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From Data Warehouse To Big Data: E-Government Initiatives

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***Abstract*— Indeed, Big Data offers new opportunities for discovery, value creation, and rich business intelligence for decision support in any organization, whether private or public. Comparatively with Big Data, data warehouse has experienced a number of problems, including; slow time to build, lack of agility as well as inability to effectively integrate disparate systems. Therefore, many recent studies suggested that big data can replace the data warehouse in the public or private sector. In the similar vein, most of the countries are steadily moving towards digitizing most of the government departments, scheme and services in Federal, State and Local levels. Due to increase digital literacy of the citizens and availability of data intensive network access that is emerging, the need for use of electronic government initiatives is one of the increase. Interestingly, gathering and processing of the vast amount of data is not new to humanity. The new is related to process a complex data and extracting actionable business intelligence or big insight from data. All these characteristics are considered as a nature of big data for cleansing and organizing unstructured data through new technologies (such as Hadoop). In this paper, the researchers seek to review the buzzwords related to the using Information and communication technologies (ICTs) in public sector, namely; electronic government (or e-government), data warehouse and big data.**

Keywords—Big data, Data warehouse, E-government, Review study

I. INTRODUCTION

The waves of e-government are rising through public sector across the world. More and more governments are using information and communication technology, especially Internet or web-based network, to provide services between government agencies and citizens, businesses, employees and other nongovernmental agencies (Mbatha & Lesame, 2013). Indeed, partially if not wholly the existing e-government initiatives were built based on the data warehouse technologies (Oracle, 2014). With massive amounts of the data and variety of sorts (structured and unstructured data), the current e-government applications experienced a several of the challenges pertaining to the unstructured data. Especially, when included the modern technologies such as social media in the e-government initiatives to enhance the transparency and enhance the engagement between the government and citizens.

On the other hand, Kim, Trimi and Chung (2014) referred that, although the business sector is leading big-data-application development, the public sector has begun to derive insight to help support decision making in real time from fast-growing in-motion data from multiple sources, including the Web, biological and industrial sensors, video, email, and social communications. Indeed, several scholars and reports suggested that, the governments around the world can use big data to help them serve their citizens and overcome national challenges (such as rising health care costs, job creation, natural disasters, and terrorism). These arguments supported by Woodside, Amiri and Boldrin (2015), who says that, Big data will help enhance the use of e-government along with the use of several other technologies. Furthermore, Chen and Hsieh, (2014) stated that, in the current development of the technologies and complex of the sources the big data will be more suitable in the public sector and also improved personalization of e-government services. Therefore, governments across the world (such as U.S. government) has recognized the importance of big data by promoting research on core techniques and technologies for advancing big data science and engineering. This paper will review the exist literature of the e-government initiatives and its related to the data warehouse and big data technology. This paper will be divided into four key sections, in the first section will discuss on the data warehouse and using in the public sector. Second section the big data and its applications will be discussed. In the third section, e-government initiatives and its types will be highlighted. Finally, these three buzzwords will be discussed in more details with the most popular studies pertaining to the e-government and two technologies (Data warehouse and big data).

II. DATA WAREHOUSE

The concept of the data warehouse (DW) is based on two main ideas - the integration of separated detailed data within a single storage and separation of data sets and applications used for operative processing and applied to solve problems of analysis. This section discussed all the elements related to data warehouse and also summarize the previous study related to this phenomenon.

A. Definition of Data Warehouse

Data Warehouse is most widely used for data analysis which supports the management's decision making process (Nagar & Chandwani, 2014). A data warehouse is a place where data is stored for archival, analysis and security purpose. According to Bondarev and Zakirov (2015) data warehouse is a subject oriented, enterprise informational database specifically designed and intended for the analysis of business processes in the organization in order to support decision-making. As well as, Khachane (2013, p.1) defined data warehouse as "an architectural construct of an information system that provides users with current and historical decision support information that is hard to access or present in traditional operational systems." Moreover, Vogel et al, (2014) stated that, a data warehouse is a type of database that contains data that is uploaded from operational business systems primarily for reporting purposes. In addition, Bondarev and Zakirov (2015) and Hu (2010) stated that, there are four main features for the data warehouse, these features are:

- ***Subject-Oriented*:** Data warehouses are designed to help you analyse data.
- ***Integrated:*** Integration is closely related to subject orientation. Data warehouses must put data from disparate sources into a consistent format. They must resolve such problems as naming conflicts and inconsistencies among units of measure.
- ***Non-volatile:*** It means that, once entered into the warehouse, data should not change.
- ***Time Variant:*** In order to discover trends in business, analysts need large amounts of data.

Additionally, there are several scholars conducted the empirical or theoretical studies discussed the concept of data warehouse with public sector, especially e-government. According to Agarwal, Singh and Pandey (2010) data warehouse is an essential component of the e-Governance initiative. Table I summarizes of the previous works on data warehouse and e-governance.

TABLE I. SUMMARIZES PREVIOUS STUDIES RELATED TO DATA WAREHOUSE AND E-GOVERNMENT

Author (S)	*Year*	*Area*	*Country*	*Theoretical / Practical*	*Summary*
Liu and Li	2009	Personalized information service, travelling	China	Theoretical	This study sought to design Conceptual data warehouse By using star schema
Gouider and Farhat	2010	National Social Security Fund	Tunisia	Practical	In this empirical study, the researchers designed data warehouse and implemented by using star Schema
ElFangary	2011	Education	Egypt	Practical	Practical implementation of data warehouse and knowledge discovered using Classification and Clustering
Agarwal, Singh and Pandey	2010	Agriculture	India	Practical	Conceptual discussion regarding data warehouse and practical implementation of clustering
Bhanti, Kaushal and Pandey	2011	Education	India	Theoretical	Conceptual discussion of data warehouse design using Star schema and data mining
Suresh and Mahale	2011	Education	India	Theoretical	Conceptual data warehouse design using Star schema
Rivera-Vázquez, Gurabo and Ortiz-Fournier	2011	Criminal Information, Police department	Puerto Rico	Theoretical	Conceptual discussion regarding data warehouse
Subrahmanyam and Doja	2011	Data Mart approach	India	Practical	Conceptual design of centralized data warehouse and practical implementation data warehouse implementation of Andhra Pradesh state
Mohammed, Hasson, Shawkat and Al-khafaji,	2012	Education	Iraq	Theoretical	This study sought to create an architecture that uses data warehouse platform to integrate the universities' databases in one common warehouse with e-government technology

B. Architecture of Data Warehouse

A data warehouse acts as a centralized repository of an organization's data. Moreover, data warehouse provides the base for the powerful data analysis techniques such as data mining. Making use such these techniques along with data

warehouse can result in easier access to the information the user need for more informed decision making. With regard to Data warehouse architecture, it is inclusive of all reporting requirements, data management, security requirements, band width requirements, and storage requirements. Based on Khachane (2013) and Lane, Schupmann and Stuart (2005) there are three common types of data architecture which are as follows:

1) Data Warehouse Architecture: Basic

In this kind of the data warehouse, the end users directly access data derived from several sources systems through the data warehouse. Fig 1 illustrates a simple architecture for a data warehouse.

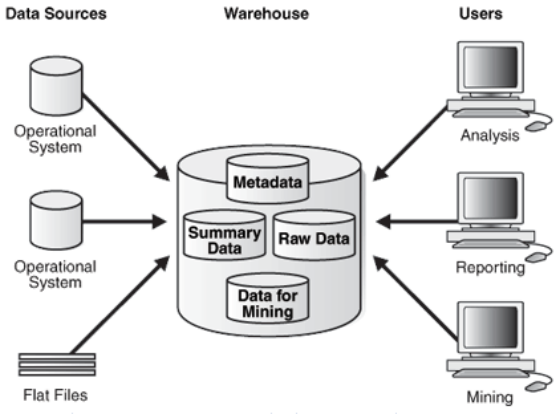

Fig. 1. Architecture of a Data Warehouse

2) Data Warehouse Architecture: With Staging Area

In case the organization or the company need to clean and process the operational data before putting it into the warehouse. This organization can do such this process programmatically, although most data warehouses use a staging area instead. In fact, a staging area simplifies building summaries and general warehouse management. Fig 2 below shows the elements of such type of data warehouse architecture.

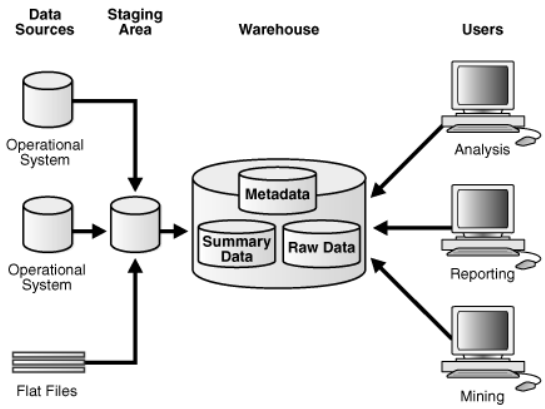

Fig. 2. Architecture of a Data Warehouse with a Staging Area

3) Data Warehouse Architecture: With A Staging Area and Data Marts

In case the organization want to customize their warehouse's architecture for different groups within organization. This organization or company can do this by adding data marts, which are designed for a particular line of business. For instance, separated the purchasing, sales and inventories. Therefore, a financial analyst can to analyze historical data for purchases and sales.

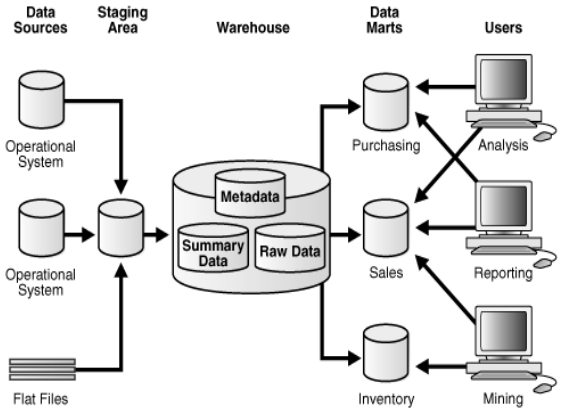

Fig. 3. Architecture of a Data Warehouse with a Staging Area and Data Marts

C. Building of data warehouse

According to Inmon (2007) building a data warehouse is only extracting the operational data and entering it into the data warehouse, which sounds simple. Nevertheless, creating a data warehouse is more than that. Generally, there are our steps of building data warehouse (Hu, 2010) as depicted in the Fig 4 below.

Fig. 4. Steps of building data warehouse

1) Data Collection: Before start to build data warehouse, must identify the data source. The organization need to figure out what are the data that required to be put into their data warehouse. Indeed, the data inside the warehouse usually come from a number of source systems. Most of the data have been stored originally in transactional databases. External data may be stored in spreadsheets or personal databases. In some cases, source data may be collected automatically. If new data are required, a suitable system may need to be built to collect them. Otherwise, only minor changes should be needed to existing systems. In all cases, the owners of source data are responsible for maintaining quality, and this may require substantial effort.

2) Transformation and cleansing: This step is considered as a most time consuming part where the organization need to

grab the data from various data source and store it into the staging database. In this process, data are usually restructured to optimize subsequent use for querying, reporting and analysis. This is often done in stages, in a data staging area. These data feeds need to be run on a regular basis to keep the data warehouse up-to-date. Generally, task of this stage is very hard and time-consuming, and usually can be done with the help of ETL tools.

3) Aggregation and analysis: Selected data are taken from the central warehouse using query tools and processed to produce useful results. Often, the most frequently accessed data are first summarized and stored in data marts to improve response times. Additional performance measures are typically derived at the same time. Analytic applications may also be developed to help users get useful information.

4) Presentation: It is displaying results for end users, usually in the form of reports. Several different report types are normally needed to suit different types of user. The results might appear as text, tables or charts and could be viewed on-line, printed, published on a web server or distributed by email.

D. Tools of data warehouse

Most of the previous studies stated that, developing data warehouse is very complex and time-consuming task. Therefore, to build data warehouse have many tools can help developer to build it. According to the purpose, data warehouse tools can be divided into ETL tools, OLAP tools, report tools, data mining tools, and database management systems (DBMS). Fig 5 categorized these tools and the techniques used with it.

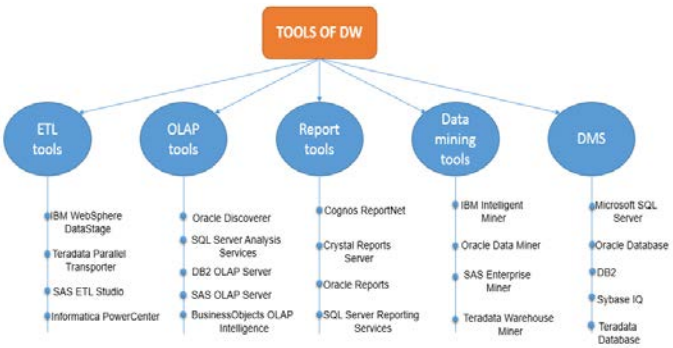

Fig. 5. DW tools

III. Big Data

The promises and potential of Big Data in transforming digital government services, governments, and the interaction between governments, citizens, and the business sector, are substantial (Bertot & Choi, 2013). Therefore, in this section the chief elements of the big data have been discussed, such as its characteristics and tools. In generally, big data is data that exceeds the processing capacity of conventional database systems. The data is too big, moves too fast, or doesn't fit the structures of companies or organizations database architectures (Dumbill, 2013). To gain value from this data, the certain companies or organizations-owner must choose an alternative way to process it (Özdemir, 2013). In turn, Batty (2013) referred big data as "any data that cannot fit into an Excel spreadsheet"

A. Big Data Characteristics

Big data recently is becoming the new power to promote the social innovation in the 21st century, due its characteristics. According to Kune et al. (2016) Big Data is characterized into four dimensions called 4V's; Volume, Velocity, Variety, Veracity as depicted in Figure 6.

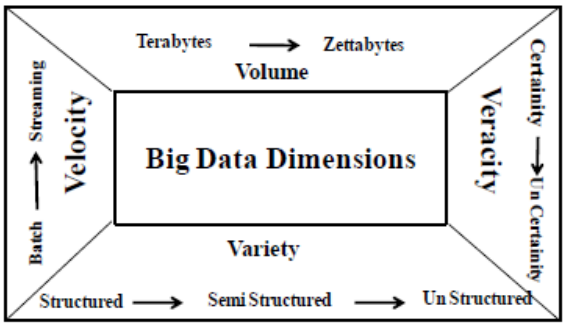

Fig. 6. 4'V for Big Data

1) Volume: is concerned about scale of data i.e. the volume of the data at which it is growing. According to Gantz and Reinsel (2012) stated that, the volume of data will reach to 40 Zeta bytes by 2020 and increase of 400 times by now. The volume of data is growing rapidly, due to several applications of business, social, web and scientific explorations.

2) Velocity: The speed at which data is increasing thus demanding analysis of streaming data (Demchenko et al, 2013). The velocity is due to growing speed of business intelligence applications such as trading, transaction of telecom and banking domain, growing number of internet connections with the increased usage of internet, growing number of sensor networks and wearable sensors.

3) Variety: It depicts different forms of data to use for analysis such as structured like relational databases, semi structured like XML and unstructured like video, text (Kune et al., 2016).

4) Veracity: It is concerned with uncertainty or inaccuracy of the data (Kune et al., 2016). In many cases the data will be inaccurate hence filtering and selecting the data which is actually needed is really a cumbersome activity.

B. Big Data Tools

In order to make sense of big data, the organizations need to select proper tools or technologies for this purpose. In the Table II described the popular tools used for analyzing big data.

TABLE II. MOST POPULAR BIG DATA TOOLS

Tool	Description
BigQuery	Enables users to run SQL-like queries against very large datasets, with potentially billions of rows. This can be your own data, or data that someone else has shared for you. BigQuery works best for interactive analysis of very large datasets, typically using a small number of very large, append-only tables
BigTable	BigTable is designed to scale into the petabyte range across "hundreds or thousands of machines, and to make it easy to add more machines [to] the system and automatically start taking advantage of those resources without any reconfiguration."
Dremel	A scalable, interactive ad-hoc query system for analysis of read-only nested data. By combining multi-level execution trees and columnar data layout, it is capable of running aggregation queries over trillion-row tables in seconds. The system scales to thousands of CPUs and petabytes of data, and has thousands of users at Google.
MapReduce.	MapRe-duce served as the initial foundation for Hadoop

C. Big Data Architecture

Building a big data architecture is more complicated than setting up a data warehouse to support business intelligence applications. According to Ramesh (2015) big data architecture is an architecture that provides the framework for reasoning with all forms of data.

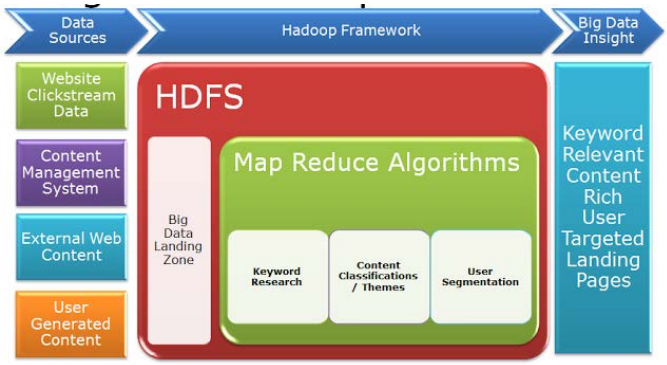

Fig. 7. Architacher of the big data (private sector)

Big data architecture is highly distributed, with the scale of thousands data and processing nodes. Chauchan (2013) stated that, Big data architecture is generally highly resilient and fault tolerant because the data is horizontally partitioned, replicated and distributed among multiple data nodes available.

IV. E-GOVERNMENT APPLICATIONS

At present, the development of information network technology makes government-owned, production, use and transfer of information have undergone profound changes, and office automation needs of all levels of government are constantly upgraded (Tao & Yu, 2014). Original variety of office automation systems are becoming increasingly difficult to meet the high standards of the Internet age government offices, which are on government management, decision-making and service functions of a higher requirement. E-government is a government application of modern information and communication technologies and services will be managed through the network technology integration, restructuring of government organizations to optimize the structure and work processes on the Internet, beyond the limitations of time and space and between departments, for the community to provide quality and comprehensive, standardized and transparent, in line with international standards of management and services.

A. Government to Government

This model refers to the services which are shared between the governments. There is lots of information that need to be shared between various government agencies, department and organizations. These types of services or information are as:

- Sharing of information between police department of various state.
- Government document exchange which includes preparation, approval, distribution, and storage of all governmental documents is also done through e-governance.
- Most of the finance and budget work are also done through e-governance.

B. Government to Businesses

Through this model, bond between private sector and government increase and businessmen use to communicate. They share information through this model like:

- Collection of taxes.
- Rejection and approval of patent is also done by this model.
- Payment of all kind of bills and penalty.
- Sharing of all kind of information, rules and data.
- Complaints or any kind of dissatisfaction can be shown by this.

C. Government to Citizens

This model of e-governance refers to the government services which are shared by citizens. Here, citizens visit to the link of services that they want to use. This models strong the bond between government and its citizen. Type of services which are provided by this model includes:

- Payment of online bills such as electricity, water, telephone bills etc.
- Online registration of applications.
- Copies of land-record.
- Online filling of complaints.
- Availability of any kind of online information.

D. E-government decision-making system

As we discussed earlier, using the modern technology in the public sector can not only improve the efficiency and transparency of government departments can also use these technologies to collect large amounts of data, through the establishment of proper decision-making system. Tao and Yu (2014) designed decision model in e-government that provides a scientific basis for decision-making at all levels of government.

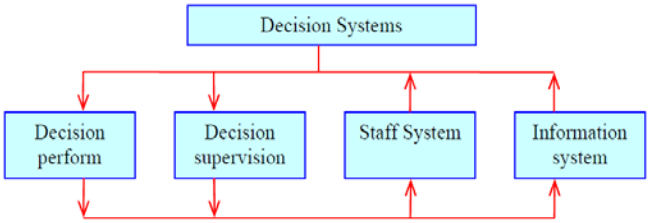

Fig. 8. Decision Making Model

Specific steps decision-making system is running: think-tank systems using information systems to provide information, to develop a variety of possible decision alternatives. Think-tank system provides a platform through the e-government system will be reported to the decision-making program decision-making system. The system to determine the optimal decision making program decisions based on the information generated by the information system and generate the necessary decision-making instructions. Decision-making system through e-government platform distributed decision-making command decisions under execution systems and surveillance systems. Under the supervision of the supervision system, the implementation of the decision-making system is responsible for the implementation of Decision Directive. Decision Directive implementation and results will be fed back to the think tank system through the information system. Think-tank system will provide feedback or decision to revise the program decision-making system based on specific circumstances. Decision-making system to identify new or amended programs for feedback, and issued execution. In short, the new technologies when use with e-government (such as Big Data) can help improve the speed and accuracy of decision-making and improve the overall efficiency of government agencies.

V. E-GOVERNMENT INITIATIVES BETWEEN DATA WAREHOUSE AND BIG DATA

In order to keep costs down, government agencies must reduce IT infrastructure costs, manage large volumes more efficiently and reduce the time it take to load, update and analyze data. Without a doubt, e-government initiatives can not only improve the efficiency and transparency of government departments can also use the system to collect large amounts of data, through the establishment of proper decision-making system and decision support model that provides a scientific basis for decision-making at all levels of government (Tao & Yu, 2014). Thus, e-governess produces a huge amount of data that need to be supported by a new type of e-Infrastructure capable to store, distribute and process (Kalbande, Deshpande & Popat, 2015).

Government agencies deal with enormous of data, therefore previously in order that such data put to an effective use in facilitating decision-making, a data warehouse is constructed over the historical data (Panwar & Deptt, 2008). It permits several types of queries requiring complex analysis on data to be addressed by decision-makers. According to literature, data warehouse concepts are adopted in many government sectors like healthcare, agriculture, education, social security fund, pollution control, electronic voting, rainfall prediction, customer complain, road traffic violation and crime control. However, there are considerable disadvantages when using data warehouse in the government sectors. For instance, data warehouse build can have high costs. In addition, data warehouse is usually not static and its maintenance costs are highly.

Indeed, recently, most government departments have been used the modern technologies to eliminate the boundaries and speed the processes pace. With increase in use of mobile devices, smart sensors and cloud computing, huge amounts of data are being generated. This ever expanding digital information needs more complex storage, processing, security and disposition features. With regard to the big data and e-government initiatives, Wang, Wang and Alexander (2015) stated that, big data as a new technology can help improve the speed and accuracy of decision-making and improve the overall efficiency of government agencies. In addition, according to Sanyal and Ranjan (2015), it is crucial for the government to exploit Big Data technology and analytics to help with good governance and shape its public policy. Therefore, governments has created initiatives to exploit big data in many disciplines, for instance science and engineering, healthcare, and national security (Chan, 2013). Big Data tools helps agencies for providing powerful predictive tools in a single, affordable end-to-end solution that is also fast and easy to use.

U.S. government was one of the pioneer government that sought to encourage the agencies to harness the new technology (Big Data) for managing, analyzing, visualizing and extracting information from large, diverse, distributed and heterogeneous data sets (Tene & Polonetsky, 2012). Thus, approximately $200 million was invested by many federal agencies in big data analytics to mine valuable information from the massive quantities of data that public agencies have collected (Krishnamurthy & Desouza, 2014). Moreover, to launch this initiative in the proper manner, six of federal agencies of the U.S. Federal government announced additional budget to improve big data tool and techniques (Wang et al,. 2015).

In the similar mode, The U.K. government was one of the earliest implementer EU countries of big-data programs, establishing the U.K. Horizon Scanning Centre (HSC) in 2004 to improve the government's ability to deal with cross-

departmental and multi-disciplinary challenges (Kim, Trimi & Chung, 2014). Based on the more recent report by House of Commons Science and Technology Committee (2016), apply big data tools will be created 58,000 new jobs over five years, and also will contribute 216 billion to the UK economy. Using the big data in the public sector in UK also will increase the operational efficiency and targeting of service delivery. More especially, Sanyal and Ranjan (2015) referred that, the UK is a world leader in big data research across many disciplines.

Moreover, the recent United Nation survey related to the e-government and big data, gave high marks to several Asian countries, notable South Korea, Singapore and Japan as well as Australian also ranked. These leaders have launched diverse initiatives on big data and deployed numerous projects. For Instance, South Korea launched big data in 2011 by the President's Council on National ICT Strategies, aims to converge knowledge and administrative analytics through big data (President's Council on National ICT Strategies, 2011).

In 2004, to address national security, infectious diseases, and other national concerns, the Singapore government launched the Risk Assessment and Horizon Scanning (RAHS) program within the National Security Coordination Centre. Collecting and analyzing large-scale datasets, it proactively manages national threats, including terrorist attacks, infectious diseases, and financial crises. (Habegger, 2010). The RAHS Experimentation Center (REC), which opened in 2007, focuses on new technological tools to support policy making for RAHS and enhance and maintain RAHS through systematic upgrades of the big-data infrastructure. A notable REC application is exploration of possible scenarios involving importation of avian influenza into Singapore and assessment of the threat of outbreaks occurring throughout Southeast Asia.

In fact, the private and public sector in Singapore recognizes the importance of big data in the information age (Brandon, 2013). Where, most of the companies exploited big data for identifying new sources of revenue and developing new products or services. Despite the benefits which bring by using big data, the organizations in Singapore faced several challenges such as, budget, security, and scarcity of talent to implement, lack of talent to run as well as difficulties to integrate with existing systems. However, Singapore government taken several steps to eliminate obstacles to implement the big data project correctly. It began training more data scientists in Singapore to take advantage of commercial and government datasets and Singapore has attracted foreign big data companies to step up in the country.

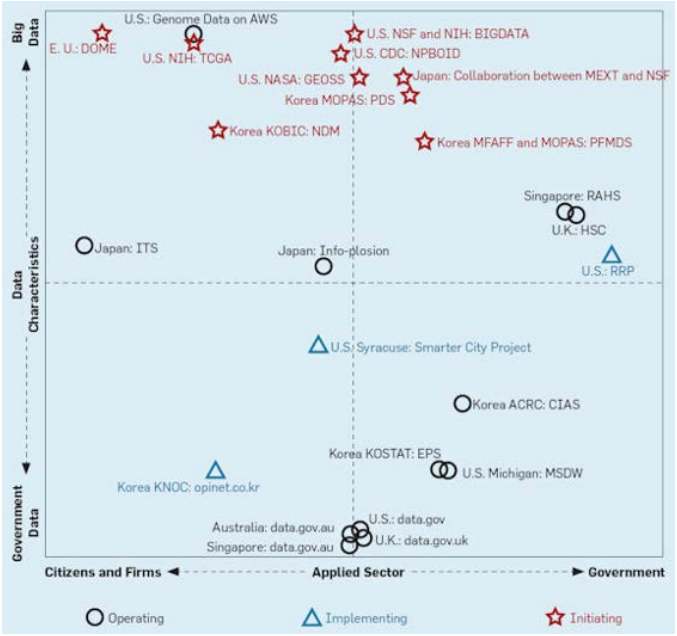

Fig. 9. Big data and public sector around the world

Fig 8 illustrates the comparing between the pioneer governments in big data and e-government fields. In the same context, the Australian Government Information Management Office (AGIMO) provides public access to government data through the Government 2.0 program, which runs the http://data.gov.au/ website to support repository and search tools for government big data. The government expects to save time and resources by using automated tools that let users search, analyze, and reuse enormous amounts of data. In the same vein, The Japanese government has initiated several programs to use accumulated large-scale data. From 2005 to 2011, the Ministry of Education, Sports, Culture, Science, and Technology (MEXT), in association with universities and research institutes, operated the New IT Infrastructure for the Information-explosion Era project (the so-called Info-plosion). Since 2011, the government's top priority has been to address the consequences of the Fukushima earthquake, tsunami, and nuclear-power-plant disaster and the reconstruction and rehabilitation of affected areas, as well as relief of related social and economic consequences. MEXT has been collaborating with the country's National Science Foundation to enhance research and leverage big-data technologies for preventing, mitigating, and managing natural disasters

Moreover, the several scholars referred that, big data allows governments to improve public sector administration and assists global organizations in analyzing information to devise strategic planning (such as Lu, 2014). Although the business sector is leading big-data-application development, the public sector as discussed earlier has begun to derive insight to help support decision making in real time from fast-growing in-motion data from multiple sources, including the Web, biological and industrial sensors, video, email, and social communications.

VI. Future Research Directions

The future research will include more explanation on the big data tools and their components and who exploited in the public sector will improve the decision making for government agencies. Furthermore, focus on the e-commerce and big data technologies must also not neglected and need more research on this area whether practical or theoretical.

VII. Conclusion

The recent advancements in the general ICT and big data technologies facilitate the paradigm change in modern e-governess. Big Data was used as a powerful tool to address various societal ills, offering the potential of new insights into areas as diverse as cancer research, terrorism, and climate change. Leveraging Big Data can enable breakthroughs in e-government initiatives, where, like the many industries using Big Data to identify opportunities for innovation, governments are able to act on the best available information. Thus, several governments encourage their agencies to exploit the benefits of using big data tools to extract the valuable information from massive quantities of data that public agencies have collected. Using big data in the public sector will improve decision-making in critical development areas such as healthcare, employment, economic productivity, crime and security, and natural disaster and resource management. With important of this new technology (known a big data), few studies review related of this phenomena with e-government and how using big data will enhance the decision-making of the government in the critical conditions. Modern technologies such as big data analytics, social media and mobile will help the governments to achieve their goals. The literature also asserted that, based on the advancement that witness of the ICT now, the current systems need fundamentally change, such as healthcare systems.

In general, this paper discusses the big data as a new buzzword and related to e-government initiative. In addition, the present study highlighted the different between data warehouse and big data and why the big data is consider as a best decision for governments around the world.

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