Towards A Readiness Assessment Model for Value Management in Construction Industry

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Abstract. Value management (VM) has over the years gained acceptance by various countries all over the world as a tool towards achieving value for money for clients. Ongoing research and development into value management adoption and implementation within the construction industries of developing countries is on the run. This has made researchers investigate on a better, more effective and more efficient implementation towards achieving the full benefits it offers. VM implementation efforts in the developed countries necessitate the assessment of the readiness of the industries prior to the introduction and adoption of VM. However, there is little effort made in developing a readiness assessment model for VM in the construction industry. Therefore, this paper aims to carry out a comparative review of the available readiness models in the construction industry and some few more from manufacturing industry in view to laying a base towards the development of a readiness assessment model for VM implementation in developing countries. This paper adopts the document analysis method for the review and comparison of the assessment models. The readiness models have been examined and assessed along with their strengths and weaknesses revealed. The paper identifies the readiness assessment criteria that could be adopted for developing a readiness model for value management in construction industry. It further identifies the requirements of value management and provides a guideline towards the development of a VM readiness assessment model.It finally concludes the necessity of a readiness assessment of the construction industry in developing countries prior to its introduction. The paper finally identifies development of a readiness assessment model as an area for further study.

Keywords: Value Management; Readiness Assessment; Implementation; Review; Requirement.

1. Introduction

In the current global revolution, the construction industry has been one of the most contributing sectors of the economy for most countries across the world especially the developing ones (Durdey and Ismail, 2016). Value management as a methodology, has for some decades proved to be of high positive impact to the construction industry as witnessed in countries like the US, UK, China, Malaysia, Saudi Arabia and several others(Jay & Bowen, 2015)(Qiping Shen & Yu, 2012). Its practical benefits include: Encouragement of use of local materials in construction; Adoption of new construction techniques/innovation; Cost effectiveness; Effective delivery system/meeting completion period; Effective conflict management; Improvement of quality of work; Promotion of adaptability and flexibility; Guarantee the true worth or value for money to clients; Enhancement of competitive edge for contractors; Enhancement of quality performance of construction projects; Elimination of unnecessary design; Improvement of functional space quality of projects; Enhancement of economic investment; Reduction of cost and improvement of value; Increment of the performance level in construction industries; Helps in decision-making; Enhancement of teamwork amongst construction professionals; Enhancement of mutual relationship and confidence (Oke & Ogunsemi, 2011).

Although, the significance of value management benefits are indisputable in the construction industry, it is flabbergasting that after over fifty years since its first introduction into the construction industry by Dell'Isolla in early 1960s, some countries are still reluctant to adopt the technique, some of the ones that have adopted are unable to explore its full benefits(Sabiu & Agarwal, 2016). The growing evidences on the reluctance of some countries to adopt the value management technique and others not exploring its full potentials, had motivated researchers to investigate on the reasons behind such. Extensive researches on the barriers of value management adoption and implementation have been conducted. Various constraints have been identified by various researchers with similarities and differences from different countries' case studies. These factors have been examined by researchers and some strategies formulated for the successful implementation of value management in various countries. They have concluded that, there is much to be done if the expected benefits of VM can be realised in the construction industry. Among these strategies, Aghimien et al. (2018)concluded that, to successfully implement and achieve the full benefits of value management in the construction industry, there is need to conduct a 'readiness assessment' of the industry and its stakeholders prior to its introduction. This helps to ascertain the extent to which the industry and its stakeholders are ready to adopt and implement value management practices. The assessment would also help to identify areas that need improvement and plan well the VM implementation in order to achieve its full benefits.

This paper compares some existing readiness assessment models, investigates their appropriateness for VM adoption in the light of current practices, and provides a guide for the development of a VM readiness assessment model.

2. Readiness Assessment

Readiness has been defined by various researchers in various ways depending on their perceptions and angle looked from. Dada (2006) defined readiness as the *"the measure of the degree to which an organisation or industry may be ready, willing or prepared to obtain benefits that arise from an innovation"*. Harvard University Centre for International Development's (CID, 2000) defined the term readiness as *"the degree to which a community is prepared to participate in the networked world - a world in which everyone, everywhere, has the potential to reap the benefits of connectivity to the network"*. Fong & Shen (2000)defined readiness as *"as a measure of the maturity level of all industry's stakeholders to implement value management techniques effectively"*. Generally, the term 'readiness' is a measure of the capability of an industry or organisation to adopt value management prior to its implementation.

3. Comparison of Readiness Assessment Models

A total of eight readiness assessment models have been identified and examined for the purpose of this study. Five of these models have specifically been developed to be used in the construction industry, while the other three, are purposely used in the manufacturing industry. The readiness assessment models selected are: Benchmarking Readiness Assessment for Concurrent Engineering (BEACON); Verify End-user Readiness using a Diagnostic Tool (VERDICT); Standard Process Improvement for Construction Enterprise (SPICE); Sustainable Construction Readiness Assessment Model (SCRAM); and Building Information Modelling Maturity Index (BIMMI). On the other hand, the readiness models from the manufacturing industry used for this study, are: Readiness Assessment for Concurrent Engineering (RACE), Capability Maturity Model Integrated (CMMI) and General Practitioner Information System (GPIS). All of these models were examined and evaluated in view to coming up with a new readiness assessment model for value management implementation in the construction industry. The evaluation was done in terms of model description; purpose; parameters & indicators; assessment criteria; survey method; status; strengths; weaknesses; and compatibility to be used for value management readiness assessment. Table 1 shows a brief description and comparison of the models.

3.1 Model Description & Purpose

Each model developed has in one way or the other some unique features attributed to it that differentiates it from the others. Some of the models were developed as a result of integration of two or more models.

The BEACON model was developed by Malik Khalfan *et al.* in the year 2001. The BEACON (Benchmarking Readiness Assessment for Concurrent Engineering) model for example, is an improved version of the CERAM Construct Model (Concurrent Engineering Readiness Assessment Model for Construction) which had two elements (process & technology) initially. The CERAM was later improved by the addition of two more elements (people & project) leading to the development of the now BEACON. It consists of an associated model-based questionnaire called the BEACON Questionnaire which is used to assess the construction organisations with respects to the elements

covered. The BEACON is used in assessing readiness of organisations for concurrent engineering implementation in view to improving project delivery processes. It is purposely made for use in the construction industry. Its process and people elements can be used for VM implementation.
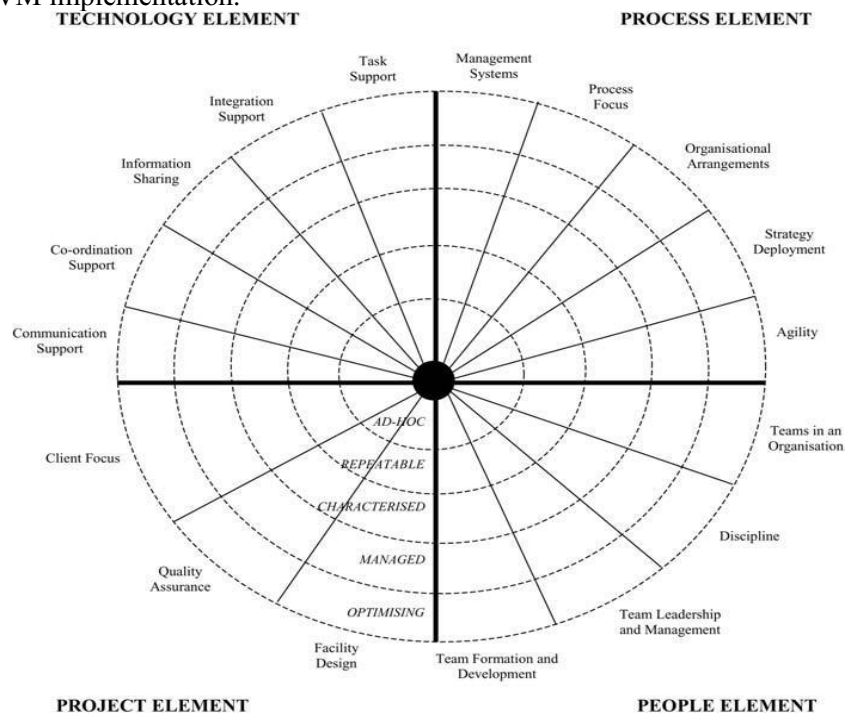

Figure 1. BEACON model(Malik, Chimay, & Patricia, 2001)

The VERDICT (Verify End-user Readiness using a Diagnostic Tool) model was developed by Ruikar*et al.* in the year 2006. It is an internet-based prototype application that assesses the overall e-readiness of end-user construction firms to adopt information & communication technologies (ICTs) such as e-commerce tools. It can be used to assess e-readiness of construction companies, departments within a company, or even individual work groups within a department. It comprises four elements for assessment. Its inclusion of the 'Management' element, makes it unique from other models as its emphasis on the necessity of total commitment from the management to adopt and implement a new innovation. 3 of its four elements can be used for VM implementation.
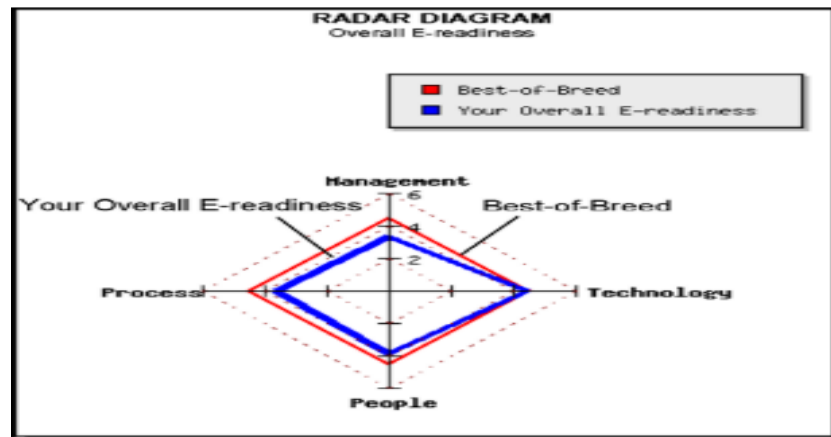
Figure 2. VERDICT model(Ruikar, Anumba, & Carrillo, 2006)

SPICE (Standardised Process Improvement for Construction Enterprise) model was developed at the University of Salford, UK, in 1998. It is in the form of a questionnaire designed to evaluate the construction processes within a construction organisation. It is a systematised step by step process improvement model for the construction industry. It evaluates the fundamental construction processes within an organisation and is usually used for process improvement. It is meant to be used in the construction industry. In addition to the questionnaire, a semi-structured interview is also used for the assessment. Its 'Process' element can be used for VM implementation.
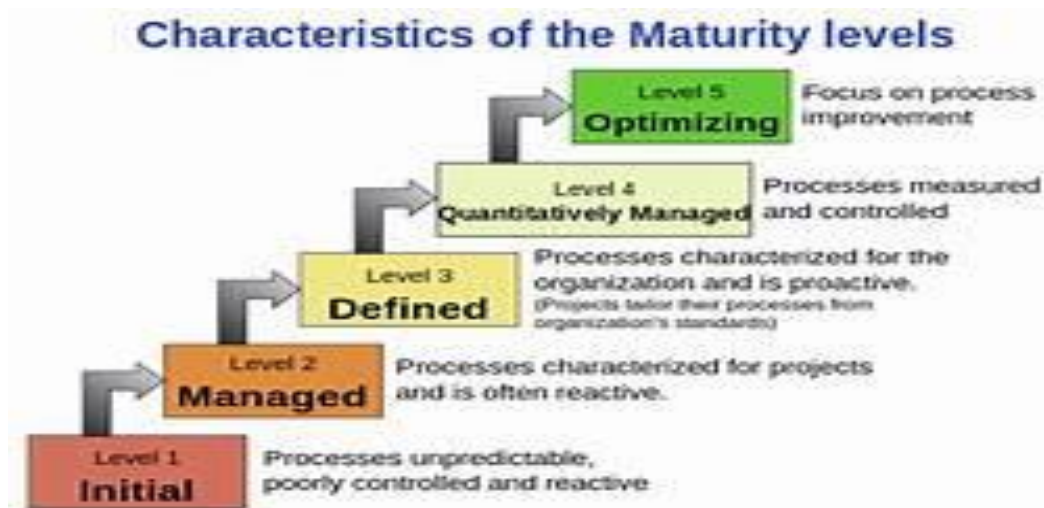

Figure 3. SPICE model (University of Salford, 1998)

SCRAM (Sustainable Construction Readiness Assessment Model) was developed in the year 2015 by Wirahadikusumah and Ario. It was developed as a tool to identify the baseline conditions of contractors' readiness, i.e. awareness, willingness, and capacity towards sustainability practices. It's mainly used to measure the readiness of contractors to implement sustainable construction practices in their projects. It is meant to be used in the construction industry. Its 'construction practices' element can be modified to fit in for VM implementation readiness assessment.
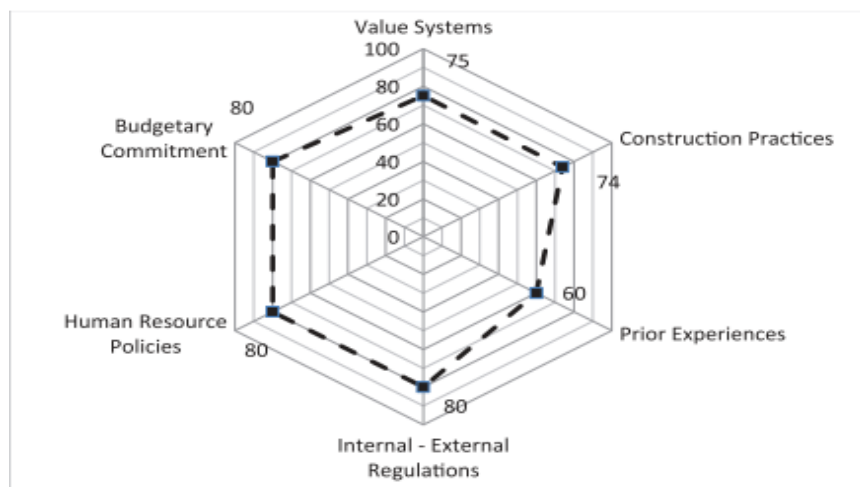

Figure 4. SCRAM (Wirahadikusumah & Ario, 2015)

BIMMI (Building Information Modelling Maturity Index) was developed by Succar in 2009. It is a readiness assessment model specifically designed to measure the maturity levels of an organisation with respect to processes, technologies & policies. It is purposely developed for BIM application in construction. Its Maturity Levels reflect the extent of BIM abilities, deliverables and their requirements as opposed to minimum abilities reflected through Capability Stages. The maturity levels allow for a basic distinction between immature and mature. It has 12 individual scores relating to 10 competency areas, 1 capability stage and 1 organisation scale. Its 5-level maturity assessment can be used for VM readiness assessment.

Figure 5. BIMMI model (Succar, 2009)

On the other hand, the three readiness models from the manufacturing industry also have their own unique features that differentiate them and serve different purposes. There are many readiness models available in the manufacturing industry but only these three (RACE, CMMI & GPIS) were selected for the purpose of this study considering the similarities of their features with those in the construction industry.

CMMI (Capability Maturity Model Integrated) comprises best practice that can be used to improve process within an organisation, department or project. Its assessment measures the maturity and capability of the process within the organisation.

RACE (Readiness Assessment for Concurrent Engineering) tool was developed at West Virginia University (United States) in the early 1990s and is widely used in the software engineering, automotive and electronic industries. The RACE model is conceptualised in terms of two major components: the organisational processes for product development, and the information technology to support the product development process. Its 'process' & 'technology' elements can be used for VM implementation readiness with some modifications.

GPIS (General Practitioner Information System) is a general IT/IS model that focuses on recipient organisation. It is used to assess the readiness of organisation to use Information Technology/Information System.

3.2 Framework for Comparison of the Readiness Models
The seven readiness models described earlier, were compared and contrasted under a number of criteria as outlined below:

- Developer/Year: this shows the inventor's name and the year of the model development.
- Description & Purpose: this criterion gives a brief description of the model, its design and the purpose for which it is made for. It also states the industry for which the model is meant to be used in (whether construction, manufacturing or automobile)

- Parameters & Indicators: this outlines the main aspects covered by each model and the indicators upon which the organisations would be assessed for readiness.
- Assessment Criteria: this shows the levels of maturity or readiness of the organisation's assessment results. It shows the level of maturity or immaturity of the organisation to adopt/implement an innovation.
- Survey Method: this identifies the tool used to collect the data for the assessment mostly questionnaire, interview or a hybrid.
- Status: shows the current state of the model in terms of being a research prototype, commercial or under development.
- Strengths: this outlines the capabilities and benefits of the model
- Weaknesses: this outlines the limitations and setbacks of the model with regards to performance and operation.
- Usability to VM: this shows the capability of the model to be used for value management readiness with few modifications.

3.3 Discussion

It has been observed that, compared to other industries like the manufacturing and automobile industries, the construction industry is by far lagging behind in terms of readiness assessment models developed. Aziz and Salleh (2011)reported just three readiness assessment models developed for the construction industry. And of these three models, none was developed to assess readiness for value management implementation in the industry. Since then, one more model was developed in 2015 by (Wirahadikusumah & Ario, 2015)that assesses the readiness of contractors on use of sustainable construction in their projects.

Table 1 shows all the four models from construction industry and a further four from other industries were compared and assessed. All of these models were developed to serve different purposes to yield the intended results. Each of the models have their respective strengths as well as weakness, hence improvements and modifications need be done in developing more comprehensive model (like value management readiness model). From the comparative analysis, it can be deduced that all the models with the exception of one (RACE) are research prototypes, that is to say they are under development. Another observation is that, the models tend to have some parameters in common as core elements for their respective readiness assessment. It could be observed that, the 'process' & 'technology' elements are evident in all the models but one (SPICE) which was mainly developed to improve construction processes. The 'management' element appeared only in the VERDICT model which make sit distinct from the remaining models. Its developers argued that the 'management' element is in fact the most important element as the adoption of any new innovation or approach within an organization/department/work group requires total commitment from the management (or group leader).

Table 1. Comparison of Readiness Assessment Models and Tools

CRITERIA/ MODEL	RACE	SPICE	BEACON	VERDICT	GPIS	BIMMI	SCRAM
Developer/Year	West Virginia University (1990)	University of Salford (1998)	Khalfan et al. (2001)	Ruikar et al. (2006)	Alshawy (2007)	Succar (2009)	Wirahadikusuma (2015)
Description & Purpose	Readiness Assessment for Concurrent Engineering model was developed at West Virginia University (United States) in the early 1990s and is widely used in the software engineering, automotive and electronic industries. The RACE model is conceptualised in terms of two major components: the organisational processes for product development, and the information technology to support the product development process.	Standardised Process Improvement for Construction Enterprise (SPICE) is a systematized step by step process improvement model for the construction industry. The SPICE evaluates the fundamental construction processes within an organisation. It is used usually used for process improvement.	Benchmarking Readiness Assessment for Concurrent Engineering is an improved version of the CERAM Construct Model i.e. Concurrent Engineering Readiness Assessment Model for Construction. The BEACON is used in assessing readiness of organisations for concurrent engineerin implementation in view to improving project delivery processes.	Verify end-user is an internet-based prototype application that assesses the overall e-readiness of end-user construction firms to adopt Information & Communication Technologies (ICTs) such as e-commerce tools. It can be used to assess the e-readiness of construction companies, department(s) within a company, or even individual work groups within a department.	General Practitioner Information System is general IT/IS model that focused on recipient organisation. It is used to assess the readiness of organisation to uptake Information Technology/Information System. It Comprises 6 level of maturity (level 1-6). The assessment must be carried out prior to system implementation to identify the readiness gap	Building Information Modelling Maturity Index is a readiness assessment model specifically designed to measure the maturity levels of an organisation with respect to the processes, technologies & policies. The maturity levels allow for a basic distinction between immature and mature. It has 12 individual scores relating to 10 competency areas, 1 capability stage & 1 organisational scale.	Sustainable Construction Readiness Assessment Model was developed as a tool to identify the baseline conditions of contractors' readiness, i.e. awareness, willingness, and capacity towards sustainability practices. It's mainly used to measure the readiness of contractors to implement sustainable construction practices in their projects.
Area of application	Concurrent Engineering	Project Management (PM)	Concurrent Engineering (CE)	Information & Communication Technology (ICT)	Information Technology	Building Information Modelling (BIM)	Sustainable construction

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Parameters & Indicators	**(1) Process** - customer focus - product assurance - leadership - team formation - strategy development - agility - teams within the organisation - process focus - management system - discipline **(2) Technology** - project architecture - application tools - communication - coordination - information sharing - integration	- brief management - project planning - project tracking & monitoring - contract management - quality D4assurance - project change management - risk management - organisation process focus - organisation process definition - training programme - inter-disciplinary coordination - peer review - technology management	**(1) Process** - management systems - process focus - organisational arrangements - strategy deployment - agility **(2) People** - teams in an organisation - discipline - team leadership & management - team formation & development **(3) Project** - facility design - quality assurance - client focus **(4) Technology** - communication support - coordination support - information sharing - integration support - task support	**(1) Management** - commitment & support - business strategies - change management - resources availability **(2) People** - organisational structure - skills & capability - roles & responsibilities - work environment - awareness **(3) Processes** - working rules - business ethics - procedures **(4) Technology** - infrastructure availability - hard & software usage - performance - operation	**(1) Process** - generic practice **(2) People** - head of IT - staff - skill **(3) Environment** - culture - leadership - structure **(4) IT infrastructure** - systems	**(1) Technology** **Competency Sets** - software - hardware - network **(2) Process** **Competency Sets** - infrastructure - human resources - product & services - leadership **(3) Policy** **Competency Sets** - regulatory - contractual - preparatory	(1) value systems (2) construction practices (3) prior experience (4) internal-external regulations (5) human resource policies (6) budgetary commitment

	5-level maturity assessment	**5-level maturity assessment**	**3-level e-assessment indicators**	**6-level maturity assessment**	**5-level maturity assessment**	**3-level readiness assessment (%)**
Assessment Criteria	the levels range from 1-5 and assessed according to the presence of key processes in each level. The assessment is based on implementation of the key processes.	- ad-hoc (not ready to adopt CE) - repeatable - characterised - managed - optimising (ready to adopt CE)	- red light (not e-ready) - amber light (needs improvement) - green light (e-ready)	-incomplete (0) - performed (1) - managed (2) - defined (3) - quantitatively managed (4) - optimizing (5)	- initial/ad-hoc - defined - managed - integrated - optimised	- not ready (0-50) - partly ready (51-70) - ready (71-100)
Survey Method	Questionnaire & Interview	Questionnaire	Internet-based Questionnaire	Interview		Questionnaire
Status	Research Prototype / Commercial	Research Prototype	Research Prototype	Research Prototype	Not certified yet; On-going Research Prototype	Research Prototype

Strength					
*uses other software like SPSS *ease of use *software availability for generation of assessment results	*provides guidelines for improvements *identifies both process strengths and weaknesses *provides strong platforms to discuss process improvements *the questionnaire is well structured and provides additional space for comments	*simple & easy to use *addresses the four key elements of CE implementation *provides guidelines for effective CE implementation *identifies areas that need improvement in an organisation prior to CE implementation *a useful tool for self-assessment of an organisation not just for CE but also other inventions like I.T., BIM, VM etc *provision of an associated software for automatic generation of assessment results on the model diagram	*simple & easy to understand *uses triangulation methodology that increases validity & reliability of the data *inclusion of a leading aspect (management) without whose commitments, all efforts would be wasted and ineffective *identifies critical issues that need to be addressed to achieve e-readiness *it shows organisations strengths & weaknesses to achieve e-readiness *being internet-based, it is flexible, portable, accessible & independent *its benchmarking feature makes it unique and an excellent assessment model	*adequate level of maturity *addressed the four key elements of IT	*Maturity levels reflect the extent of BIM abilities, deliverables and their requirements as opposed to minimum abilities *incorporates many BIM framework components *it is unique, applicable, flexible and measurable

Weakness					
*technological aspect is difficult to answer *it's only for experts/specialists	*elimination of zero (0) in the assessment levels. This is because, there may be no key process implemented in a particular level and thus only zero can justify that. *finance & marketing aspects are excluded *the people aspect is not adequate *it is limited to process & procedure only *some terms in the questionnaire are difficult to understand	*lack of justification within the maturity levels i.e. no adequate assessment. Some organisations may fall within same maturity level (e.g. ad-hoc) but with one organisation better than the other. *needs to catch up with current technological advancements	*the 3-level scale assessment is inadequate *does not indicate how improvements can be made *too many questions to answer in the questionnaire *needs to catch up with current technological advancements	*difficult to use *complex in nature *the process aspect is inadequate	*survey method yet to be defined *complex in nature

The comparison table shows a 3-level and 5-level assessment criteria for almost all the models. BEACON & BIMMI used almost the same 5-level assessment criteria vis: ad-hoc, repeatable/defined, characterised/managed, integrated & optimising. The VERDICT & SCRAM used 3-level of assessment (not ready, partly ready & ready). Questionnaire and/or semi-structured interview were used as the survey method for all the models with the questionnaire in all the models. Some of the models like the VERDICT & BEACON already have software that automatically generate the assessment results and present them in their respective models.

4. Value Management Readiness Assessment for the Construction Industry

4.1 The Necessity
As emphasized by various researchers, readiness assessment is necessary in achieving a successful adoption and implementation of an innovation in an organisation or even the industry at large. The readiness assessment is to be conducted prior to the introduction of the innovation or technology. This goes contrary to what is commonly done nowadays, various organisations tend to assess readiness way after several failed attempts in implementing the new innovation or approach. Same is done in the case of value management [2].

Readiness assessment of value management investigates the extent to which the industry is capable of adopting and/or implementing its methodologies to achieve the expected benefits that it offers. Therefore, in reducing the number of failures in value management implementation, there is need to assess the readiness of the industry prior to VM implementation to attain higher success rate. This ensures that all stakeholders in the construction industry have reached a certain level of maturity and readiness with regard to the requirements and success factors for value management adoption and/or implementation. The assessment may most likely indicate the following benefits:

- ensures a better, more effective and more successful VM implementation in the industry;
- enables the industry to assess and benchmark the VM outcomes with best of breeds from other countries' construction industries;
- enables the industry to identify areas that need improvement in order to attain the expected readiness level in VM implementation;
- prevents failures in attempts to implement value management in construction projects; and
- provides guidelines for effective VM implementation.

4.2 Development of a Readiness Assessment Model for Value Management in Construction Industry
The development of a readiness assessment model for value management in the construction industry would require series of steps and procedures. Certain aspects of the VM need be examined and analysed just same way previous models (in Table 1) went through. The procedures would pave way and lay a base for the development of a readiness model for VM but which may not be limited to. They are as follows:

- Extensive literature review on the definition and concept of value management;
- Review of the available readiness assessment models; [8]
- Identification of the 'requirements *for* value management'; [7]
- Identification of the 'requirements *of* value management'; [7]
- Identification of the construction stakeholders involved; [5]
- Identification of the elements/parameters/aspects that value management covers; [2, 8, 14]
- Identification of the parameters' indicators; [3, 14]
- Determination of the survey method;
- Determination of the assessment criteria/levels; [11, 13]
- Determination of the diagrammatic representation of the model; [3, 11], and

- Development of the software that would automatically generate the assesed results in the diagram [8, 2, 11]

Extensive literature review of value management needs to be carried out to determine the meaning, scope and concept of value management in the construction industry. The literature would identify the critical success factors as well as the pit-falls during value management implementation.

The next step to be carried out is the review of the available readiness assessment models in construction industry and few others from manufacturing industry. This would include a comparative study of the models to determine the best-fit for construction and specifically for value management.

Then follows the identification of the requirements 'for' value management (R *for* VM). These refer to certain conditions or qualifications that need to be met prior to the introduction of value management in construction projects. For value management to be adopted and even so implemented, these conditions need be met, else it can't be actualised. These requirements can also be termed as 'prerequisites for 'value management'.

Identification of the requirements 'of' value management (R*of*VM) follow suit. These requirements are different from "requirements *for* value management" described previously. The distinction between the two lies in the fact that, as the former (R*for*VM) are prerequisites to VM adoption, the latter (R*of*VM) refer to the conditions that need to be met to achieve a successful value management implementation after its adoption. R*of*VM also refer to certain conditions and procedures that need be followed in order to ensure an effective and successful value management workshop.
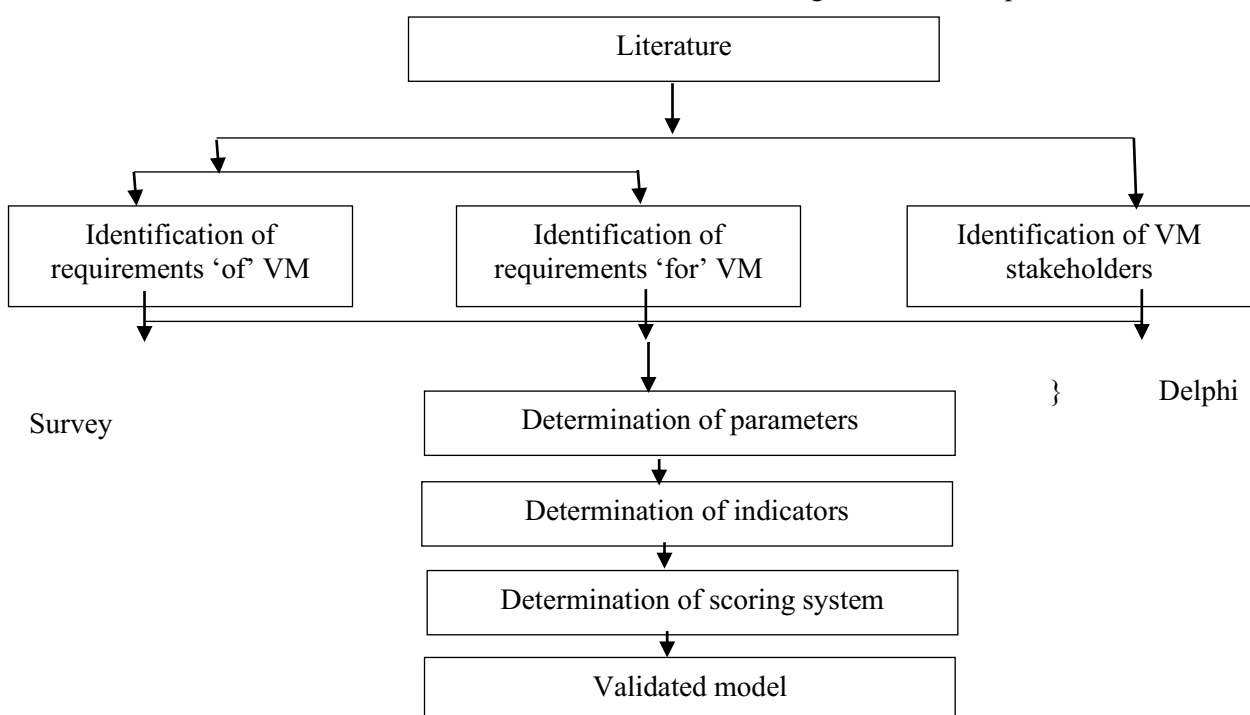

Figure 6. The development of a readiness assessment model for value management in the construction industry

There are several stakeholders in the construction industry like clients, contractors, craftsmen, engineers, architects, quantity surveyors, end-users, project managers, suppliers, etc, but not all the stakeholders are involved in a value management workshop/process. Therefore, the stakeholders involved need be identified and their roles addressed. This would help in the assignment of indicators to respective stakeholders.

Parameters are considered the prerequisites for value management to be adopted and/or implemented. The parameters would be identified from several literatures of value management and precisely from the requirements of VM (**R**of**VM**)& requirements for VM (**R**for**VM**). The assessment is usually done base on the parameters.

Each parameter would consist of a series of indicators attached to it. The indicators are sub-parameters that further highlight certain requirements that need be achieved to attain the required readiness in that parameter. The indicators also describe and explain more on the parameter. The assessment is done by scoring the stakeholders base on these indicators.

The next step is the determination of the survey method to be used. Table 1 revealed just two survey method that were used in almost all the models. These survey methods are: questionnaire and interview. Some of the models used a combination of both while others used one. The questionnaire may be hard or internet-based.

The criteria for assessment need to be determined to show the levels of maturity or readiness attained. This would help in making decisions and conclusions on the assessment results. It highlights the areas that have attained readiness and those that need improvements to attain readiness. In fact, this is the essence of the model – to show the level of readiness of the organisation/industry towards adopting and/or implementing value management.

Finally, the look or diagrammatic representation of the model needs to be determined. This may depend on the number of parameters/aspects covered and the wish of the developer.

Figure 7 shows the value management requirements that must be met prior to the introduction of VM in the industry.
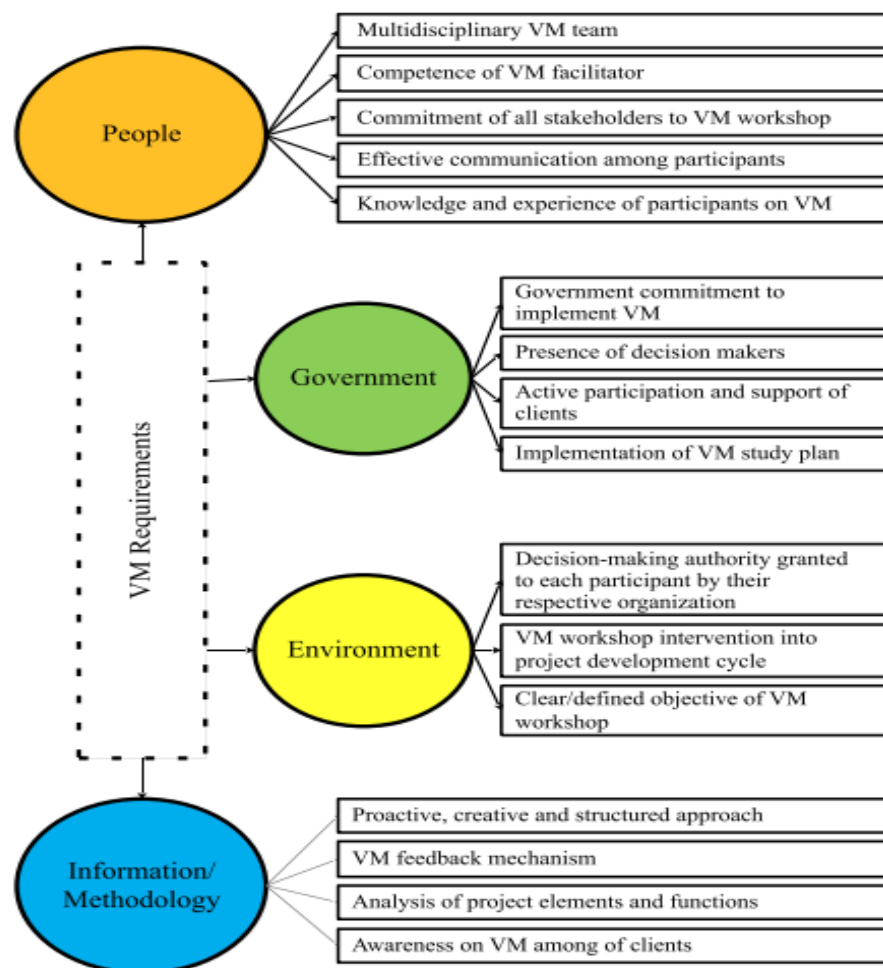
Figure 7. Requirements for Value Management (Tanko, Abdullah, Mohamad Ramly, & Enegbuma, 2018)

5. Conclusion

This paper discussed Value Management readiness assessment for the construction industry and presented a comparative review of some available tools and models from within construction industry and few other industries like the manufacturing. It has also outlined the guidelines to be followed towards the development of a VM Readiness Assessment Model for construction industry. The following conclusions can be drawn:

- To develop a readiness assessment model for VM implementation in construction industry, certain readiness criteria need be developed which would be used for the assessment.
- In order to determine the readiness criteria, the requirement of value management need be identified first, from which the readiness criteria could be developed.
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- Readiness assessment of the construction industry is a necessity to be conducted prior to implementation of VM so as to ensure maximum benefit is achieved.
- To assess the industry, a readiness assessment model is required for VM due to lack of one.
- The guideline will help towards the development of VM readiness assessment model
- The model when developed will facilitate formulation of strategies for effective VM implementation to achieve maximum benefits.

References

[1]   Aghimien, D. O., Oke, A. E., & Aigbavboa, C. O. (2018). Barriers to the adoption of value management in developing countries. *Engineering, Construction and Architectural Management*, *25*(7), 818–834. https://doi.org/10.1108/ECAM-04-2017-0070

[2]   Aziz, N. M., & Salleh, H. (2011). A readiness model for IT investment in the construction industry. *African Journal of Business Management*, *5*(April), 2524–2530. https://doi.org/10.5897/AJBM10.1025

[3]   Baier, R. R., Jutkowitz, E., Mitchell, S. L., McCreedy, E., & Mor, V. (2019). Readiness assessment for pragmatic trials (RAPT): A model to assess the readiness of an intervention for testing in a pragmatic trial. *BMC Medical Research Methodology*, *19*(1), 1–8. https://doi.org/10.1186/s12874-019-0794-9

[4]   Bakhsh, M., Mahmood, A., & Ahmed Sangi, N. (2018). M-Readiness assessment model development and validation: Investigation of readiness index and factors affecting readiness. *International Journal of Distance Education Technologies*, *16*(1), 1–23. https://doi.org/10.4018/IJDET.2018010101

[5]   Benssam, A., Taboudjemat, N. N., & Nouali, O. (2016). An e-readiness assessment model for disaster management. *International Journal of Information Technology and Management*, *15*(2), 118–143. https://doi.org/10.1504/ijitm.2016.076412

[6]   Butel, J. A., Banna, J. C., Novotny, R., Franck, K. L., Parker, S. P., & Stephenson, L. (2018). Validation of a Collaboration Readiness Assessment Tool for Use by Supplemental Nutrition Assistance Program–Education (SNAP-Ed) Agencies and Partners. *Journal of Nutrition Education and Behavior*, *50*(5), 501–505. https://doi.org/10.1016/j.jneb.2017.11.002

[7]   Chatzipoulidis, A., Tsiakis, T., & Kargidis, T. (2019). A readiness assessment tool for GDPR compliance certification. *Computer Fraud and Security*, *2019*(8), 14–19. https://doi.org/10.1016/S1361-3723(19)30086-7

[8]   De Soysa, S., & Nanayakkara, J. (2006). Readiness for ERP implementation in an organization: Development of an assessment model. *2nd International Conference on Information and Automation, ICIA 2006*, *00*, 27–32. https://doi.org/10.1109/ICINFA.2006.374147

[9]   Doculan, J. A. D. (2016). E-L Earning R Eadiness a Ssessment T Ool F or Philippine Igher E Ducation I Nstitutions. *International Journal on Integrating Technology in Education (IJITE) Vol.5,5*(2), 33–43.

[10]   Donkor, A., Luckett, T., Aranda, S., Vanderpuye, V., & Phillips, J. (2020). Developing a readiness self-assessment tool for low- and middle-income countries establishing new radiotherapy services: A participant validation study. *Physica Medica*, *71*(February), 88–99. https://doi.org/10.1016/j.ejmp.2020.02.015

[11]   Fathian, M., Akhavan, P., Hoorali, M., & Jafari, M. (2012). Application of Delphi Technique for Development of E-Readiness Assessment Model: A Study on Small and Medium Enterprises of Iran. *SSRN Electronic Journal*, 1–13. https://doi.org/10.2139/ssrn.2188229

[12]   Fong, P. S., & Shen, Q. (2000). Is the Hong Kong construction industry ready for value management ? *International Journal of Project Management*, *18*, 317–326.

[13]   Ghavamifar, A., Beig, L., & Montazer, G. A. (2008). The comparison of different e-readiness assessment tools. *2008 3rd International Conference on Information and Communication Technologies: From Theory to Applications, ICTTA*, 1–5. https://doi.org/10.1109/ICTTA.2008.4529945

[14]   Haron, A. T. (2013). *Organisational readiness to implement building information modelling: A framework for design consultants in Malaysia*.

[15]   Heslop, L. A., McGregor, E., & Griffith, M. (2001). Development of a technology readiness assessment measure: The Cloverleaf model of technology transfer. *Journal of Technology Transfer*, *26*(4), 369–384. https://doi.org/10.1023/A:1011139021356

[16]   Jaafar, M., Abdul Aziz, A. R., Ramayah, T., & Saad, B. (2007). Integrating information technology in the construction industry: Technology readiness assessment of Malaysian contractors. *International Journal of Project Management*, *25*(2), 115–120. https://doi.org/10.1016/j.ijproman.2006.09.003

[17]   Jay, C. I. I., & Bowen, P. A. A. (2015). Value management and innovation: A historical perspective and review of the evidence. *Journal of Engineering, Design and Technology*, *13*(1), 123–143. https://doi.org/10.1108/JEDT-03-2013-0021

[18]   Jones, D. W. (2012). Development of a bariatric patient readiness assessment tool for the emergency department. *Advanced Emergency Nursing Journal*, *34*(3), 238–249. https://doi.org/10.1097/TME.0b013e31825f42ff

[19]   Khalfan, M. M. A., Anumba, C. J., & Carrillo, P. M. (2005). Concurrent engineering readiness assessment tool for construction. *Architectural Engineering and Design Management*, *1*(3), 163–179. https://doi.org/10.1080/17452007.2005.9684591

[20]   Khalfan, M. M. A., Anumba, C. J., Siemieniuch, C. E., & Sinclair, M. A. (2001). Readiness Assessment of the construction supply chain for concurrent engineering. *European Journal of Purchasing and Supply Management*, *7*(2), 141–153. https://doi.org/10.1016/S0969-7012(00)00023-X

[21]   Kim, E. H., Wells, W. G., & Duffey, M. R. (2003). A model for effective implementation of Earned Value Management methodology. *International Journal of Project Management*, *21*(5), 375–382. https://doi.org/10.1016/S0263-7863(02)00049-2

[22]   Lachman, B. E., Wong, A., & Resetar, S. A. (2007). *An assessment of DOD's readiness and environmental protection initiative to buffer installation encroachment.*

[23]   Lee, T. Y., Wong, W. K., & Yeung, K. W. (2011). Developing a readiness self-assessment model (RSM) for Six Sigma for China enterprises. *International Journal of Quality and Reliability Management*, *28*(2), 169–194. https://doi.org/10.1108/02656711111101746

[24]   Lim, S. A. H., & Antony, J. (2016). Statistical process control readiness in the food industry: Development of a self-assessment tool. *Trends in Food Science and Technology*, *58*, 133–139. https://doi.org/10.1016/j.tifs.2016.10.025

[25]   Liu, A. M. M., & Leung, M. Y. (2002). Developing a soft value management model. *International Journal of Project Management*, *20*(5), 341–349. https://doi.org/10.1016/S0263-7863(01)00023-0

[26]   Maar, M., Yeates, K., Barron, M., Hua, D., Liu, P., Lum-Kwong, M. M., … Tobe, S. W. (2015). I-RREACH: An engagement and assessment tool for improving implementation readiness of researchers, organizations and communities in complex interventions. *Implementation Science*, *10*(1), 1–13. https://doi.org/10.1186/s13012-015-0257-6

[27]   Male, S., & Kelly, J. (1989). Organizational responses of public sector clients in Canada to the implementation of value management: Lessons for the UK construction industry. *Construction Management and Economics*, *7*(3), 203–216. https://doi.org/10.1080/01446198900000023

[28]   Malik, K., Chimay, A., & Patricia, C. (2001). Development of a readiness assessment model for concurrent engineering in construction. *An International Journal*, *8*(3), 223–239. https://doi.org/10.1108/09574090910954864

[29]   Mirzaei, J., & Madani, F. M. (2009). Proposing a conceptual readiness assessment model of mis/is deployment in manufacturing companies (a case study conducted on the applications of the suggested model in mehrcampars co.). *Proceedings - International Conference on Information, Process, and Knowledge Management, EKNOW 2009*, (1), 141–146. https://doi.org/10.1109/eKNOW.2009.32

[30]   Muladi, N., & Surendro, K. (2015). The readiness self-assessment model for green IT implementation in organizations. *Proceedings - 2014 International Conference on Advanced Informatics: Concept, Theory and Application, ICAICTA 2014*, 146–151. https://doi.org/10.1109/ICAICTA.2014.7005931

[31]   Mutula, S. M., & van Brakel, P. (2006). An evaluation of e-readiness assessment tools with respect to information access: Towards an integrated information rich tool. *International Journal of Information Management*, *26*(3), 212–223. https://doi.org/10.1016/j.ijinfomgt.2006.02.004

[32]   Nagarajan, S., Ganesh, K., & Sundarakani, B. (2009). Organisational readiness assessment framework and model for knowledge management - Application for manufacturing supply chain. *International Journal of Electronic Customer Relationship Management*, *3*(3), 264–280. https://doi.org/10.1504/IJECRM.2009.027953

[33]   Ojo, S. O., Olugbara, O. O., Ditsa, G., Adigun, M. O., & Xulu, S. S. (2007). Formal model for e-healthcare readiness assessment in developing country context. *Innovations'07: 4th International Conference on Innovations in Information Technology, IIT*, 41–45. https://doi.org/10.1109/IIT.2007.4430380

[34]   Oke, A. E., & Ogunsemi, D. R. (2011). Value Management in the Nigerian Construction Industry : Militating Factors and the Perceived Benefits. *Second International Conference on Advances in Engineering and Technology*, 353–359. https://doi.org/10.1186/1471-2458-9-343

[35]   Olama, M. M., McNair, A. W., Sukumar, S. R., & Nutaro, J. J. (2014). A qualitative readiness-requirements assessment model for enterprise big-data infrastructure investment. *Next-Generation Analyst II*, *9122*, 91220E. https://doi.org/10.1117/12.2050605

[36]   Papafotiou, G. A., Demetriades, G. D., & Agelidis, V. G. (2016). Technology readiness assessment of model predictive control in medium- and high-voltage power electronics. *IEEE Transactions on Industrial Electronics*, *63*(9), 5807–5815. https://doi.org/10.1109/TIE.2016.2521350

[37]   Qiping Shen, G., & Yu, A. T. w. (2012). Value management: Recent developments and way forward. *Construction Innovation*, *12*(3), 264–271. https://doi.org/10.1108/14714171211244631

[38]   Ruikar, K., Anumba, C. J., & Carrillo, P. M. (2006). VERDICT-An e-readiness assessment application for construction companies. *Automation in Construction*, *15*(1), 98–110. https://doi.org/10.1016/j.autcon.2005.02.009

[39]   Rütten, A., Röger, U., Abu-Omar, K., & Frahsa, A. (2009). Assessment of organizational readiness for health promotion policy implementation: Test of a theoretical model. *Health Promotion International*, *24*(3), 243–251. https://doi.org/10.1093/heapro/dap016

[40]   Sabiu, B., & Agarwal, V. C. (2016). Minimizing the Factors Hindering the Practice of Value Management in the Nigerian Construction. *International Journal Of Science, Engineering and Technology Research*, *5*(10), 2974–2978.

[41]   Saleh Torkestani, M., & Ahadi, P. (2008). Readiness assessment of Islamic micro-finance institution to implement micro-insurance concept (case of Iran). *International Journal of Islamic and Middle Eastern Finance and Management*, *1*(3), 249–261. https://doi.org/10.1108/17538390810901177

[42]   Satari, E., Akbari Kamrani, M., & Farid, M. (2019). Necessity for redesigning premarital counseling classes based on marriage readiness from the perspective of adolescents and specialists: A need assessment based on the Bourich model and quadrant analysis. *International Journal of Adolescent Medicine and Health*, 2–10. https://doi.org/10.1515/ijamh-2019-0042

[43]   Succar, B. (2009). *Building Information Modelling Maturity Matrix*. https://doi.org/10.4018/978-1-60566-928-1.ch004

[44]   Tanko, B. L., Abdullah, F., Mohamad Ramly, Z., & Enegbuma, W. I. (2018). An implementation framework of value management in the Nigerian construction industry. *Built Environment Project and Asset Management*, *8*(3), 305–319. https://doi.org/10.1108/BEPAM-09-2017-0078

[45]   Tran, Q., Huang, D., Liu, B., & Ekram, H. M. (2011). A Construction Enterprise's Readiness Level in Implementing E-Procurement: A System Engineering Assessment Model. *Systems Engineering Procedia*, *2*, 131–141. https://doi.org/10.1016/j.sepro.2011.10.016

[46]   Umar, A. H. (2015). An assessment of the Nigerian construction industry's readiness to adopt value management process in effective project delivery. *A Masters Thesis*, *1*(1), 1–80.

[47]   Uygun, Ö., Canvar Kahveci, T., Taşkin, H., & Piriştine, B. (2015). Readiness assessment model for institutionalization of SMEs using fuzzy hybrid MCDM techniques. *Computers and Industrial Engineering*, *88*, 217–228. https://doi.org/10.1016/j.cie.2015.07.008

[48]   Wirahadikusumah, R. D., & Ario, D. (2015). A readiness assessment model for Indonesian contractors in implementing sustainability principles. *International Journal of Construction Management*, *15*(2), 126–136. https://doi.org/10.1080/15623599.2015.1033817

[49]   Workineh, M., Garcia, N. M., & Midekso, D. (2017). Cloud computing as technological solutions for higher education institutions: Adoption readiness assessment model: Reseach in-progress. *Proceedings of the IEEE International Conference on Computing, Networking and Informatics, ICCNI 2017*, *2017-Janua*, 1–7. https://doi.org/10.1109/ICCNI.2017.8123812