

A Conceptual Framework for Big Data Analytics Adoption Towards the Success of Industry 4.0

Nur Khairiah Muhammad^{1,*} Nor Hasni Osman¹, Nurul Azita Salleh¹

¹*School of Technology Management and Logistic, Universiti Utara Malaysia*

**Corresponding author. Email:nurkhairiahmd@gmail.com*

ABSTRACT

The rise of Big Data has inspired business organizations to venture into Big Data analytics, however academic research and empirical evidence about the business value remains scarce. This paper attempts to evaluate the readiness of Malaysia companies in taking advantage of Big Data adoption. Initial insights highlighted the definition and challenges surrounding Big Data. The research finds a great interest about Big Data Analytics (BDA) solutions that fuel with sound decision making and influence organizations into growth mindset. Big Data provides various advantages to organization that would seriously consider all its perspectives alongside its lifecycle in the pre-adoption or implementation phase. The research attempts to outline the different aspects of Big Data as a management practices to leverage the values of Big Data adoption as part of Industry 4.0 vision in future organizations. This is of great interest to researchers, professionals, and policy makers.

Keywords: *Big Data Adoption, Industry 4.0, TOE Framework, Resource-Based view, Data Quality Management*

1. INTRODUCTION

The situation today, with advancement of technologies and the increase ability to collect and store data the organizations are facing with the growth of data or commonly known as Big Data. The complication of this, it has given different spectrum where organizations are struggling to build appropriate strategy foundation on how to make use of the data to extract business values and build understanding out of data to drive competitive advantage. The implications to organizations, they would have lost the operation's productivity rates and profitability from 5% to 6% [1]. At the same time the organizations lost the opportunity to identify foremasot impacts on reducing business costs, and business strategic information. Subsequently, organizations may jeopardize service quality rendered, and effectiveness of corporate decision making [2],[3].

Lately, the world is going through a cycle of industrial evolution, bringing automation, and artificial intelligence into plants and factories. One of the immense challenges of adopting Big Data analytics (BDA) is dealing with large amount of unstructured data [4]. Demand for good quality data is critical for the organizations to focus more time on analytics technique than having through the laborious work of cleansing and gleaning the data. This research presents a conceptual framework of Big Data challenges that hinder the rapid growth of BDA adoption to pursue Industry 4.0 vision for organization performance.

The term of Big Data represents a massive growth of datasets in term of size, variety and complex structure

which make it hard to gather, analyze and put in informational graphic data for further analysis to achieve good outputs. As accordance to [1], Big Data is characterized as extremely huge record sets that maybe analyzed using computational algorithm to reveal designs, patterns, and associations. The characteristic of 3Vs (Volume, Variety and Velocity) in data environment was introduced by Doug Laney in 2001. The term "Big Data" was then commercialized by Roger Magoulas and mentioned in O'Reilly Media [2]. Big Data denotes an extensive series of record sets or big chunk of data which managing it can consume time and almost impossible to handle. It can't even be processed using traditional data management tools and this is due to the overloaded of data and consequently the complexity [5]. By now, there are many Vs associated to Big Data, however 4Vs are mainly significant to Big Data characteristics.

1.1 Big Data Attributes

Volume - The volume of data generated that needs to be processed, analysed to generate new value creations.

Velocity - Speed of data generated, received, understood and processed.

Variety - The growth of information coming from various sources from internal and external source of the enterprise

Veracity - The integrity and irregularities of data create issues in data quality and provenance.

In Big Data usage, contrasts in sizes, level of interconnectedness, administration, and different qualities

are amplified on account of the higher scale and expanded data unpredictability. Running examination is a multistep procedure. It includes data exploration, data cleansing and transformation, making investigative models, conveying and scoring those models, distributing results, and afterward refining the models. It's additionally an iterative procedure. On the other hand, the fundamental expository framework performs inadequately while running explanatory inquiries, this adds latency to the general procedure [6]. The amount of data has flooded each time with another capacity medium. With the current technology trend of data usage, there has been no new stockpiling medium [7]. Flood of data had caused upsetting period to the organizations. Many organizations have kept tremendous amount of data but do not know what to do with the data in order to bring values to the business. The results of data examination are essential for decision making and they can be influenced by the traded off nature of data. Wrong data costs an expected measure of 600 billion dollars to US organizations yearly [3]. Due to gigantic volume, exasperating rate, and heterogeneous combination, data quality is blemished. Blunder rate recorded 1-5% in data association rule, it is outperforming 30% for specific association. In a couple of data warehousing wanders, upgrading the data quality by the purifying strategy uses 30-80% of the improvement time and spending design [8].

Many organizations presumed they have adopted Big Data Project by generating a lot of Business Intelligence or have many dashboards. Although Business Intelligence leads to description of data trending, information published only to show data in the past or present. In summary, the business intelligence tools only show the state of what had happened but not prescriptive. Because of this, organizations are still behind with the optimization of data discovery or prescriptive insights. According to [9], there are five type of analytics, which described degree of intelligence in data which are Descriptive, Diagnostics, Predictive and Prescriptive and recently in 2016 new type of analytics was added that is automatic analytics [4].

Fig. 1 illustrates the degree of intelligence against competitive advantage phases through type of situations by analytics model. The higher the analytics type, the better degree of intelligence.

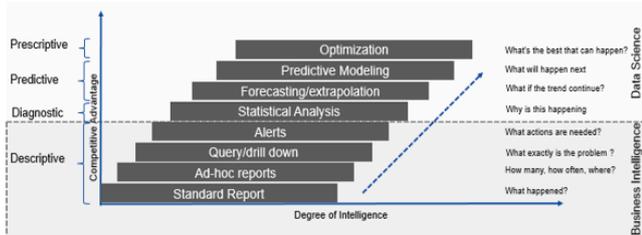


Figure 1. Data Analytics Phases

This paper is organized as follows: Section 2 discusses the relevant and current literature review for this research study, as well as the Malaysia scape in adopting Big Data. Section 3 outlines the research methodology that describes

the indices and datasets. The proposed model is described in Section 4 and finally the recommendations and concluding remark is presented in Section 5.

2. LITERATURE REVIEW

This subject of Big Data appears in multidiscipline such as engineering, mathematics, business social, and decision science. In 2008, the research of Big Data has been increased due to exponential growth of internet, social media, and Internet of Things (IoT) [10]. Throughout, there is also a situation of confusion and variability about what really is a “Big Data”. Is it a type of new technology? Is it about new process in data management? Or is it refer to physical look of the data? There are also arguments as what size consider “Big Data”. There are number of significant research boards struggled to establish their own trendsetter for definition of Big Data. The interest of Big Data generated a wide range of new methodology, and practices together with evolution of debates within followers, critics, and skeptics. The lack of consistent definition had led to uncertainties and hinders dialogue relating to Big Data. As it has become higher interest of business enterprises, it is important to understand in depth of Big Data characteristics.

In order to capture valuable insights out of the large dataset, organizations are facing several challenges. The issues may potentially due to data management complexity, lack of support from top management, data security protection and ease-of-use. There are adequate literatures that support the challenges of Big Data that hinder companies to leverage in Big Data Adoption. Moreover, slow uptake of Big Data adoption was reported in IDC report [11]. All these factors had shown that broad adoption of Big Data has not yet really materialized, therefore, there is a need to study on companies’ adoption of Big Data in Malaysia.

In Gartner’s 2017 Report on Data and Analytics [5], forward-thinking companies are on the path to create more holistic approaches to Big Data and analytics that involve the entire organization from end to end. The new insights for Big Data techniques drive the innovation penetration including every aspect of society, which are health care, customer service industry, retail, manufacturing, and financial services [12]. Big Data will be an important factor to society and business in near future. It was believed that Big Data Adoption will be the latest phenomenon in the predictable future [13]. The usage of Big Data has become the basis of growth and competition for organizations, and has become a critical process for leading companies to outpace their competitions [14]. Big Data drives fundamental changes across all industries. Losing market position in a competitive and fast paced market has created a sense of urgency in incorporating Big Data technology into today’s organizational decision-making.

2.1 Big Data in Malaysia Landscape

In Malaysia context, the mission to harness Big Data adoption by most organizations in Malaysia had brought positive impact. In fact, with the rise of Big Data technology to leverage deeper insights and smarter decision making, a growing need for skilled data expertise in extracting, managing and analyzing data to derive values for competitive advantage has become critical [6]. The complexity surrounding the Big Data Adoption creates challenges to the organizations to accelerate the adoption of Big Data. To pursue Big Data Adoption, Malaysia Digital Economy Corporation (MDEC) had commissioned Big Data and Analytics (BDA) Maturity Scape assessment study to understand the current maturity of the BDA adoption in seven selected industries in Malaysia [7]. The study was collaborated with International Data Corporation (IDC) and the result shows that Malaysian organizations have progressed within stage 1 (Ad-hoc). Ad-hoc stage is a stage where few processes are defined, and eventually even chaotic which success depends on individual effort [8]. That makes Malaysia behind compared to other prominent countries such as Australia, Singapore, and Hong Kong in the APeJ region. The IDC MaturityScape framework incorporates all levels of models, aligned to all kinds of IT functions and services. The Maturity Model is classified to 5 stage format that represent a progression from disorganization Ad-hoc, Opportunistic, Repeatable, Managed, and Optimized [8].

2.2 Big Data Challenges

Flood of data had caused upsetting period to the organizations. Many organizations have kept tremendous amount of data but do not know what to do with the data in order to bring values to the business. The results of data examination are essential for decision making and they can be influenced by the traded off nature of data.

Complexity in data management portrays the data and technological complexity of Big Data – as introduced by its characteristics of volume, speed and assortment, which at that point prompts apparent complexity in Big Data Adoption. More elevated amount of apparent complexity will create larger amount of uncertainty in connection to fruitful appropriation and execution of new technology [15]. There are numerous assessments requiring long term research to manage Big Data. Stonebreaker and Hong (2012) contend that the plan for the frameworks and fragments that work with Big Data will require a comprehension of both the necessities of the customers and the innovations that can be used to handle the issue being inquired about – i.e., not every Big Data and its prerequisites are the same.

In the context of Malaysia, the challenges of unstructured form of data were mentioned in Big Data Analytics project for National Hydraulic Research Institute of Malaysia (NAHRIM). NAHRIM is an agency to collect and visualize 90 years of projected rainfalls after-effect based on river basin in Malaysia. NAHRIM has been appointed to lead BDA projects. Based on NAHRIM experience

implementing BDA POC project, Big Data Analytics is not just about the technology, data or problems but the concept requires a full commitment and broad perspectives to understand the capacity and main objectives [17]. With the revolution of Industry 4.0, data are not just grow in the form of quantity but the evolution of data plays an important role that makes data as new commodity and assets to discover underlying cause in the decision making process.

According to Open Data Readiness Assessment Report [9], Malaysia shows clear evidence in expressing support for open data. The evidence of open data initiatives by public ministerial has visibly emphasized the importance of open data to encourage data-driven decision making. Nevertheless, data management procedures have become notably a challenge. The various type of data such as paper form makes it hard to release the data for reusable format. Some organizations have not embraced to digital data, where little data is available online.

3. METHODOLOGY

This study is confirmatory in nature, in which data were collected cross-sectionals and all the variables were measured at the same point of time. All the characteristics and measurement tools that will be used in this study has been identified in advance to get the appropriate results to determine the factors influence Big Data Adoption in Malaysia. The population consists of MSC Malaysia companies, due to prescribed assertion of having a number of knowledge workers. The MSC companies are chosen as they are involved in implementation of Big Data Adoption [10] and participated in MDEC digital transformation program of which Big Data Analytics was part of the program. The study was conducted with the aim of probing how Data Quality leads the success of Big Data Adoption.

Purposive sampling technique is suggested to derive a sample of 45 respondents. This sampling technique was chosen as the study is to test the instrument and develop an initial result before the actual survey is conducted. Moreover, purposive sampling works in selecting a particular subset of population based on experiences and skill in the subject matter.

The proposed research framework for this study was developed incorporating key variables derived from a review of the research literature on innovation adoption in organizations.

4. CONCLUSION

The purpose of this paper is to evaluate the preliminary investigation of Big Data adoption from the context of management of Big Data Techniques. Resource Based View and TOE Framework are adopted as conceptual research framework and adapted to measure data quality and top management support. This study examines the theoretical relationship wherein capability of data quality management and data usage experience constitute intangible assets (or resources) that lead a firm to higher IT capability. In this light, heightened quality of corporate

data could be a positive force in shaping an organizational culture that encourages usage of internal and external data for operational and strategic decision making. The expanded IT capability in data management and utilization is expected to become a virtuous force in furthering adoption of new data related IT capability. The technological context considers the available technologies important to the firm, both internal and external, that might be useful in improving organizational productivity. The organizational context is defined in terms of resources available to support the acceptance of the innovation.

5. RECOMMENDATIONS

The exponential growth of data advancement alludes the applications of data analytics solution in the real world. Following year's ahead, new phenomenon of data type that is unstructured data type and the booming of Big Data technology to solve the manual works. Some of the models and methodologies mentioned in the discussion paved the way towards that. Data quality dimensions are still entangled to the context of usage. Discussions and research in data quality dimensions was still in the context of well-structured data. In the context of Big Data technology, the measurement and assessment methods of these critical dimensions could be different as Big Data provide massive volume of data with high data velocity and high data variety characteristic.

In Malaysia context, although there were several reports published on Big Data, however Malaysia is depending on 3rd party from other countries to perform the analysis on the maturity state of Big Data. Furthermore, there are not many executions happened to progress the maturity level.

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