

The Influencing Factor of Big Data Adoption for Indonesia Open Government

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Abstract

The development of digital technology in the industrial revolution 4.0 has made all aspects change, including in the field of government. This is a pressure and challenge for public organizations, as well as an opportunity to reform and adapt through Open Government. Open Government is the starting point of the Big Data era along with the Open Data process as a direct implication of openness in government. Big Data is one of the main elements of Open Government required to be adopted in government business processes. Therefore, the readiness of public organizations in adoption is an important thing to be followed up. This study aims to deliver a literature review the influencing factor of organizations readiness for Big Data adoption with the TOE (Technology, Organization, and Environment) conceptual framework. From the literature review, it is known that for the context of technology, several factors, including advantage, compatibility, complexity, scalability, and information security technology infrastructure influence the readiness in Big Data adoption. From the organizational context, the top management support, financial, human resources are also concluded to have a positive influence. Finally, from the environment point of view, the availability of laws and regulations and the focus on public services are external support systems for Big Data adoption.

Introduction

The Industrial Revolution 4.0 that carries digital technology has made the online environment develop rapidly where the relationship between information and innovation makes the structure that was originally closed and internal into a much more open and networked governance. Digital technology is considered to have a beneficial impact on the sustainability of the organization and its development.

Industry 4.0 makes the adoption of technology and information enormously significant because of its importance impact to improve the efficiency and effectiveness the organization. The adoption of technology and information then directly also increases agility, quality standards and efficiency and productivity (Reinhardt et al., 2020).

This directly puts the public sector under increasing pressure as well as new chances to reform and adopt. As such, Open Government has broken new ground in most democratic countries with the initiation of President Obama 2009 Open Government Policy and subsequent the government intention. The Organization for Economic Co-operation and Development (OECD) describes the Open Government as the new approach on transparency, accessibility, and responsiveness of the government to deliver the action, services, and information. The Open Government practices has been followed by more than sixty countries by agreement of Open Government Partnership to conduct the support and agreement for any arrangement (Roy, 2016).

The goal of Open Government focuses on transparency through increased democratic awareness, oversight, the engagement by the public sector, private sector and society in a broad context. In realizing these goals, it requires the ability of organizations to develop innovations in the public sector through the idea of Open Data (Roy, 2016). Open data is any information that is available for everyone to access, reuse, and redistribute without restriction as long as it is, at the very least, equally shared and connected. (Gascó-Hernández, 2014). Open Data enables citizens and stakeholders can access the government data without any interference of legal or politics (Meijer et al., 2014). Thus, open data is the result of cross-organizational decision-making and multi-actor policy interactions. Through the conceptualization of Open Data, the government as a policy maker realizes the need to share data and provide data sharing at any levels (Crompvoets et al., 2010). Open Government and Open Data are inseparable because the concept of Open Government needs Open Data to execute the approach.

All the elements of public, private and community can participate through data sharing to conduct the Open Data. Gascó-Hernández (2014) explains the data sharing process through four phases, namely collection, management (organization and administration), exchange and the use of data & information itself. When the government has implemented Open Data from all lines, it has implications for the production of large, diverse and fast data. This process is the beginning of the birth of Big Data, which then becomes an asset in the process of determining policies in Open Government because of its value which contributes greatly to the government decision making in the Government 3.0 era.

Researchers have defined the concept of big data from various perspectives. In 2013, Gartner revised one definition of big data, defining it as high-volume, high-speed information assets and/or a range of information assets that require creative, cost-effective formats of information. In addition, Big Data is also defined as a collection of the structured and unstructured data in the form of text, numbers, images, videos, tables, and other forms. Big Data is then processed with techniques and methodologies through smart models and algorithms to answer questions/make decision making. The relationship between Open Data and Big Data indirectly makes Big Data an important part and factor in the Open Government process to be carried out in a sustainable manner.

However, the adoption of big data in public organizations in Indonesia is still very limited. Sirait (2016) in his study using TDWI (The Data Warehousing Institute) Big Data Maturity Model analysis concluded that of the four sample institutions that have initiated and utilized Big Data in their business processes, three of them are still in the pre-adoption phase, namely the Government Goods / Services Procurement Policy Agency (LKPP), the Geospatial Information Agency, and the Ministry of Finance (Director General of Taxes) and only one institution has been at the Corporate Adoption level, namely the Bandung City Government. In addition, research related to Big Data Adoption in government organizations in Indonesia is still very minimal. From these limitations, this research was conducted to provide a literature review of the influencing factors of the Big Data adoption to contribute to the accomplishment of Open Government in Indonesia in the internal and external context with the TOE (Technology, Organization, and Environment) framework.

Open Government is a concept initiated by President Obama in 2009 that emphasizes openness and participation in carrying out government functions (Fernandez, 2016). The concept is a response to the emergence of digitalization as part of industrial progress involving technology and information. Open Government then marked the birth of the Data Openness era which directly created "Big Data" from the Open Data process. The implementation of Open Government continues to develop and is applied by countries that adhere to democracy, including Indonesia. The concept of the Open Government has been followed up by joining

the Open Government Partnership together with the United Kingdom, the United States, Mexico, Brazil, Norway and South Africa in 2011 to develop the concept of Open Government with the action plans. This was followed up through the preparation of a national action plan on Open Government with a focus on improving public services and increasing information disclosure and integrity of government institutions. Open Government needs to be supported by the transparency of information derived from public data. Public data in various forms and sources is Big Data, which ultimately contributes to the implementation of Open Government. Organizational readiness to adopt Big Data further determine Big Data implementation for Open Government

Big Data and Big Data Analytics

Big Data is defined as the data set that is too complex for conventional data tools and need the advance technology. In recent years, Big Data processing technology has become very popular in various sectors, ranging from business, government, science, research, as well as accounting and auditing. This is happening because organizations are faced with unprecedented levels of massive semi-structured and unstructured data, which must be used and managed by companies to be innovative, effective, and competitive.

Big Data contains the structured or unstructured data, that is usually explained through the four "Vs" of Volume, Variety, Velocity, and Veracity. Volume related to a large collection of data that cannot be processed with traditional tools. Variety represents the different model of data such as text-based, number, and picture, videos, and other forms. Velocity is defined as the speed of which the new data is produced, which is increasing generated in fast pace. While veracity is associated with quality and relevance that corresponds to the actual state (truth). Big Data also refers to the technologies used to create the conclusions from different types of data.

Big Data Analytics (BDA) is the procedure for examining, filtering, transforming the Big Data to distinguish and explain the useful information and finally suggest conclusions and decision (Mishra et al., 2021) using "smart" algorithms (Davenport, 2014). Big Data Analytics is then a new technique and tool that plays a role in many sectors, especially in government/public to realize effectiveness and efficiency in public administration.

Organizational Readiness

According to the ecological approach by John M. Gaus, public administration and its development are influenced by its setting or ecology and each factor has a relationship with the surrounding environment. Gaus describes seven environmental factors that affect public administration including human resources, organizational location, physical technology (hardware and software to run the organization), social technology (organizational structure), ideas and aspirations, and leadership aspects. With major changes in technology and information globally, this directly impacts the innate character of organizations that adapt to any changes. These adjustments are the realization of the Open Government reform agenda which directly requires organizations to always be ready for environmental developments, in this case to implement Big Data and Big Data Analytics. Organizational readiness to implement these changes is also associated with organizational capabilities to use organizational resources to achieve certain outcomes (O'Regan & Ghobadian, 2004).

Mnoney & Van Belle (2016) looked at organizational readiness factors and organizational capacity in adopting and implementing Big Data in the Retail Industry from the perspective of Technology, Organisation, and Environment (TOE) that combined with the Task Technology Model (TTF) approach. The TOET model is conducted to assess of the readiness and ability of retail organizations in South Africa in adopting Big Data. The TOET framework can be detailed as follows:

Table 1. Determinants of Big Data in the Organizational Environment

Technology	Understanding Big Data	Benefit	Complexity of Big Data	Big Data Tool Availability
Organization	Management Support	Human Resources	Financial Resources	Organizational Culture
Environment	Retail Industry	Competitors	Big Data Vendors	Government Regulation
Task Technology Model	Big Data Use Cases			

A study on organizational readiness in Big Data adoption was also conducted by Ghaleb et al. (2021) in the perspective of the health sector in Malaysia. The research framework is based on the Technology Organization Environment (TOE) and the Technology Readiness Index (TRI) theory. The following is the conceptual framework for the study by Ghaleb et al. (2021)

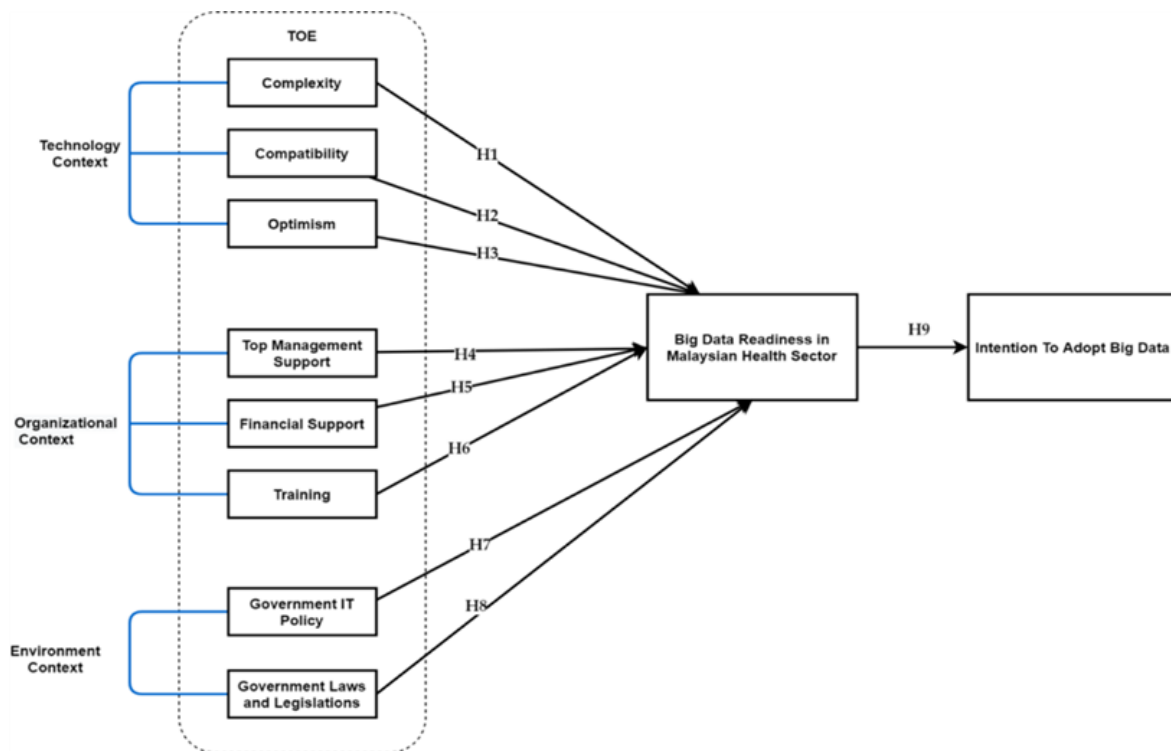


Figure 1. Conceptual Framework by Ghaleb et al. (2021)

Other factors were also identified by Nasrollahi & Ramezani (2020) that were considered likely to be determinants of organizational readiness in adopting Big Data. The design and methodology of the study determined 12 factors involved in determining organizational readiness including process, financial, stakeholders, technology, usability, organizational environment (including size and business strategy) BDA features, organizational culture, knowledge management, external environment, managerial aspects of the organization, and capabilities (referring to human resources).

In addition to the above literature, Kalema & Mokgadi (2017) investigated the readiness of Big Data Analytics in public organization in South Africa using the quantitative methods. The study examines the influencing factors of BDA readiness through the Technology, Organization and Environment (TOE) framework. It investigated four characteristics that influence the readiness for Big Data Analytics, where each character consists of several factors. The conceptual framework of the study by Kalema & Mokgadi (2017) can be described as follows:

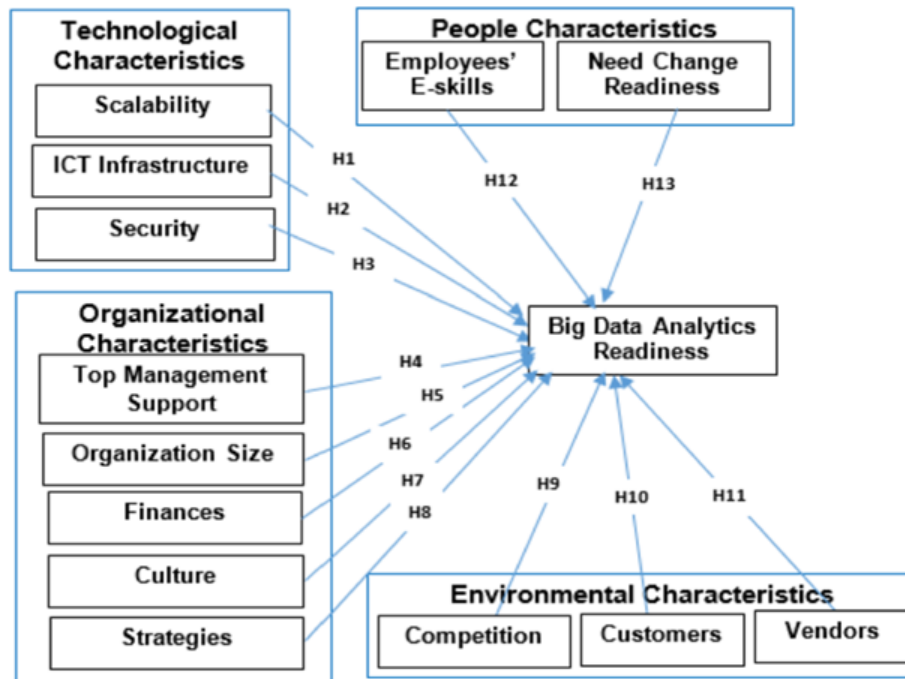


Figure 2. The conceptual framework of the study by Kalema & Mokgadi (2017)

Recent Research of Open Data Indonesia

The concept of Open Government has been initiated to the Indonesian Government at large scope. In 2014, the Indonesian Government delivered the president election through democratism principle with direct election by citizens. It was organized by General Election Committee (Komisi Pemilihan Umum) and successfully executed. The Open Government concept was evolved in the context of centralized and decentralized government by then. One of the big leap to support the implementation of Open Government is Presidential Regulation Number 95 year 2018 about Electronic Basis Government System. This regulation become the rules to deliver the Government with digital transformation approach that is finally initialised open data in Indonesia. The Government also continue to emphasize this Open Data Establishment with the Presidential Regulation Number 39 Year 2019 about Indonesia One Data (Satu Data Indonesia) as the policy for governance data. The Indonesia One Data aimed to become the Open Data Portal that generate the public data and managed by the Ministry of National Development Planning. The portal provide quality, up to date, and reliable data that can be accessed and shared among all of the government parties (central and regional).

The researches about the open data to support the Indonesia Open Government has been executed with the locus in some organisational settings included central and regional government level. First, the research of open data maturity model was conducted in Central Bureau of Statistics as Indonesia Open Data Coach to assess the implementation of Open Data on the internal context of Bureau (Rahmatika et al., 2019). In addition, the study to assess the big data maturity is also delivered in general Directorate Custom and Excise under The Finance Ministry. Besides, from the regional government context, the concept of open data is delivered into some related approach with smart governance in Yogyakarta (Felasari & Roychansyah, 2017), East Java Province e-government (Basuki & Nugroho, 2023), Sidoarjo Regency e-government (Abadi et al., 2017); Bojonegoro Regency e-government (Sayogo & Yuli, 2022). Last, from the perspective of government agent, the study of the Big Data Interaction for decision making is also conducted in the Social Health Insurance Administration Body

(Nugraha et al., 2013). The research outcome will be explained below on the chapter result and discussion to elaborate the influencing factor of big data adoption for Indonesia Open Government.

Methods

This study uses a qualitative approach with data collection techniques through literature studies of previous research results. This study uses secondary data from journals with related topics that have been published.

Results and Discussion

This part will explain about the influencing factors of the Big Data Adoption using TOE framework. It is a concept of technological innovation decision making for organizations that developed by Tornatzky et al. (1990). The approach determine three context of an organization that influence the innovation decision making, including the adoption. These context are TOE: Technology, Organization, Environment. The TOE framework does not specifically specify explanatory variables so that the variables arranged under each of the technology, organization and environment constructs are flexible and can be widely used for studies related to the adoption and implementation process of policies, strategies and business models (Wei & Gu, 2022). Besides, the influence and interrelation examination will be supported by some research result in Indonesia context.

In the context of technology, organizational readiness in accepting new technology depends on being measured based on internal and external capabilities for the organization by considering four variables, namely advantage, compatibility, complexity, triability, and observability of applications (Ghaleb et al., 2021). In addition, the variables of understanding Big Data and Availability of Big Data Tools were measured by Mneney & Van Belle (2016) in their study. Besides, the variables of scalability, IT infrastructure and security were the factors assessed related to the readiness to adopt Big Data from a technological context (Kalema & Mokgadi, 2017). Aligarh et al. (2023) define benefits as the added value of an innovation adoption. The decision maker in the organization have to understand the relative advantage for the new innovation. Furthermore, the innovation needs the compatibility where it is align with the current practice and organisation requirement. In addition, the scalability variable refers to the ability of systems and networks to handle a given load (of big data), while IT infrastructure is related to the ability to process big data that requires adequate storage media and data tools such as proper computerization (Chen et.al, 2012). In addition, aspect of security must consider protect the data and the privacy of data provider.

In the organizational context, several variables are measured to determine their influence on adoption readiness, including top management support, organizational size, and employee knowledge (Ghaleb et al., 2021), finance, culture, and strategy (Kalema & Mokgadi, 2017). The supports from top management bring beneficial impact for new technology. The top management role to direct the entire company resources and services implicate the adoption of any related policy within the organization, including the technology adoption which is big data (Kalema & Mokgadi, 2017; Ghaleb et al., 2021). Similarly, organizational size (Kalema & Mokgadi, 2017; Bening et al., 2023) also influence the adoption as large organizations have more capacity and resources than smaller organizations. Last, the employee knowledge also affect it because employees are the ones who will do the technical running of the organization.

In addition, in the context of the environment, Ghaleb et al. (2021) measure big data adoption readiness through government regulations variable. Government regulations terminate the motivation of organisation to adopt big data and technology to run it. When governments require organization to obey with new innovation in technology, public organizations will be

encouraged to adopt it which is big data. In addition, Kalema & Mokgadi (2017) measured the readiness of public organizations in South Africa to adopt Big Data through vendor and competitor and customer variables.

From the results of the previous research, it is known that in each TOE context (Technology, Organization and Environment), certain variables influence the readiness of organizations to adopt Big Data.

Technology

Understanding of big data and the availability of tools for big data are considered to have a significant influence on adoption readiness Mneney & Van Belle (2016). On the other hand, the variables of advantage, compatibility (Zhen et al.,2023; Ghaleb et al., 2021), complexity (Bening et al., 2023), triability, and observability of applications (Ghaleb et al., 2021) also influence on organizational readiness to adopt Big Data for the health sector.

Nasrollahi & Ramezani (2020) also concluded a positive and significant influence of trialability, ease of use, observability, complexity and data quality and integration to the BDA readiness. In addition, aspects of scalability, information technology and communication infrastructure, security are things that significantly affect organizational readiness for Big Data (Kalema & Mokgadi,2 017). In another form of quantitative research, Bening et al. (2023) concluded that the factors of advantage, compatibility, complexity, and security are things that influence the application of Big Data in organizations. The results of the Aligark et al. (2023) study also confirm that the benefit and complexity factors support organizational readiness for Big Data innovation.

There are some research in Indonesia to elaborate some of those influencing factors. The study of Big Data Readiness in East Java Province has conducted with CARL (Capability, Accessibility, Readiness, and Leverage) approach and use the gap analysis through in-depth interviews and data review (Basuki & Nugroho, 2023). The result shows that Information and Technology (IT) resources influence the big data readiness. This can be explained that IT is the main tools to strengthen the big data implementation. The score of big data readiness of five government agency as the research sample in East Province sample was on the level 4 out of 5 from technology and information context. Besides, the research of big data security in tax is also performed to support Indonesia One Data Governance (Misran et al., 2022). The study conclude that the security of data influence the big data adoption. From the explanation, the implementation of blockchain technology for data security can develop the tax system. The technology can be depend on figuring the issues of tax digitalization transformation. In addition, the feature of the technology influence the readiness of Big Data for the Smart Government in Yogyakarta (Felasari & Roychansyah, 2017). The application primary feature, including the data about public transportation, businesses, travel, culture, education, and health services available in Yogyakarta improve the citizen access to the government. This feature generate big data that provide the important information and feedback about the city for the government decision making. Last, the study of big data analytics capability and its influence to the decision making is examined in the Social Health Insurance Administration Body (Badan Penyelenggara Jaminan Sosial Kesehatan/BPJS). Big Data Analytics with the technology advancement enable the complex, fast dan varies data become easier and effective. As BPJS delivered insurance health service for the 235,292,977 people, the big data output contributes the decision making consideration for the government policy from the planning to formulation.

Organization

Some of the study show that top management has a positive influence to Big Data adoption as the top management walk-on the organisation to manage organizational resources directly and

deliver the business thoroughly (Ghaleb et al., 2021, Bening et al., 2023; Zhen et al., 2023). In addition, the size of the organization is directly an influential factor. The large firm will have more benefit than the smaller firm due to the greater number of resources. More specifically, human resources in this case are not limited to quantity, but also quality through training is an important variable and must be adequate before adoption. In executing each new program, the availability of financial support in the form of a sufficient budget is the main thing besides the human resource factor. These things have a significant effect on organizational readiness in Big Data adoption (Kalema & Mokgadi, 2017; Bening et al., 2023).

From some studies in Indonesia, it is known that the organisational factor interrelate the big data adoption. The study of Big Data Readiness in East Java Province with with CARL (Capability, Accessibility, Readiness, and Leverage) approach also determine the influencing factor organisation context (Basuki & Nugroho, 2023). The human resources in East Provincial Government does not fulfil the IT expertise needs for the big data readiness. In addition, the data analyst is executed by various educational background employee. From the assessment and interview with the officials, the lack of human resources will be figured out by the recruitment of new IT experts.

Besides, the training is another option to improve the data analyst knowledge. The analysis of understanding the big data by top-level executive in local government also conducted in the Regency of Bojonegoro, East Java Province (Sayogo & Yuli, 2023). The study is delivered through the in-depth interview and found that the organisation factor which is top-level executive, determines the readiness of big data. The top-level executive has the responsible to execute the decision making for the organisation. From the interview, it is known that top-level executive prefer to use experiences and intuition rather than the 100% data from the public. The study conclude that the top-level executive not all data is not utilized for decision, and examine the urgency of the certain problem will influence the decision making for the government policy.

Last, the bureaucratic capacity is also defined as the influencing variable of e-government readiness (Abadi et al., 2015). It refers to the ability of the local government to manage the organisation resources and implemen policy. The IT facilities, career management and competence employee needs are the contributing factor of bureaucratic capability. The shortcoming of those factors means the suboptimal capability that also influence the e-government readiness. Those finally are also potential to inhibit the readiness of open government in the local government.

Environment

Environmental variable is the extent of measurement from external border that may intersect with the organization when they deliver the business. (Ghaleb et al., 2021). In the environment, organizations are often more susceptible to the dynamic nature of the external ecosystem. From the previous research, the TOE framework identify some external factor such as government legislation, competitive pressure, external support. In addition, the vendors that facilitate the adoption process of Big Data technology greatly influences organizational readiness (Kalema & Mokgadi, 2018), apart from the availability of Government legislation as a legal umbrella in the implementation of Big Data adoption (Ghaleb et al., 2021) as one of the main tools supporting Open Government. However, in the context of public organizations, competition is not a variable that is considered to affect organizational readiness in the implementation of Big Data because public organizations do not compete and are profit-oriented but focus on public services.

In the context of Indonesia Government, the environment factor of adoption of Big Data has been supported by the government regulation about Open Government and Open Data. The Open Government concept was evolved in the context of centralized and decentralized government by then. One of the big leap to support the implementation of Open Government is Presidential Regulation Number 95 year 2018 about Electronic Basis Government System. This regulation become the rules to deliver the Government with digital transformation approach that is finally initialised open data in Indonesia. The Government also continue to emphasize this Open Data Establishment with the Presidential Regulation Number 39 Year 2019 about Indonesia One Data (Satu Data Indonesia) as the policy for governance data.

Conclusion

Open Government carries the value of transparency through increased democratic awareness and involvement by the public sector, private sector and society. It is an opportunity as well as a challenge for Indonesia to adapt to world developments in running the government. To be able to realize the success of Open Government, it requires the ability of organizations to develop innovations in the public sector through the idea of Open Data, which opens all access to information and data to the public and from the public (Gascó-Hernández, 2014). This then became the starting point of the Big Data era.

The adoption of Big Data in public organizations is something that must be done by all government structures considering the role of Big Data to provide data analysis results for public policy in Open Government. In adopting Big Data, organizational readiness is needed so that the process can be carried out easily. Based on the TOE Conceptual Framework (Technology, Organization and Environment) by Tornatzky et al. (1990) with subsequent developments, it is known that variables have a positive and significant effect on organizational readiness in adopting Big Data and Big Data Analytics. In the context of technology, the factors of advantage, compatibility, complexity (Ghaleb et al., 2021; Aligark et al. (2023); Bening et al., 2023), triability, observability of applications (Ghaleb et al., 2021), scalability, information technology and communication infrastructure, security (Kalema & Mokgadi, 2017) affect organizational readiness in Big Data adoption. On the other hand, from the organizational context, top management support, financial, human resources are concluded to have a positive and significant effect. Finally, from an environmental point of view, the availability of regulation as a legal support for the application of Big Data and the focus on public services are external support systems for adoption.

From the results of study about the influencing factors of organization readiness for big data adoption, there are some recommendations for the government official to involve in policy intervention. From the perspective of organisation, there are some options to enhance the top-level executive's role to support the big data adoption. First, establishing the working group from some local government offices can enhance the top-level executive awareness and knowledge for big data. This will lead the adoption of big data for government decision making and policy formulation. Second, conducting the regular and scheduled training in information and technology, especially leading in big data organisation will improve the human resource capability. In addition, the placement of the right man on the right place with IT specialisation will emphasize organisation capacity to adopt big data. Finally, the public organisation should set up the roadmap of big data adoption and include the SWOT (Strength, Weakness, Opportunity and Threat) Analysis. Therefore, those identified organisational aspects can be developed to ease the adoption. The author hope that this study will contribute to the public institutions in preparing the organization in the adoption of Big Data, so that the process can be carried out properly and provide benefits for the implementation of Open Government.

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