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Big Data and E-government: A review

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Abstract—Rapid moving in the technology and the need to respond to the massive changes in the big data create another challenge for the government to make the deal with a huge amount of data easier and to implement effectively multi-channel platforms for digital transformation. The need for technology such as social media, e-participation tools and new models of open data to generate big data also have added to these challenges, in addition to the slow adoption of the public sector and citizens for these new concepts of openness and effective interaction through electronic technology. For citizen's improvements the e-participation processes, government innovations, and citizen satisfaction governments need to enhance the collaboration and engagement. As well, it needs to improve the value that delivers inside and outside of government sectors also satisfies the citizens' demands for better services by collecting data from citizens' activities. When e-government utilizing the big data technologies, which offers a new effective technology to provide interactive services, the e-government will be more than just a big and more than just a data. The term of "Big data" must be used in e-government. In this paper, the authors explore a review in big data issues that applied to e-government as well as challenges and issues facing these agencies and proposed a possible solution for the challenges of implementing big data in e-government. Most of the recently published papers clearly show that the challenges are difficult and the growing in terms of big data is increasing exponentially.

Keywords—*Big Data; E-government; Big data initiatives.*

I. INTRODUCTION

During the past few years, data has been grown in terms of the large scale and the various fields . International Data Corporation (IDC) gave a report in 2011, which said that the overall generated and copied data size in the whole world was 1.8ZB (≈ 1021 B). This size increased exponentially by almost nine times within five years [1,2]. Recently, the expression of "big data" has been much popular in the academic area include the research of awareness, the adoption, and perceived usage, and in the social media interactions [3,4].

Electronic government or the term of e-government aims to improve and increase the accessibility of information, transactions, and government services by using the information and communications technologies (ICT) including the computers, the Internet, automation equipment , and mobile devices [6].

The investment in ICT to enhance the services delivery of the public sector and engaging with internal and external entities , has started with e-government initiatives and projects which focused on enhancing the public service transparency, collaboration , e-participation, and efficiency [9]. Electronic transformation for the government services using ICT considered a complex and costly task, usually associated with the computerization of public services and business systems combination and it needs to formulate the legislation and policies to enhance the quality, data accuracy, privacy, security, and control the flow of the e-government data [8,9] .

Big data can enhance the process of the decision making and enhance efficiency and effectiveness of the organizational, but only if organizations use a kind of scientific methods to make knowledge of the data. Big data can reduce the cost such as a new information technologies , improves the time required to make a computing processes, and deliver a high quality new service and product that meet the demands . It can also improve the internal business decisions such traditional analysis. The concepts of the technologies behind the big data allow the organizations to achieve a variety of aims and objectives [10].

Leading organizations starting recognize the significance of utilizing their data as a strategic asset. Some organizations start the analysis initiatives to enhance the quality of customer experience by acting on sentiments analysis for the customers data. Others analysis technique to predict a customer's interest to buy new products or services to make good recommendations for future. This approach offers a long term relationship and empower the organization with analytic insights to improve internal processes, safety, and determine the operational issues to obtain profitability, competitive advantage , and efficiency in the market [11].

Most of the customers are familiar with the Big Data, but many customers are still unsure about the benefits and profits of the big data promises and projects. Part of uncertainty is possible due to the widely definition of the big data concept .

Heretofore, best practice of Big Data success stories emerged from the internet leaders, sensor networks, telecommunication companies, and scientific organizations. The measurement and productivity of operational data produced in these domains far exceed that of the largest enterprises. Moreover, many customers are still attempting to optimize the existing ordinary data for the investments in Big Data technology, which include predictive analysis platforms, data warehouses. Shortly, the business perceptive for investing in Big Data projects must turn on the Digital transformation contents and more traditional data analytic approaches. The core benefit of using Big Data analytic is the promises of analytical ability to integrate policies based on an estimating of the whole range of influences and impacts . [11,12].

A big challenge for the government of developing national initiatives is to find out how can use the offered opportunities by ICT to promote an effective services [13, 14, 21]. Under the right constraints, ICT offers an effective resource to assist citizens through e-Government strategies and action plan in very wonderful and exciting ways. For a long time, nations across the globe attempted to use ICT in government in different ways to reach the development aims and also give a transparent,accountable government purposes, convenient access to government online services, enhanced democracy, decrease the costs of administrative services and eventually enhanced the living criterion of their citizens.Implementing the Big Data in ICT has the power to transform e-government transactions with added value for public services and has the ability to support the digital innovations for e-government [13, 15, 17, 20].

Due to the rapid growth of online social media and the huge growth of data , different concepts have developed in different research fields to explain digital environments and their social sites effects. There are many definitions and terms to refer to the "social" in the Big Data. The most general terms so far are Big Social Data (BSD) and Social Big Data (SBD). Different definitions and methods are performed and compared in order to describe the existing research ways [16, 18, 19].

The existing studies have not facilitated a discussion on the role and volume of the available information at the supply chain level and corporate. Moreover, although a series of papers have been published in the domain of the Big Data Analysis, only some papers presented have been conducted at the intersection of Big Data Analysis. Against this short outline, it seems difficult to identify constructs that could be developed on for a typical positive research study. Investigating the field with a more approach seems verified as this allows knowing key issues [22].

II. DEFINITION OF BIG DATA

Big data is a big term , so there are many definitions of Big Data, one of this definition is by Gartner in (2013) who define the Big Data concept as “high-volume, high velocity and/or high variety information assets that demand cost-effective innovative forms of information processing for enhanced insight, decision making, and process optimization” [13,2].

Other researchers have produced various definitions for the big data ,SAS define big data : “Big data is a popular term used to describe the exponential growth, availability, and use of information, both structured and unstructured” , IBM add another definition for big data “Data, coming from everywhere; sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction record, and cell phone GPS signal to name a few” , “Big Data is defined as large set of data that is very unstructured and disorganized”, “Big data is a form of data that exceeds the processing capabilities of traditional database infrastructure or engines” [8].

Big Data becoming bigger and bigger ,so other researcher defined the big data as a very large database that represents the gigabytes of data volumes. Later the term big data means the level of terabytes [2]. “Big data is high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making.” [2,27] . “ Big Data is less about data that is big than it is about a capacity to search, aggregate, and cross-reference large data sets “ [30]. Big data also produces a new opportunities for discovering new values, helps us to gain a deep understanding of the hidden values, and also incites a new challenges and issues related effectively organize and manage such data sets [1]. Big data is the technology which enables processing of unstructured big data. Recently, Hadoop, MapReduce, Spark , Data Discovery and etc... are grown for the purpose of processing and analysis of the data with 5's characteristics of volume, velocity, variety, value and veracity. The applications and development of these technologies allow achieving the efficiency ,effectiveness and certainty [14] .

Generally, the definition of the big data in [26] was as “Big data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information”.

III. THE FEATURES OF BIG DATE

The features of big data classified into five main parts as shown in Figure 1 . The following subsections will show and explain the five features of big data.

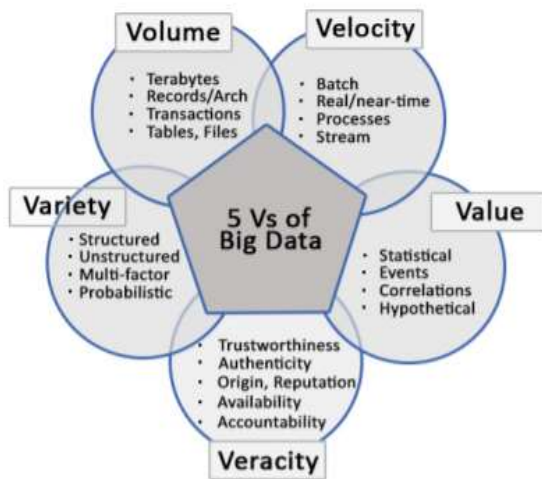


Figure 1: The five features of the big data.

A. Volume

Volume is an essential characteristic of big data [2]. It describes the size of the big data set that used in many applications. The volume also relates to the measurement of data. It is a huge information set in comparison with analytic results and data managed in habitual storage. The size of big data sets represents in multiple terabytes, and petabytes. Also, the size can be greater than petabytes, which can be either exabytes or zettabytes. Size too can be pointed to a number of all types of data produced from various sources. Furthermore, big data can also be quantified by computing the reports of data, transactions, a number of tables, and a number of files [19,20].

B. Variety

Variety is a range of datasets and sources. The data can grow from several resources, such as internal or external resources. These data records from distributing resources cause a change in the data set. Variety also refers as a structural coherence in a dataset. The data can classify into three classes: (i) Structured (ii) Semi-structured (iii) Unstructured data. According to [2], data which originates from pictures, audio, video, and other resources are hard to classify. Generally, the text, images, video, audio are common examples of unstructured dataset, which seldom shortage the structural arrangement essential by virtual machines for analysis. Moreover, extensible markup language (XML) is the common example of semi structured data. Semi-structured data does not correspond to fixed fields but holds tags to distribute data elements. The variety means that the data gets from all aspects of sources: structured data which can be traditional databases such as SQL; semi structured (i.e., data contains tags and markers)

but without the formal or unified structure such as a database; and unstructured which means the unorganized data but with no business intelligence [19].

C. Velocity

Velocity is introduced as a rate at which data are produced and the speed at which it should be analyzed and described [2]. It can be defined as the number of data generation or the frequency of data transfer as well. Generally, velocity is the production rate, which is remarkably high for the big data. The large growth in data means that the data should be interpreted more quickly. In other terms, the quicker data grows need for the data increases. Ultimately, velocity can be described as the speed of data delivered, generated, and processed [20].

D. Veracity

Veracity is the characteristics or features of big data quality as bad, good, or undefined due to data inconsistency, ambiguity, incompleteness, latency, approximations, and deception [2]. It focuses on the quality of big data. Generally, veracity associated with the unpredictability of some data needs analysis in the domain of the big data to get a reliable prediction. Also, it can be defined as the accuracy of data, where the data be collected from true resources and it also must provide the security of the data [19, 20].

E. Value

Value is defined as the attribute of the big data, which is introduced by Oracle [2]. Big data is usually characterized by approximately "low-value density". Hence, the data obtained in the original form are normally has a low value related to its size or volume. Although, a high value can be obtained by analyzing large sizes of that precise data. Another phase of value is conducting business value to the organization and it is challenging to join the business value with the organizational goals. In other words, big data need to create a value-added to encourage the organization [19, 20].

IV. BIG DATA AND E-GOVERNMENT

Big data will become one of the most powerful investment sectors for government. E-Government can use big data to discover the trends and patterns of peoples' behavior on the social networking so that the government can provide better, effective, efficient service. The term of Big Data offers a new opportunities for value creation, discovery, prediction and empower the business intelligence for decision support in e-government [13].

Since the public sector starts their online transactions and activities, the e-government initiatives adopt the big data strategies in their next implementation. Big data provides the government with the better understanding of their people's habits and interests with the aid of applications in their mobile and social networking based on their browsing, clicks, search engines, purchase histories, booking, etc. With these capabilities, the government can understand its people's habits, tastes, personalities, and preferences, which can help predict what their people want and offer appropriate advertise and programs that would satisfy their needs and concerns [20]. Big data helps government to structure smart government by providing faster, effective, and reliable services to their citizens [2].

In public sectors the big data is a new concept and powerful technology used to define the growth and availability of various data. E-government can try to brief service delivery and offer higher speed, transparency, effectiveness, efficiency, and certainty. Big data has the power to transform e-government practices in generating added value for public services and has ability to motivate and support the digital innovation for e-government [9,20].

Toward enhancing the e-government services and the increasing of effectiveness and efficiency, the added values of big data are explored in business analysis. In addition, the big data is discussed in identical administration structures about the issues of integration of various information sources, security risk and digital confidentiality. The viewpoint research directions are specified in big data issue for public sector [14,29].

E-government not need a big data, it need the right big data, where big data is delivering meaningful value to e-government as a new revolution that leading the entire ICT agency, where the new activities and valued data are being generated faster than ever before. Where these big data hold the key to unlock a new race of activities that will make both the government and the public have a better understanding of business that will make it more effective and efficient. Many leaders defined Big Data as the next edge for innovation, productivity, competition, and quality [13,29].

The main principle of big data is valuing predictions, and it optimizes abilities and rules that create value to support data management. Big data is available in various structures and formats, and it can be used for different objectives, such as predicting a search keyword or social networking activities. The e-government initiative needs to recognize the importance of big data management, benefits, analysis, and technologies into their e-government strategic plan [20].

V. BENEFITS AND OPPORTUNITIES

The investment in ICT to enhance the services delivery of the public sector and engaging with internal and external entities, has started with e-government initiatives and projects focused on enhancing the public service transparency, collaboration, e-participation, and efficiency [9].

E-government services and the increase of effectiveness, efficiency, and the values of big data chances are explored in e-government. Big data can provide a pattern of people's activities and information while the e-government dealing with big data to predict and assume the current needs and satisfaction of their people [14,20].

In public sectors the big data is a new concept and it will be a new application used to define the growth and availability of various data. E-government can try to brief service delivery and offer higher speed, transparency, effectiveness, efficiency, and certainty. Big data has the power to transform traditional e-government to a new powerful smart government. Also it can reduce the cost such as a new information technologies, improves the time required to make a computing processes, and deliver a high quality new service and product that meet the demands. In addition, big data can also improve the internal business decisions [14,11,27].

The concepts of the technologies behind the big data allow the governments to achieve a variety of aims and objectives [10] to enhanced levels of sustainability and governance. In addition to improving the citizen's quality of life and introducing intelligent management of infrastructures and natural resources, big data application in e-government can support provide better citizens interests, experiences and services, which assist businesses, earn better performance, obtain competitive advantage, and increase profits [8,28].

The researchers can summarize some benefits of having a big data in e-government include the following:

- Providing and integrating efficient resource of big data.
- Integrate valued data in e-government to decision making processes.
- Ability to generate data faster.
- Higher revenue.
- Increasing of storage capacity.
- Availability of different types data.
- Empower and Enhance the quality of life.
- Controlled utilization of E-government resources efficiently.

- Increasing of transaction processing efficiency .
- Increase the levels of transparency .

The opportunities to achieve the benefits of big data require a high levels of development and participation in terms of the applications, tools,resources and people engagement .

However, this investment needs more technology,efforts,better development and effective use of valuable big data . Also it need to formulate regulations and policies to ensure data security ,accuracy,privacy, high quality ,and control of the data[3,8].

Big Data analytic provide the e-governments with a tools and applications to empower policies integration for ensuring sustainable growth in the big competitive market . According to the UN (2012,2014) , the new term of Big Data analytics refers to tools, applications and methodologies that support digital transformation of massive volume of raw data into useful outputs [12].

Recently , big data has become a significant factor that could be a material assets for e-government structure to collect more valued data assets for government , businesses and citizens. Also the McKinsey report referenced to the big data role in government by improving the efficiency , profit ,productivity quality ,competitiveness of public sectors, and create a massive benefits for citizens [1] .

VI. CHALLENGES OF BIG DATA IN GOVERNMENT

Big data is being collected every second, every day around the world from various sources,like the internet, social media, computer , etc.... where the structured , sim-structure , or unstructured data and any transaction will be stored in the form of bytes from as small as megabytes (MB) to as big as petabytes (PB), that cannot be easily integrated due to the unbelievable average of data being flow with a high speed of data [20] .

Challenges include issues related to legal frameworks, policies and principles; data management and protection; identity management and privacy;105 UN Member States have policies and legislation on the right to access e-government information. Also the same number produce online policies on open government data and about 113 countries offering online personal data protection Acts and legislation [12].

There are many challenges facing the journey of implementing the big data in e-government. E-Government initiatives living the existence of an extended variety of challenges and obstacles to its implementation and management of this new trend which is now a talk of all .

In this section, we will briefly introduce the main challenges facing e-government and their management through

implementing big data and proposed a possible solutions for these challenges .

The main challenges for integrating e-government services through the era of a big data can categories in Three proposed areas : first will be from the perspective of Technology, second from perspective of People ,and third from perspective of Business as following :

1. Technology Perspective

Big data analytic requires a new technique, skills to optimization of processes , and ability to store and analyzing data using data management tools that use the technology of Big Data like (Hadoop ,Spark,...).Where the increasing in volume needs additional data storage system , storage mechanisms , and new environment and technologies that meet the demand s of massive data [1] .

This new revolution requires efficient processes to move the big data into a meaningful added value. Big data application in e-government is difficult to perform without sufficient ICT infrastructure. Because big data comes in all types of formats, structure data in traditional databases, simi- structures , or unstructured like emails and financial transactions , it needs large processing abilities [2,4].

Also volume and rapid growth of data increasing every day and that precede the ability and capability of modeling and analyzing it in the same speed [28] . Researchers summarize challenges from the technology perspective as the following :

- The capability of IT and infrastructure (technology-awareness,e-readiness,computer literacy, telecommunication equipment) .
- Data Security issues and Policy issues (legislation and regulation) .
- Lack of experts and skills in human capital of big data like big data analysis skills.
- Lack of control under the umbrella of big data .
- Lack of compatibility with existing IT systems, where the current storage system could not support such massive volume of data.
- Rapid growth of big data precede the modeling and analyzing these data .
- Lack of using data management tools that use the technology of Big Data (Like Hadoop ,Spark,ets.).

2. People Perspective

Online service providers save and store all data that customers have typed, browsed, and clicked, where service providers get to know who their customers, what they do, where they live, and what they prefer. Also, the online service providers can sell users' data to other third parties and advertisers, so that they can advertise to us something that they choose. Therefore, people need to be educated on what data

can be shared and what can not. The main issue is that privacy cannot be all protected and all social networking activities can be read by third parties who manage the big data. Unfortunately, many people have very little understanding about how companies are using big data [20,25]. Researchers summarize challenges from the people perspective as the following :

- Lack of Human capital development and learning skills, capabilities, and experience.
- Culture resistant .
- People can't trust technology .

3. Business Process Perspective

Big Data will enlarge e-government services because a huge volume of data will generate value for public services. Support from the government should be required. Governments need to support more research and partnership concerning big data implementation. Big data can generate knowledge, motivate the competitiveness, improve performance, and provide an effective decision making, when governments carrying out e-participation as a tool in achieving a knowledge economy and strengthening competitive advantage and added value [1,20,28].

Investment in big data draw a critical challenges from the business process perspective that should be solved to obtain a high quality value form big data and summarize as following :

- business strategy change(vision,mission,aims , objectives) .
- Transformation and management change (structure,culture, skills, process, resistance to change) .
- Partnership and collaboration public and private partnership (PPP).
- Community and network creation .
- Leadership role (motivate, involve, influence, support).

Table (1) will proposed the possible solutions based on categorize critical challenges of implementing big data in e-government :

Table 1 : Challenges and proposed possible solutions

Challenge	Possible Solutions
Technology Perspective	<ul style="list-style-type: none"> • Increasing of storage capacity and utilizing the available storage like cloud storage for storage and processing of big data. • Implementing security issues policy issues, legislation and regulation . • Using the effective data management tools to analyze structure, unstructure, and simi-structure data from several sources. • Providing and integrating efficient resource of big data.
People Perspective	<ul style="list-style-type: none"> • Improving the skills of available Human capital in big data like data analysis ,big data security and import the expert that can support the implementation of big data . • Implementing a national initiative that support collaboration between big data and e-government . • Increasing awareness about big data and the impact in e-government . • Enabling the citizens to be more creative and express themselves effectively the social networks.
Business Process Perspective	<ul style="list-style-type: none"> • Draw an effective strategy that support the road map to implementing big data in e-government . • Establish public and private partnership . • Create a network between community and government under the umbrella of big data . • Formulate an effective strategies and road map that leads to a big data environment. • Leadership should motivate, involve, influence and support implementing big data in e-government . • Integrate a valued big data in e-government to decision making processes . • Empower the role of e-Leadership and Information management in formulate the strategical plan and Decisions.

VII. BIG DATA BENCHMARKING REQUIREMENTS

In this section, the requirements of the big data benchmarking are discussed as below [30, 32] :

1. A Measuring and analyzing big data methods and design. First of all, the idea of big data benchmarks is to estimate, assess, and compare big data methods and architecture in terms of user attention, e.g., production, energy efficiency, and cost effectiveness. Regarding the broad use samples of big data systems, for the sake of truth, a big data benchmark wing candidate need cover not only general application situations but also different and representative real datasets [30, 32].
2. Being data-centric. Big data are defined in four dimensions named "4V" [32]. Size means big data systems require to be able to control a large size of data, e.g., PB. Variety leads to the capacity of processing data of various types, e.g., unstructured, semi-structured, structured data, and various sources, e.g., text and graph data. Velocity relates to the capacity to deal with regularly or irregularly renewed data. Additionally, a fourth V "veracity" is appended by IBM data scientists. Veracity involves the possibility of data, indicating that raw data attributes must be processed in processing big data [8,30].
3. Diverse workloads. The fast development of data size and type makes a big data applications frequently different, and innovative utilization domains are continuously developing. Big data workloads taken in the benchmark data set should reflect the variety of application situations, and include workloads of various types so that the systems and construction researchers could get the general workload characteristics of big data, which presents useful leadership for the configuration and optimization of the system [30, 31].
4. Covering illustrative software stacks. It is developed for particular user interests. For examples, for online assistance or service, being latency-sensitivity is of essential importance. The control of software stacks to big data workloads should not be ignored, so including representative software stacks is a great requirement for both architecture and systems research [32].
5. State-of-the-art methods. In big data demands, workloads change usually, while the rapid evolution of big data makes great possibilities for emerging methods, and a big data benchmark dataset candidate should remain in pace with the developments of the underlying application. Thus,

big data benchmark datasets candidate include developing methods in various domains. In addition, it must be extensible for future developments [30, 32].

6. Usability. The complexity of big data operations in terms of application, datasets, workloads, and software keeps ordinary users in order to easily using big data benchmarks datasets. Thus, its usability is of vast significance, require that the benchmarks dataset should be simple to configure, deploy, and manage, and the effectiveness and performance of the data should be easy to achieve [30, 32].

VIII. CONCLUSION

The concepts behind the big data allow the governments, organizations, and citizens to achieve a variety of aims and objectives in a special way. The investment in e-government to enhance the services delivery of the public sector and engaging with internal and external entities will enhance the public service transparency, collaboration, e-participation, and efficiency. The massive amount of available data right now has difficulties to hand and analyze in the organization. One of the main challenges that faced these governments is the implementation of the big data. Nevertheless, the governments need to make an effective plan and strategies before taking initiatives and adopt projects to build a big data analytic and ensure that the investment of the projects is worth (profit) to the nation. This paper aimed to show the definition of big data and e-government and analyzes the initiatives of the big data in the government in many situations including the Big data features, Big data challenges, Big data initiatives, Big data and e-government issues .Moreover, this paper combined information about initiatives and more published research works in the area of the Big Data and e-government to lead researchers to find some comprehensive information, which helps to extend further in that area. Also, this paper proposed a possible solution for challenges that facing e-government through implementing of big data. In addition, this paper offered benchmarking requirements which aimed to facilitate Big Data initiatives in e-government.

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