UNIVERSITI PUTRA MALAYSIA

FACTORS INFLUENCING USER INTENTION TOWARDS BIG DATA TECHNOLOGY ADOPTIONS IN EDUCATIONAL ORGANIZATIONS

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By

NOOR BAIZURA BINTI HARUN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

December 2021

DEDICATION

I dedicate this thesis to

Ayah- Al-Marhum Harun Bin Mat
Mak-Aminah binti Muhamad
Muhamad bin Zamri
Fil and Mil
All Siblings
In Laws
Nieces and Nephews
Friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman : Associate Professor Habibah binti Ab Jalil, PhD
Faculty : Educational Studies

The emergence of new technologies in the field of Educational Technology such as Learning Analytics has led Big Data to play an increasingly essential role. Big Data is making its presence known in almost every industry and has the potential to not only transform the business world but the educational governance too. Given that organizations in the Malaysian Ministry are still in the early stages of using Big Data, studying factors influencing the users' intentions to adopt Big Data technology in Malaysia is critical and timely. Grounded in the Dissemination of Innovation (DOI) theory, Technology Acceptance Model (TAM), and Technology-Organization-Environment (TOE) framework, an integrative model is developed to examine the factors influencing the adoption of Big Data technology in this study. The model specifies four technological factors (perceived usefulness, perceived ease of use, compatibility and security), three organizational factors (top management support, IT expertise and organizational resources), and environmental factors (competitive pressure, external support and privacy) as determinants of the users' intentions to adopt big data technology. The moderator tested was the size of the organization. The size of the organization may exert a moderate effect on the direct relationships previously disclosed. Using a cross sectional survey, empirical data were collected. A total of 227 questionnaires were obtained and screened. There are 3 insufficient answers were subsequently discarded leaving 224 valid structured data review questionnaires. Data was analized using the Partial Least Square Modeling of Structural Equations due to one of the best software for verifying structured data on structural equations modeling (SEM) Smart PLS 3.0 as analytical tools. This study finds that the predictor variables (compatibility, security, top management support and organizational resources) are significant and critically direct to the users' intentions to adopt big data technology. Among the factors identified in the model, three (top management support, organizational resources and security) are found to play a vital role in all levels of users' intentions to adopt Big Data. The results indicate that the model is suited for studying users' intentions to adopt Big Data technology in educational organizations. This study can help the Malaysian ministry of education to emphasize the important factors in

further developing the use of Big Data technology in organizations. The findings provide important recommendations and implications for BDA technology practitioners and application developers, which could coincide with successful BDA technology deployment. This study provides practitioners with practical recommendations for guidance in incorporating and endorsing BDA activities in their organizations in order to maximise the benefits of revolutionary technology, particularly in government agencies.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

FAKTOR-FAKTOR YANG MEMPENGARUHI NIAT PENGGUNA MENGGUNAKAN TEKNOLOGI DATA RAYA DALAM ORGANISASI PENDIDIKAN

Oleh

NOOR BAIZURA BINTI HARUN

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Data Raya memainkan peranan yang lebih penting lantaran kemunculan teknologi baharu seperti Analitis Pembelajaran dalam bidang Teknologi Pendidikan. Data Raya semakin dikenali dan digunakan dalam hampir setiap industri, dan mempunyai potensi bukan sahaja untuk membuat perubahan dalam dunia perniagaan, malah tadbir urus bidang pendidikan. Memandangkan organisasi-organisasi di Kementerian Malaysia masih di peringkat awal dalam penggunaan Data Raya, kajian faktor-faktor yang mempengaruhi niat pengguna untuk menggunakan teknologi Data Raya di Malaysia adalah kritikal dan tepat pada masanya. Dalam kajian ini, model integratif dibangunkan berdasarkan teori Penyebaran Inovasi (DOI), Model Penerimaan Teknologi (TAM), dan rangka kerja Teknologi-Organisasi-Persekitaran (TOE) untuk mengkaji faktor-faktor yang mempengaruhi penggunaan teknologi Data Raya. Model ini menyatakan empat faktor teknologi (persepsi kebergunaan, persepsi kemudahan penggunaan, keserasian dan keselamatan), tiga faktor organisasi (sokongan pengurusan atasan, kepakaran IT dan sumber organisasi), dan faktor persekitaran (tekanan persaingan, sokongan luaran dan privasi) sebagai penentu-penentu niat pengguna untuk menggunakan teknologi Data Raya. Moderator yang diuji adalah saiz organisasi. Saiz organisasi mungkin memberi kesan yang sederhana terhadap hubungan langsung yang telah dilaporkan sebelum ini. Menggunakan tinjauan keratan rentas, data empirikal dikumpul. Sebanyak 227 soal selidik telah diperoleh dan disaring. Terdapat 3 jawapan yang tidak sesuai kemudiannya dibuang dan hanya 224 soal selidik semakan data berstruktur yang sah. Data dianalisis menggunakan Pemodelan Separa Kuasa Dua Terkecil Persamaan Struktur kerana salah satu perisian terbaik untuk mengesahkan data berstruktur pada pemodelan persamaan struktur (SEM) Smart PLS 3.0 sebagai alat analisis. Kajian ini mendapati bahawa pembolehubah peramal (keserasian, keselamatan, sokongan pengurusan atasan dan sumber organisasi) adalah penting dan kritikal terhadap niat pengguna untuk menerima pakai teknologi data raya. Tiga faktor yang dikenal pasti dalam model, iaitu sokongan pengurusan atasan, sumber organisasi dan keselamatan didapati memainkan peranan penting dalam setiap peringkat niat pengguna untuk menerima pakai Data Raya. Hasil

dapatan menunjukkan bahawa model ini sesuai untuk mengkaji niat pengguna untuk mengguna pakai teknologi Data Raya dalam organisasi pendidikan. Kajian ini, dapat membantu kementerian pendidikan Malaysia untuk menitikberatkan faktor-faktor penting dalam perkembangan penggunaan teknologi Data Raya selanjutnya dalam pelbagai organisasi. Penemuan ini memberikan cadangan dan implikasi penting untuk pengamal teknologi BDA dan pembangun aplikasi, yang mungkin bertepatan dengan penggunaan teknologi BDA. Kajian ini menyediakan saranan praktikal sebagai panduan kepada pengamal untuk mengambil kira dan mengesahkan aktiviti BDA dalam organisasi mereka untuk memaksimumkan manfaat revolusi teknologi, khususnya dalam agensi kerajaan.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
BD	Big Data
BDA	Big Data Analytics
BDT	Big Data Technology
BDTA	Big Data Technology Acceptance
BI	Business intelligence
DRSA	Public Sector Big Data Analytics
INTAN	Institut Tadbiran Awam Negara (National Institute of Public Administration; Malaysia)
IoT	Internet of Things
JPA	Jabatan Perkhidmatan Awam (Public Sevices Department of Malaysia)
JPN	*Jabatan Pendidikan Negeri*
MAMPU	Malaysian Administrative Modernisation and Management Planning Unit
MDEC	Malaysia Digital Economy Corporation
MOE	Ministry of Education Malaysia
PADU	Education Performance and Delivery Unit
PPD	*Pejabat Pendidikan Daerah*
UI	User Intentions
VUCA	Volatility, Uncertainty, Complexity, and Ambiguity
4IR	Industrial Revolution 4.0

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discusses the context of the study and background, problem statement, research objectives, research questions, significance of the study, research scope and limitation, definitions of terms, and as well as the chapter organization.

1.2 Research Background

Several notions in the information environment have evolved recently due to the introduction of new crucial technologies. Along with automated systems and cloud computing, the term Big Data (BD) is commonly used by IT practitioners and analysts. However, the adoption and use of Big Data technology (BDT) in Malaysia are still unactualized (Sin & Muthu, 2015; PADU Malaysian Education Blueprint Annual Report, 2018), particularly in the public sector, even though Big Data technology such as Big Data Analytics can be used to better data management in an organization.

Big Data, with its potential to ascertain valued insights for the improvement of the decision-making process, has recently attracted substantial interest from both academics and practitioners. Big Data Analytics (BDA) is increasingly becoming a trending practice that many organizations are adopting to construct valuable information from Big Data (Utayasankar, Muhammad, Zahir & Vishant, 2017).

As a consequence, Big Data can be used in a wide range of fields. Although there are many studies in other fields, such as economics, there have been few studies in the field of education. To fit into the VUCA world, the use of Big Data technology shall accelerate in the field of education to serve as a shield in dealing with threats such as the covid-19 pandemic. Big Data in education is one of the most important areas of the Big Data scenario (Utayasankar, Muhammad, Zahir & Vishant, 2017).

Academic institutions are also focusing on creating methods for enhancing the learning process by identifying student successes and weaknesses to assist students in improving their abilities in the future. People raised the issue of accountability and transparency to achieve equal quality for better performance, which necessitates the use of BDA in educational institutions. However, not all organizations and government agencies are financially capable of taking on the challenge (Charde, Yadaw, Kumar, Sood, Singh, & Sahu 2018). Big Data is still an emerging phenomenon but in the recent past years its significance in different industries and countries (Uthayasankar et al., 2017). The benefits of Big Data in education (Drigas & Leliopoulos, 2014) are improved instruction

and learning, matching students to programs, matching students to employment, transparent education financing and forming an efficient system.

Implementing big data technology in educational organizations can improve students' performance and learning abilities making the lessons more personal. The courses can be adjusted by the teachers with the help of analytics. Then, Open Data can help parents and students to find the best school or educational program (Drigas & Leliopoulos, 2014). Therefore, the companies and candidate employees can discover alternative and more effective tools to use open data to upgrade their skills with the needed skills. Apart from that, students would be able to find and submit job applications that match their abilities more efficiently. Besides, this allows students to participate in educational activities, which they were not able to do previously. Furthermore, students would be able to gather relevant information on higher education and discover the most appropriate programs for them. Then, the school education systems would be able to develop a competent school supply which can help the management of more effective education resources (Drigas & Leliopoulos, 2014).

As aforementioned, in terms of Malaysia's context, Malaysia is one of the few countries with a structured Big Data Analytics (BDA) roadmap to fully unleash the value of Big Data. Therefore, business owners, government, and citizens all stand for Malaysia's vision as the ASEAN's leading BDA solution hub (Hamzah, Yatin, Yusof, Rashid, Shuhaimi, Suleiman, Mansor, & Taib, 2020). BDA is capable to handle Big Data sets to uncover insights, correlations, and useful information. BDA plays a significant role in the transformation of data into information. However, to achieve desired results, intent-to-use BDA is essential. The BDA requires technology, skilled resources, and structured business processes. As the strategy, various application systems developed internally and externally are hosted at the Enstek Data Center and Complex Data Center E, Putrajaya (MAMPU, 2016). The users of these application systems are the staff of all the agencies under the Ministry and the public sectors.

Organizations in the public sectors in Malaysia have already been directed to use and adopt Big Data technology. However, in the Ministry of Education, especially in the field of education technology, Big Data technology is still underused as the data cannot be simply obtained due to various factors, for example, privacy, security, etc. (PADU Malaysian Education Blueprint Annual Report, 2018). Therefore, this research has been conducted to determine the factors that influence the adoption of Big Data technology in the Ministry of Education.

In addition, the administering aspect of Big Data is seen as underdeveloped even though it is growing fast (Sin & Muthu, 2015). However, there was a study conducted in Malaysia on Big Data governance to control floods in Kelantan that exhibited the use of technology in which the data can provide valuable information (Fazidah, 2016). The findings showed positive insight and perspectives on other areas including educational technology.

1.3 Big Data Phenomenon

Big data refers to a vast amount of structured and unstructured data generated at a high rate from a variety of digital and traditional sources. (Rahman & Aldhaban, 2015). Big data also refers to sized data beyond normal database software capabilities to collect, store, manage and analyze them (McKinsey, 2016). Since the advancements in information and communication technologies, the amount of data generated by digital media and devices has increased exponentially since 2000 (Gartner, 2013). The evolution of the Internet and mobile communication has fuelled the rapid spread of new IT technologies such as social media, VoIP, and business informatics.

The data explosion is intended to be accelerated by cloud computing, the Internet of Things, and 3D multimedia. The growth of data with features such as volume in data amount, velocity in data transmission speed, and variety in data sources have fueled the new digital transformation known as big data (Laney, 2001). Big data's emergence is linked to social needs, data technology advancements, and data development. Big data is planned to be a multipurpose social capital because it can be used to respond to climate change, disease prevention, and other issues using data science. Data infrastructure and data applications make up big data (Miele & Shockley, 2013). Data infrastructure refers to the technology that allows for the collection, storage, and analysis of data, while data applications refer to the different applications that use data infrastructure in the private and public sectors.

Through data application, big data is intended to be a strategic necessity for generating new market opportunities and competitive advantages for companies (Manyika, 2011). Across the value chain, big data can aid organizations in cost reduction, effective operations, product growth and innovation, customer segmentation, and customer retention. Therefore, in terms of technical capabilities and cost, data-related technology, such as data storage, data processing, and data analysis, has advanced considerably, considerably expanding the market and technical potential of big data (Agrawal, 2015).

As aforementioned, the data are considered big, fast and diverse necessitates capacity and storage that the traditional information management infrastructure cannot provide (Rahman & Aldhaban, 2015). In this context, technology is referred to the hardware and software used to deal with big data. This technology will support big data access, management, and analysis.

Big Data, according to Microsoft (2013), entails applying "serious computing power to seriously massive and often highly complex sets of data." Hadoop, which allows for distributed data processing across different, remotely located commodity machines (or nodes), is a popular technology for dealing with massive data sets beyond the capabilities of conventional systems (Shvachko, Kuang, Radia, & Chansler, 2010). Hadoop makes Big Data more usable by bringing scalable parallel computing to commodity hardware (Ularu, et al., 2012). While Big Data is not limited to the sphere of technology, the

concerns of storing, processing, and analysing Big Data are key technological obstacles that suggest Big Data technologies are a must-have for employing Big Data.

Since data has no inherent meaning, the value variable has become a central concept in Big Data. Business intelligence and business analytics are terms used to describe the criteria for making proper use of Big Data. Business intelligence (BI) is an umbrella term that refers to "a wide category of applications, technologies, and processes for collecting, storing, accessing, and analysing data to help business users make better decisions" that became common in the 1990s (Watson, 2009). The term is often used to describe the use of data from traditional databases and warehouses (Johannessen, 2017). In addition, the Malaysian industry (public and private sector) also predicts that the use of Big Data could lead to savings money regard to the ROI (Arun, 2014).

The proliferation of knowledge through Big Data is also aligned with the developments in mobile and Internet usage (Nuaimi, Neyadi, Mohamed & Al-Jaroodi, 2015). Different types of structured and unstructured social media data such as blogs, and Twitter have driven massive, varied, accessible, and value-added Big Data (volume, variety, velocity, veracity) to terabyte and petabyte size data. As a result, the growth of the Big Data process led to the development of new technologies and open up the space for government and private agencies to improve the consumers' service (Arun, 2014).

Big data structures are full of unknowns including some of the youngest developments of our generation (Anshari, Alas, & Guan, 2015). Big data requires collecting large and complex data sets. Current programs in the database and software are unable to handle these. Big data processing and analytical technologies can be generalized to various applications with high impact, for example, e-government, e-commerce, market intelligence, health care, and security (Chen, Chiang, & Storey, 2012).

This study concentrates on big data technology, which has three major components: products and services, human behaviours, and expertise. Aspects are intertwined and mutually beneficial. As a consequence, the application of big data technology is often accompanied by a detailed review of these three considerations. According to this perspective, technology, which is shaped by society, affects people's actions, social norms, interactions, and institutions, as well as how a culture expresses itself. This is one of the main technological developments in the large-scale applications of big data structures. Due to the exponential growth of big data technologies, managers must adopt the technology (Selen, 2019). Hence, the use of big data technologies to solve Industrial Revolution 4.0 is inevitable.

There are four unique technological advancements; artificial intelligence; high-speed mobile internet; widespread adoption of big data analytics and cloud technology. These were predicted to influence the period 2018–2022 as drivers that would positively impact the growth of business worldwide (World Economic Forum, 2018). According to the investment plan report based on the organizations surveyed, 85% of respondents are

likely or very likely to have increased their adoption of big data analytics by 2022 (Figure 1.1).

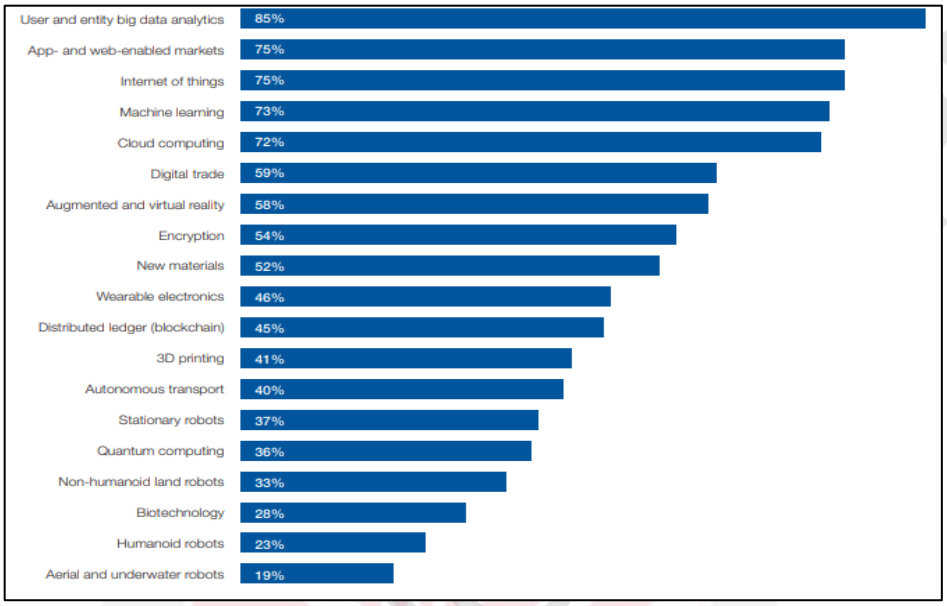


Figure 1.1 : Future of job survey 2018, World Economic Forum

There are various drivers in the development of Industry 4.0 (Schwab, 2016), including Big Data, the Internet of Things (IoT), Cloud Computing, and Robotic and Artificial Intelligence (AI). Big Data becomes a critical element for decision-making in Shift 11, Industrial Revolution 4.0 (4IR) kit (Schwab, 2016). For instance, in the business sector, the data volume is doubled, thus, entails some improvements in new business models, technology and as well as workplaces (Boonsiritomachai, 2014). This is crucial since we are facing 4IR. Due to 4IR, the MOE instructs all organizations within the ministry to use Big Data technology since Big Data is seen as a must technology in education (IT and Government Internet Committee Meeting on 2014 March 28). In addition, the organizational structure of the Ministry is very large, comprising 34 divisions, 16 JPNs, 142 PPDs, 27 Teacher Education Institutes and 10,208 schools (EMIS data on 31 January 2020). This large number of institutions contributes to the enhancement of the issue of current ICT landscape effectiveness concerning technology, capabilities, competencies and infrastructure.

The Malaysian Government has allocated a total of 160 million Ringgit Malaysia to achieve the government's ambition in the implementation of Malaysia's education plan in the field of educational technology. To achieve this goal, the Ministry of education aims to improve the provision of technical services and provide specialized training activities for the Ministry of Education to achieve the objective (PADU Malaysian Education Blueprint Annual Report, 2018).

Big Data is a vast amount of data that consists of various types of data and accumulates at a rapid rate (McAfee & Brynjolfsson, 2012; Ali, 2016). Organizations that can integrate Big Data will obtain useful insights and enhance their decision quality. The transformation of data into information and information into knowledge is part of a traditional value chain of information, as stated by Abbasi, Sarker and Chiang (2016). Organizations now rely on sophisticated business processes and analytics to be competitive in the global marketplace (Abbasi, Sarker & Chiang, 2016). This is the same scenario as in the education sector (Sin & Muthu, 2015). It is estimated that the amount of data produced by different business practices and functions is rising at an exponential rate (Ali, 2016).

In the Malaysian context, Big Data represents part of information and communications technology (ICT) which is a critical initiative to enhance the efficiency and effectiveness of the ministry's delivery system for management and administration as well as teaching and learning. The Ministry provides a huge amount of yearly allocation for implementing ICT based on initiatives encompassing the provision of various infrastructures such as security, networking, hardware, equipment, and application system development (Aliah, 2014).

Big Data is able to transform the public service for better productivity through efficient service delivery. Through the use of Big Data, the government could make better decisions based on faster and more precise data analysis (Fazidah, 2016). External data analysis such as from social media could give input from specific domains, people, and the international world. The correlation of internal and external data can improve the decision-making process by providing descriptive, diagnostic, predictive, and prescriptive decisions. The global practice has proven that Big Data analytics can enhance the delivery of Government services through proactive and effective plans to formulate the policies (MAMPU, 2016).

At this time, there are three strategic imperatives of Big Data stated in MAMPU. First, the Development of Data scientists, second, unlocking the value of the government's Open Data and third is driving Industry-driven Innovation for impact use cases. In line with these strategic imperatives, MAMPU with MDEC joint venture has conducted four pilot projects (Figure 1.2). The Ministry of Education Malaysia (MOE) has launched the first phase of setting up Big Data Centres of Competency in four universities and one polytechnic in the country with the Prestariang Group. This will provide the training platforms to nurture and guide the talents toward supporting and consolidating the global growth of Big Data today and in the future.

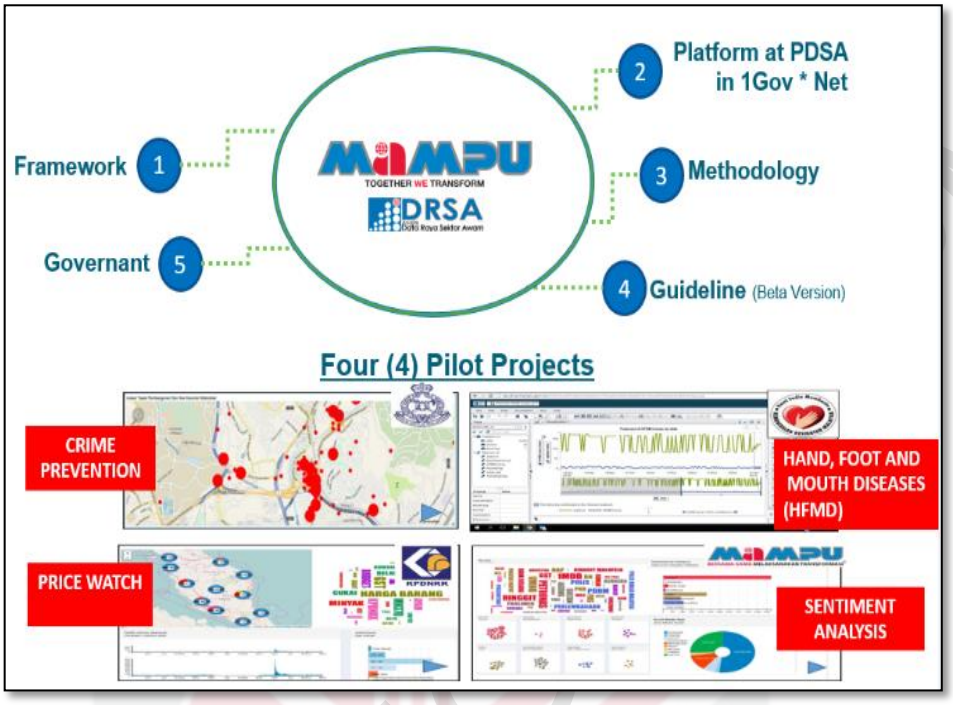


Figure 1.2 : Pilot Projects on Government Sector Big Data Analytics
(MAMPU, 2016)

Asformention, some factors influence the user intentions towards adoption of big data technology focusing on technology, organization and environment context. Therefore, in the context of technology, the factors for example; perceived usefulness, perceived ease of use, compatibility and security are discussed in the next chapter. Then, for organisational context, the factors for example top management support, IT expertise and organizational resources that see can influence the user intention on Big Data technology adoption in the educational organization are discussed. In the environmental context, the factors for example; government support, government policies, competitive pressure, external support and privacy that may influence the Big Data technology adoption in the educational organization are also discussed.

1.4 Problem Statement

In Malaysia, Big Data is referred to as "Data Raya." Since 2013, MAMPU has provided a forum for all Malaysian ministries to embrace Big Data technology, especially in the areas of technology, industry, and economics but mostly in education. Education is a necessary component of raising generations that are more humane and technologically capable. As a response, this research aims to go further into the MAMPU's mandate to

adopt Big Data technology in education through the Ministry of Education (MAMPU, 2016).

Throughout this vein, investigating the factors that influence the user intention to adopt Big Data technologies is crucial and timely as more users use this technology, the more operations and management are organized, and the costs are reduced (Lamba, & Dubey, 2015). In Malaysia, based on the 2017 Annual Report Malaysia Education Blueprint 2013-2025, there are several issues identified. The issues related to Big Data are underutilization of the latest technology, development of a silo system, overlapping functions among applications, difficulty in maintenance and operations and lack of expertise, and competency.

Malaysia's education system is awash with data and it is not easy to analyze the data that has been collected through many entities in multi-level, centralised and decentralized organizations in this complex system. Organizations' personnel, in education in particular are still unskilled and do not feel the importance of Big Data technology. To make matters much more complicated, the importance of Big Data is often case-dependent, with certain data being extremely valuable to one organization but less to another (Ylijoki & Porras, 2016). Even organizations that believe in Big Data's transformative power are left wondering how to accomplish it because there is no consistent path to value. As a result, the real challenge is considering the worth of data (Jin, et al., 2015; Court, 2015).

While Big Data is seen as meaningful, educational organizations with limited resources and knowledge may be unable to manage the jumbled data they have. Producing appropriate decisions can be difficult without the required data handling tools and a structure that encourages data usage, which could restrict an organization's effectiveness (EMC, 2013). Furthermore, when it comes to Big Data technology, the main item to consider is the cost of the technology which is expensive. Organizations may be hesitant to use this technology because of the ongoing maintenance costs (Khanna, 2016). Another requirement includes ensuring proper infrastructure and data governance (Manyika et al., 2011). As a result, optimizing the potential of Big Data presents significant obstacles for organizations.

Big Data technology and data science is a new area that has been identified as a key component in ICT, especially in IR4.0. In line with that case, data scientists are expected to be the most essential new profession and visible career in future years. At this time, there are only eighty (80) data scientists in Malaysia and none of them is from the public sector. While the MDeC is aware and has targeted to have 2,000 data scientists by 2020. Hence, the Malaysian public sector needs to produce data scientists so that another twenty Big Data projects will be developed using internal expertise.

Government budgets will be cut by using internal expertise, as there would be no reliance on a third party. Even though tools and software will assist in the advancement of Big

Data projects, the expertise and competency of IT officers are more critical. Several programmes and projects, such as conferences, training, and certification requirements, were implemented to expand the number of data scientists. Unfortunately, the initiatives' implementations are still insufficient. Besides that, JPA, INTAN, and MAMPU have jointly launched the competency model for IT Services, however, the roadmap does not include any specific to the data scientist competency development.

Although Big Data is cutting-edge technology, there is still a lack of experienced staff with the necessary skills. According to a Russom (2013) study, 46% of respondents said that "inadequate personnel and expertise are the leading barriers to BDA". Before being able to use the method, educators and students must be qualified to understand it. Big Data domains present information clearly and understandably. Finding competent experts who understand how to extract, analyse, and make effective use of data, as well as how to recognise the cognitive structures that should be promoted in technology-enhanced learning environments, is a difficult challenge (NARST, 2015). Not to mention the high cost of hiring such experts, which is a separate issue. According to the International Data Corporation (IDC), there is currently a need for 181,000 deep analytical experts, as well as five times the number of positions requiring Big Data management and interpretation skills (Bienkowski, Feng, & Means, 2012).

Malaysia's public sector introduced "Digital Government" in early 2015 to fulfil Malaysia's 2020 mission aspiration. Digital government, according to Fazidah (2016), is a revolution in technology that uses data to improve, transform, and create government services for individuals and the government. According to Multimedia Development Cooperation (MDeC) (2014), Big Data is a key component of Malaysia's Information and Communication Technology (ICT) services and a critical sector in Malaysia's digital economy.

Malaysia's public sector, led by the Prime Minister's Department's Malaysia Administrative and Modernization and Management Planning Unit (MAMPU), has developed a Big Data project called "*Data Raya Sektor Awam*" (DRSA), or Public Sector Big Data Analytics. DRSA's goals are to improve service delivery to citizens and businesses while also assisting stakeholders in strategizing their business functions. Four (4) government agencies were involved in the early stages of DRSA development in initiating domain projects. DRSA was developed using the expertise of a third party. The development of the system by a third party in the Malaysian public sector, not only for DRSA but for other projects as well, is due to a lack of skill among Malaysian public sector IT officers.

According to Deloitte (2012), the common issues and problems of hiring a third party are organization information being exposed to the outsiders, not compliance with the existing legal and regulations, no business continuity, and Government costs will increase. Besides that, another risk of IT outsourcing is IT staff will lose out in terms of knowledge and know-how in certain areas. Based on the Malaysian Public Sector ICT Strategic Plan (2016), by 2020 Malaysian Government aims to strengthen the capacity

of public sector IT officers to develop another twenty (20) Big Data projects. Hence, the Malaysian public sector needs internal expertise called data scientists to develop and manage the Big Data projects.

Then, there is high demand for IT experts especially data scientists, particularly in Malaysian organizations. Data scientists, in particular, must perform the task of uncovering hidden patterns, detecting trends, or finding useful information from raw data – this is critical for any organization hoping to benefit from Big Data (Manyika, et al., 2011). However, qualified candidates are hard to find, making recruitment difficult and costly (Carnelley & Schwenk, 2016). Therefore, the IT expertise factor in this research will help the organizations to indicate the significance of this factor towards Big Data adoption.

The data proficiency gap, on the other hand, is being dealt with from a variety of angles. Universities have developed degree programmes to prepare the next generation of analytically literate employees, for example. Businesses and governments are looking for graduates with relevant credentials in not only mathematics, statistics, and computer science, but also social science and economics, to form multidisciplinary data, and science teams. However, educational organizations in the Ministry of Education are still lacking in data skills (Fazidah, 2016). In absence of that, the syllabi in schools and universities need to be aligned with the needs of the job market which is to form data scientists that can help to address this issue.

Traditional security methods such as firewalls, disaster recovery plans, encryption, strong password policy, and antivirus software are not sufficient enough to secure advanced technologies such as Big Data, the Internet of Things (IoT), and Cloud Computing. Aside from securing the storage, transmission, and processing of vast sets of diverse educational data forms, it shows that education institutions lack adequate policies that control and govern intellectual property as well as data access (Daniel, 2014).

Big data poses big privacy concerns and how to preserve privacy in the digital age is a prime challenge. Huge investments have been made in Big Data projects to streamline processes; however, organizations are facing challenges in managing privacy issues, and recruiting data analysts, thus hindering organizations in moving forward in their efforts towards leveraging Big Data (Porambage, 2016).

Security is a major issue and is identified by Lu et al. (2014) who argue that if security challenges are not appropriately addressed then the phenomenon of BD will not receive much acceptance globally. Securing Big Data has its distinctive challenges that are not profoundly different to traditional data. Among the several Big Data related security challenges are the distributed nature of large Big Data which is complex but equally vulnerable to attack (Yi et al., 2014), malware has been an ever-growing threat to data security (Chong, Abawajy, Ahmad, & Hamid, 2014), lack of adequate security controls

to ensure information is resilient to altering (Bertot, Gorham, Jaeger, Sarin, & Choi, 2014), analysing logs, network flows, and system events for forensics and intrusion detection has been a challenge for data security (Cardenas, Manadhata, & Rajan, 2013), lack of sophisticated infrastructure that ensures data security such as integrity, confidentiality, availability, and accountability, and data security challenges become magnified when data sources become ubiquitous (Demchenko, Grosso, De Laat, & Membrey, 2013).

The significant resources have been allocated to support the data-intensive operations (i.e. acquisition, warehousing, mining and cleansing, aggregation and integration, processing and interpretation) – all of this lead to high storage and data processing *big costs* (Raghavendra, Ranganathan, Talwar, Wang, & Zhu, 2008). The cost of data processing and other operational expenditures of the data centre is a sensitive issue that may also impact the way organizations adopt and implement technological solutions (Nuaimi et al., 2015).

To sum up, there are several issues identified in this research. The issues related to Big Data are underutilization of the latest technology, development of a silo system, overlapping among applications, difficulty in maintenance and operations and lack of expertise, and competency (Annual Report Malaysia Education Blueprint 2013-2025). Then, lack of security and privacy concerns become the issue to be addressed in this research.

1.5 Research Objectives

Given the advantages of using Big Data analytics and technology, the Malaysian government should concentrate on ways to improve the technology's ongoing use. The study's primary goal is to look at the adoption of Big Data technology in Malaysia's Ministry of Education. As a result, the study's goals are as follows:

1. Determine whether the factors of perceived usefulness, perceived ease of use, compatibility, security, top management support, IT expertise, organizational resources, competitive pressure, external support and privacy significantly influence the user intention toward Big Data technology adoption in educational organizations.
2. Determine the role of organization size as a moderator between top management support, IT expertise and organizational resources with user intention to adopt big data technology in educational organizations.
3. Determine the importance of every factor that influences user intention toward Big Data technology adoption in educational organizations.
4. Develop a prediction model to predict factors that influence user intention to adopt big data technology in educational organizations.

1.6 Research Questions

The following research questions were asked for this study in order to accomplish the above objectives:

1. Do perceived usefulness, perceived ease of use, compatibility, security, top management support, IT expertise, organizational resources, competitive pressure, external support and privacy significantly influence the user intention to adopt Big Data technology in the educational organization?
2. Does organization size moderate between top management support, IT expertise and organizational resources with user intention to adopt big data technology in the educational organization?
3. How important is each of the factors influencing user intention toward Big Data technology adoption in the educational organization?
4. What are the contributions of this suggested model toward educational organizations in Malaysia?

1.7 Research Scope and Limitation

The organizational structure of the Ministry is very large, comprising 34 divisions, 16 JPNs, 142 PPDs, 27 Teacher Education Institutes and 10,208 schools (EMIS data on 31 January 2020). This large number of institutions contributes to the enhancement of the issue of current ICT landscape effectiveness concerning technology, capabilities, competencies and infrastructure.

This study involved only the organizations located in the MOE. Since there are only 434 organizations which consist of divisions, JPNs, PPDs and subunits in divisions, JPNs and PPDs. This study used questionnaires to find the factors that led to the adoption of big data technology in MOE organizations. Therefore, the questionnaire provided to the organizations is limited to the questions contained in the questionnaire only. In addition, data collection relies heavily on MOE's permission, timeliness, understanding and honesty of organizational respondents to answer questions provided by the researcher.

Due to the Covid-19 pandemic, the response to the survey experienced a time constraint. The researcher needed to contact the purposive sample one by one to respond to the questionnaire. Hence, the limits of this study are recognised, and future research may benefit. Although this research looked into several significant topics, it has some flaws. These limitations will make it difficult to apply the results of this study to all levels of Malaysian educational institutions.

Because of the Covid-19 Pandemic, researchers have limitations when it comes to obtaining review feedback. It would be agreeable if the survey could be done entirely online. Researchers have used the survey monkey application method and yet have to use the traditional method to obtain survey questionnaire feedback. This research design used cross-sectionally may still be in a state of uncertainty. It is better to recommend that these limitations be overcome by conducting observational studies for a longer time.

1.8 Significance of the study

This study is expected to contribute to both theoretical and practical perspectives. There are two main reasons that the study aims to accomplish namely; First, many of the existing studies on individual adoption of information technology (IT) have focused on investigating the intention to use or to adopt an IT, while less attention is paid to the post-adoption environment where individuals decide whether to continue or discontinue using an IT (Thong, Hong & Tam, 2006) particularly in the Malaysia context.

In concentrating on the ideas, this study integrates three specific theoretical and practical reasoning for the significance of this study. The contributions are:

Theoretically,

1. This study develops and validates a research model by adapting and integrating the TOE model, TAM Model and DOI Model. Then, the organizational size is a moderator to superintend the adoption of big data technology in MOE.
2. Secondly, this study will add to the growing body of literature by identifying and highlighting the factors that influence big data adoption, especially in the education field.
3. Thirdly, this study is expected to contribute to the evidence in support of the determinants of big data technology adoption, especially in the Malaysian context.

Practically,

1. This research can help the policy maker to have a better understanding of the factors that influence the officers to use big data technology as mentioned in the mandate. Thus it would provide valuable suggestions in the development of practice and policy-making to enhance big data technology usage.
2. Although several studies have been conducted by various parties including independent researchers all over the world, most of them have focused on the pre-adoption environment of intention to use, hence this research is more focused on the post-adoption environment whereby the findings of the study are expected to provide empirical evidence of big data technology adoption from the officer's perspectives.

1.9 Operational and Conceptual Definitions

Discussed below are the operational and conceptual definitions of this research.

1.9.1 Big Data Technology (BDT)

Big Data Technologies can be defined as software tools for analyzing, processing, and extracting data from an extremely complex and large data set with which traditional management tools can never deal. Big Data technology refers to the software and hardware which allows for the analysis, data collection, process, and interpretation of large amounts of data with a wide variety of formats and speeds. In Ministry of Education in Malaysia applied various software and hardware to support this technology. Power BI, CouchDB, Hadoop, Cassandra, Hive, Pig, MongoDB, and AsterData are examples of Big Data technologies. In this study, Big Data refers to the various software and hardware to support the management and operation of the education organizations under the Ministry of Education.

1.9.2 Big Data Technology Adoption (BDTA)

Big data technology adoption is the stage at which a decision is made about adopting particular hardware and software technology (Thong 1999) and involves various activities, including managerial and professional/technical staff decision-making in both the internal and external environment.

The implementation of big data technology focuses on the government sector in educational organizations. The use and adoption of big data in government processes make for cost, efficiency, and innovation efficiencies, but it is not without faults. Big data technology become an innovation in technology. Based on Damanpour (1991) defined innovation as the generation, expansion, and adaptation of new ideas. Although researchers in developing countries have been limited, various studies are being conducted to look at technology adoption (Wang et al., 2010). In addition, according to Zhu et al. (2006), the process of application of innovation is highly suitable for a focused study in emerging economies and the regulatory environment and economic status of these countries are different from developed countries.

In this context, the implementation of big data technology focuses on the government sector in educational organizations. The use and adoption of big data in government processes make for cost, efficiency, and innovation efficiencies, but it is not without faults. Data analysis often requires multiple parts of government (central and local) to work in collaboration and create new and innovative processes to deliver the desired outcome.

1.9.3 User Intention (UI)

This approach is recommended by Venkatesh, Thong, and Xu (2016) as the path forward for a multi-level framework for the Unified Theory of Acceptance and Use of Technology (UTAUT). This study focused on users' beliefs and trust in their intention to use BDT for decision making. However, in this study, the earlier model which is TAM Model will be used.

1.9.4 Perceived Usefulness (PU)

Describes the subjective possibility that adopting a certain application system will increase a potential user's work performance within an organisational setting (Davis et al., 1989). Describes the possibility that adopting a certain application system will increase a potential user's work performance in MOE organizations.

1.9.5 Perceived Ease of Use (PE)

The difficulties to handle the technology may be best referred to as the attribute of perceived ease of use. It also can be described in this research as "the degree to which a person feels that using a particular system will be painless" (Davis et al. 1989). Then, operational definition, in this research is the degree to which an organization feels that using a particular system will be painless.

1.9.6 Compatibility (CO)

In this context, the extent to which a user determines the suitability of an item in line with current ambitions, previous experience, and organizational needs is referred to as compatibility (Rogers, 1983). In this context, the suitability of big data technologies is to be applied in MOE organizations.

1.9.7 Security (SE)

Security refers to the protection of the enormous amount of revealed information that can cause disaster if misused at the personal, industrial, governmental and country-level (Salleh and Janczewski, 2014). This study predicts that Big Data security needs to be empirically addressed in adoption research. As a result, this thesis will add to Salleh and Janczewski's work by seeking to clarify how security concerns may affect the adoption of Big Data technology. Due to uncertainties in the world, the data need to be protected. It becomes an important factor in maintaining and storing data to prevent the occurrence of destruction.

1.9.8 Organization Size (OS)

The adoption is reflected in organization per se, the size of an organization is believed to affect several organizational aspects, including resource availability, decision-making, and organizational structure (Rogers, 1995; Hameed, et al., 2012b). Reflecting the organization in MOE per se, the size of an organization is believed to affect many organizational aspects, including resource availability, decision-making, and organizational structure which predict can moderate competitive pressure and privacy with user intentions.

1.9.9 IT Expertise (IE)

It has been suggested that a highly-skilled, knowledgeable, and experienced workforce is a key factor affecting the adoption of IT and innovations (Ettlie, 1990; Lucchetti & Sterlacchini, 2004). In this study, IT expertise is related to the experience of IT employees in terms of skill and knowledge (Hameed, et al., 2012b), and has been widely studied in adoption literature under highly similar terms such as IS competence (Nam, et al., 2015), IS knowledge (Thong, 1999), IT competence (Zhu, et al., 2006b), employee skill (Meyer & Goes, 1988), and technology readiness (Ifinedo, 2011). In this study, IT expertise is related to the experience of IT employees in terms of skill and knowledge in Big Data technologies.

1.9.10 Top Management Support (TMS)

Top management support has been a recurring critical factor in IS adoption research (Thong, et al., 1996), and is believed to play a crucial role in all stages of innovation adoption (Hameed, et al., 2012b). This study refers to support given by the leader or top management to their officers to adopt big data technologies and use them in their organizations.

1.9.11 Organizational Resources (OR)

This study refers both to organizational resource availability (Boonsiritomachai, 2014) and resource slack (Li, et al., 2011). Through good resources, the intention of organizations to adopt new technology is affected by the appropriate availability of financial, technological, and human resources (Hameed, et al., 2012). This study refers both to organizational resource availability and resource slack such as software and hardware, training and financial resources.

1.9.12 Competitive Pressure (CP)

Competitive pressure definition is the degree of pressure that the company faces from competitors within the industry (Boonsiritomachai (2014). This study is concerned with Competitive Pressure (CP) which touches more on the business side rather than the educational side. This attribute will examine whether it influences big data technology adoption in the public sector. Porter and Millar (1985) analyzed the strategic rationale underlying the relationship between competitive pressure and IT innovations (Zhu, et al., 2004).

1.9.13 External Support (EX)

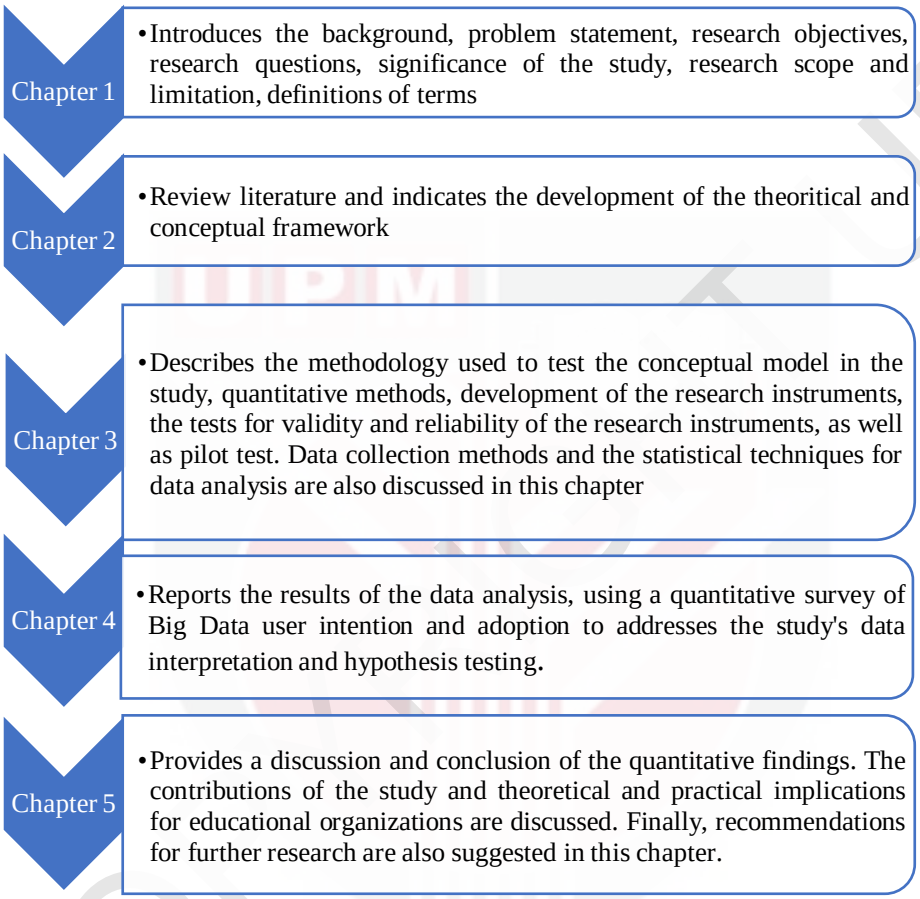
External support is described as the "availability of support for developing and using an information system" (Premkumar & Roberts, 1999). This study is hypothesized to increase an organization's willingness to try novel technologies (Premkumar & Roberts, 1999). It is also believed to serve as a means by which organizations may compensate for a lack of internal IT expertise (Thong, 1999). In the absence of internal IT knowledge, this study may discover that organizations tend to seek the help of consultants and vendors.

1.9.14 Privacy (PV)

Organizations need to keep confidentiality and all secrets need to be controlled so that information does not get leaked out of the organization. Such information is not disclosed to third parties, and it is known as privacy (Porambage, et al., 2016). In the public sector in particular it is necessary to protect the basic principles of privacy because there is a lot of data if the number of users is increasing (Datatilsynet, 2013). Besides, the information is not disclosed to third parties, known as privacy ((Salleh and Janczewski 2016; Porambage, et al., 2016). Organizations need to keep confidentiality and all those secrets need to be controlled so that information does not leak out of the organization.

1.10 Organization of the thesis

This thesis is organised into five chapters as follows:



1.11 Chapter Summary

This chapter presented the research background which consists of the introduction of big data technology, and factors that are predicted to influence user intentions to adopt big data technology. Formerly, followed by the problem statement, research objectives, research questions, research scope and limitation, the significance of the study and definitions of key terms have been listed and discussed based on educational organizations in Malaysia.

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