

Readiness of Applying Big Data Technology for Construction Management in Thai Public Sector

Korb Srinavin¹, Wuttipong Kusonkhum¹, Boonyarit Chonpitakwong¹, Tanayut Chaitongrat², Narong Leungbootnak¹, and Phatsaphan Charnwasununth³

¹ Department of Civil Engineering, Khon Kaen University, Khon Kaen, Thailand

² Faculty of Architecture, Urban Design and Creative Arts, Mahasarakham University, Mahasarakham, Thailand

³ Department of Housing, Faculty of Architecture, Chulalongkorn University, Bangkok, Thailand

Email: korbbsri@kku.ac.th, w.kusonkhum@gmail.com, boonyarit_por@kkumail.com, Tanayut.c@msu.ac.th, Narongl.fec@gmail.com, Phatsaphan.C@chula.ac.th

Abstract—The world is currently driven by data. With fast improving technology, the construction industry is inevitable to accept that their industry is being driven by the data. However, implementation of new technology into construction industry is difficult unlike in other industries. Thailand is attempting to improve the country with big data technology, which impacts the construction industry. The readiness of applying big data technology for Construction Management is therefore important. This research employed the qualitative approach to identify the readiness factor of applying big data technology for construction management of the Thai government. Semi-structured questionnaires and interviews were used as a research instrument. More than seven government officers are Key Informants (KIs), selected by a convenience sampling method. The KIs have been working in a field of information technology at seven different government departments. Typology and transcribed analysis was used to analyze the data. The findings revealed that the Thai government has been preparing infrastructure to support big data technology. However, the readiness factors of concern are Technological and Organizational factors, as the government has launched a new policy for the country. Government agencies have to start applying big data technology to support their work to conform to the new policy.

Index Terms—big data technology, readiness factor, Thai government

I. INTRODUCTION

Nowadays, the world is driven by many types of data [1]. The increasing use of data affects the business environment and is making many organizations change as competition for development increases. Therefore, the organizations are improving their operation with Information Technology (IT) [2]. However, the growth of data within organizations affect the traditional analytic tools and requires software vendors to offer new analysis tools to manage massive amounts of data which is also known as Big Data [3]. Big Data (BD) refers to large sets of complex data, both structured and unstructured, which

traditional analytical techniques and algorithms are unable to implementing. The aims of BD technology reveal hidden patterns or knowledge of the large data that led to the development of data-driven science [4].

Many industries improve productivity with many algorithmic techniques [5]. The construction industry has been developing with this revolution. The industry is dealing with the collection of significant amounts of data occurring from executing in the project life cycle [6]. But data of this industry is hard to be applied because it comes from various sources and is in different formats. Security of data has been of concern and the knowledge is poor [3]. However, most studies on BD technology only study the advantages of using the available analytics data for their business without looking at the readiness of technology for organizations [2], [7]. The endeavor of implementation BD in organizations should be clear in that it requires many abilities such as collection, management, and analysis of large amounts of data that may occur when the data from various sources with high velocity [8].

Many researchers have defined that massive factors influence BD technology readiness. However, like other technologies, these factors may differ from one organization and industry to another [3], [8], [9], including; scalability, ICT infrastructure, security, machine learning management support, size of organization, financial, competitive pressure, organization demand, as well as analytic tools [3], [9].

The opportunities of BD technology are vast. There are many applications such as waste minimization through design is the future of waste management research [10] and other concepts to adopt this technology such as BD with BIM, clash detection and resolution, performance prediction, etc. [11].

The aim of this study is to explain on “How can we improve construction management in the Thai government using BD technology?”. The finding will give the readiness factors to explain on “Why can we know the factors affecting the adoption of BD technology?” and this study will show that BD will give benefits of using the available analytics tools for the Thai government organizations [2], [7].

II. BACKGROUND OF STUDY

A. Big Data Technology

The lack of ability to manage BD within organizations has led to the failure to leverage IT and inability to make right decisions, even though people have many opportunities and channels to make data with their business. As a result, the data growth rate within organizations is increasing overwhelmingly [8]. There are many studies that have been focused on advantage of BD technology [12].

B. Big Data for Construction Management

The construction industry has been allowing a digital revolution. They are applying BD technology to Building Information Modelling (BIM) by managing the data of construction projects. BIM data are managed with typically 3D geometric encoded, compute intensive compressed, in diverse proprietary formats, and intertwined. Accordingly, the data are enriched gradually and persisted, although project life cycle that make BIM files can quickly get voluminous, with the building model easily achieving fifty gigabytes in size [6], [13], [14].

C. Readiness of Big Data Technology for the Government

As the amounts of data grows very fast, new techniques and approaches have been studied and adopted in many industries [15]. Researchers [8] proposition that when the government has been developed with these technologies, BD users will be more productive, more successful and have differential impacts across many industries. There are concerns though as trained personnel are in short supply and there is lack of tools to work with BD. However, five of the readiness factors are making the government's goals clear are: Technological, Organizational, Environmental, Process, and Quality Readiness. **Technological Readiness** is a factor that includes complexity, compatibility of technology and scalability [16], [17]. **Organizational Readiness** factor includes lack of IT skills to manage BD projects, lack of skills to analyze the data and lack of business support and deciding what technology is best [18]. **Environmental Readiness** includes poor internet access and connectivity as well as user involvement [19]. **Process Readiness** includes project management and process of technology [21]. **Quality Readiness** refers to the ability and quality of a given data that intended to be used. [22].

III. RESEARCH METHODOLOGY

The qualitative research technique [23] has been used in this study. The study focused on six governmental agencies: The Comptroller General's Department, Department of Rural Roads, Department of Public Works and Town and Country Planning, Department of Lands, Office of the National Water Resources, and Royal Irrigation Department. Each of which works with BD technology concept related to the new policy of Thailand [24].

Prior to launch the semi-structure interviews, the reliability and validity of the interview tool were determined by experts. Data were collected and analyzed follow these procedures: select topic, focus question, design study, data collection, data analysis and validation [25].

The key points in the interview are (a) what is the stage that Thai government is applying the BD technology, and (b) what are the current data for Thai government that could be applied in BD technology.

The information of participants has been recorded in tape recorder and filed note. The data, then analyzed using the typology and transcribed method by means of computer software (Microsoft Excel and Nvivo), which includes; read the data from interview sheet, review impression previously recorded in research journals and/or bracketed in protocols and record these in memos, read the data, identify impression, and record impression in memos, study memos for salient interpretations, coding place where interpretations are supported or challenged, write a draft summary, review interpretations with participant, write a revised summary and identify any exceptions [26].

IV. RESULT AND DISCUSSION

Thailand is somehow lack of infrastructure for BD technologies. However, it has been improving because of the Thai government's new policy [27]. It can be seen from Table I that technological and organizational are the most factors mentioned. The organizational factor is a second mentioned. The employee in the organization are not quite enough understanding about technologies and lack of skill and knowledge. Another studies [28], [29] suggested that the employee need to be prepared and willing to adopt BD analytics with their organization goal and responsibility. The Thai government is still concerning about privacy and security regarding the implementation of BD because of the above reasons. However, when the organization decide to implement the BD, well planning and strong security will be of concern [30].

TABLE I. CODING READINESS FACTOR

No.	Factor	Amount of coding
1	Technological Readiness	5
2	Organizational Readiness	5
3	Process Readiness	4
4	Quality Readiness	2
5	Environmental Readiness	1

The traditional process of data collection in Thai government's organizations do not support the BD technology because they have been implanting with paper, not digital files. The key solution to this obstacle could be the top management in the department have to cooperate with the central agencies to share the knowledge and data and also help each other to improve the infrastructure for

the BD technology [31], [32]. The factor according to the data relates to the technologies factor and quality factor. The issue become of this factor are: inexperienced personnel, lack of technology, lack of training, and lack of support. Some other factors found to contribute to data warehouse implementation failure [33].

Four out of six Thai government departments are being prepared the technology and improving the employees' skills and knowledge for the new BD technology (Table II). However, they are still having the issue in tradition process that makes a lot confuse of new technology.

TABLE II. READINESS OF BIG DATA TECHNOLOGY FOR THAI GOVERNMENT

No.	Factor	Government					
		A	B	C	D	E	F
1	Technological Readiness	●		●	●	●	
2	Organizational Readiness		●			●	●
3	Environmental Readiness	●				●	
4	Process Readiness						
5	Quality Readiness			●	●		

Table III explained Thai government progress with BD technology. All of the departments have been starting with BD technology. Only two departments have already planned and started to use BD [27].

TABLE III. THAI GOVERNMENT PHASE OF BIG DATA TECHNOLOGY

No.	Project phase	Government					
		A	B	C	D	E	F
1	Initiation	●	●	●	●	●	●
2	Planning	●		●	●	●	●
3	Execution			●	●		
4	Implementing						
5	Developed						

The case study of implementing BD technology in Thailand revealed some interesting points. The PTT Public Company Limited used analytical data with BD technology to improve its products and services. Khon Kaen University used BD technology for planning, tracking, and monitoring the bus operated in the campus. This helps their students and officers to check where the bus is and when the bus will come. Another project by the Department of Highways using the data from CCTV in the country to prepare an application of BD technology in government because the amounts of data will increase in the future [34].

Finally, the result of this study explained the possibility of the Thai government being ready for BD technology. The importance is because of the new policy of Thai government that is needed to develop the country. The world is trending towards the use of this data [26]. The summarize of result is shown in Fig. 1.

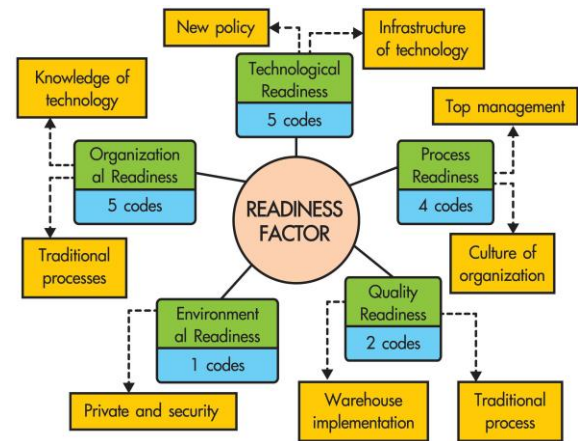


Figure 1. Readiness factor of big data technology

V. CONCLUSION

The study showed that some departments of Thai government have been implementing BD technology and earn the high value of their aims to solve people issues or uptake their organizing related to the new policy. However, some departments cannot implement BD technology because of the readiness factors.

The most significant readiness factor for the Thai government are Technological and Organizational factors. The technological in organization needs to be prepared and related to the organization's objectives to improve their works. The data within the organization should be swapped from traditional paper based to digital files so it could be utilized by BD technology.

Finally, the new Thailand policy will force all Thai government departments to implement BD technology.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Kusonkhum W. and Chonpitakwong B. conducted the research; Chaitongrat T. and Charnwasunuth P. analyzed the data; Srinavin K. and Leungbootnak N. supervised the research; all authors had approved the final version.

ACKNOWLEDGMENT

We would like to thank the Graduate School Khon Kaen University and Mahasarakham University for their funding support. We would also like to thank the Thai government officers who given a lot of perspective to this study.

REFERENCES

- [1] V. Mayer-Schönberger and K. Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think*, Houghton Mifflin Harcourt, 2013.
- [2] K. Michael and K. W. Miller, "Big data: New opportunities and new challenges [guest editors' introduction]," *Computer (Long Beach, Calif.)*, vol. 46, no. 6, pp. 22-24, 2013.

- [3] S. Singh and N. Singh, "Big data analytics," in *Proc. the International Conference on Communication, Information and Computing Technology*, Mumbai, India, Oct. 19-20, 2012.
- [4] D. Boyd. (2012). Critical questions for big data. [Online]. Available: <http://www.tandfonline.com/doi/pdf/10.1080/1369118X.2012.678878>
- [5] (2013). Blog post by Anand Rajaraman on how 'More Data Usually Beats Better Algorithms'. [Online]. Available: <http://anand.typepad.com/datawocky/2008/03/moredata-usual.html>
- [6] R. Eadie, M. Browne, H. Odeyinka, C. McKeown, and S. McNiff, "BIM implementation throughout the UK construction project lifecycle: An analysis," *Autom. Constr.*, vol. 36, pp. 145-151, 2013.
- [7] F. Insights. (2015). Betting on big data: How the right culture, strategy and investments can help you leapfrog the competition. [Online]. Available: www.forbes.com/forbesinsights
- [8] S. Kaisler, F. Armour, J. A. Espinosa, and W. Money, "Big data: Issues and challenges moving forward," in *Proc. 46th Hawaii International Conference on System Sciences*, 2013, pp. 995-1004.
- [9] J. Wielki, "Implementation of the big data concept in organizations-possibilities, impediments and challenges," in *Proc. Federated Conference on Computer Science and Information Systems*, 2013, pp. 985-989.
- [10] M. Osmani, J. Glass, and A. D. F. Price, "Architect and contractor attitudes to waste minimisation," in *Proc. the Institution of Civil Engineers-Waste and Resource Management*, 2006.
- [11] L. Wang and F. Leite, "Knowledge discovery of spatial conflict resolution philosophies in BIM-enabled MEP design coordination using data mining techniques: A proof-of-concept," *Computing in Civil Engineering*, pp. 419-426, 2013.
- [12] D. Kuketz, "The 7 biggest business benefits from big data," *Utopia: Perfect Data, Perfectly Possible*, 2012.
- [13] Y. Jiao, S. Zhang, Y. Li, Y. Wang, B. Yang, and L. Wang, "An augmented Mapreduce framework for building information modeling applications," in *Proc. the IEEE 18th International Conference on Computer Supported Cooperative Work in Design*, 2014, pp. 283-288.
- [14] J. Lin, Z. Hu, J. Zhang, and F. Yu, "A natural-language-based approach to intelligent data retrieval and representation for cloud BIM," *Comput. Civ. Infrastruct. Eng.*, vol. 31, no. 1, pp. 18-33, 2016.
- [15] K. Bakshi, "Considerations for big data: Architecture and approach," in *Proc. IEEE Aerospace Conference*, 2012, pp. 1-7.
- [16] F. Tekiner and J. A. Keane, "Big data framework," in *Proc. IEEE International Conference on Systems, Man, and Cybernetics*, 2013, pp. 1494-1499.
- [17] C. Low, Y. Chen, and M. Wu, "Understanding the determinants of cloud computing adoption," *Ind. Manag. data Syst.*, vol. 111, no. 7, pp. 1006-1023, 2011.
- [18] A. Malero and H. Seif, "Hadoop and big data readiness in Africa: A case of Tanzania," *Int. J. Sci. Res. Dev.*, vol. 1, no. 8, pp. 1609-1612, 2013.
- [19] E. O. Yeboah-Boateng and K. A. Essandoh, "Factors influencing the adoption of cloud computing by small and medium enterprises in developing economies," *Int. J. Emerg. Sci. Eng.*, vol. 2, no. 4, pp. 13-20, 2014.
- [20] Personal Interview with Bogota City Council-related Data Manager, BCC, 2014.
- [21] A. Z. Emam, "Critical success factors model for business intelligent over ERP cloud," in *Proc. International Conference on IT Convergence and Security*, 2013, pp. 1-5.
- [22] B. H. Wixom and H. J. Watson, "An empirical investigation of the factors affecting data warehousing success," *MIS Quarterly*, pp. 17-41, 2001.
- [23] W. Lawrence, *Social Research Methods: Qualitative and Quantitative Approaches, Plus Mysearchlab... Without Etext.*, Pearson Education Limited, 2013.
- [24] Royal Thai Government Gazette. (2018). Thailand's 20-year national strategy. [Online]. Available: https://http://www.ratchakitcha.soc.go.th/DATA/PDF/2561/A/082/T_0001.PDF
- [25] P. Birmingham and D. Wilkinson, *Using Research Instruments: A Guide for Researchers*, Routledge, 2003.
- [26] J. A. Hatch, *Doing Qualitative Research in Education Settings*, Suny Press, 2002.
- [27] A. Othma. (2017). Open Data Readiness Assessment (ODRA). [Online]. Available: http://https://www.academia.edu/38270704/Open_Data_Readiness_Assessment_ODRA
- [28] T. Oliveira and M. F. Martins, "Understanding e-business adoption across industries in European countries," *Ind. Manag. Data Syst.*, vol. 110, no. 9, pp. 1337-1354, 2010.
- [29] A. Lin and N. C. Chen, "Cloud computing as an innovation: Perception, attitude, and adoption," *Int. J. Inf. Manage.*, vol. 32, no. 6, pp. 533-540, 2012.
- [30] P. Porambage, M. Ylianttila, C. Schmitt, P. Kumar, A. Gurtov, and A. V. Vasilakos, "The quest for privacy in the internet of things," *IEEE Cloud Comput.*, vol. 3, no. 2, pp. 36-45, 2016.
- [31] M. Bradford and J. Florin, "Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems," *Int. J. Account. Inf. Syst.*, vol. 4, no. 3, pp. 205-225, 2003.
- [32] K. M. Sam and C. R. Chatwin, "Understanding adoption of big data analytics in China: From organizational users' perspective," in *Proc. IEEE International Conference on Industrial Engineering and Engineering Management*, 2018, pp. 507-510.
- [33] D. Mukherjee and D. D'Souza, "Think phased implementation for successful data warehousing," *Inf. Syst. Manag.*, vol. 20, no. 2, pp. 82-90, 2003.
- [34] R. Thai. (2017). Big data for Thai government. [Online]. Available: https://library2.parliament.go.th/ejournal/content_af/2559/dec2559-4.pdf

Copyright © 2021 by the authors. This is an open access article distributed under the Creative Commons Attribution License ([CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)), which permits use, distribution and reproduction in any medium, provided that the article is properly cited, the use is non-commercial and no modifications or adaptations are made.



Korb Srinavin is an Associate Professor in Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, Thailand. He obtained his B.Eng. in Agricultural and Civil Engineering and M.Eng. in Structural Engineering and Construction from Asian Institute of Technology. He gained his Ph.D. in Construction Engineering and Management from Griffith University, Australia. His research interests involve project management and construction industry development.



Wuttipong Kusonkhum is a Doctoral degree student in Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, Thailand. He obtained his B.Eng. in Civil Engineering from Mahasarakham University and his M.Eng. in Civil Engineering from Khon Kaen University. His research interests involve project management and construction industry development.



Boonyarit Chonpitakwong is a Master degree student in Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, Thailand. He obtained his B.Eng. in Civil Engineering from Khon Kaen University. His research interests involve project management and construction industry development.



Tanayut Chaitongrat is a Lecturer in Faculty of Architecture, Urban Design and Creative Arts, Mahasarakham University, Thailand. He earned his B.S.Tech.Ed. in Civil Engineering from King Mongkut Institute of Technology North Bangkok and his M.Eng. and Ph.D. in Civil Engineering from Khon Kaen University. He is interested in public procurement in construction, Construction Project Management, Planning Management and Evaluation & Grading Project.



Narong Leungbootnak is an Associate Professor in Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, Thailand. He obtained his B.Eng. in Civil Engineering and his M.Eng. in Structural Engineering from Khon Kaen University. He gained his Ph.D. in Construction Engineering and Management from Asian Institute of Technology. His research interests involve project management and construction industry development.



Phatsaphan Charnwasununth is a lecturer in Department of Housing, Faculty of Architecture, Chulalongkorn University, Bangkok, Thailand. He obtained his B.Eng. and M.Eng. in Civil Engineering from Chulalongkorn University. He gained his Ph.D. in Construction Engineering and Management from Chulalongkorn University. His research interests involve project management and construction industry development.