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Exploring the Big Data and Cloud Computing Management in E-Government Services: A Qualitative Case Study in Terengganu Public Sector

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ABSTRACT

The emergence of big data has caused various challenges to data management lifecycle including storage, processing, sharing, and applications. During the same time frame, the fast development in cloud computing provides increased efficiency in computing support that address these challenges. However, there are issues in big data and cloud computing management which include security concerns, data fragmented, and distrust in using clouds that could become the roadblock to e-government services success. Although ensuring data management has been the responsibility of providers in the public sector, this issue seems to be unavoidable. In such circumstances, initiatives from the public sector agencies are crucial to ensure data is effectively managed. This research in progress aims to investigate how the public sector agencies in Terengganu manage data to improve the e-government performance. The research uses the interpretive research paradigm and adopts the qualitative research methodology using a case study design. A single case of a public sector which utilizes big data and cloud computing within the e-government platform is selected as the case for this research. The findings of this research are expected to be used in developing a framework of big data and cloud computing management which will assist in providing reliable and accurate information to citizens within the e-government environment.

Keywords: Big data, Cloud computing management, E-government services, Terengganu Public Sector.

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INTRODUCTION

In recent years, the public sectors have increasingly adopted cloud-based technologies as a means that allows for flexible access to computing resources and cost reduction in staffing (Pierre et al. 2020; Tsohou et al. 2014). This situation is also emergent as large amount and high complexity of data from various sources are gathered and need to be managed by organizations. Hence, most 21ˢt century public sectors are moving towards electronic government which aims to provide a holistic and quality services and administration by utilizing big data and the cloud-based solutions. These enhanced performances could be achieved by improving the data management (Shams and Solima, 2019) and the cloud security and control to maintain a safe position of the organization while working in cloud infrastructures (Spanaki et al., 2019). Another critical aspect is to empower the staff to optimize their knowledge and skills in utilizing cloud-based tools thus help in achieving quality in e-government.

Cloud computing has a great impact on changing business and government operations. Originally, the cloud platform was introduced to customers as a way to backup data files stored in local hard drives (Mcneish, Francescucci and Hazra, 2015). Cloud computing refers to "the abstraction of hardware, software, networks, storage spaces and services used by system developers to execute complex processes and to provide those facilities" (Ghaffar, 2020, p.2). With the

transformation in businesses and the government sector in providing services, many government bureaus have realized the importance of using the clouds and internet channel to deliver quality services to citizens (Tsohou, Lee and Irani, 2014; Mourtzis and Vlachou, 2016). For example, the advancement use of clouds can assist in enhancing government service to customers and reducing operation costs to organizations.

In the Malaysian context, big data and cloud computing technology are not new concepts and are leading towards a full-fledged cloud computing hub. According to the Asia Cloud Computing Association's Asia Readiness Index 2020, Malaysia is ranked eight out of 14 Asian nations in cloud readiness, which is a position held since 2018 (Jalil, 2020). The Malaysian government has initiated many cloud-based government projects such as in the recent announcement made in the budget 2020 where the government allocated RM21.6 billion into the National Fiberisation and Connectivity Plan (NFCP) (Abraham, 2020). Such a large amount of budget indicates the effort of the government towards accelerating digital transformation by promoting increasing cloud adoption and roll-out of 5G connectivity throughout Malaysia (Abraham, 2020).

Despite the benefits that clouds could provide and the efforts made by the government, impact studies show that cloud

computing applications are not fully utilized due to lack of infrastructure support, weak Information Technology (IT) knowledge, and lack of awareness among the public sector employees (Amron et al., 2019). Furthermore, increasing in data and information needs via electronic government platform require a manageable and successful data management solution for the public sector (Ambira, Kemoni and Ngulube, 2019; Decman and Mirko Vintar, 2013). Unlike traditional ways of offering services, the electronic service entails greater risks to online users. Such risks include security concerns, data fragmented, and distrust in using clouds within the electronic government environment (Ghaffar, 2020; Adu and Ngulube, 2016; Stefanou and Skouras, 2015; Adjei, 2015). In addition, the imbalance between services offered by the local authorities to the citizens occur because the users' need of information may increase over time which demand for more flexibility, accessibility and scalability in using the cloud data (Tsohou et al. 2014).

Although the advancement in cloud technology and big data analytics suggest that the local authorities could improve the data management, the public or citizens are generally concerned with loss data in the clouds (Wasike and Njoroge, 2015), data privacy trust (Coss and Dhillon, 2019) and difficulties in finding information and services provided by the local public authorities (Tsohou et al. 2014). The reasons being,

the information available to citizens is fragmented, inaccessible and disclosed without consent (Ghaffar, 2020). Thus, to gain deeper understanding of the big data and cloud computing management issues in the Malaysian context, this study aims to explore how the public sectors manage data for improving the electronic-government performance.

While on one hand big data and cloud computing offer many benefits, on the other hand, there is a concern about how local e-government manages big data and the cloud-based technology. This is because, without appropriate data management strategy, the implementation of this potentially digital transformation in the e-government could become a massive failure (Stefanou and Skouras, 2015; Shahzad, 2014; Decman and Mirko Vintar, 2013). Consequently, the data management for clouds could affect the e-government existing policies, legislation, processes, and standards in delivering services to the public especially in the new digital environment and changes (Decman and Mirko Vintar, 2013).

It means that, a lack of a clear framework for managing big data and cloud computing poses a major threat to the sustainability and quality of services offered through the local e-government platforms (Ambira, Kemoni and Ngulube, 2019). A holistic framework is thus, needed to describe how big data and cloud computing could be utilized together for improving data management efficiency (Li, et al., 2020). Inefficient data management not only limits access to reliable and quality information but also the flow of services of e-government could be at risks. Hence, gaps in data management within the e-government could undermines the government efforts in promoting quality services (Rotchanakitumnuai, 2008). Therefore, this research aims to explore the practice in managing big data and cloud computing for the purpose of developing a framework of big

data and cloud computing management to improve the e-government performance in the public sector services.

LITERATURE REVIEW
Big Data
The rise of big data addresses the recent trends in the growth of data, characterized by its volume, velocity, and variety of information which usually are cost-effective and innovative in increasing insight, proper decision making and maximum output (Gartner, 2018). Other researchers added veracity and value to the criteria which indicated the quality, trustworthiness, authenticity, origin and availability of data (Anshari, et.al., 2016; Zainal, et.al., 2016).

The growth of social media and machine-to-machine communication also contributes to the high volume, velocity and variety of data. It is estimated that 6,000 tweets are sent every second and the number of active users of Facebook exceeds 2.6 billion monthly as of the first quarter of 2020 (Noyes, 2020). Since big data is generated by large, network-based systems, it can be in either a standard or non-standard format. If the data is in a non-standard format, artificial intelligence from the cloud computing provider may be used in addition to machine learning to standardize the data. Meanwhile, to process or handle big data, the Big Data Analytic is used. To make data analytics powerful, tools and storage technologies play a critical role. However, it is evident that big data creates overbearing demands on networks, storage and servers, which prompted organizations to proceed to the cloud to be able to gain maximum benefits of big data.

The data management strategy has evolved from computer file systems to database management systems, data warehousing, and business intelligence. Big data and cloud computing emerged as a result of technology advancement in business (Chan, 2020). Essentially, big data refers to the large sets of data collected, while cloud computing refers to the mechanism that remotely takes this data in and performs any operations specified on that data. The cloud infrastructure allows for real-time processing of big data and lets big data analytics to occur in a fraction of the time it used to.

Cloud computing
Cloud computing is the delivery of on-demand computing services from applications to storage and processing power, typically over the internet or on a pay-as-you-go basis. It is referred to as *"a technology that provides flexible location-independent access to computing resources that are quickly and seamlessly allocated or released in response to demand"* (Tsohou et al. 2014, p.252). Meanwhile, the definition by the National Institute of Standards and Technology (NIST) provides a comprehensive picture of cloud computing characteristics, deployment and service models (Aziz, et.al., 2013). There are five characteristics of cloud computing which are broad network access, on-demand self-service, resource pooling, rapid elasticity and measured service. The three types of cloud deployment models are the private cloud, public cloud, and hybrid cloud. Meanwhile, among the basic services offered by the cloud providers are the Software as a Service (SaaS) for example Dropbox, Platform as a Service (PaaS) for example Google App Engine and Microsoft Azure and Infrastructure as a Service (IaaS) for example Amazon Web Services.

The adoption and implementation of cloud computing technology have been emergent in this era of Industry Revolution 4.0 (IR4.0). In the Malaysian public sector, the government cloud initiatives or MyGovCloud was introduced and officially launched in July 2013 to embark the initiative of National Digital Economy. The MyGovCloud deployment model was based on a private cloud and the service was based on Infrastructure as a Service (IaaS) (Sallehudin, et. al., 2020). As reported by Gartner Inc., a leading research company in technology, cloud computing users will double and simultaneously, its value will increase from $153 billion in 2017 to $302 billion for 2021(Wheatley, 2018). It is because, this technology offers enormous and multifaceted advantages, ranging from cost savings, increased efficiency, improved reliability and security to the great flexibility and scalability.

Among the key benefit of using cloud services is organizations can move faster on projects and test out concepts without lengthy procurement and big upfront costs because they only pay for the resources they consume. There is no need for organizations to buy servers, update applications or operating systems, and dispose of hardware or software when they become outdated, as it is all taken care of by the cloud suppliers. Another benefit claimed by cloud computing services and resources is the high efficiency obtained in service delivery due to a fast and accurate processing of information (Armbrust et al., 2010).

However, the main adoption issue of cloud services remains within the security concerns. Users fear of any fraudulent use of data in the cloud, unauthorised downloads, and malware threats while data moving to and from the cloud. For the government, the challenges would be the issues of integration and standardization of the systems, ability of the service to reach end users because of network infrastructure and trusts from the public about the reliability of the government services (Aziz, et.al., 2013).

E-government

E-Government is an innovative transformational of technological platform, a mechanism that the government uses to improve the citizen-government relations by providing quality services to the citizens. Its purpose is to increase citizens' satisfaction with the services and a way to gain their trust in the government (Morgeson, et.al., 2011). It is done through offering a better quality government Web sites, transparent government information and improved services due to the growing public concern about openness and accountability of the government. Examples of e-government projects in Malaysia are Electronic Procurement (eP), Human Resource Management Information System (HRMIS), E-Syariah, Electronic Labour Exchange (ELX), e-Tanah, e-Consent, e-Filing, e-Local Government (e-PBT), Custom Information System (SMK) and many more.

The benefits of the e-government implementation are found to lower administrative and operational costs as business processes are reduced and streamlined. The systems also provide latest integrated information online that help users to improve the accuracy of decisions (Kaliannan, et.al., 2007). However, due to the rapid growth of telecommunication technology such as social media and the large growth of online data, the e-government faces challenges in terms of technology, people, and business process perspectives. The numerous repeated transactions and exchange of information caused the need for the increase in storage capacity and processing ability of the e-government system. According to Al-Sai and Abualigah (2017), the solution for this situation were the adoption of cloud computing and application of big data management. Other challenges are the lack of experts and skills in human capital, and lack of compatibility with existing IT systems.

Organizational Information Processing View (OIPV Theory)

This research uses the Galbraith's Organizational Information Processing View (OIPV) to examine the fit between information processing needs and information processing capability in an organization. The OIPV suggests that organizations' structure, mechanisms, and processes revolve around information flows (Tushman & Nadler, 1978). The main objective of this theory is to reduce uncertainty in information flows and management which lead to the data utilization across different context (Kowalczyk & Buxmann, 2014). Every organization involves in different kinds of organizational tasks that require different needs for the processing of information. Briefly, the information processing capabilities must match with the organization's needs for handling and processing the information. Thus, in this research, OIPV provides a useful lens to examine how the organizations manage their big data and cloud computing to improve the e-government services.

METHODOLOGY

This research proposes to develop a framework of big data and cloud computing management to improve the e-government performance in the public sector services. The first step taken was databases search, in order to help us obtained initial understanding of the current research scenario and prior literatures in this field. Databases such as Science Direct, SpringerLink, Emerald, EBSCOhost, and Scopus were used to search for peer-reviewed articles, chapters and conference proceedings (Lepmets, Cater-Steel, Gacenga, & Ras, 2012). The keywords used included "big data", "cloud computing", "e-government", "public service", "data management", "information processing", and "qualitative case study". Some of the keywords are found from information system, science and technology, and public service literatures.

This research intends to be conducted using a qualitative case study to explore the data management for big data and cloud computing in an organization with the e-government services. A face-to-face semi-structured interview will be used to obtain in-depth understanding and identify the concepts surrounding the issues in managing big data. A total of 15 participants from a public sector organization in Terengganu will be chosen for the interviews. They will be selected using the purposive and snowball sampling to cover a range of roles in managing data for the e-government platform (e.g., IT managers, managers, officers that handle customers e-form, e-profiles and utilize big data and cloud computing).

Data collection

This study will interview the staff who had experience with big data, cloud computing and the e-government. The potential participants will form a diverse mix of individuals working in different functional roles within the department in the selected government organization. The interviews are planned to be conducted over a period of two months. The interviews will be semi-structured in nature, which allowed for "non-structured interviews" as recommended by Yin (2012, p.12) to reveal how case study participants view reality and think of the phenomenon, not just providing specific answers to the researcher. The average duration of the interviews is expected to be between 30 to 40 minutes. In addition, this research

will also use multiple sources of evidence to support the interviews such as field notes, document search and observations. The interviews will be recorded and transcribed using the latest version of the Atlas.ti software. After collecting the data, we will analyze the data simultaneously (Yin 1993). Coding and patterns will be used to generate basic themes. The themes that represent the problem statement and provide answers to the research question will be maintained and improved. Next, the resulting themes will be examined against the initial themes derived from the literature review and thus, help to develop the research framework. Finally, the themes will be interpreted and a narrative strategy will be used to write the case report.

DISCUSSION

This research is driven by the concerns of information availability, accessibility, security and trusts among citizens in using the e-government services. With the advancement in technologies, citizens are demanding for the value-added services particularly those which are made possible using big data and cloud computing. As governments are usually the largest collector of data and the main source of information provider, increasing use of data and cloud applications has pressured the public organizations to enhance the efficiency of data management. Thus, the developed framework from this study could assist the government to provide reliable and accurate information within the e-government environment.

This research is expected to contribute to theory and practice in several ways. From the theoretical perspective, big data and cloud computing is crucial to public services because the reliability, availability, accessibility and quality of information is greatly relied on the efficiency of data management. Based on OIPV theory (Galbraith, 1974), there were five strategies that can be chose by organization to balance its information processing needs and capabilities. One of them is by increasing the capacity to process information through investment in vertical information system. The use of computers and advanced technologies such as cloud computing, big data analytics and artificial intelligent are mechanisms that can efficiently process and distribute information upwards without overloading the top organization's system.

This research is also significant because big data and cloud computing are the area of high importance for development and growth of digital transformation in public service in Malaysia. It provides an excellent introduction to organizations which are encountering these technologies for the first time by giving them deeper understanding whether there are specific factors to be acknowledged, or requirements to be fulfilled, for them to succeed in the digital transformation. This is also important so that their investment in implementing the technology will be worthwhile. For organizations which are already utilized the big data and cloud services, it is to improve the way they manage the data and information to enhance citizens trust towards e-government services.

CONCLUSION

This conceptual paper is intended to be used in future research to answer the research questions and achieving the research objectives. By examining the combination and interaction of the elements in the conceptual model, this study will lead to the identification of the best practice that e-government service providers use in attaining organizations' goals and improving efficiency. Notwithstanding the above discussion, this research will continue to improve through continuous review of the literature and related theories as well as gathering actual data from qualitative in-depth interview with e-government service providers.

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