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The Impact of Intention of Use on the Success of Big Data Adoption via Organization Readiness Factor

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ABSTRACT: *Big data is one of the most contemporary issues. It is innovative processing solutions for a variety of new and existing data to provide real business benefits. Unless it is tied to business goals and objectives, processing large volumes or wide varieties of data remains merely a technological solution. The intensive literature showed scarce research that have been conducted on the fields of Big Data adoption, intention to use and organization readiness. There is absence of comprehensive and integrated model for Big Data adoption. The aim of this research is to propose a framework of organizations' readiness to adopt Big Data. This framework will assist in the success adoption of big data based on the intention to use and infrastructure readiness. The framework is developed through a detailed review of past literature and expert inputs using UTAUT as a theoretical background. The findings can be used as a road map for future research in identifying the common factors of successful big data adoption*

Keywords: Big Data, Intention of Use, ICT Adoption, Organization Readiness

1. Introduction and Background

An accumulation of a vast amount of values and variables in one area is referred to as data that results in an increasing need for data storage. This rapid increase in data has called for development of applications/tools/large databases to retrieve and store valuable information (statistics) from the accumulated data. The datasets with large sizes or more complexity is called as Big Data (Julie and Kannan, 2011), which is often accumulated from a combination of sources and is unstructured (Patel et al., 2012). Stated as "*datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyze*", BIG data is highly affected by time (Maniyka et al., 2011). Ward and Barker (2013) accumulated many definitions of BIG Data. Few notable ones are as follows.

Author	Definitions
(Beyer, 2012)	*"Big data is high volume, high velocity, and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization"*
(Manyika, 2011)	"*Big Data refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze*"
(Gantz, 2011)	"*Big Data technologies describe a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high-velocity capture, discovery, and/or analysis*"

To meet the demand for growing volumes of data, the system of "Share Nothing" was introduced (DeWitt and Gray, 2011). The "Share nothing" system was based on parallel database system with the architecture comprising of individual processors and storage on disk. Amongst these was Teradata System, a very significant system introduced in 1986 for parallel database systems (Walter, 2009). Big Data, as identified by Gantz and Reinsel (2011), is a combination of architectures and innovative technologies designed to capture value and vital information from huge volumes of data in different variety, resulting in data analysis and high velocity capture. Contrasting between traditional and big data, authors Chen and Liu (2014) generated rate based on the volume identified, created structure and segregated data store, access and integration.

The Four Vs of BIG Data forming the dimensions of BIG Data according to IBM are Velocity, Volume, Variety and Veracity (Www-01.ibm.com, 2017).

- The first V is Volume designating the amount of data collected and stored.
- Second V is the variety designating the various forms of data collected through various channels or platforms.
- Third is the velocity designating the streaming data analysis including how many TB trade utilized, number of sensors found in newly developed cars, Etc.
- Last but not the least; the fourth V is Veracity designating the uncertainty of data.

Priya and Chandrakant (2014) highlighted the challenges faced by conventional methods to analyze or store data due to the increased volume with datasets comprising of Tera and Peta bytes of data size. The grouping leads to increasing the size of the data gigantically. The accumulation of data emerges as unstructured, sorted or semi-structured. There are various channels of data collection along with different formats such as video, audio, and logs to name a few.

According to a prediction by IDC – International Data Corporation, the data volume 2005- 2020, will increase to 40,000 Exabyte's from 130 Exabyte's (Gantz & Reinsel, 2012). The proposed solutions by Jaseena and David (2014) to deal with volume dimension of BIG data illustrate the use of BIG Data volume to mine the data within allotted time. Jaseena and David (2014) also proposed the exemption of the conventional methods to mine to save time. Some of the real-time application of BIG data, as identified by Richa et al. (2014), include electronic health records in healthcare, real time alerting during emergencies such as natural disasters, predictive anlaysis using a combination channels such as social networking, and telecommunications, to name a few.

2. Problem Statement

The measure of the data is growing exponentially across various industries globally. With this growth, there is a direct need to develop a system that allows assimilation as well as examination of the data for better decision making. Following Patel et al. (2012) research, it can be noted that there are diverse procedures for setting up the data covering aspects such as consolidation, isolation, naming, look up and access for both unstructured and structured data. Data has the capacity to change, from a couple of dozen terabytes to various petabytes of data. The main challenge is the management and examination of the broad measure of data to identify key trends for decision making (Hilbert and Lopex, 2011).

A point to note is that past research on BIG data has focused primarily on the technical attributes (such as machine learning or technical algorithms) and development of system (Kwon et al., 2015). However, not much research is found on how different factors effect BIG data adoption or the challenges encountered during implementation. In this research two factors will be examined: the Intention of use and the organization readiness in term of technology. **From the theoretical side**, there are many researches, which have been conducted on the fields of Big Data Adoption, intention of use and organization readiness, But there are a lack of research that examine the relationship between three areas of research and the Absence of clear model for exploring relationships between them. **From the empirical side,** based on the reviewing the statistical indexes in the International and National levels, there are no research which has been empirically conducted that exploit these variables empirically to improve the successful adoption of Big Data by government's organization at UAE.

This is due to the heterogeneous data available with some being incomplete as well as complex. In line with Jaseena and David (2014), BIG data being open to structured and unstructured variety of data brings in additional challenges which conventional database tools cannot handle, as conventional methods are restricted to structured data. Traditional database systems were designed to address smaller volumes of structured and consistent data whereas Big Data is geospatial data, 3D data, audio and video, and unstructured text, including log files and social media. This heterogeneity of unstructured data creates problems for storage, mining and analyzing the data.

3. The Objectives

With the growth in BIG data plays a significant role in decision-making and advancements in a particular field (whether structured or unstructured), key decision makers from top management in big organizations may not have a clear view on the impacts of BIG data, primarily due to lower exposure on the technical aspects involved. The motivation to choose BIG data adoption and implementation as the area of this research is the prominence of BIG Data in leading organizations in improved decision-making, supportively with an outlook for advancements. ***The objective of this research has been focusing on the proposing new model that assisting in*** the success in big data adoption based on the intention to use and infrastructure readiness. Following are two figures that shows the high rank of UAE for two indexes (UN-Development Index, Global Innovation Index 2014,2015,2016)

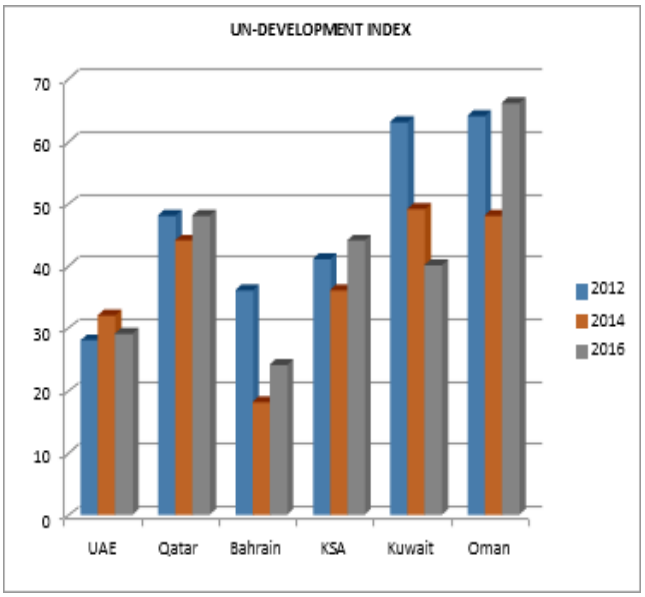

Figure1: GCC Development **Index**

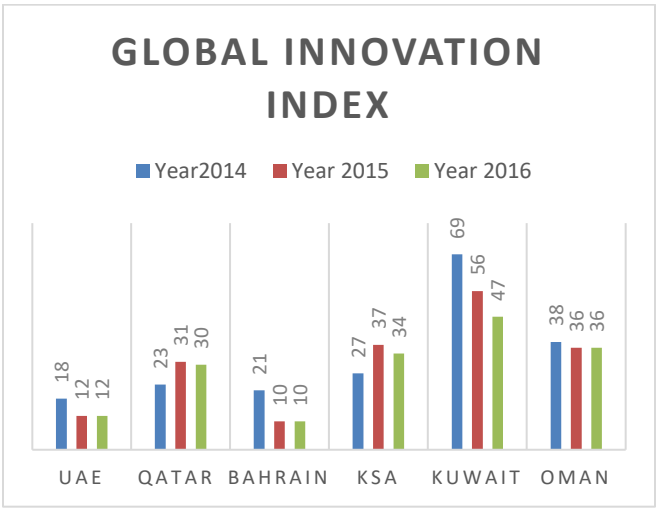

Figure2: GCC Innovation Index

4. Research Methodology

Descriptive analytics is a preliminary stage of data processing that creates a summary of historical data to yield useful information and possibly prepare the data for further analysis. Descriptive analytics is sometimes said to provide information about happened. In this research, the information was collected through written sources and references, which include books, periodicals, magazines, university researches and thesis documented researches, published or unpublished. For achieving the objectives of the research, descriptive method is used for collecting the real and detailed information on this subject, and then discussing the theoretical framework of the research topic and analyzing the findings of the previous studies. As well as the literature reviews that published in local and international websites through scientific researches, literary researches, media and journalistic researches, cultural researches and related research in order to achieve the search level in an appropriate theoretical framework with the research problem determining the quality of information that collected.

Research Category	***Description***
Data Acquisition	The accumulation of data arranged in a structured digital form for further processing and analysis is termed to be as data acquisition (Cuzzocrea, Song, & Davis, 2011). According to Chen and Liu (2014), data acquisition involves collection, transmission and pre-processing of data.
Data Storage	Big data storage key focus is to manage datasets, which are in large number by storing them for future use and analysis. Chen et al. (2014) essence the inclusion of storage and infrastructure as basic entities of data storage.
Programming Model	Chong and Shi (2015) highlighted the significance of MapReduce, Graph processing model, Stream processing model and MapReduce-related processing models for programming.
Big data analysis	The analysis of BIG data is mostly significant in combating missed opportunities and improving systems to perform better and achieve good results. Different analysis projected for BIG data including but not restricted to Descriptive, predictive and prescriptive analytics (Chong and Shi, 2015).
Benchmark	Chong and Shi (2015) concluded two benchmarks as in Component based or System based. According to Zhang et al. (2012), Sandholm and Lai (2009) and Gray[1], the benchmark focusing on scope, which is limited and involves component evaluation of systems for BIG data, is Component benchmark. Some benchmarks for Standard Performance includes - TeraSort (O'Malley, 2008) and (SPEC)'s Central Processing Unit (CPU) benchmark.
Application	Social, Business and Scientific applications are few applications areas of BIG data. The key applications of BIG data highlighted by Chen et al. (2014) are shown in Figure1.

Table 1: Research Categories of BIG data

4. The proposed model

BIG data is a term attributed to datasets that are found to be difficult to assess or analyze using traditional ICT applications as they are complex and large in nature. It is defined as enormous unstructured datasets produced by high performance applications (Cuzzocrea et al., 2011, Al-Maamari et al., 2017). For governments, the benefit from applying BIG Data is primarily to transform its decision-making capability derived from data. With the potential to revolutionize the decision making and management strategy, BIG data has the capacity to mold data into identifiable patterns and drive decision making that related directly to an increase in efficiency, productivity and effectiveness (Manyika et al., 2011). BIG data, originally BIG data analytics, has been the attention with the rapid evolution of the internet and online transactions (Tkacz and Kapczynski, 2009). In the public sector, data administration is found to be highly effected due to the lack of adequate data analytics solutions (Bryant, 2007). Amongst the different research categories concerning BIG data include accumulated data storage and data acquisition, programming model for BIG data, analysis for BIG data, Applications and Benchmark, as identified by Chong and Shi (2015). In this research, an overview of these categories is presented with a critical discussion (shared in Table 2).

Past researches on BIG data reviewed different aspects with few studies revolving on the scope, benefits and challenges of applying BIG data (Sagiroglu and Sinanc, 2013; Borkar, Carey and Li, 2012, Abdulrab et al., 2017) and adoption and implementation of BIG data (Power, 2014; Ebner et al., 2014). Garlasu et al. (2013) highlighted computing through grid as the most powerful means for storage purpose and high processing power. The analytics of big data helps uncover hidden patterns and vital information (Mukherjee et al., 2012). In this paper, the problem of applying appropriate analysis and evaluation techniques or strategies to data collected is reviewed, and focuses on which one would be better to be adopted for the organization.

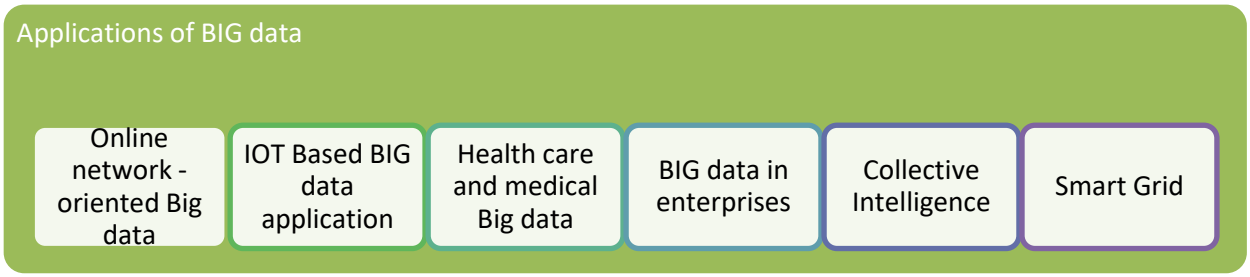

Figure 3: BIG Data Application: Source: Chen et al., 2014

Most importantly, according to Simone et al. (2012), Big Data evolution has led to emergence of different approaches to encapsulate and stock data with the ease of different storage equipment or databases with different mechanisms. Cho and Garcia (2002) illustrated about an online web crawler storing web pages, utilized by search engines for various downloading purposes. As highlighted by Philip (2011), analysis of data plays a vital role in leading companies to uncover hidden information and gain advantage of the market conditions (Gazem, Rahman, & Saeed, 2016)

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In support, Sharma and Navdeti (2014) captured challenges of BIG data concerning security and privacy highlighting four key areas whereas an unauthorized user: Gains access privileges and may submit a job to a queue or delete or change priority of the job, Eavesdrop/sniff to data packets being sent to client, Accesses files and could execute arbitrary code or carry out further attacks, and read/write a data block of a file.

In BIG data, there are six core research areas as shared in the figure 2. The table 3 presents an overview of the research areas and the challenges identified in these areas:

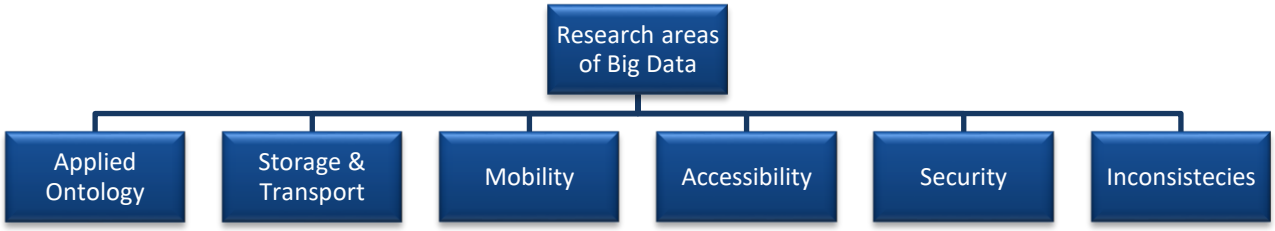


Figure4: Research areas in BIG data

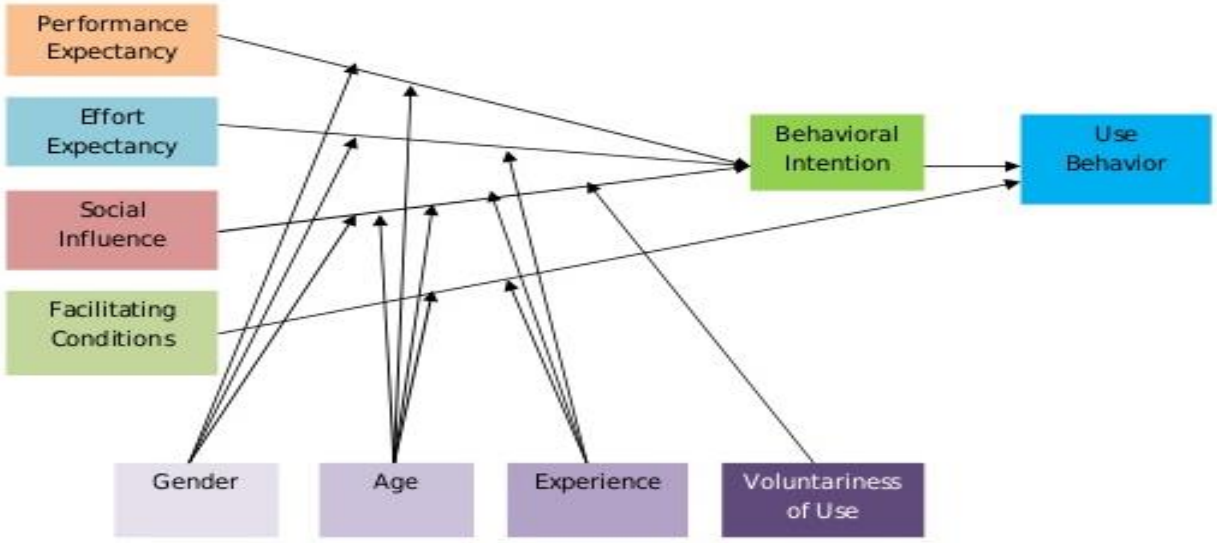
Research Areas	Focus	Challenges	Sources
Applied Ontology	It entails application of ontological resources associating actions of a person in the target world.	It includes challenges such as scalability and performance issues when web semantics and big data are combined.	(Beyer et al., 2012 ; Chong and Shi, 2015 ; Ebner et al., 2014)
Storage and Transport	There are different ways to handle data in BIG data from different streams/industries	The challenge in this research area is the limited space technology per disk. This demands a revolutionary upgrade in data storage	(Kaisler et al., 2013; Elragal and Haddara, 2014; Gantz and Reinsel, 2012)
Mobility	Technology firms are increasing investment in apps that support mobile devices. This includes mobile and spatial computing technologies that rely on location based dataset, and mobile app data.	With the huge influx of data from mobile users (especially through traditional routing services) raise the challenge of increased computable costs and data storage from mobile devices impacting the limited bandwidth of mobile stations.	(Hey and Trefethen, 2002; Jaseena and David, 2014)
Accessibility	With growth in technology, new algorithms are developed to handle data analytics.	For high dimensional data, existing algorithms may not respond well over time, and may lead to lower consistency.	(Jaseena and David, 2014; Mukherjee et al., 2012) (Mohammed et al., 2017)
Security	There are various processes in Big data such as Staging, Pre-processing, Processing, storage of Meta data & long term/short term storage of factual data.	With a huge increase in data volume, the issue of safety and privacy protection in transaction rises.	(Tasevski, 2011; Chen et al., 2014)
Inconsistencies	Big data is networked with various spaces and technical dimensions, and has a direct/indirect impact on the society.	Big data is related to different industries, and in such scenarios, inconsistencies arise at three levels: data, knowledge and information.	(Zhang, 2013; Kamaldeep et al., 2014)

Amongst technical challenges, BIG data may always face a threat of outdated technology with the outdated technology or systems. Systems, that are capable to handle 100% of the data volume today, may not be able to contain even 50% of the data after few years leading to failure handling error. The data types of BIG data being unstructured, semi structured or linked, may arise heterogeneity challenge as it is difficult to link data from one form to other. Maintaining quality of the data is also a core challenge as large firms such as in the IT may find it difficult to make informed decisions if the quality of the data is poor.

5. Theories based of the Proposed Model

The conceptual framework is developed through a detailed review of past literature and expert inputs. There are many frameworks that explain the acceptance of technology, like the Technology Acceptance Model (TAM), Unified theory of acceptance and use of technology (UTAUT) and others.

The research will use the UTAUT model which was developed and Formulated by Venkatesh and other on 2003. The UTAUT aims to explain user intentions to use an information system and subsequent usage behavior. This model has four determinants shown in the figure below.



The UTAUT model has been used for many studies like internet banking, mobile commerce and other. It has been cited intensively more than 16581 times. The model proposed for researching the three variables under consideration is shown below where the organization readiness (technology) will act as a mediator factor.

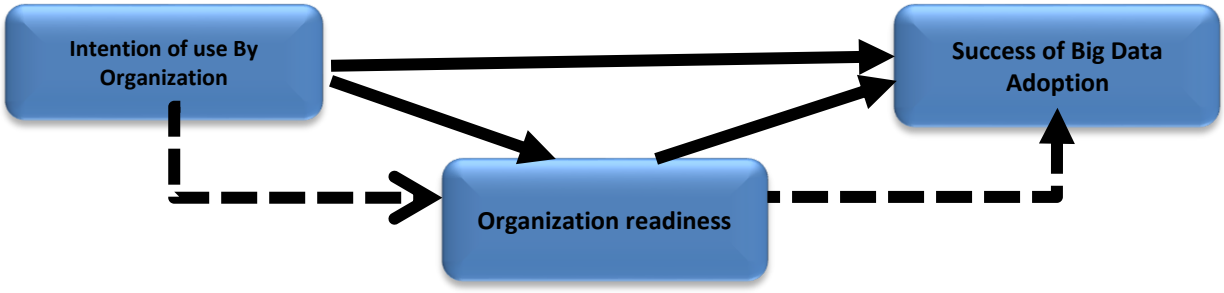


Figure 5: Proposed Conceptual framework

6. The proposed hypotheses of the research:

The hypotheses of the research are:

H1: There is a significant impact of intention of use on the success of big data adoption.

H2: There is a significant impact of organization readiness on success of big data adoption.

H3: There is a significant impact of intention of use on the organization readiness.

H4: There is a significant impact of intention of use and the success of big data adoption through organization readiness as mediator Factor.

7. Conclusion and Recombination

Research so far focused on BIG data analytics with negligible research on BIG data adoption and factors that might affect the successful adoption. With this research, this underlying area will be examined with inputs from the government's organization at United Arab Emirates (UAE) leading to better adoption of the BIG data. Based on the intensive literature review and the sharp increasing on importance of big data in the world, it was important to carry out many studies to fill cognitive gaps through conducting to cover selected set of governments and local authorities. It vital to doing scientific research to provide a comprehensive picture illustrating the key ideas from the specialists in the context of BIG data, leading to development of a framework for BIG data strategy adoption. The model be later used in reference by firms outside of UAE for subsequent development through enhance BIG data adoption and implementation. The research is aiming to bring about a positive change with more clear focus and directions facilitating adoption of BIG data, the framework will guide firms to achieve improved decision making. These future research it could assisting in identifying **the underlying common factors** of successful big data adoption, Intention of use, and organization readiness and a propose a suitable model that assist in the success big data adoption based on the intention to use and infrastructure readiness.

References

Abdulrab, M., Zumrah, A. R., Almaamari, Q. & Altahitah, A. 2017. The Role of Psychological Empowerment on Work Engagement: The Development of Conceptual Framework. *International Journal of Business Management and Economic Research*, 8**,** 1157-1163.

Al-Maamari, Q. A., Abdulrab, M., Al-Jamrh, B. A. & Al-Harasi, A. H. 2017. The Relationship between Total Quality Management Practices and Individual Readiness for Change at Petroleum Exploration and Production Authority in Yemen. International Journal of Business and Industrial Marketing, 6, 48-55

Beyer, M.A. & Laney, D. (2012). The importance of big data: a definition. Stamford, CT: Gartner, pp.2014-2018.

Bifet, A. (2013). Mining Big Data in Real Time. Informatica (Slovenia), 37(1), 15-20.

Borkar, V., Carey, M. J., & Li, C. (2012). Inside Big Data management: ogres, onions, or parfaits? In Proceedings of the 15th International Conference on Extending Database Technology (pp. 3–14). ACM.

Bryant, R.E. (2007). Data-intensive supercomputing: The case for DISC. Online available at: http://repository.cmu.edu/compsci/258/ (Retrieved on 21st September 2015)

Chen, M., Mao, S. & Liu, Y. (2014). Big data: A survey. Mobile Networks and Applications, 19(2), 171-209.

Cho, J., & Garcia-Molina, H. (2002). Parallel crawlers. In: Proceedings of the 11th international conference on World Wide Web. ACM, pp 124–135

Chong, D., & Shi, H. (2015). Big data analytics: a literature review. Journal of Management Analytics, 2(3), 175-201.

Cuzzocrea, A., Song, I.-Y., & Davis, K. C. (2011). Analytics over large-scale multidimensional data: The big data revolution! In Song, I. Y. (ed.), In Proceedings of the ACM 14th international workshop on data warehousing and OLAP (pp. 101–104). New York, NY, USA: ACM.

David, J.M., & Balakrishnan, K. (2013). Performance improvement of fuzzy and neuro fuzzy systems: prediction of learning disabilities in school-age children. International Journal of Intelligent Systems and Applications, 5(12), 34-52.

DeWitt, D., & Gray, J. (1992). Parallel database systems: the future of high performance database systems. Communications of the ACM, 35(6), 85-98.

Ebner, K., Buhnen, T., & Urbach, N. (2014). Think Big with Big Data: Identifying Suitable Big Data Strategies in Corporate Environments, in 2014 47th Hawaii International Conference on System Sciences, Los Alamitos, CA, USA, pp. 3748–3757.

Elragal, A., & Haddara, M. (2014). Big data analytics: A text mining-based literature analysis. Retrieved from http://ojs.bibsys.no/index.php/Nokobit/article/view/35.

Gantz, J., & Reinsel, D. (2012). The digital universe in 2020: Big data, bigger digital shadows, and biggest growth in the Far East. Framingham, MA: IDC.

Gantz, J. and Reinsel, D., (2011) Extracting value from Chaos, IDC Iview. (Available at http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for _innovation, accessed Feb 2017)

Garlasu, D., Sandulescu, V., Halcu, I., Neculoiu, G., Grigoriu, O., Marinescu, M. & Marinescu, V. (2013). January. A big data implementation based on Grid computing. In Roedunet International Conference (RoEduNet), 2013 11th (pp. 1-4). IEEE.

Gazem, N., Rahman, A. A., & Saeed, F. (2016). Factors that Facilitate Systematic Problems Solving Process in Small and Medium Enterprises. Indian Journal of Science and Technology, 9(34).

Gupta, R. (2014). Journey from data mining to Web Mining to Big Data. arXiv preprint arXiv:1404.4140.

Hey, T., & Trefethen, A.E. (2002). The UK e-science core programme and the grid. Future Generation Computer Systems, 18(8), 1017-1031.

Hilbert, M., & López, P. (2011). The world's technological capacity to store, communicate, and compute information. Science, 332(6025), 60-65.

Jaseena, K.U., & David, J.M. (2014). Issues, challenges, and solutions: big data mining. NeTCoM, CSIT, GRAPH-HOC, SPTM–2014, pp.131-140.

Kaisler, S., Armour, J. F., Espinosa, A., & Money, W. (2013). Big Data: Issues and Challenges Moving Forward, Proceedings of 46th Hawaii International Conference on System Sciences, IEEE, (pp. 995-1004 Year of Publication: ISBN: 978- 1-4673-5933-2.

Kamaldeep., S., et al. (2014). Big Data Analytics framework for Peer-to-Peer Botnet detection using Random Forests. Information Sciences, Elsevier. 278: 488-497.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. & Byers, A.H. (2011). Big data: The next frontier for innovation, competition, and productivity. Online available at: http://abesit.in/wp-content/uploads/2014/07/big-data-frontier.pdf, retrieved on February 2015).

Mohammed, F., Alzahrani, A. I., Alfarraj, O., & Ibrahim, O. (2017). Cloud Computing Fitness for E-Government Implementation: Importance-Performance Analysis. IEEE Access, PP(99), 1-1. doi:10.1109/ACCESS.2017.2778093.

Mukherjee, A., Datta, J., Jorapur, R., Singhvi, R., Haloi, S., & Akram, W. (2012). December. Shared disk big data analytics with apache hadoop. In High Performance computing (HiPC), 2012 19th international conference on (pp. 1-6). IEEE

O'Malley, O (2008). Terabyte sort on Apache Hadoop [online]. Yahoo, pp. 1–3. http://sortbenchmark.org/Yahoo-hadoop.pdf.

Oliveira, S.F., Fürlinger, K., & Kranzlmüller, D. (2012). June. Trends in computation, communication and storage and the consequences for data-intensive science. In High Performance Computing and Communication & 2012 IEEE 9th International Conference on Embedded Software and Systems (HPCC-ICESS), 2012 IEEE 14th International Conference on (pp. 572-579). IEEE.

Sharma, P.P., & Navdeti, C.P. (2014). Securing big data hadoop: a review of security issues, threats and solution. International Journal of Computer Science and Information Technologies, 5(2), 2126-2131.

Patel, A.B., Birla, M., & Nair, U. (2012). December. Addressing big data problem using Hadoop and Map Reduce. In Engineering (NUiCONE), 2012 Nirma University International Conference on (pp. 1-5). IEEE.

Philip, R. (2011). Big data analytics. In TDWI best practices report, fourth quarter. Retrieved fromhttp://public.dhe.ibm.com/common/ssi/ecm/en/accessed December 28, 2016.

Power, D. J. (2014). Using 'Big Data' for analytics and decision support. Journal of Decision Systems, 23(2), 222–228.

Priya P. Sharma, Chandrakant P. Navdeti, (2014), "Securing Big Data Hadoop: A Review of Security Issues, Threats and Solution", IJCSIT, 5(2), pp2126-2131.

Sagiroglu, S., & Sinanc, D. (2013). May. Big data: A review. In Collaboration Technologies and Systems (CTS), 2013 International Conference on (pp. 42-47). IEEE.

Sandholm, T., & Lai, K. (2009). MapReduce optimization using regulated dynamic prioritization. ACM SIGMETRICS Performance Evaluation Review, 37(1), 299-310.

Tasevski, P. (2011). Password attacks and generation strategies, Tartu University: Faculty of Mathematics and Computer. Online available at: http://courses.cs.ut.ee/2011/security-seminar-spring/uploads/Main/pedrag-slides.pdf (retrieved on 20th December 2016).

Walter, T. (2009). Teradata past, present and future. UCI ISG lecture series on scalable data management. Online available at: http://isg.ics.uci.edu/scalable_dm_lectures2009-10.html (retrieved on 12th August 2015).

Ward, J.S., & Barker, A. (2013). Undefined by data: a survey of big data definitions. arXiv preprint arXiv:1309.5821.

Www-01.ibm.com. (2017). IBM big data platform - Bringing big data to the Enterprise. [online] Available at: http://www-01.ibm.com/software/data/bigdata/ [Accessed 2 Feb. 2017].

Zhang, D. (2013). Inconsistencies in big data, Proceedings of the 12th IEEE International Conference on Cognitive Informatics, New York City, NY (Page: 61-67, ISBN: 978-1-4799-0781-6)

Zhang, J., Wang, F.Y., Wang, K., Lin, W.H., Xu, X., & Chen, C. (2011). Data-driven intelligent transportation systems: A survey. IEEE Transactions on Intelligent Transportation Systems, 12(4), 1624-1639.

Zhang, Z., Chourasia, L., Verma, A. & Loo, B.T. (2012). Automated profiling and resource management of pig programs for meeting service level objectives. In Proceedings of the 9th international conference on Autonomic computing (pp. 53-62). ACM.

Zikopoulos, P. & Eaton, C. (2011). Understanding big data: Analytics for enterprise class hadoop and streaming data. McGraw-Hill Osborne Media.