provide answers to queries without streamlining data and enhancing its value.

Business Analytics was commenced to outline the principal analytical element in BI in the late 2000s. Afterwards, the terms of big data and big data analytics have been utilised to describe analytical techniques for data- sets that are so large and complex, needing advanced data storage, management, analysis and visualization technologies. In that rapidly growing environment, the velocity of data makes the conversion of data into valuable knowledge quickly a necessity. The differences between conventional analytics and fast analytics with Big data are in analytics characteristics (type, objective and method), data characteristics (type, age/flow, volume) and primary objective (Table 1) [15, 16].

The development of the Internet and later on the connectivity coming from the web has contributed in the increase of the volume and speed of data. Since the early 2000s, Internet and Web technologies have been offering unique data collection and

Table 1 Conventional and big data analytics

	Conventional analytics	Big data analytics
Analytics type	Descriptive, Predictive	Predictive, Prescriptive
Analysis methods	Hypothesis-based	Machine learning
Primary objective	Internal decision support and performance management	Business processes driver and data-driven Products
Data type	Structured and defined (formatted in rows & columns)	Unstructured and undefined (unstructured formats)
Data age/flow	>24 h Static pool of data	<Min Constant flow of data
Data volume	Tens of terabytes or less	100 terabytes to petabytes

analysis for enterprises. Web 1.0 systems enable enterprises to establish a web presence and offer their products/services online interacting with their customers. Web 2.0 systems, including the introduction of social media networks like Facebook, provide enterprises more data with information about enterprises, products and customers. The ongoing increase of mobile devices against the number of computers introduced a new era of business analytics, including the analysis of user-generated content by social media channels. Mobile devices have the capability to promote e.g. highly mobile, location-aware and person-centered processes and transactions. Therefore, Data-driven decision making is on data coming from all the sources of enterprises, while predictions and machine learning are based on traditional data and new innovative sources like IoT and AI.

Data analysis is the process of inspecting, cleaning, transforming and modeling data gaining useful information for suggestions and support in decision-making. It has multiple facets and approaches, encompassing diverse techniques under a variety of names, in different business, science and social science schemes, while "Big Data Analytics" refers to advanced analytic techniques, considering large and various types of datasets to examine and extract knowledge from big data, constituting a sub-process in gaining insights from big data process. Using advanced technologies, Big Data Analytics (BDA) includes data management, open-source programming like Hadoop, statistical analysis like sentiment and time-series analysis, visualization tools that help structure and connect data to uncover hidden patterns, undiscovered correlations and other actionable insights.

The process of BDA is a resource for strategic decisions leading to significant improvements in operations performance, new revenue streams and competitiveness against rivals. In that context, the process of getting insights from big data can be divided into two phases: data management and data analysis. Data management is related with the processes and technologies for data generation, storage, mining and preparation for analysis, while data analysis refers to the methods and techniques for analysis and interpretation of the insights coming from big data [17] (Fig. 3).

Analytics can be divided into four categories, ranging from descriptive and diagnostic analytics to the more advanced predictive and prescriptive analytics.

Fig. 3 Process of leveraging big data

Descriptive analytics, based on historical and current data, is a significant source of insights about what happened in the past and the correlations between various determinants identifying patterns using statistical measures like mean, range and standard deviation. Descriptive analytics using techniques like online analytical processing (OLAP) exploits knowledge from the past experience to provide answers in what's happening in the organizations. Common examples of descriptive analytics include data visualization, dashboards, reports, charts and graphs presenting key metrics of enterprises including sales, orders, customers, financial performance etc.

Diagnostic analytics based also in historical data provide insights about the root-cause of some outcomes of the past. Thus, organizations can take better decisions avoiding errors and negative results of the past.

Predictive analytics is about forecasting and providing an estimation for the probability of a future result, defining opportunities or risks in the future. Using various techniques including data mining, data modeling and machine learning, the implementation of predictive analytics is significant for any organization's segment. One of the most known applications of that type of analytics is the prediction of customer behavior, determining operations, marketing and preventing risk. Using historical and other available data, predictive analytics are able to uncover patterns and identify relationships in data that can be used for forecasting [17]. Predictive analytics in the digital era is a significant weapon for organizations in the competitive race. Therefore, organizations exploiting predictive analytics can identify future trends and patterns, presenting innovative products/services and innovations in their business models.

Prescriptive analytics provide a forecasting of the impact of future actions before they are taken, answering "what might happen" as outcome of the organization's actions. Therefore, the decision-making is improved taking under consideration the prediction of future outcomes. Prescriptive analytics using high level modeling tools is able to contribute remarkably to the performance and efficiency of organizations, through smarter and faster decision with lower cost and risk and identifying optimal solutions for resource allocation [18].

The advanced predictive and prescriptive analytics can play crucial role in efficient strategic decision making dealing with significant problems of organizations like design and development of products/services, supply chain formation etc. [19].

1.2.1 Big Data Analytics Applications

Nowadays, as the growing generation of available data is a recognized trend across enterprises, countries and market segments, the majority of enterprises regardless industry is collecting, storing and analyzing data in order to capture value. Digital economy through the tremendous use of internet and digital services has transformed almost all the industry sectors, including agriculture and manufacturing, to more service-centered [20]. There are many and different sectors, like e-commerce,

politics, science & technology, health, government services etc., where big data analytics are applied. Data-driven companies from various industries clarify the power of big data, making more accurate predictions leading on better decisions.

The large streams of data generated everyday need better infrastructures in order to be captured, stored and analyzed. A market with a wide supply of new products and tools designed to cover all the needs of big data has been created and it is developing rapidly [21]. There is a wide variety of analytic tools that can be used to perform BDA, among others on the basis of SQL queries, statistical analysis, data mining, fast clustering, natural language processing, text analytics, data visualization and artificial intelligence (AI). These techniques and tools provide easily and rapidly exploitation of big data.

The knowledge derived from exploitation of big data provides enterprises added value through new ways of productivity, growth, innovation and consumer surplus [7], thus big data becomes a major determinant of competitiveness and enterprises are in need of data analysis capacity to exploit the full potential of data.

Enterprises that learn to capitalize big data utilizing real-time information coming from various sources like sensors, connected devices etc. can understand in more detail their environment and define new trends, create new and innovative products/services, respond quickly in changes and optimize their marketing actions. The leverage of big data is able to contribute to the efficient resources' allocation and supervision, waste reduction, facilitation of new insights and higher level of transparency in different sections of enterprises from production to sales.

Therefore, BDA applications in almost every business sector exist. Applications also in politics and e-government, science and technology, security and safety, smart health and well-being exist [3]. In addition, there are plenty and various types of big data applications among enterprises and industry sectors. BDA can be employed in e-commerce and marketing applications like online advertising and cross-selling, while it helps enterprises to analyze customer behavior in shaping 360-degree customer profile for implementation of targeted and optimized marketing actions to impact customer acquisition and satisfaction. It offers better understanding of customers' behavior and preferences and thus improve customer service.

Some examples of the ways BDA are exploited showing the significance of analytics in various themes [22]:

Marketing	Market basket analysis	Recommendation systems	Customer Intelligence	Retention modeling	Customer churn prediction
Processes	Supply chain analytics	Demand and supply forecasting	Business Processes analytics	HR analytics	
Government	Fraud detection	Terrorism Detection	Tax avoidance	Cost reduction	Social security

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Risk Management	Credit risk modeling	Market risk modeling	Fraud detection		
Web and Social media	Web analytics	Social media analytics	Multivariate testing		

Enterprises and organizations collect large amounts of security-relevant data such as software application events, network events, people's action events. The generation of data coming from these actions are increasing rapidly per day as organizations enable logging in more sources, running more software programs, have more working employees and move to cloud solutions. Unfortunately, the volume and variety of security data quickly become overwhelming and existing analytical techniques cannot work efficiently and trustworthily. BDA applications become part of security management and monitoring, since it contributes to cleaning, preparation and analysis of various complex and heterogeneous datasets efficiently [23]. One of the most common uses of BDA is fraud detection, thus financial institutions, governments and phone companies use big data technologies to eliminate risk and enhance their efficacy.

In addition, BDA is widely applied in supply chain and logistics operations playing a significant role in developing supply chain strategies and supply chain operations management. BDA can support decision making through the understanding of changes of marketing conditions, identification of supply chain risks and exploiting supply chain capabilities to model innovative supply chain strategies, thereby improving the flexibility and profitability of supply chain. BDA contributes also in decision making at operational level, since it measures and analyses supply chain performance taking into account demand planning, supplies, production, inventory and logistics. It thus improves efficiency of operations, measures supply chain performance, reduces process alterability and contributes to the implementation of the best supply chain strategies at operational level [24].

Talking about digital and data-driven enterprises, the firsts coming in mind are Google, Amazon, Apple and Facebook. Amazon that was born digital, exploited big data achieving to disrupt traditional book market and became the leader in digital shopping. Another example of a famous born-digital firm is Google that harness data from engine search to digital marketing in order to provide and personalize search to its users, while Google and Facebook collect data providing opportunities for personalized and customized marketing.

Nevertheless, traditional non-technological enterprises are also attempting to gain data-driven benefits. General Electric (GE) has developed a cloud-based platform for Industrial Internet application named "Predix" that provides real-time insights for engineers to schedule maintenance checks, improves machine efficiency and reduces downtime. GE this way provided new service value propositions in the conservative market of the oil and gas industry, while it faces its most pressing challenges: improving assets and operations productivity and eliminating the cost of tacit knowledge from aging workforce [25].

Walmart and other major retailers using BDA in the entire business process, from supply-chain management to marketing, gained benefits from data. Applications of BDA are everywhere and not only in digital sectors, but also in no web-based sectors including manufacturing, agriculture, health care, energy, traveling and others. In healthcare sectors, various applications of BDA exist, from quality of treatment services and cost efficiency of hospitals to improvement and predictions of patient health condition. In traveling and retail, BDA applications are able to provide customer intelligence through web and social media analytics, thus enterprises can offer personalized products/services. Additionally, in energy management the majority of the enterprises use data analytics to track and control devices achieving a more efficient energy management without services deviation.

1.2.2 Big Data Analytics Prospects

Analytics in decision making procedure is not something new, since business analytics appeared as early as in the mid1950s—Analytics 1.0 era—with the advent of tools that were able to generate and capture larger amounts of data in enterprises data warehouses and discover patterns more quickly than human minds with business intelligence tools. In that first era, managers gained a data-based comprehension going beyond intuition in decision making. Until mid-2000s, the rapid growth of data generation and the arrival of big data have signaled a new era—Analytics 2.0—where enterprises have the opportunity to leverage that data with new more powerful tools. The need of new innovative technologies appeared and enterprises moved quickly to acquire the necessary capabilities and knowledge for gaining insights from big data, with the major difference between eras being in skills required for data analysis [26]. In the next era, analytics is an integral part of enterprises supporting decision making and enterprises move to creation of analytics-based products/services. Moving ahead, the next era—Analytics 3.0 or "data economy"—is characterized by the tremendous increase of data generation coming from the growth of Internet of Things (IoT) with 8.4 billions connected devices in 2017 globally and 20.4 billion by 2020 [27].

The most recent era—Analytics 4.0—includes cognitive technologies including machine learning, where actions and decision making are shifted to augmentation with dynamic machine automation. The main characteristics of all these eras are appeared in Fig. 4 [28].

In the current era of analytics, the emerging new technologies will increase the generation of data, thus enterprises and organizations have to face up technical challenges in order to have access to more and better data. The worldwide revenues of big data and business analytics (BDA) will be more than $203 billion in 2020 and banking, manufacturing, government and professional services will be the top industries in BDA investments according to International Data Corporation (IDC) [29].

Therefore, enterprises should focus on capturing value from data using analytical techniques and tools. BDA can help enterprises to examine trends and discover new

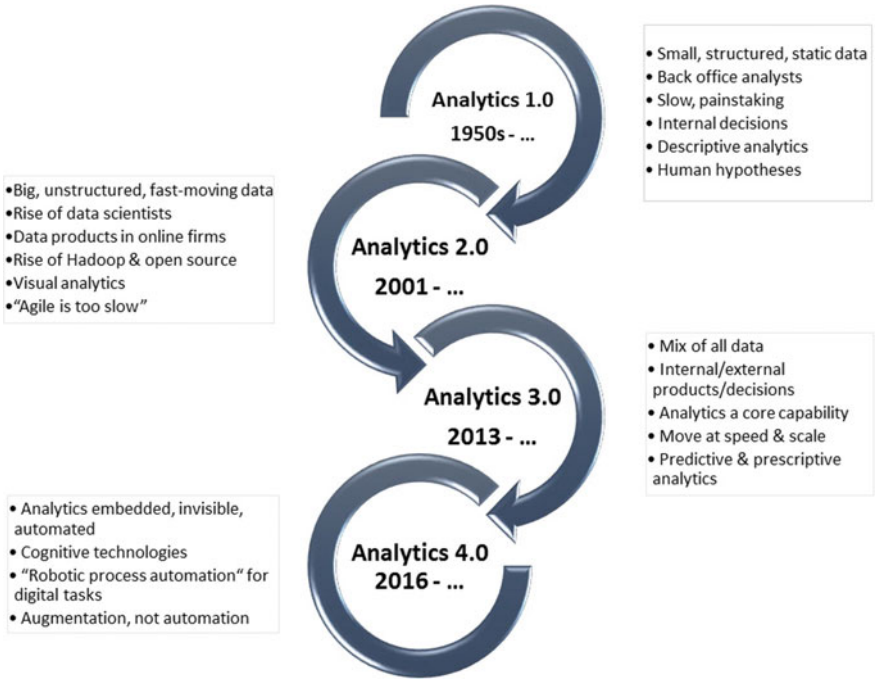

Fig. 4 The evolution of analytics eras

ones for gaining competitive advantage, introducing new and improved products. Among others, data visualization and process simulation, text and voice analytics, social media analysis, predictive and prescriptive techniques can provide valuable knowledge to enterprises, while they are able to make insights more transparent and impact any enterprise's section.

Data science and big data technologies—techniques promote data-driven decision making and thus contribute in better enterprise's performance, since the ultimate goal of data science is the improvement of decision making. Therefore, whether organizations couldn't capture value from applying data-driven decision making as their strategy, they have failed [4]. There is evidence that data-driven decision making contributes significantly and positively to enterprise's performance in terms of productivity and profitability [30]. Data-driven approach can provide great opportunities for gaining competitive advantage, as measuring and managing more precisely business analytics can enable organizations to make better predictions and smarter decisions also to target more-effective interventions [13].

Moving to a whole new era in data analytics, organizations and enterprises are exploring new innovative strategies and techniques to remain competitive in their market. Using BDA help them to introduce new and/or improved products/services, manage more efficiently their supply chains and processes, eliminate risk through fraud detection and security improvement and exploit customer intelligence.

Applications of BDA can provide several advantages in organizations and enterprises that have an efficient data-driven approach. Big data analysis is able to provide in-depth knowledge about the different departments of an organization and thus using big data analytics for prediction making will contribute to increased performance and higher returns on investments with lower cost and risk, while more transparency is achieved.

Some of the prospects of big data analytics are:
Gaining insights from big data analytics of all the departments of an organization to develop a comprehensive business strategy, or the entire organization. This strategy will be able to contribute to higher level of productivity and efficiency, within the departments, but also in the whole organization with cost reduction and elimination of processes.

Organizations will exploit more artificial intelligence (AI) technologies that are able to reinvent organizations in various ways. However, organizations should develop automations and structured analytics, before they move on the adoption of advanced AI. The integration of structured and unstructured data analytics with AI systems makes it possible to examine, explain and predict customer preferences and behavior [31].

Data-driven innovation (DDI) relying on the knowledge-based capital, refers to innovations arising from data-driven decision processes [2] that lead to the discovery of new and disruptive business models, the enhancement of customer intelligence [32] and the introduction of new/improved products or services. The potential of data-driven innovation big data in UK private and public sector businesses will lead to £24.1 billion contribution to UK economy during 2012–2017 [11].

Real- time analytics is a big trend that enterprises need to pay attention at in the near future. Despite the challenges and issues that are addressed, it is proven that analytics-driven management has significant implications on enterprises, whether they are looking for growth, efficiency or competitive differentiation. Therefore, Big data analytics have seemingly unlimited potential to help an enterprise to grow and reveal its data potential.

The rapid growth of the demand for data analytics in combination with the lack of talent lead on collaborations and initiatives between academia and industry in order to bridge the talent gap. In that context, many universities are preparing and starting academic courses related with data science. In addition, companies realizing the potential of big data, provide training to their employees. Recently AirBnB started its own internal university called “Data University” to democratize data science and help to drive data-informed decision making.

There are different expectations from enterprises regarding big data analytics. Organizational leaders want to exploit analytics to be smarter and innovative like never before, while senior executives want to use data-driven decision making for their efficient operations [33]. Managers using a data-driven decision system (DSS), have access to historical and new data supporting them to gain insights for organization processes and resources’ performance. DDS are significant not only for

global organizations but also for small and medium organizations that can exploit them to their benefit [10].

1.2.3 Big Data Analytics Challenges and Barriers

The major challenges in adopting big data analytics from enterprises are more managerial and cultural than associated with data and technology, while the main barriers are the lack of comprehension of how to utilize big data analytics to enhance the business and the lack of management spectrum from competing priorities [33]. Studies among different industry sectors indicate that organizations use less than half of their structured data in decision making process, while less than 1% of their unstructured data is analyzed or exploited, 70% of employees have access to data they should not and 80% of analysts' time is to discover and prepare data [34].

Leadership. According to management challenges, enterprises that achieve to be successful in the data-driven era have leadership teams that determine aims, modulate achievements and ask the right questions to be answered by data insights. Despite its technological approach, the power of big data cannot be exploited without vision or human insight. Therefore, leaders of enterprises with vision and ability of revealing the future trends and opportunities, will have the ability to act innovative, motivate their teams work efficiently to achieve their targets.

Talent management. Enterprises in order to leverage data through big data analytics need human capital with high level of technical skills to use and exploit these systems in order to achieve exploitable knowledge for end users, mainly C-suite. People's specific skills include statistics, big data mining, master visualization tools, business oriented mindset and machine learning. These are required to get valuable insights from big data contributing in decision making procedure [13]. However, these people (data scientists, data analysts etc.) are extremely difficult to be found and thus demand for them is high. There is a challenge in finding data scientists with skills both in analytics and in domain knowledge. In general, there are existing fewer data scientists than needed [35].

Decision making procedure. In efficient enterprises, decision makers and knowledge derived from data exploitation are in the same place. Nonetheless, it is difficult for decision makers to handle huge amounts of data. Therefore, there is need of decision-makers having problem-solving skills and the ability to provide answers to problems with the right data or cooperation of different people in problem solving through leveraging big data [13].

Decision making Quality. The quality of decision making adopting a data-driven approach is a significant factor for taking advantage of the possibilities that big data analytics are offering. In that context, ensuring decision making quality is correlated with factors like data quality of big data sources, big data analytics capabilities, staff and decision-maker quality [36]. The accuracy of big data sources is significant in providing high value in decision making eliminating wrong actions, while big data

analytics capabilities are related with the utilization of the right techniques and tools from specialists with knowledge of big data analytics.

Data-driven culture. Another significant challenge for adopting data-driven approach is enterprise culture. The basis in obtaining data-driven culture is the capabilities to quickly condense, analyze and distribute crucial business information to decision makers. That basis is extremely significant for enhancement of business performance, while development and improvement of that capabilities empower enterprises leading to improvements in all business segments and higher returns on investments. In that context, enterprises have to adopt data-driven decision making in all issues and stop acting solely on hunches and instinct. Therefore, management must fully understand the significance of getting insights from data exploitation. In addition, for a data-driven enterprise, people who are involved in the process of data-driven decision making need to meet some requirements. Managers should be able to manage efficient data-analytics teams and projects, while marketers should be able to understand metrics and analytics in order to manage efficiently marketing activities.

New technology utilization. Many enterprises conceiving the power of data, have developed technology skills in business intelligence and/or data warehousing, but technologies of big data analytics are different and new. Therefore, enterprises have to utilize techniques and technologies that are available in order to capture value from big data. As these technologies are evolving rapidly, IT departments should be able to develop their capacity and be up to dated to that ongoing innovation. For instance, problems will emerge when database software does not support big data analytics options.

Data privacy. The collection of data is considered to be deeply suspicious by many people. For them, big data is an invasion of their privacy. Marketers are struggling with consumers' perception of data, as the 71% of them believe that brands with access to their personal data are using it unethically, while the 58% of them have not used any digital service due to privacy concerns that lead to decision-making about the applications they download, the email addresses they share and the social media sites to use in order to connect to other websites [37]. Therefore, enterprises need to use safeguards in order to ensure that data are not used to violate the customers' personal privacy [7]. In that direction, data policies including privacy, security, intellectual property and liability issues, should be addressed in order to exploit big data value.

2 Conclusions

The growth of Internet with the beginning of Web 2.0 era enabled companies getting access to big amounts of data easier and cheaper, while the opportunities for external data collection have even increased with the appearance of the Web 3.0.

Enterprises and organizations from all sectors began to focus on data exploitation for gaining competitive advantage.

Nowadays, the big data era has quietly settled down on almost every company, because they realized that data-driven decisions tend to be better and more accurate decisions. However, that many companies in several industries are applying business analytics including big data analytics, it doesn't mean that they all take benefit from it by getting valuable insights and real business value from the available data.

Becoming a data-driven company is more than using analytical techniques and tools. The companies need to hire people equipped with systematic thinking to promote the success in data-driven decision making. Success in the data-oriented business environment today includes being able to think data-analytically. Since the amount of data is continuously growing, domain knowledge and analysis can't be considered as separate areas. Both academic and applied professionals of the companies are expected to have the analytical skills and to understand business processes.

Employees, who don't have the basic understanding of data-analytic thinking, do not really know how the business of an organization is working. If they are able to understand the process and its steps, it will be easier for them to find suitable solutions for the weaknesses of the concerning process step. But to be able to perform data-driven, organizations have to face some challenges, both managerial and technical.

Big data is not just about data volume, but also about variety and velocity. Big data analytics have the ability to help enterprises understanding their business environments, their customers' behavior and needs and their competitors' activities. Thanks to big data analytics enterprises are able to form their products and actions in order to fulfill customers' needs and innovate against rivals through better predictions and smarter decisions on basis of evidence instead of intuition. Organizations that achieve to manage the challenges and adopt a data-driven culture, they can expect good prospects. There is strong evidence that business performance can be improved via data-driven decision making, big data technologies analytical tools and techniques on big data. As more companies learn the essential skills of using big data and how to engage with current technologies, which are continuously developing, may soon stand out from their competitors and have a decisive competitive advantage.

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