

Conceptualizing the Relationship between Big Data Adoption (BDA) Factors and Organizational Impact (OI)

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Abstract. With concern to the growing and limited number of studies in Big Data impact for Malaysia context, this paper proposes a framework linking Big Data Adoption (BDA) factors and organizational impact (OI). The independent variables adapting Technology-Organization-Environment (TOE) Model, operationalized the three contexts comprises technology, organization, and environment. The organization dimension further refers to relative advantage, security and privacy, complexity and compatibility. The organization dimensions cover on skills, top management support, financial readiness and firm size. The third dimension that is the environment consists of competitive pressure, government support and market turbulence. This study focused on the correlational between Big Data adoption factors and OI specifically productivity, cost-savings and innovation. The proposed framework is most appropriate to be studied using survey research at the firm or organizational level as the unit of analysis.

Keywords: Big Data Adoption, Organizational Impact, Technology-Organization Environment Model

1 Introduction

Big Data is a new phenomenon in Information Management due to advancement of the digital data management revolution. The term Big Data is widely used in various areas of study to give a better description and understanding at the certain situation. Big data is defined as the large volumes of data regardless of size, structure, speed to manage them with limited capabilities. The existence of big data able to improve business organization prospects by creating new growth opportunities and entirely new categories of companies (McGuire et.al, 2012).Big Data was claimed to provide ability to speed decision making supported with resourceful information and reliable data might bring the organization to the global business environment. As a result,

organizations start exploring the best and powerful hardware, software, algorithm tools to deal with Big Data to perform analysis to seek great impact of big data (Zolotov et.al, 2019).

The growing amount of data created every day from various platform becomes more important since it is valuable resource in business activities. The characteristic of Big Data that able to transform at a lowest cost, reassure organization to gain significant meaning, valuable insights with the existing IT infrastructure in every day operations. As the advent of technologies updates, organization still yet, looking for the better solutions to obtain the value of Big Data in the current business landscape.

The aim of this paper is to propose a framework based on BDA in business organization in Malaysia's MSC status companies that correlate with existing factors. In order to achieve this goal, we review the literature hence for analysis and synthesis of previous existing model on BDA and organizational impact on Big Data for the development of the proposed framework. As a result, we found new variable that contribute to this study. Remarkable, BDA become intelligent solution for organization as the way transforming their operational activities. Hence, those changes require investment at cost to the technology which at the end offering new opportunities and giving the new perspective of decision making. Thus, most of the multinational organizations abroad adopt Big Data to accomplish significant impact for competitive advantage locally and globally.

In Malaysia, five years back the Government has encouraged business organizations to maximize the usage of big data to improve sustainability. Currently there is a framework established by Malaysia Digital Economy Corporation (MDEC) to execute Big Data initiative implementation in Malaysia. However, the impact of Big Data on Malaysia business organization is still unclear but need to be understood for good future Malaysia economy sustainability. There is a need to establish a framework to measure Big Data adoption implementation and specifically focus on impact to business organization.

The remainder of this paper is organized as follows. Section 3 is literature review. Section 4 is proposed framework and relationship. Section 5 is discussion. The final section contains the concluding remarks.

2 Challenges in Big Data

Despite of global turbulent of research, education, industrial, commercialization, R & D and regardless of ICT advancement, the 3Vs of big data started with Volume, Velocity and Variety has been expanded to 7Vs by adding Variability, Veracity, Value and Visualization (Ajab, 2017; Alkatheri et.al, 2019; Olszak & Mach-krol, 2018; Schroeck et al. 2012). depending on its purposes. Organizations are constantly looking for the opportunities in any ways to be competitive in the current business landscape. Big Data emerged numerous technologies are producing tons of digitized and raw data about the firms' activities that could bring benefit to them and achieve certain objectives.

Applied Big Data in the organization offers huge potential such as performing analysis to speed decision making, extract values, visualization of data, provide real-time data, predict risk and forecasting, customize data set and many more. Structured and unstructured data has been collected from open sources and social media supplied to complete the paper works, various reports, analysis, transcript, articles, thesis, dissertations and many more. However, due to Big Data features, organizations may have to face challenges to process, manipulate, classify, storage and extract them. Hence, large data sets nowadays become more complex with volume of data produced requiring advanced storage systems, variety format of data structured and velocity of speed necessitated fast processing (Upadhyaya & Kynclova, 2017).

Capitalizing to the high-end technologies and infrastructure meaning that organizations are expending an amount of money to invest in Big Data's dynamic ecosystem. The technologies and infrastructure really benefit and contribute to the valuable business input, it is well understood that IT could bring positive influence; it might also bring the negative effect. Despite the growing absolute value in Big Data in organization, the technology issues such IT infrastructure, data integration complexity and proper technology data analytics and capabilities are still among the issues that to be considered (Weibl & Hess, 2018). Moreover, (Aladmaai, 2018) highlights the limitation of technology capabilities and lack of business model's approaches became barriers for the SMEs to integrate with Big Data analytics. As a result, only a small percentage of SMEs applied to Big Data analytics (SBA, 2017).

Having advancement technologies in the organization might drive to the competitive environment in business. The characteristics of traditional Big Data requires data expertise to handle, manage to support the crucial part in the organization. Importantly to note, the position in the organization must be fit to the task to accomplish objectives. Hence, there are barriers in adoption of Big Data analytics as short of employees with appropriate skills to gain insights into Big Data valuable resources (Fernando et. al, 2018). In addition, exploitation Big Data from anonymous sources and enormous quantities of data expected new skills and new management styles in the current business environment (Raguseo, 2018).

Competitive pressure seems to be positive for organizations to create, innovate and generate new ideas in the current business environment. Organizations might face numerous challenges to be at a higher level in the global business landscape. In addition, organizations always need to ensure to collaborate in open innovation concepts with other organizations, which require them to adapt to the different situation. However, in this constantly changing world and the advent of technology not all organizations are able to have the same Big Data infrastructure with their competitor. Moreover, only large-scale firms afford to adopt Big Data since they have extra resources compared to small companies (Sun et.al, 2018). In fact, BDA in developed countries are more progressive with sophisticated technologies compared to other countries (Hilbert, 2013).

3 Literature Review

Big Data Definition

Big Data term used widely to describe voluminous of data with different speed and format created and existed whether internally or from external that related to the organizations. The complexity of Big Data characteristics requires advance techniques and beyond the ability of typical database to manage them (Bremser et. al, 2017; Haddad et.al, 2018). Yet, it can describe as multi-various of data exist in terms of capacity, format and speed generated from transactional processes of human and machine that need to be considered in operational activities.

The constant changes in data produced derive from advancement technology perceive to expand of the V's characteristics. This also forms the basis for the most used definition of big data as stated. *Volume*: Heterogeneous amount of data, from datasets with sizes of terabytes to zettabytes created from internal or external and growing every second in the fast speed derived from high-end technology. *Velocity*: The speed of data created from time to time created from real time transactions and streaming. *Variety*: The format of characteristics of data generated structured, semi-structured and unstructured form numerous sources such as text, images, audio and video. *Variability*: The variation data generated from application randomly require knowing its sources. *Veracity*: The accuracy of data as it is changing and spreading very fast, the accuracy of the information might change. *Value*: Data has high impact by Analyzing and extracting from hidden patterns, trends and knowledge models. *Visualization*: Refers to making the overwhelming amount of data understandable, readable and usable. The uniqueness of Big Data characteristics offers several opportunities to manipulate using powerful software tools since it provides high values to organization. Thus, focusing on Big Data adoption to get insights and value discovery might bring the organization to the global business environment.

Big Data Applications

These days, Big Data application has been expanded to several areas of the field with the emergence of technology as well as advanced tools and techniques. Applications Big Data in Smart City provides Government the valuable information on traffic statistics, transporters, utility poles, water lines, weather conditions, criminal data, construction, visitors' data to improve on the public services. Yet, the smart-based application for Smart City changes urban population in living, public service delivery, transportations and infrastructures (Hashem et.al, 2016).

Big Data contribution in Healthcare and Pharmaceutical seems to vary as predictive model in drug discovery, clinical trial execution to mining data, targeted groups for patient's populations and behavior, safety and risks data to counterfeit activity and sales for underserved markets, optimizing workflow, clinical research (Quinn, 2016). Big Data applications in education and learning give benefits to students, academicians and administrators. A study by Molina (2019) highlights Big Data analytics use

to see patterns of executive leadership, analyzing historical data of students, teachers, research, enrolment, Learning Management System (LMS) platforms, Bring Your Own Device (BYOD), E-Learning, Intelligent Tutoring Systems (ITSs). Other great contribution of Big Data in the airline industry such to reduce frequency of decision making, understand customer behavior, customize and optimize service that boost to loyalty program (Himmi et.al, 2017). Hence, the new concept and business models based on data capable to create value. Big Data roles in Supply Chain used for efficient manufacturing in operational process from external data (social networks and supplier's data) combining with existing data for better decision making, quality data analysis, product design, relevant manufacturing cost, optimize production, improved demand forecasting, developing production operation, web search-based applications (Ismail et.al, 2018; Zhao & Yang, 2017; Soroka et.al, 2017).

Big Data Emerge Technologies

Businesses are facing challenges in the management and capitalization of data with the significant increase in such complex environment. The phenomenon of Big Data overwhelms in various field help to facilitate the organization to achieve their objectives. Cloud Computing technology allows on demand, minimal requirement of management and interaction with the service provider, convenient and ubiquitous network access to computer resources. The cloud-based Big Data analytics technology become high demand to the organization as it capable to provide services and facilities in optimum level with minimum cost that gives significant impact to the management and operational level (Khan & Al-Yasiri, 2016). In banking sectors, Big Data with machine learning technology helps to make decision in financial loan, examine the probability of bankruptcy with high accuracy for company or individual with some risks. Clearly, the technology facilitates banks to really know their potential clients (Bakar, 2018). Machine learning relies on dataset before learning and later performs the learned tasks, such as prediction and classification. Therefore, various categories of the specified purpose of conducting analysis for social media data (Ghani et.al, 2019). Business intelligence in public sector allow governments to use Big Data to help serve their citizens and overcome national challenges such as rising health care costs, unemployment, natural disasters and terrorism. Some other private sectors depending on Business Intelligence technology to manage the large amount of data saved from both internal and external sources (Woodside et.al, 2015).

4 The Proposed Framework

The framework is proposed for studying the impact of Big Data implementation in terms of the relationships between BDA factors and OI of an organization. The framework is conceptualized based on previous work on factors of BDA using the Technology-organization-environment (TOE) model, for this study adapted Diffusion

of Innovation (DOI) theory, Institutional theory and Dynamic Capabilities (DC) theory to measure the Organizational Impact (OI) as in Figure 1.

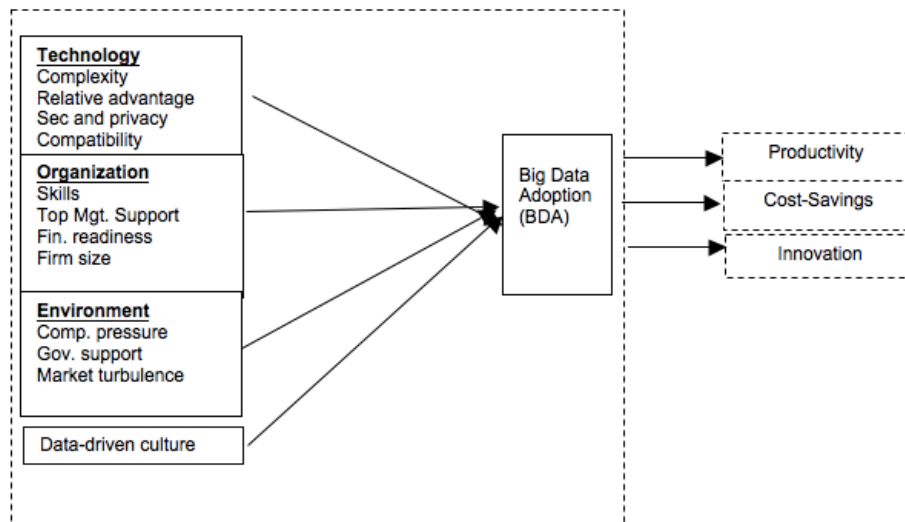


Figure 1 The proposed research framework

Technology-organization-environment (TOE) model

This study derived from the TOE (Tornatzky & Fleischer (1990) model and DOI (Rogers 1962) by since most studies on IT adoption at the firm’s level. The three elements in TOE comprises technological context, organizational context and environmental context that antecedents the technology adoption within organization. This proposed research framework is derived from several literatures of Big Data’s related works.

Technological context

Technological context describes any relevant technologies to the firm that includes existing or current technology. It includes available, existing and outside technologies that practice in the current operation to adopt Big Data. This study highlights technological context;

Complexity: Big Data technology is something that very solid and tough to be used, understand and learn in the organization. In Big Data security aspect, it refers to the difficulty in providing security tools (Salleh & Janczweski, 2016).

Relative advantage: The capability of Big Data being explored to get great value and experience unique discovery, improved at another level than previous system. Sam & Chatwin (2018) refers relative advantage as the ability of BDA in processing

and managing data with high technology offers greatest productivity for the China's firm.

Security and privacy: It refer to the safety aspect on company's data, compliance and System Operating Procedure (SOP) in the usage of Big Data in organization. In the condition with data increasing in every single minutes, security and privacy in healthcare refers to the concern of personal patient's data (Mgudlwa & Iyamu, 2017).

Compatibility: the ability of organization to exploit Big Data with existing technology in the organizations without having any new addition of ICT hardware in the business activities. A study by Malak (2016) refers compatibility as existing infrastructure, working culture and experiences in the organization is appropriate to adopt Big Data environment.

Organizational context

Organizational context refers to expressive measures about organization structure. It also describes organization's resources characteristics that support or constrain to the BDA. This study emphasizes organization setting;

Skills: It refers to a qualified human expert that well trained to handle Big Data from the foundation until the complex process. According to Wamba et.al (2017) Big Data analytic skills refers to data analyst with capability in management, infrastructure and talent (technical and business relation).

Management support: Encouragement in BDA from upper level management by providing necessary mechanism to the business operation. Sufficient resources allocated, fast approval for new resources, data-driven culture in the process of Big Data implementation in the organization (Bremser et.al ,2017; Sun et.al, 2018).

Financial Readiness: According to Bremser et.al (2017) financial readiness carried out the Big Data tasks when organization afford to provide their own lab for use cases and partnering with their trading partners.

Firm size: Describes well established firms may support the BDA as could support in various aspects (Sun et.al, 2018).

Environmental context

Environment context denotes the circle entities of firms conducting its business. It describes the site, setting, domain where the firm operate their commercial activities includes deals with government (Salleh & Janczweski, 2016).

Environment perspective for this study includes;

Competitive pressure: It describes as the situation of surrounding entities of the organization such suppliers, vendors, partners, and competitors already get benefit and resourceful with Big Data activities.

Government support: related to any acts, policies, guidelines, and initiative develop by government and its associates to encourage Big Data eco system for business organization in the country.

Market turbulence: The condition when fluctuation on customer’s preferences in Big Data environment (contemporary on preferences, demand and needs on product and services).

Big Data Adoption (BDA)

Initially, Tornatzky & Fleischer (1990). used to study the adoption of innovations in the agriculture and farming communities in the mid-western United States. In his study he describes the diffusion of innovation for product or IT development by the population or social system that attentively to the diffusion of innovation theory (DOI). In addition, this study is much closer to DOI and seems related to adoption of technology for innovation for Big Data in the organization. This study highlights BDA acceptance to the Big Data in the organization for the social changes that includes Big Data implementation, BD application, Big Data strategy and Big Data analytics. This adoption study involves adoption and implementation.

Organizational Impact (OI)

Organizations expect to achieve excellence and more productiveness in their business. Therefore, it seems significant for them to measure the firm’s achievement through BDA. In other words, impact study on BDA needs to be assessed since it gives great values to utilize with the appropriate tool and techniques and expertise to manage with internal and external data. Therefore, organizational impact depends on several context in any major changes such as structure, nature of work, knowledge and culture coming from inside or outside the firm (Bianca, 2017) to have clear view on vital aspect that affect changes, variations, transformation in the output, outcome and new income from the Big Data activities.

Adopting big data technologies capable to optimize use of resources such as time, human and raw materials lead to cost efficient and effective. Organization will make utilize of free open sources software, inexpensive server and cloud-based analytics which both of the fact will reducing cost and give significant effect on business value and firm performance leading to savings, reduce operating costs, communication costs, increase returns improve customer relations and developing new business plan (Jeble et.al, 2018).

Table 1. Impact studies by other researchers.

Authors	Impacted on
(Peristeris & Redzepovic, 2015)	savings, innovation
(Ajab, 2017)	savings
(English, 2018).	competitive advantage
(Akter et. al, 2016)	firm performance
(Curry, 2016)	competitive advantage

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(Gandomi & Haider, 2015).	savings
(De Mauro et. al, 2015).	competitive advantage
(El-Haddadeh et al, 2019).	firm performance
(Schüll & Maslan, 2018).	firm performance
(Nguyen et al, 2017).	firm performance
(Andrian et al, 2016).	productivity

Table 1 shows the gaps of BDA impact from the previous study the year 2015-2019. Increasing firm performance enables organizations to sustain the current business landscape. Somehow measuring increasing firm performance seems overly generic. It is evidence in Table 1 that the literature in BDA impacting specific the productivity, cost-savings and innovation still at low attention from the researchers.

Data-driven Culture

Literatures states organizational culture has become one of the major challenges in BDA (Lunde et.al, 2019). The three elements in organizational culture that comprises organizational learning, management and data-driven culture measuring cultures in different aspect. Data-driven culture define as the condition which decision made in the organization based on extracted data. In addition, Cao & Duan (2015) states critical role in understanding and using data or information as it might be contradicted to traditional practices on decision making regardless of creating new products. Clearly, data-driven culture encourage management to develop learning culture, data insights task forces on Big Data and provides adequate resources for the Big Data activities (Corte-Real, 2019; Tabesh et.al, 2019). Hence, Big Data requires advance techniques or relevant technologies to get the insights from extracted data for the decision making.

The framework is design with the novelty of examining the impact of Big data application on Malaysia business organization. It is taking care of the impact of the Big Data application by covering aspects on productivity, saving and innovation. The three aspects are important in determining sustainability for gaining competitive advantage over the long term.

5 Methodology

This study is exploratory in nature. A single method with a quantitative approach is chosen for this study for measure the framework by testing theory, exploring an area and developing hypotheses. Researchers will test the theory by indicating hypothesis and data that had been collected will specify whether to support or contradict the hypothesis (Creswell, 2014). It was decided to adopt a survey research method in order to analyze relationships between variables and provide systematic information to describe variables (Malhotra & Galletta, 1999).

The structured questionnaire is designed by literature review. In this study, the research questions make clear references to understanding the level of BDA factors in organization and its impact on MSC-status companies. To enhance content and construct validity of this study, pretesting of the instrument will be conducted. Content validity is significant to evaluate the suitability of scale items as well as to examine that comprehensiveness of the measurement of the dimensions. Construct validity establishes the appropriateness of scale representation for intending measurement. Pre-testing or piloting procedure is used to recognize the fault in the questions, questionnaire. For pre-testing 3-8 experts are required to check the overall appropriateness of the survey instrument. Population of the study is MSC status companies that registered under Malaysia Digital Economy Corporation (MDEC). For this study, the IT professionals and person in-charge in the Information System in that representing their organization will do the pre-testing. After all the valuable suggestions, amendments and changes will be incorporated in the questionnaire. Level of capacity and capability respondents will be examined using Likert Scale. The findings of the pilot study will be explored statistically using SPSS and SmartPLS to ensure that instrument is acceptable without further improvements.

6 Significant

Malaysia's Digital Economy has been introduced since 2016. In order to contribute the outstanding percentage to the Growth Domestic Product (GDP), Malaysia need to create a dynamic ecosystem for Digital Economy by giving attention to the three main important area such digital infrastructure, digital entrepreneurship and taxing digital economy [54]. Thus, big data plays an important role in Digital Economy as it changes the way of decision making, business transactions beside emerging technology in big data would lead to innovation, quality of delivery and added value to industries.

Novel theories

The study will develop novel framework in the field of Big Data environment to be able to pursue the digital ecosystem. In order to develop the framework, several frameworks from the previous study is adapted. The preliminary findings will be used to ensure the framework is apply to the actual case in the MSC-status companies. Therefore, combination of different theory and framework on big data adoption, important factors to the successful in implementation will provide new ideas, determine few aspects to be accounted in to boost the digital economy in Malaysia.

Potential Applications

The study will develop novel framework for as a reinforced commitment to the digital economy sustainable development to ensure that Malaysia's digital connectivi-

ty growth exponentially to all sizes of businesses contributing to the GDP. Thus, creating dynamic ecosystem in line with the three-aspect digital connectivity covers digital entrepreneurship and taxing the digital economy and provides the right skill for workers (World Bank, 2018).

Impacts on Society, Economy and Nation

Impact on Society

Upgrading digital infrastructure within the country encourage societies to participate in the digital environment. This situation may reduce the digital divide and leveraging technologies among societies. Hence, Malaysia may have the generation with literate technology which capable to work in various field. In future, digital environment become crucial to the country whereby specific work tasks exist and needed in the Big Data ecosystem. Thus, this study expectantly will aid Malaysia's government efforts provide new programs in education to prepare the right skills for the public and provide more job opportunities in this field.

Impact on Economy

The research will lead to better growth of economy for the nation. In the current Malaysia business landscape, organization will continuously to be data-oriented culture and competency with manipulating data into the high-end information that valuable for competitive advantage and new innovation at the minimum cost operation to deliver high quality products and services to the consumer. Hence, will assist Malaysian government target to become a high-income nation and achieve 20% GDP for the next few years.

Impact on Nation

This is in one of the thrusts in the Twelfth Malaysian Plan (12MP) which to increase productivity, spur innovation, and improve livelihoods. The economic empowerment dimension will include new sources of growth, including Industrial Revolution 4.0, digital economy, aerospace industry, integrated regional development as well as growth enablers such as sustainable energy sources and infrastructure connectivity.

7 Conclusion

The research framework developed in this paper provides an opportunity to improve implementation of Big Data in Malaysia. By examining the important factors that lead to adoption and impact of Big Data on business organization, it could assist Malaysia government to set up a new Big Data policy for attaining post implementation condition. Hence, in order to validate the framework and the corresponding prepositions, a survey research is planned to be conducted involving companies operating

within the area of Multimedia Super Corridor (MSC) in Klang Valley, Malaysia. Apparently, the unit of analysis would be the

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