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Assessing the Big Data Analytics Readiness based on Technology-Organization-Environment (TOE) Framework of Malaysian Libraries: Descriptive Analysis

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Abstract

The growing interest in big data is mostly due to its enormous potential for revealing previously unknown patterns or profiles that aid organisations in making critical service decisions. Following other sectors' adoption of big data, the information services sector, such as libraries, has recently jumped on board. Although libraries face challenges in adopting new service models to assist with the transformation of data into information, big data has been identified as one of the potential mechanisms for enhancing service delivery. Libraries must increase their technology knowledge and capability in order to capitalise on emerging opportunities in the developing field of library data analytics, which provides fresh insights into established service models. Regardless of the dedication of libraries and information services to promote big data, the readiness of libraries, as well as their staffs and infrastructure, such as technology, is critical to the effective deployment of big data. Inadequate applications of big data prior to maturity might backfire and result in long-lasting operational and institutional mutilation. Thus, this study used a quantitative approach to investigate the readiness (Technology-Organization-Environment readiness) of Malaysian libraries for big data potentials. The findings indicate that the dimensions of Malaysian libraries' readiness for BDAs are primarily high-level (in nature, encompassing technological, organizational, and environmental dimensions. The study included academic libraries, public libraries, and special libraries, and utilised a survey research methodology involving 370 libraries. The findings of the study are expected to provide important insight into the factors affecting the preparation of Malaysian libraries for big data potentials and the projected effect of increased/lower change readiness in Malaysian libraries.

Keywords: Big Data, Technology-Organization-Environment, Malaysian Libraries, Analytics Readiness

Introduction

The important of the Big Data Analytics (BDA) has been covered substantially well in the literature. BD can be defined as data can be defined as unprocessed data, such as footfall, online browsing history, and travel routes, which are automatically recorded daily (Hey, 2004). The information professional faced a big challenge in dealing with data issues, such as managing data and data analytics readiness. BDA is reported to offer new opportunities and big threats in information services perspective since the library's use of data may help to secure competitive advantage and high performances (IFLA, 2015). MAMPU (2018) was list some of the private and public sectors which already under BDA project such as Polis Diraja Malaysia (PDRM), Kementerian Kesihatan Malaysia (KKM), Digital Economy Cooperation (MDEC) and Agensi Pengurusan Bencana Negara (NADMA). National Library of Malaysia (2017) mention that, the information professional faced a big challenge in dealing with data issues, such as managing data and data analytics readiness. Despite extensive research in a variety of settings, including banking (Foo, 2018), health institutions (Benjelloun et al., 2015; Kankanhalli et al., 2016), police department (Yu & Hu, 2016), human resources (Hilbert, 2016), government sector (Romijn, 2014), sport (Zeng & Jia, 2017), education (Nathan & Scobell, 2012) and media and entertainment (Suri et al., 2018). Unfortunately, studying BDA in the context of library science is quite rare. There have undoubtedly been various research that attempt to investigate BDA usage and implementation in libraries, for example. Al-Barashdi & Al-Karousi (2018) studied BDA readiness in academic libraries and Kim & Cooke (2017) mention on the usage of BDA in public libraries. However, the studies not comprehensive as studies done (Mokgadi Motau & Kalema, 2016; Rahman et al., 2021; Romijn, 2014). This is the reason for this study was been conducted to focus on assessing the BDAR among Malaysian libraries. The study's findings have expanded understanding of BDA and propose an acceptable technique for implementing BDA in MLs.

Literature Review

Overview of Big Data

BD was first exposed in the librarianship on the year 1944 by Fremont Rider (Narendra, 2016). IFLA (2017) mention the big data was warmly spoken in 1997 when the Library of Congress used big data concept to record almost 100 trillion bit of data. Gleason (2018) stated in Industrial Revolution 4.0 (IR 4.0), libraries were operating in an increasingly more complex competitive environment. Accordinng to the modification of library data that was affected by changes in the national agenda need to amplify the proportion of university and colleagues students in certain disciplines, embed administrative centre graduate attributes, and ensure that the quality of learning programmes are both nationally and globally relevant. The library was identified as the organization's data storage location. Library was recognized as the data storage venue that exists in the organization (IFLA, 2017). As libraries are offering more to on-line sources and services, librarians are in a position to use emerging tools such as analytical tools to gather online data and facts to see the performance of library in fulfill the user need (Affelt, 2017; Robinson & Bawden, 2017).

Researchers such as Al-Barashdi & Al-Karousi (2018); Campbell & Cowan (2016); Noh (2015) have indicated in their study that big data have a big impact in libraries due to understand the required services that should provide to cater user needs. Due to fulfill the need for analytics skills, data librarian, or data scientists are the needed person for BDA adoption in library (Jharotia, 2016; Jones & Salo, 2018). Patil & Nikam (2014); Xie & Fox (2017) in their study found that librarians are in position to use advanced mechanisim such as

analytical tools to gather greater and massive online data due to online services offered to the users.

In case of Malaysia, a study conducted by Mampu (2014) only 25% of the private and public sector that use BD bit it still at the early stage. The BD usage already increase to 60% to government sector in 2017 (MAMPU, 2018). The increasing number for organization using BD due to the advantages and benefit given by BD. Before this, the vast majority of the organizations redistributed the analytic process of their snap stream data or basically given it "a chance to fall on the floor" since the organization couldn't process it in an opportune and financially savvy way. However a few government sector such as healthcare, education and police already use BD for their daily basis activity and decision making (Baro et al., 2015; Kim et al., 2014; Groves et al., 2013; Raghupathi & Raghupathi, 2014; Rajagopalan & Vellaipandiyan, 2013; Wang et al., 2018; Yu & Hu, 2016). However, only a few studies looked at the BD usage in Malaysia libraries because it is quite new and still need to do more research and study on the BD adoption and readiness in libraries even though a lot of awareness and training was been organize Malaysia government (MAMPU, 2021). However, no specific reports on the assessment and adoption or readiness for BD in libraries were discovered.

Models and Framework for Assessing BDA

The previous literature in the study was developed based on various model and framework for measuring the BDA adoption. Among the prominent researchers in highlight the model and framework are:

- The Technological Acceptance Model (TAM) (Davis et al., 1989)
- Technology Readiness Index (TRI) (Parasuraman, 2000a)
- Technology-Organization-Environment (TOE) (Tornatzky et al., 1990)
- ICT infrastructure (Blasiak, 2014)
- Management Changes Theories (Ates et al., 2018; Pryor et al., 2007)

In the context of this study, Tornatzky et al (1990) TOE model dimensions were selected. This model was choses due some reasons. Firstly, Tornatzky can be considerd as the person who found the TOE model and that model suitable for measuring the readiness for organization to adapt a new work activities that relate to new technology usage. Secondly, Tornatzky dimension ie (Technology, Organizational, Environment Context) has high reliability and validity in between 0.632 to 0.881 as tested by previous researchers (ie Kalema & Mokgadi, 2017; Motau & Kalema, 2016; Romijn, 2014). The model was divided into four domains which are Library Technology Capabilities, Library Characteristics, Library Environment Characteristic and Big Data Analytics Readiess. The Library Technology Capabilities domain divided into ICT infrastructure, security, reliabiliy and data scalability. The library characteristics has five variables which are management support, magnitude, budgeting, strategies and talents. Meanwhile, operational acceptance and culture variables to be use as measurement for Library Environment Characteristics. The Big Data Analytics Readiness domain is measured using variables namely data collection, data management and data quality. The librarian served as the study's population in this study.

Methodology

The research survey approach was used to carry out this study. The librarian and assistant librarian from a public library, an academic library, and a special library were the study's population in this study. The position were different depends on the libraries name because it is the combination from government and private sectors. The position level for

government sector start from S29 and above. Different for private sector the levels start from executive level or librarian and above. This grade level is claimed to be functioning well with a lot of services that's play with online and other services which produce daily data. Quantitative data was collected using Big Data Analytics Readiness in Malaysian Libraries which consists 59 items. The questionnaire was designed based on the work of Baker et al. (2016); Kalema & Mokgadi (2018); Lalic & Marjanovic (2017); Lemekwane et al. (2016); Liu & Shen (2018); Motau & Kalema (2016); Romijn (2013); Tornatzky et al. (1990); Wu et al. (2014) and Yasin et al. (2004). All measurements must be accompanied by a scale. (1) Strongly Disagree, (2) Disagree, (3) Sometimes Disagree, (4) Not Sure, (5) Sometimes Agree, (6) Agree and (7) Strongly Agree.

Reliability of the Instruments

Technology Capability, Library Characteristics, and Library Characteristics variables have the highest consistency (greater than 0.93 score), while Library Environment variables have the lowest consistency (0.89). According to Sekaran & Bougie (2016), argued that the minimum accepted level is 0.60, if below that that the instrument considered as poor, however Dillon et al. (1990) state that scores over 0.50 are acceptable. Table 1 shows the detailed Cronbach alpha scores. Following the factor analysis, one of the research model's measures was removed.

Table 1
Reliability of instrument measures

Measures	No. of Variables	No. of Items	Cronbach's Alpha
Library Technology Capability	4	17	0.90
Library Characteristics	5	22	0.93
Library Environment	2	8	0.89
Big Data Analytics Readiness	3	12	0.92

Findings and Discussion

Respondent's Demographic Profile

In total, 400 questionnaires were distributed to all academic libraries in public and private universities, public libraries and special libraries in Malaysia. A total 0f 370 (92.5%) questionnaire were well answered by the participant. A proper data collection strategy helps researchers achieve a higher response rate. In the context of this study, the researcher decided to use online questionnaire to approach the entire participant through email for answering the questionnaire. The actions were takes capture the interest of the respondents to participate in the study and answer the questionnaire.

The questionnaire were distributed via email through the Head Librarian and personal email to the librarian for library which don't have hirararchical in house authoritiveness such as special libraries. This approach was proven effective because the Head Librarian is already aware of the important of the research. Each librarian was given at least two weak to complete the digital survey. Table 4.2 indicates the total number of distribution as well as the number of returned and usable questionnaire frim the three categories of libraries. In total, 370 out of 400 returned responses were used. The first category academic libraries 179 or

(n=48.4 %), meanwhile public libraries 104 or (n=28.1 %) and special libraries 87 or (n=23.5 %)

Big Data Analytics Readiness (BDAR) Factors

Library Technology Capabilities

Technology Capability refers to people's willingness to learn about and apply new technology (Ariani et al., 2018; Parasuraman, 2000b). The greatest mean score among the four variables is 4.998, while the lowest mean score is 4.178, and the total mean score of the four variables is 4.415, as shown in Figure 1.

Data security refers to protective digital privacy measures that are applied to prevent unauthorized access to computers, databases and websites (Li et al., 2017). In the aspect of Malaysian libraries data security, it may be considered with a high score of 4.998 for mean value. This figure reflects that all libraries in Malaysia agreed that data security is the important part for all system to have because some of the data in libraries contain valuable information and statistics which is effect for decision making and planned activity for library future planning development. Consequently, data security is the most important part in every system in every organization. Thus, data security high scoring can be justified.

Data scalability is the capacity of a framework to deal with a developing measure of work, or its capability to perform increasingly absolute work in the equivalent passed time when preparing power is extended to suit growth as the fourth variable of Library Technology Capabilities with scored mean value 4.666. This shows that respondents agreed that they were aware that the large data scale are the key factor for the successfulness for BDA adoption and usage. This shows every library in Malaysia always created new data based on daily services especially for online services but at the same time all libraries also still produces data in manual format. The generate data always been analyse every six month to see the effectiveness of the services provide.

Sai & Sia (1987); Wu et al (2014) refers reliability as the accuracy and completeness status of created data which can analysed and processed in anytime. With a mean of 4.178, it was recommended in this study that Malaysian libraries agreed that they require trustworthy data that is correct and comprehensive to be analysed for decision making and yearly planning for libraries to be sustainable and relevant to users, particularly in supporting research and learning activities. Nowadays, every users need to be fulfilled as real time based. Thus, the findings for this study also been supported by previous study such as (Baker, 2012; Motau & Kalema, 2016; Romijn, 2013; Tornatzky et al., 1990).

The lowest domain for Library Technology Capability is ICT Infrastructure, which recorded mean of 3.816. ICT structure and a fitting operational structure are needed for creating data in large amount. ICT infrastructure is likewise identified with whether new technologies that can help individuals and team in the company in finishing proficient purposes exist in the territory of clients (Kuo, 2013; Lavoie & Daim, 2018). Since nowadays, libraries already improved in technology and ICT infrastructure was made all the respondent were think the ICT infrastructure were not in the BDAR and adoption planning because each year technology development will still be made.

Items	Mean	Std. Error	Std. Dev.	Var.	Min	Max
ICT Infrastructure						
1. My library has reductive analytics hardware and software solutions for Big Data Analytics (BDA)	3.710	0.082	1.577	2.488	1.00	7.00
2. My library has enough technical expertise to deal with Big Data Analytics	3.586	0.079	1.524	2.324	1.00	7.00
3. My library has enough technical expertise to deal with Big Data Analytics (BDA)	3.932	0.090	1.615	2.611	1.00	7.00
4. My library provides steering committees from ICT department and libraries for new IT projects	4.035	0.090	1.723	2.966	1.00	7.00
Average	**3.816**	**0.084**	**1.610**	**2.597**	**1.00**	**7.00**
Data Security						
5. My library has an identifiable staff (direct and indirect) responsible for data protection	4.887	0.077	1.472	2.166	1.00	7.00
6. My library has backup procedures including the frequency of the backups, the retention schedule, and the storage location of the data	5.084	0.067	1.280	1.638	1.00	7.00
7. My library has a security access in the system for protecting data	5.0410	0.068	1.310	1.714	1.00	7.00
8. My library restricts and regulates our library staff to access to data	5.092	0.064	1.240	1.536	1.00	7.00
9. My library provides suitable training for data protection and confidentiality.	4.887	0.068	1.311	1.718	1.00	7.00
Average	**4.998**	**0.069**	**1.322**	**1.754**	**1.00**	**7.00**
Reliability						
10. My library data up-to-date	5.307	0.066	1.262	1.594	1.00	7.00
11. My library data always ready with analytic result for decision making	5.199	0.067	1.291	1.668	1.00	7.00
12. My library controls access to confidential data by various channels	5.231	0.067	1.280	1.638	1.00	7.00
13. My library analytics systems directly communicate with the system server for extracting the data	5.151	0.067	1.282	1.643	1.00	7.00
Average	**4.178**	**0.066**	**1.279**	**1.636**	**1.00**	**7.00**
Data Scalability						

14. The features of planned system is fulfil BDA requirement and ready to use by library system admin	4.612	0.070	1.343	1.804	1.00	7.00
15. The library server can handle the growing data process	4.999	0.071	1.374	1.889	1.00	7.00
16. My library has a high specification and high-performance server which has the capability to process and create huge data.	4.620	0.081	1.555	2.419	1.00	7.00
17. The library server was designed for sufficient of 10 years period data storage need and technology.	4.434	0.068	1.303	1.699	1.00	7.00
Average	**4.666**	**0.072**	**1.394**	**1.953**	**1.00**	**7.00**
Average Library Technology Capability	**4.415**	**0.073**	**1.401**	**1.985**	**1.00**	**7.00**

Figure 1 Descriptive profile of Library Technology Capabilities

(1) Strongly Disagree, (2) Disagree, (3) Sometimes Disagree, (4) Not Sure, (5) Sometimes Agree, (6) Agree and (7) Strongly Agree

(2)

Library Characteristics

Figure 2 shows the descriptive profile of the Library Characteristics domain. Five variables for measuring Library Characteristics domain in term of Management Support, Magnitude, Budgeting, Strategies, and Talents. All item recorded a mean value from 4.012 to 4.778 with average mean 4.454.

According to Grimes et al (2014), magnitude in the library are refer to the size of collection development and population size of the organization. Hsinchun et al (2018); Ornes (2013); Toro (2015) agreed that libraries already dealt with a large volume of data are starting to inspire about the capacity to deal with another kind of data which organization size is regularly emphatically connected with the accessibility of the sources. The larger magnitude and of collection and population in the organization, the library can create much more data for analytics. As shown in Figure 2, the value for magnitude at a mean value 4.778 and it is possible that all libraries really understood on the needed for large number of data for BDA readiness assessment and adoption.

Budgeting refers to which organization can put resources into presenting and working with BDA (Cao et al., 2014). Estimation of income and costs over a predetermined future timeframe; it is assembled and rethought on an occasional premise. It takes a great deal of budget that is related in BDA adoption in MLs. The weight of budget related expenses is probably going to cause libraries to falter before BDA adoption. With an average mean score of 4.776, the majority of respondents largely applied on this sub-domain. The analysis of the findings clearly shows that libraries require a substantial budget for BDA readiness and adoption. Thus, with sufficient budget every project and activity can be done successfully.

The mean score for sub-domains talents is 4.357. Talents are the method of utilizing key human asset intending to improve business esteem and to make it workable for organizations and institutions to achieve their objectives. The researchers presumes that, talents are the key factors for successfulness for BDA adoption and libraries should ready with a group of talented librarian to understood and skillful enough on the data analyze capabilities. Ahalt &

Kelly (2013) noted that, each new adoption for every activity and technologies require a good talent in ensuring the project to be successful implement.

According to Xie & Fox (2017), strategies take the management of the library to set the larger mission and vision step-by-step for ensuring it is parallel with the BDA adoption. With the right strategies planning of the libraries it can ensure the successful to BDA adoption. The strategies in Library Characteristics recorded a mean value of 4.346 as recorded in Figure 2. Without a doubt, a clear strategies it will come out with a dynamic long period plan and activity that maps for the libraries the course towards to take accomplish the acknowledgment of an organization's objectives and vision. Libraries usually similar to other oriented services profession which have a strategy to do the libraries project and activities which already been planned through the year.

The mean value of management support was just 4.012 out of the five factors under library characteristics. This variable had the lowest mean score. This variable scored at the lowest mean. The low score might be attributed to a lack of support from senior management in libraries that are unfamiliar with BDA adoption. Even though the top management always provide the allocation for system development but some of them still learn on the important of data usage for libraries planning over the year. But the situation and environment still change due to industrial revolutions which take place in all industries. Also with the growth of open access which need the librarians to have an analytic skill was evolved the top management overview on the important to analyse data.

Items	Mean	Std. Error	Std. Dev.	Var.	Min	Max
Management Support						
1. My library top management has sufficient knowledge about BDA.	4.081	0.074	1.429	2.042	1.00	7.00
2. My library management supports the BDA initiative	4.265	0.077	1.485	2.206	1.00	7.00
3. My library has a BDA department and gets support from the top management.	3.760	0.077	1.479	2.189	1.00	7.00
4. My library has a strategic plan which is included in the IT investment for BDA.	3.941	0.075	1.436	2.061	1.00	7.00
Average	**4.012**	**0.076**	**1.457**	**2.125**	**1.00**	**7.00**
Magnitude						
5. My library has enough material which can produce data that can be analysed	4.708	0.066	1.26499	1.600	1.00	7.00
6. The population user of my institution is huge.	4.854	0.0767	1.46515	2.147	1.00	7.00
7. My library system server can support data growth which will be created in the future.	4.576	0.067	1.29244	1.670	1.00	7.00

8. My library data collection or volume is huge	4.973	0.067	1.27061	1.614	1.00	7.00
Average	**4.778**	**0.069**	**1.323**	**1.758**	**1.00**	**7.00**
Budgeting						
9. My library allocates enough budgets for BDA initiatives	4.808	0.093	1.780	3.169	1.00	7.00
10. My library allocates budget for IT infrastructure development	4.921	0.095	1.822	3.319	1.00	7.00
11. My library provides enough budgets to support human resources for BDA initiatives.	4.673	0.097	1.861	3.462	1.00	7.00
12. My library allocated enough budgets for BDA training	4.700	0.095	1.826	3.333	1.00	7.00
Average	**4.776**	**0.095**	**1.822**	**3.321**	**1.00**	**7.00**
Strategies						
13. My library strategic planning has a well-defined on the BDA implementation.	4.505	0.090	1.727	2.982	1.00	7.00
14. My library BDA project linked with the mission, vision, and overarching goals of the library.	4.616	0.092	1.765	3.115	1.00	7.00
15. My library strategic planning for BDA been supported with the realistic annual plan with specific outlines which is need to be accomplished.	4.578	0.087	1.679	2.819	1.00	7.00
16. My library BDA project well known and understood by library staff and top management.	3.957	0.079	1.522	2.318	1.00	7.00
17. My library BDA plan consistently used at all levels of the library to direct operations.	4.076	0.081	1.555	2.417	1.00	7.00
Average	**4.346**	**0.086**	**1.650**	**2.732**	**1.00**	**7.00**
Talents						
18. My library has a well-planned process to recruit, develop, and retain staff for BDA readiness.	4.251	0.089	1.706	2.910	1.00	7.00
19. My library staff has the ability to use data analytic software.	4.357	0.089	1.713	2.935	1.00	7.00
20. My library human resources division has a group and procedure to identify the talent among the staff for BDA.	4.911	0.093	1.785	3.187	1.00	7.00
21. My library provides relevant and regular training for staff in	3.989	0.082	1.570	2.466	1.00	7.00

understanding BDA tools and process.						
22. My library are willing to learn and acquire knowledge of BDA	4.276	0.086	1.638	2.684	1.00	7.00
Average	**4.357**	**0.087**	**1.683**	**2.836**	**1.00**	**7.00**
Average Library Characteristics	**4.454**	**0.083**	**1.587**	**2.5544**	**1.00**	**7.00**

Figure 2 Descriptive profile of Library Characteristics

(1) Strongly Disagree, (2) Disagree, (3) Sometimes Disagree, (4) Not Sure, (5) Sometimes Agree, (6) Agree and (7) Strongly Agree

Library Environment

The Library Environment for this study comprised two variables namely operational acceptance and culture. Based on responses from 370 people, the two variables registered mean 4.871 and 3.884. As indicated in Figure 3, the mean score was 4.871, which is deemed typical, and Malaysian libraries tended to agree with operational acceptance for assuring BDA adoption success. Operational acceptance can be defined as the establishment for creating interchanges, preparing, and other change the management strategies and plans that will help set up the organization and partners for the change. The high score for this statement because of the need for every staff to take part in the BDA adoption with a high analytics skill which need to be develop in vast group for ensuring the successfulness for BDA adoption in the libraries.

The mean score for culture by respondents is 3.884. According to Motau & Kalema (2016); Villars et al (2011), culture assumes a basic job in numerous organization with regards to the pace of appropriation of BDA adoption rehearses. But this variable scores the lowest mean. The possible explanation for the low score may due to the libraries staff which always follows the order and instruction from the top management of the libraries. Even though some of the staff maybe not agreed on the BDA adoption, but with the decision which was been done by the top need to be follow by the library staff. The development of new policies and procedures also only involve a top management of the library without argument from the subordinate staff.

Items	**Mean**	**Std. Error**	**Std. Dev.**	**Var.**	**Min**	**Max**
Operational Acceptance						
1. My library staffs demands that the library fully implement BDA.	4.919	0.086	1.648	2.714	1.00	7.00
2. My library staffs need have a strong influence on BDA.	5.043	0.087	1.669	2.784	1.00	7.00
3. My library fell lose in competing if not undertake the BDA.	5.100	0.080	1.543	2.378	1.00	7.00
4. My library demonstrates a high commitment to promoting BDA.	4.422	0.085	1.627	2.646	1.00	7.00
Average	**4.871**	**0.084**	**1.621**	**2.631**	**1.00**	**7.00**
Culture						

5. My library gives the highest priority and support for the BDA readiness implementation.	4.124	0.073	1.40872	1.985	1.00	7.00
6. My library develops new procedures and policies for BDA success.	3.695	0.071	1.35999	1.850	1.00	7.00
7. The library staff has as clear vision on BDA implementation.	3.600	0.073	1.39764	1.953	1.00	7.00
8. The library staff believes that BDA can give positive influence to their job activity involvement and performance.	4.119	0.074	1.42829	2.040	1.00	7.00
Average	**3.884**	**0.073**	**1.39866**	**1.957**	**1.00**	**7.00**
Average Library Environment	**4.378**	**0.079**	**1.510**	**2.294**	**1.00**	**7.00**

Figure 3 Descriptive Profile of Library Environment

(1) Strongly Disagree, (2) Disagree, (3) Sometimes Disagree, (4) Not Sure, (5) Sometimes Agree, (6) Agree and (7) Strongly Agree

Discussion

The statistics include mean, standard error, standard deviation, and variance to identify BDAR in Malaysian libraries. These statistics facilitates the analysis of the normality of four main dimensions and 59 variables. When the researcher analyzes the mean score, it can be said that Malaysian libraries already know the BDA concept in their libraries and also know the level of measurement to implement BDA in their libraries as a tools for management planning. This indicates that Malaysian Libraries have a high potential in total implementation for Big Data Analytics based on the dimension that was mention above like library technology capabilities, library characteristics, library environment, and big data analytics readiness. It is shows that the highest awareness level in MLs for BDA adoption is the big data analytics readiness. There is no doubt that MLs already have a high awareness and knowledge big data concept and only need a few steps to implement the analytical skills to all librarians. The librarians already know and recognize the important and the power of existence data in decision making and library planning over the year.

The high level of library technology capabilities (ICT Infrastructure, Data Security, Reliability, and Data Scalability) may enable to the success for BDA adoption and implementation. The lowest mean score of the library technology capabilities domain is ICT infrastructure. As a result, MLs already move to digital and online services. Over the year the ICT infra will be change and upgrade due to security issues and new function already insert into the system which more user friendly for daily usage for library staff. Since everyday MLs will face online services which need for real time result, the upgrading process for ICT already became important matter for MLs every year.

Additional to the library technology capabilities dimension, the data security may considered high. Due to large number of data created, it is important to have a high data security for ensuring the data is save from lost and misconduct of data usage. Basically only the system librarian has the authority to generate the data from the system server based on head of department requirement. Their score for data security is very strong preference with detailed data activity for ensuring all the data can be stored properly without any mistakes and can be used anytime. As a result with high data security, the safety of the data can be ensured and only the assigned staff can generate the data.

Data scalability dimension is the most important in the library technologies capabilities domain for ensuring the success for BDA adoption and readiness assessment level. One of BD characteristic is volume which refers to huge amount of data. Data scalability means value can be category as high in score. Evidently, everyday MLs create a lot amount of data due to online services. With the high demand for online services among the users, MLs already offered online services for daily basis services. Even though, such librarians right now feel comfortable to provide online services and training through Webinar with need all the users to use the online material that were subscribe by the libraries. With everything on your fingertips, library users can access all the electronic materials and other provided online services at any time and the data always been created every single second. Also the need for storage or server upgrading also execute for data creation and development.

In relation to reliability with the library technology capabilities domain, it is highly possible that MLs really aware on the relevancy and latest of the data. With the high score mean value for reliability reveals that, MLs data always up-to-date and increased every several minutes that are well above average. To deal with the decision makers and determine the library goals, the relevance and current data is needed. Basically to look at the performance of the library, the management will make an assessment from previous and the latest data for monitoring the performance or return of investment for each activity and services offered whether it is relate to user needs.

Library characteristics are among the important domain in BDAR with high mean score. It has been suggested that the assessment index for this domain is relevant and important for BDA adoption and assessment analysis for BDAR in MLs. Evidently MLs always try to find and adapting a new working process which will give high impact to the libraries without losing the track of the library goals and objective. Librarian in MLs always ready to adapt a new environment of working process without give a negative impact to other work process. Thus, every year MLs will plan for staff improvement with training, knowledge transfer, Webinar, conference and others activity for ensuring all the MLs librarians still on track every single year follow the changes of demands of the users and industrial changes.

In relation to management support in the library characteristics dimension, it is highly possible that the MLs management always support and alert with the new trend in libraries working environment. Usually, MLs management will assign a few teams among the librarians to study on the new things whether it is suitable to implement in the libraries. The high value mean score for management support reveals that the MLs management always ready to adapt a new process in their daily routine as long as it can give a good result to the libraries. Additionally, positive attitude from MLs management usually given an opportunity for the BDA adoption and preparation until it is success in usage.

Apart from that, if the MLs don't have high volume of data, it is possible to use BDA in decision making. Large data is the key point to use BDA in MLs. One of the criteria of BD is volume. The need for high volume of data is important. With the high mean score for magnitude it shows that MLs already aware on the data creation activity every day. Furthermore, right now all services has been emerge to online which will create diversity volume of data (Liu, 2018). Working in the field of information services, librarians always interact with real time data several day and even in the library also have the data librarian position because the need for library deal with the vast magnitude of data.

The average mean score for budgeting of the library characteristics stands out with the highest mean. MLs already alert and understand the important to have sufficient budget to implement BDA. Moreover, MLs is now a profit organization need a good reason for every

project. Moreover, MLs basically get the budget from the main organization or institution need to compete with other department to get high amount of budget. That's why for every project which was already planned need to justify with a good impact to the organization. Majority of the MLs in a non-profit organization and only a few libraries is a profit based.

Therefore, it is essential to have a carefully strategies to BDA implementation to ensure it can be fully success. The good strategies help MLs to identify accurately for each BDA development which part needs to be solving first. MLs also can draft a time frame for BDA project to be done with a well-planned structure, knowledge transfer, and human resource, embed the librarian with analytics skills, and design a clear policy for data analytics process. The researchers presumes, every single project in MLs always have a good strategy to ensuring the project succeed without any issues. Even, if there appeared some error or mistake, the team will find a solution based on the experience or knowledge to ensure the BDA process can be adapt to the MLs activity and decision making.

Talents of the library characteristics dimension records a mean value in line with MDEC (2016); Groves et al (2016) study. Evidently, MLs agreed that in the direction of their mission and goal also highlight on the talent management for each project. The identify librarian with a specific talent will sent to other organization for training purposes. The identifying process to clarify the existence talents will take sometimes to ensure the training that should the librarian embeds must be aligning with the BDA project. MLs always ready with the group of librarian with different skills to ensuring all project succeed.

The descriptive profile of operational acceptance and culture variable of the library environment dimension involves of the establishment for preparing changes of strategies and plans which will help organization to achieve their succeed in any project (Lemekwane et al., 2016; Tornatzky et al., 1990). The mean score of these variables is high. MLs in this survey need to accept all the activities that relate to data activities. Even the MLs staffs already alert on the 4th industrial revolution which involve data in their daily job scope. Even though, now all libraries always talk on the power of data in decision making and to assess performance for each activities. The job scope for the data librarian or data stewards also created. They also understand BDA were the new trend that MLs should master because librarian have since quite a while ago dealt with large volume of data and connected with reference (Hsinchun et al., 2018; Ornes, 2013; Toro, 2015). Therefore, these factors are the main point for MLs empower to use BDA.

The data management is one of the variables that related to the big data analytic readiness that shows high mean value. This finding is coherent with other variables whereby the highest score mean score of these variables is for items pertaining to big data analytics readiness assessment. Data management allows MLs to have a clear process for storing, arranging, and accessing to large volumes of data. Usually, the assign staff in MLs will attend a comprehensive training to gain skills and knowledge to manage library data. Therefore, these factors can ensure MLs to have a clear guidance and procedure in managing data.

The data collection is variables from big data analytic readiness can be considered quite high. Evidently, MLs have shown positive impact outcomes towards data that was created daily with two types of version which is structured and unstructured. The biggest data collection was created through online access via websites, online database, online chatting, video viewer and etc. The high demand for online services experienced for MLs librarian to give real time result and feedback. The data also created by other activities such as inter library loan, online training, database access, etc. which need a high speed server and large storage for the created data. Usually, the system librarian has their own procedure for backup

activities due to security issues. Basically the data will be stored around five to ten years back for analyze the library performance.

The mean value of the data quality of big data analytic readiness considers the highest. The condition probably the data creation usually done by the library system and only a few data is generated manually. With this, MLs always producing high quality data and only need some analysis process before use the data. With the high demand in the use of online services, MLs are always thinking of the best way to improve each service offered by using real-time data in planning the library direction. It is may be not easy but it can be fulfilled via a good strategic planning.

Contribution of the Study

The study's findings have numerous implications for the current knowledge in field of library science and big data analytics. Using TOE factors, this study investigate the significant factor influencing Malaysian Libraries proclivity to adopt and used BDA. Based on the findings, MLs already aware on data usage and some of the libraries already used BDA, which is a positive trend. As a result, MLs shows their readiness to more success in data usage. Furthermore, BDA ensures security for data access, operation planning and reduce decision making error. Besides that, MLs management also can minimize error in planning, predicting and action.

The suggested frameworks provide an useful insight into the wide range of variables influencing big data acceptance for MLs. While certain factors have previously been evaluated in other TOE model in different field of study, this research presents novel factors in term of big data analytic readiness, acceptance, and usage. However, because of the unique characteristics of big data, it is important consideration in this study. Similarly, a few issues in data security, policies, talents, budgets etc. should be necessitate the consideration.

Most previous research only highlighted the benefit, impact, and opportunities for BDA because it is still in early stages of understanding and usage. This also shows that, BDA is relatively new in Library Science subject. Several scholars investigated BDA, and the most recent studies either focused on a specific point or simply highlighted TOE and TAM theory separately. This is the first study that proposed a model and theories as a predictor of compartmental BDA readiness and intention. As a result, the convergence for BDA adoption contributes fresh insights to the current body of literature. This study is beneficial and contributes to the promotion of a theory for additional BDA research. MLs can gain an understanding of their own BDA capability by understand the TOE factors for adopting BDA. This capability is centered on activities with specially customized results, library management, resources, skills, and other possible services. MLs can identify, within the libraries, the most common barriers to effectively creating and executing a BDA, and then prepare to reduce these inhibitors in accordance with their findings.

In addition, the study has made a number of practical contributions as well. In light of the findings, libraries which already implement BDA may have major recommendation and repercussions that could lead to the successful implementation of BDA. The importance of connecting BDA, library technology, management and services cannot be understated. MLs will get benefit from using BDA in this manner. In order to maximize the benefits of technology usage in libraries, this study provides practitioners with an initial strategy to incorporate and approve BDA activities in their libraries. There should be fair expectations of the efficiency of big data and its incorporation challenges for successful deployment of BDA

solutions by top management in MLs. Librarian who has the analytics skill who looks for BDA adoption are expected to put together an expert team with analytic knowledge.

Conclusion and Recommendation

The purpose of this paper is to discuss the assessment of big data analytics readiness (BDAR) in MLs. The findings of the study already prove that MLs ready to use BDA and also has been proven high. However, some aspect of the BDAR still need improvement which suggest for MLs authorities to have an appropriate planning and team to handle and full implement BDA. The contributions for this study are statistically proven which can be used for other industries which provide services to public and need to be change and adjust from several angles. Firstly, the instrument developed in this study can be applied and used to measure BDAR and adoption in MLs. Furthermore, researchers who are interested in this research can use this instrument to make a further study on BDA in libraries and see the progress in MLs with a few changes and settings. Similar to other study, this research is conduct without any limitation. The assessment used in this study may be have some weaknesses in measuring the objective, but for future study it can be used to produce more accurate variables. The impact of using BDA in MLs will produce high quality action in decision making and some modification might be needed in implementing the process by provide more comprehensive training for ensuring MLs can gain more comprehensive result in fulfill user needs.

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