An Overview of Digital Leadership Dimensions in Construction Industry

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Abstract: *Even with the advances of digital construction technology nowadays, the extensive implementation of digitalization aspects is still at narrow due to lack of digital skills, visionless among leaders with limited access to opportunities and strategy adoption of digital technologies, especially in construction organization firm. This paper reviews the dimensions of digital leadership capabilities in their organization. The unclear leadership components that need to be clarified for the digital transformation implementation within an organisation which enables construction stakeholder to digitize their work environments and learning cultures. The inquiries on the status of research development and the gaps in the dimension aspects are followed. Five hundred and nine papers were screened, reviewed and critically analyzed. Four dimensions of digital leadership discovered, specifically (a) competency of digital leaders, (b) capacity of digital leaders, (c) organization structure, and (d) organization strategy. The findings insightful understanding reference in improving the overall digitalization of leaders and organization needs. A research framework is designed to point up research gaps and suggest actions for future practice.*

Keywords: Digital Leadership, Digitalization, Construction Industry
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1. Introduction

Digital leadership is the potential of the leaders to develop a meaningful and clear vision for the digitalization process and the ability to carry out strategies to execute it (Avolio et al., 2009; Stana et al., 2020). Generally, it is a social transformation process where advanced information technology acts as a mediator to influence the behaviour, attitudes, emotions, thoughts, behaviours then to the organization (Avolio et al., 2009) as in construction organization. The broad term of "digital leadership" has been used in the twenty-first century, as this term may also be striking contrasts between traditional leadership and leadership in the digital era since they primarily result in a changing workplace where technology interaction is crucial (Phelps, 2014). It is because organization culture and government agency policy and regulations can vary depending on the variety of practice in their respective nations, including Construction Industry Council (CIC) for United Kingdom, Construction Industry Training Board (CITB) for Britain, Construction Industry Development Board (CIDB) in Malaysia, and so on. For instance, construction industry has a unique phase where interrelated with other stakeholder in a short-term progress. That is why leader has to take risks, effect change, engage with teams, and recognise that subordinates has a part to play in the organization, one must be an agent of change. However, leaders can make decision in low risk as they know how handling digital

technology to help them giving an accurate and consistence information in just one click. This is where digital technology lies with the role of leaders' digital literacy to increase the productivity in construction organization to being more flexible and sustainable to be digitalize according to the passage of time in the present where construction technology is rapidly developing (Cavaleri & Reed, 2008). The organization and strategy of construction firm also a focused to the creation and growth of innovation which able to confronted with the innovation, technology adoption and digitalization issues faced by the traditional leadership approaches.

Although digital construction technology is considerably more advantageous than analogue construction technology, it is only used in a few industrialised countries, and the construction stakeholder community generally still has a low acceptance rate. Although several studies on the difficulty faced by construction firms have been undertaken, the majority of them simply have a limited view (Klus & Müller, 2021) where non-technical aspects. For examples, recent review articles highlighted the digital-related challenge being cope by leader's skill and traits (Klus & Müller, 2021), character and competency aspects of construction manager (Abbu et al., 2020), "Volatile, Uncertain, Complex and Ambiguous", VUCA environment in leader's characteristic and challenge (Hensellek, 2020), and the overall critical component to become digital leaders (Sağbaş & Alp Erdoğan, 2022). There are still not enough in-depth analyses of digital leader in dimension of capabilities components that should have in leaders indirectly impact to their organization. In which, dimension are defined in this paper as soft skill and hard skill with practical knowledge that required in leaders to lead their organization that are necessary for overall technology adoption and digitalization strategy. Hence, more research is needed to develop these dimensions (leadership capability and organisational capability), particularly from the perspective of leaders in organisations who are construction stakeholder that are relatively common due to their use of digital construction technology in the industry.

The purpose of this research is to present an in-depth analysis on dimensions of leaders and organization capabilities among leaders in construction industry. The major objectives are to (a) review the current status of digital leadership in construction industry, and (b) develop a research framework to fill the gaps for dimensions of leaders and organization capabilities in construction industry. To focus the assessment's objective and sources of data, a critical review methodology was used. This review is important in determining the necessary capability knowledge for digital leaders in organization to be successful understanding and implementation of digital adoption in construction industry.

2. Review method and strategies

In this paper, Meta-Analyses and PRISMA was used as the research strategy to identify the overall research trend and patterns of digital leadership in construction industry. This preliminary Meta-Analysis method aims to ensure a high standard and impartial evaluation of the published publications (Moher et al., 2009) as well as to provide some quantitative characteristic before to the in-depth study (Page et al., 2021). Then, it was supported by systematic thematic analysis as part of the critical review process by using qualitative analysis to determine the main theme and sub-themes related to constructs digital leadership dimensions. Hence, the strategy for this review would be to use the PRISMA results as a starting point before conducting a thematic analysis as a critical review using a systematic review method.

Figure 1 shows an illustration of the processes of identification, screening, eligibility, exclusion, and inclusion in the PRISMA process (Moher et al., 2009). For example, another

language, reports, books and policy documents were excluded. The initial search revealed results for a total of 509 articles were found. The titles and abstracts of these articles were thoroughly read and analyzed for eligibility and relevance to the digital leadership in the construction sector area. After removing publications from various fields of social science, duplications, linguistic issues, and title and abstract screening, 85 articles were filtered. Finally, following thorough reading and careful screening that is critical review, employing the same criteria for the whole text, a total of 32 articles were selected in addressing the aim of the study.
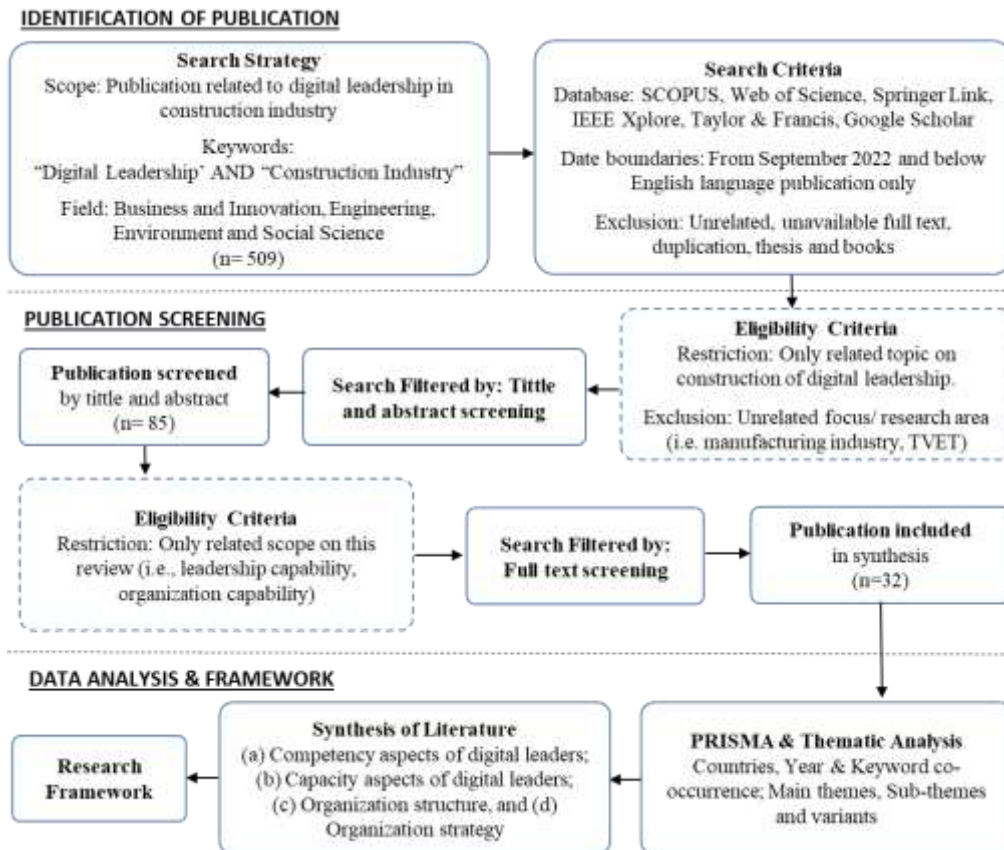

Figure 1: Overview of systematic review

3. Results and findings

3.1 Systematic Review and Meta-Analysis

The PRISMA findings are presented in this section. The data abstraction started with in-depth reading on the abstracts of the articles followed by full text screening to identify the themes. Next, critical content analysis implemented to determine the theme related to constructs of digital leadership. Table 1 show 32 articles related to the objective of this research.

Table 1: Related previous research with studies

| Author, Year	Country	Studies
(Chan & cooper, 2007)	UK	Sociological, psychological, historical and political perspectives
(Nurain Hassan Ibrahim, 2013)	US/EU/JPN/AUS	Digital collaboration technologies
(Muda et al., 2018)	MYS	Leadership capabilities
(Simonsson & Magnusson, 2018)	EU	Organizations collaborate challenge
(Aida M et al., 2019)	RU	Strategic goals of sustainable development
(Morgan, 2019)	UK	Ability of digitalization by top management

(John ekechukwu, 2019)	AUS	Digital technology influence on project leadership challenge
(Avirag Bajpai & Subhas Chandra Misra, 2020)	IND	Factor to implement digitalization
(Azzouz & Papadonikolaki, 2020)	UK	Case study of a significant, global, multi-disciplinary consulting firm
(D. O. Aghimien et al., 2020)	SA	Critical success factors of digital leaders partnering
(Shirokova et al., 2020)	EU	Importance of digital transformation for leader's construction firms
(Abbu et al., 2020)	Worldwide	Differentiated actions of leaders of digitally mature organization
(D. Aghimien et al., 2020)	SA	Construction organizations partnering
(Tereshko & Rudskaya, 2021)	RU	Construction complex under level of municipalities and regions
(Petrov et al., 2021)	RU	Digital security system
(Petrov et al., 2021)	UK	Leadership traits
(Gudergan et al., 2021)	GER	Key dimensions for contractor leaders
(Sinenko et al., 2021)	RU	Production during the construction phase
(Tadesse Gebretekle et al., 2021)	CAN	Decision makers in digital opportunities
(Srivastava et al., 2021)	Worldwide	Projects planning & delivery through leaders
(Wernicke et al., 2021)	UK	Progression towards digital strategy
(Hewavitharana et al., 2021)	LK	Leaders behaviours based on UTAUT model
(Abramitov & Dneprovskaya, 2021)	RUS	Construction field using remote and digital technologies
(Simanjuntak, 2021)	IND	Transformational leadership on project implementation team
(Maruthuvellu et al., 2021a)	MYS	Digital leadership competencies
(Farhan Roslan et al., 2021)	MYS	Construction leader in the digital economy
(Klus & Müller, 2021)	GER	Connection leadership skills and digitalization challenges
(D. Aghimien, Aigbavboa, Oke, & Aliu, 2022)	SA	Construction digitalisation
(D. Aghimien, Aigbavboa, Oke, Edwards, et al., 2022)	Worldwide	Capability of opportunities and threats towards digital leadership
(Wang et al., 2022)	CN	Barrier of digital strategy
(Jahanger et al., 2022)	USA	Implementation of (DCIM) systems by project owners
(S. Zulu, 2022)	UK	Factors driving digital transformation by top management

Figure 2 shows the total number of articles in a few nations throughout the world. There are 13 countries in all that have actively published articles on digital leadership in construction settings where worldwide is included. In Europe region such as United Kingdom, Russia and Germany, 15 out of half articles were conducted. 6 respectively more studies were carried out in the Asia and Specific region, China, Indonesia, Malaysia, Sri Lanka and North America region, including United State of America, Canada, South Africa and Australia. South Asia region only 1 study in India. The remaining 4 studies took place in a worldwide.
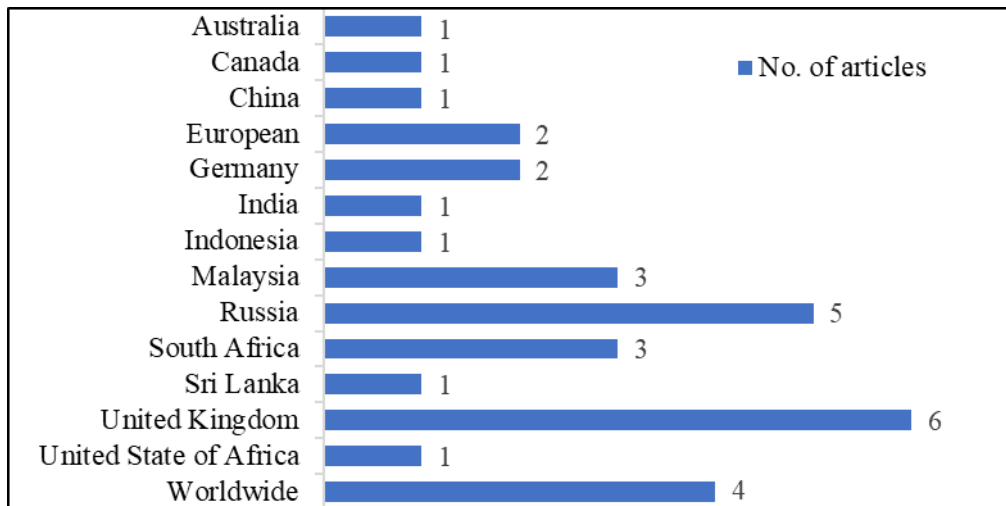
Figure 2: Countries where the research were conducted

In terms of the publication year, 5 articles were recently published in the year 2022 and 14 articles were published in 2021. Apart from that, 6 articles were published in 2020, 3 articles in 2019, 2 articles in the year 2018 and an article was published in 2007.
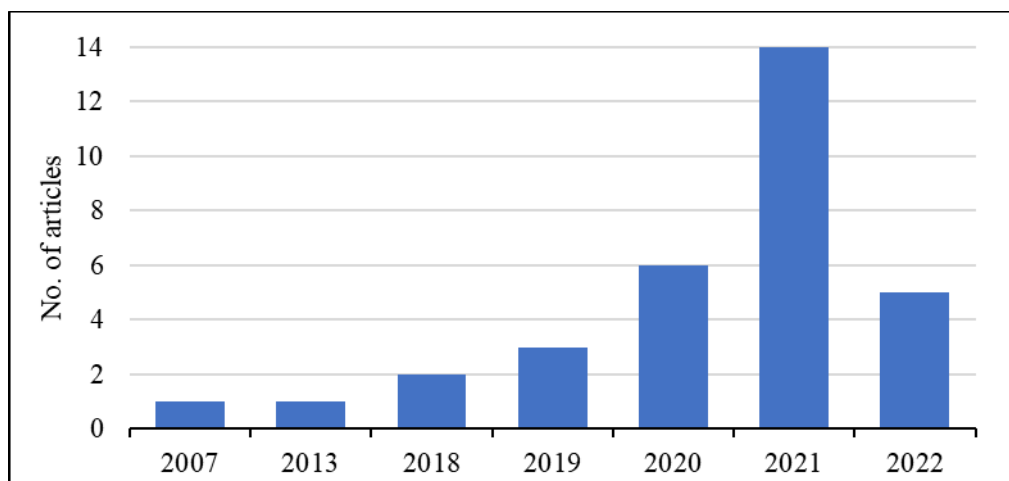
Figure 3: Article frequency by year of publication

Figure 3 illustrates the total number of articles on digital leadership by year of publication. There were just a few researches on digital leadership in the construction industry in the fifteen-past year, as the limitation focus in this area especially the development of technology in early stage. Only 13 studies were conducted in total; 1 in 2007 and 2013 respectively, 2 in 2018, 3 in 2019 and 6 in 2020. At the end of 2019 the Covid-19 pandemic has made digital technology adoption necessary., where remote management of work on construction sites and off-site construction opens up opportunities for leaders to expand the use of digital technology, where number of publications of 14 studies in 2021 represents a substantial rise. Given that it is currently the third quarter of 2022, and much research have not yet been published, the remaining three studies were conducted in 2022.

Additionally, the research of the primary topics covered in the article was done using the analysis of keyword co-occurrence. Four preliminary groups were found, as shown in Figure 4. The first group consists of "skill", "development", "innovation", "digital technology", etc. The second group includes "change", "digital innovation", "digitalization", etc. The third group

includes "management", "impact", "environment", communication, etc. The fourth group includes "strategy", "role", "implementation", "adoption", etc.

These groupings, which include the analysis of citations, serve only to identify the general and most recent trend of the study on digital leadership in the construction industry. However, they are crucial to provide specific direction in defining the full review and analysis on leaders and organization capabilities based on the objective of the review. For examples, the first group might include the competency should have in leaders. The second group can connect with the capacity of leader's ability to make an informed decision based on their experience or maturity. The third group is related to the organization structure where communication and management needed. The last group can be extended to the strategy of organization to implement the digital technology. The next section discusses in detailed about critical review of digital leaders.

Figure 4: Keyword co-occurrence with 4 preliminary group

3.2 Thematic Analysis in measuring digital leadership

The 32 articles are reviewed and analysed in-depth in this part using a critical review method. Four dimensions of the overall leader and organization capability were found and extended from the literature synthesis which is competency and capacity of digital leaders, organization structure and strategy. Further analysis and categorization of their viewpoint keywords and article focuses revealed from the main themes and sub-themes with different variants of digital leadership dimensions as shown in Table 2.

Table 2: Themes and Sub-themes in measuring leadership

Author & Year	Main Themes	Sub-themes	Example variants
(Chan & cooper, 2007)	Competency aspects	• people, place and events shape the thinking of leaders • tend to role of starters than completers	Tend to stand out, big influence (family relations), good to clients and subordinates, passionate preserving building.
(Nurain Hassan Ibrahim, 2013)	Capacity aspects	• integration of system • integration with projects/assets lifecycle consideration • integration of team and networks	Boundary objects, Tight-coupling, Clean technologies, Power relations, Paradigm trajectories, VDC development, BIM diffusion, Design management.
(Muda et al., 2018)	Competency aspects	• personal integrity • working environment • communication and interpersonal skill • develop and empower subordinate	Group collaboration, coaching, mentoring, decision making, problem solving, motivation, performance management, plan project, innovation and proactive.
(Simonsson & Magnusson, 2018)	Strategy aspects	• formulation partnership, innovation objective • co-design a new business model	Multi-mergers, increase profit margin, enable new technology, agile organizing approach, new opportunities.
(Aida M et al., 2019)	Capacity & strategy aspects	• common information space model • integrated information system of organization	Integration project management system with Primavera and BIM technologies, Automation, Information system.
(Morgan, 2019)	Structure aspects	• investment and leadership support • standards and policies • training and skill development	BIM Investment, firm capability, adaptation in an organization, formalized BIM briefings, standardize and policy used BIM.
(John ekechukwu, 2019)	Capacity aspects	• projects leadership demands • technology capability	Industry attitudes and culture, level of authority, leadership habits, behaviour, interaction and team development.
(Avirag Bajpai & Subhas Chandra Misra, 2020)	Capacity & structure aspects	• success determinants in leaders	Self-influencing through digital strategic plan.
(Azzouz & Papadonikolaki, 2020)	Competency aspects	• digital innovation in manager • organizational & technical	Boundary-spanning, identity disconnects background and competence, cross-professional.
(D. O. Aghimien et al., 2020)	Capacity aspects	• Critical success factors of digital partnering	Trust, support, digital partnering selection, common goal, long-term commitment, digital training, workshop and meetings.
(Shirokova et al., 2020)	Capacity aspects	• Analytics system and software	Microsoft Power BI, Tableau, Oracle, Qlik View.
(Abbu et al., 2020)	Capacity & competency aspects	• leadership styles	Act and behave, learn from mistake, decision making form analytics, promote mindset to employers.
(D. Aghimien et al., 2020)	Competency & strategy aspects	• benefits and barriers of digital partnering	Better competitive advantage, partnering and collaboration

(Tereshko & Rudskaya, 2021)	Capacity aspects	• stages implement BIM at micro level • proposal formation management system	Material cost: new software, employee training, consultation.
(Petrov et al., 2021)	Strategy aspects	• mechanism for decision-making • criteria to choose mechanism	Security: Google cloud NLP, Azure text analytics, StandfordNLP.
(S. L. Zulu & Khosrowshahi, 2021)	Competency aspects	• types of digital leadership	Digital leaders capabilities.
(Gudergan et al., 2021)	Structure & strategy aspects	• dimensions of digital leadership	Leadership competency network, complexity management, digital strategy and trust.
(Sinenko et al., 2021)	Structure aspects	• electronic service from all parties include government	Technology integration: Autodesk BIM 360, Cloud storage, 3D printing, Blockchain.
(Tadesse Gebretekle et al., 2021)	Structure & strategy aspects	• types of digital opportunities	organizational infrastructure, stakeholder, skills and attitudes.
(Srivastava et al., 2021)	Capacity aspects	• urge decision making • digital construction blocks' for complex project	Learning Technology: Al, Machine learning ML, IoT device.
(Wernicke et al., 2021)	Strategy aspects	• assessment areas (site operation) • assessment criteria (individual, technology, organization structure, goals, environment)	Design management, scheduling, logistics, production, HR management, QC, contract management, work safety, security, environment impacts, information management.
(Hewavitharana et al., 2021)	Competency aspects	• factors effect behaviour intention	Perceived ease to use, perceived personal benefits, facility condition, perceived risk.
(Abramitov & Dneprovskaya, 2021)	Strategy & structure aspects	• municipal service in electronic form (issues)	Unified system, state authorities, local government and construction firm.
(Simanjuntak, 2021)	Capacity & structure aspects	• transformational leadership • digital technology • cultural diversity	Project implementation team (construction phase).
(Maruthuvellu et al., 2021a)	Competency aspects	• competencies of digital leadership	Integrity, accountability, behavioural competence, emotional intelligence.
(Farhan Roslan et al., 2021)	Capacity aspects	• emerging technology	BIM, IBS, SAM, AR &VR, Cloud, 3D Scanning, Big Data, IoT, 3D Printing, Blockchain, Al.
(Klus & Müller, 2021)	Competency aspect	• leadership challenge • skill and traits of digital leadership	Self-organisation and IT skills, high degree of flexibility, commitment, and creativity to cope digitalisation-related challenges.
(D. Aghimien, Aigbavboa, Oke, & Aliu, 2022)	Competency & capacity aspects	• human-related aspects for construction's digital transformation	Technical capability of personnel, attracting and retaining digital talent and organisation's digital culture.
(D. Aghimien, Aigbavboa, Oke,	Structure aspects	• sensing, seizing and transforming	Organisational learning, enterprise resource management and strategic planning

Edwards, et al., 2022)			
(Wang et al., 2022)	Capacity aspects	• factor lack of laws, regulations, support and leadership • factor of resources and professionals	Industry-specific standards and laws, lack of clear vision, strategy and direction, lack of support from top management.
(Jahanger et al., 2022)	Competency capacity aspects	• potential impacts groups • potential influencing factors • DCIM system procedure	Reasonable capabilities of software, software compatibility with existing Systems and tools, wireless access and networking capabilities, long-term plan of technology implementation.
(S. Zulu, 2022)	Capacity & structure aspects	• leader characteristic • resources constraint • technology & risk attitudes	Old school perspectives-resistance to change. Leadership buy-in, motivation and drive.

The results shows there are four main themes included of sixteen sub-themes related to digital leadership called as digital involvement, facilitator and coordination, skill acquisition, trust and support, digital involvement, commitment to transform, technology expertise, data driven, workshop and training, collaboration and partnering, flexible organization, finance resources, exploitation and application, technology collaboration and agile, policy and cybersecurity, branding and e-participate. Based on this finding, it provides a sufficient information regarding proportions of digital leadership specifically related in construction industry field as shown in Table 3.

Table 3: Categorization of articles based on the digital leadership themes

Digital leadership dimensions	Chan & cooper, 2007	Nurain Hassan Ibrahim, 2013	Muda et al, 2018	Simonsson & Magnusson, 2018	Aida M et al, 2019	Morgan, 2019	John ekechukwu, 2019	Avirag Bajpai et al, 2020	Azzouz, & Papadonikolaki, 2020	D. O. Aghimien et al., 2020	Shirokova et al., 2020	Abbu et al., 2020	D. Aghimien et al., 2020	Tereshko & Rudskaya, 2021	Petrov et al., 2021	S. L. Zulu & Khosrowshahi, 2021	Gudergan et al., 2021	Sinenko et al., 2021	Tadesse Gebretekle et al., 2021	Srivastava et al., 2021	Wernicke et al., 2021	Hewavitharana et al., 2021	Abramitov & Dneprovskaya, 2021	Simanjuntak, 2021	Maruthuvellu et al., 2021	Farhan Roslan et al., 2021	Klus & Müller, 2021	D. Aghimien et al, 2022	D. Aghimien et al, 2022	Wang et al., 2022	(Jahanger et al, 2022	S. Zulu, 2022
Leaders Competency																																
Digital Literacy		●					●	●			●	●		●		●		●	●					●	●	●	●				●	●
Facilitator & coordination			●						●	●								●	●		●					●				●	●	
Skill acquisition	●		●				●	●								●	●		●			●		●	●		●	●				●
Trust and Support		●	●				●	●		●		●						●										●			●	
Leaders Capacity																																
Digital involvement		●					●	●		●			●				●		●					●	●	●		●		●	●	●
Commitment transform	●							●	●	●	●	●			●	●			●		●	●					●	●				●
Technology expertise		●					●	●		●	●		●				●	●						●		●	●	●			●	●
Data Driven					●		●	●				●					●		●	●				●	●	●	●				●	●
Organization Structure																																
Workshop & Training			●		●		●			●				●				●			●				●		●			●		
Collaboration & partnering		●		●				●			●	●					●	●	●	●	●								●			
Flexible organization			●		●		●	●	●				●				●		●					●			●		●	●	●	
Financial resources			●		●									●						●		●					●		●	●		
Organization Strategy																																
Exploitation & application		●		●	●		●				●			●			●	●	●	●		●			●		●	●		●	●	●
Technology collaboration		●		●	●						●		●				●	●		●				●			●			●	●	
Policy & cybersecurity					●			●							●			●	●			●			●					●		
Branding & E-participate				●	●			●				●	●				●		●	●		●			●		●		●			●

Therefore, digital leadership capability consists of competency and capacity where to assess the strength and weakness of internal leadership orientation. Then, organization capability which is structure and strategy play a role to value opportunity and threat of external organization orientation. Figure 5 illustrates an overview of the dimensions of digital leadership.
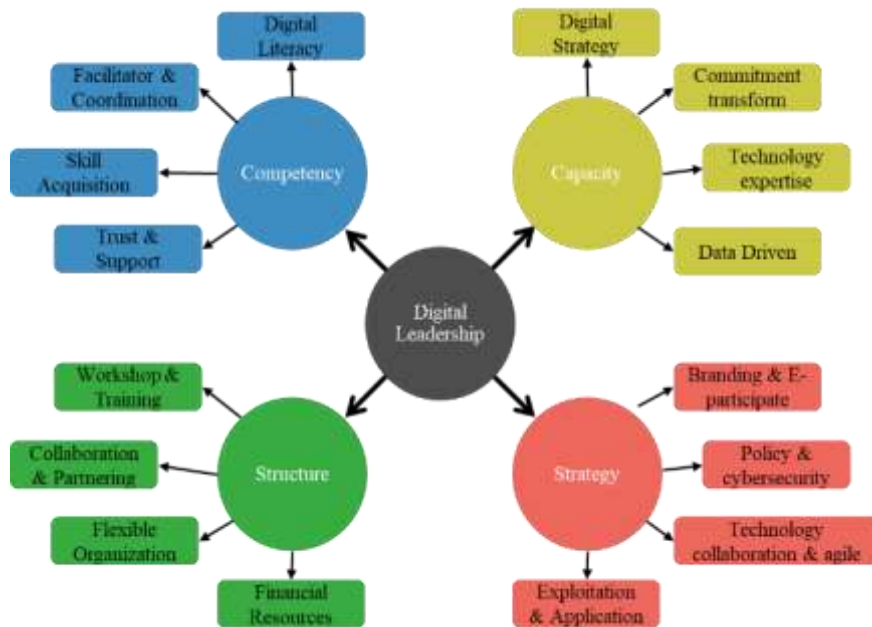

Figure 5: Overview of the dimensions of digital leadership

4. Discussions

This section highlights the current status of digital leadership in the construction industry. A comprehensive discussion of various perspectives on construction stakeholder engagement in realising dimensions of digital leadership in their organisations is explored. A framework for future research is then suggested to describe the gaps and potential research directions.

4.1 Current status of digital leadership in construction industry

In recent years, there has been a significant increase in the study of digital leadership (Stana et al., 2020) and the majority of research was done in developed countries including the US, the UK, Russia, and China. Despite traditional leadership approach, digitalization should achieve a better balance between time, money, and work quality in its overall performance (Avirag Bajpai & Subhas Chandra Misra, 2020; Hewavitharana et al., 2021; Nurain Hassan Ibrahim, 2013). Digitalization can provide a productive environment with fewer procedures in terms of data management, documentation and many more (Wang et al., 2022). This is particularly relevant for organization need where the planning and delivery throughout construction phase should be prepared in a short period, such as data share and collaboration, plot plans, activity plans, drawings, 3D, materials, and so on. Besides, high-density from developed countries like the United Kingdom and Russia are also embracing digital leadership where high demanding in construction digital technology adoption. Some government initiatives and incentives would support the industry's usage of digital technology. For instance, Construction 4.0 Strategic Plan (2021-2025) as the main catalyst in Malaysia (Farhan Roslan et al., 2021) which helps construction stakeholder not only implement but embrace the collaboration and partnering the current digital technology that brings benefits to their organization and countries gross domestic product (Alaloul et al., 2021).

59

Leaders competency is the ability to efficiently use technological tools and systems which leads to digitalization organization. It requires knowledge, skills, traits and a vision attitude to become digital literacy (Dahlström et al., 2017), while leaders capacity refers to power to make an informed decision involves experience, maturity and training to connect with a variety of people along their journey of learning specifically in digital technology expertise (Chan & Cooper, 2007). Besides, most of articles has shown that dimensions between leaders of digitally developed and digitally mature country motivate them to develop and coordinate digital skills, build trust and credibility, become proactive and forward-thinking to distinguish between firms that are digitally mature and those that are digitally developing by undertaking different actions (Abbu et al., 2020; S. L. Zulu & Khosrowshahi, 2021) to implementing digital leadership dimensions. Next, adaptive organization structure of transformational leadership need to be more democratic styles in terms of collaboration and partnering, flexible business procedures, sustained in workshop and training support with adequate budget for implementation (Tadesse Gebretekle et al., 2021), while organization strategy is an systematic plan by leaders in organization to exploited and sustained digital technology support, there is cooperation and information exchange among stakeholders with involvement of government policy and incentive, adequate data security and supporting local practices, regulations, and standards (Abramitov & Dneprovskaya, 2021; D. Aghimien, Aigbavboa, Oke, Edwards, et al., 2022). The efficient to becoming digital leadership has been enhanced by incorporating cutting-edge digital technology such as Primavera software, BIM, Qilk View, Google Cloud NLP, Azure text Analytics, Stanford NLP, Autodesk BIM 360, Blockchain, Artificial Intelligence, Machine Learning, Internet of Things devices and so on (Morgan, 2019; Nurain Hassan Ibrahim, 2013; Petrov et al., 2021; Shirokova et al., 2020; Sinenko et al., 2021; Tereshko & Rudskaya, 2021). As a result of the advancement of computing algorithms, data management, e-documentation and construction waste can be reduced while Building Completion Certificate (BCC) can be achieved on time (Roland Berger, 2015). With suitable integration of digital technology that relies with proactive and forward-thinking leaders, digitalization actually reduce energy usage on the same time maintaining comfortable levels (Holotiuk & Beimborn, 2017). This benefit can empower the construction stakeholder to reduce operational expenses without sacrificing living standards.
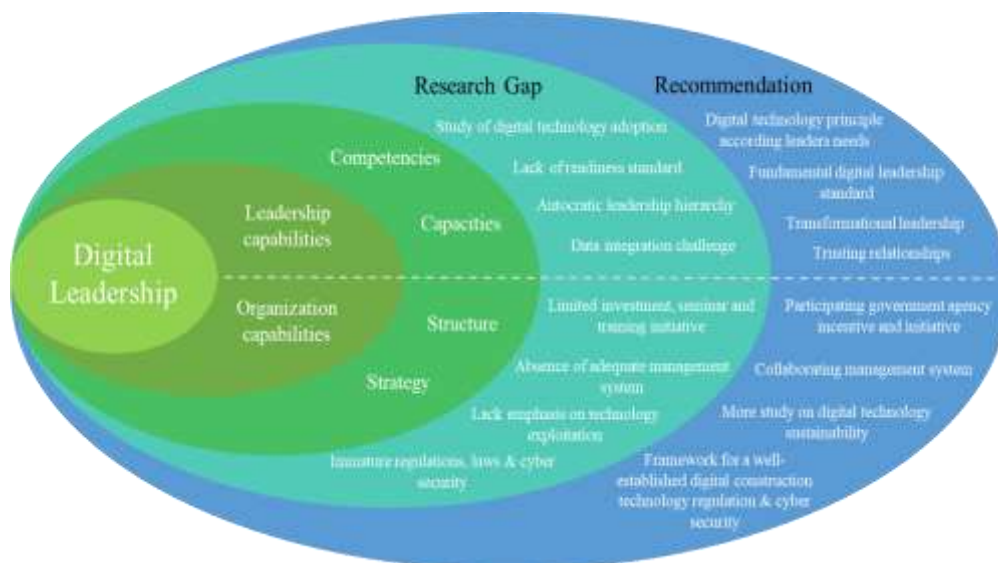
4.2 Research framework

To identify the crucial gaps and standards for the key characteristics of digital leadership in the construction industry, a research framework has been created, as illustrated in Figure 5. The framework is based on the recent dimensions and the research developments of digital leadership derive from leadership capability which is competency and capacity, including organization capability in connection with structure and strategy. First of all, from the perspective of leadership competency dimension, this review found that the current digital culture, coordinator, skill development, trust and top management support are the crucial components to becoming digitalization in organization. The major challenge faced by organization in construction industry is uncoordinated, caution, resistant and visionless leaders (Imran et al., 2020; Ismail & Hassan, 2019; Maruthuvellu et al., 2021). Due to the lack of a countrywide framework, developers, consultants, contractors, or even subcontractors that are interested in digitization do not have a clear direction. The transition to digitalization requires the trust and support of top management leaders.

Second, leadership capacity dimension in this study shows that a plan that employs digital initiatives to achieve company goals, long-term commitment, know-how to used digital technology and decision-making process is based on data, facts or assumptions rather than on opinion and intuition that relies with leader experience and maturity will becoming the

organization towards digitalization easily. In reality, most leaders still in digitization phase, only tend to role of starter rather than completers and making decision based on their experience and understanding (Chan & Cooper, 2007). Organizational leaders need a clear awareness of the possibilities offered by digital technology and how to put these opportunities into practise in a long-term digital strategy. Along with having this awareness, leaders must also be able to develop their capacity in test a new thing and tell right away whether they are working for them or not. This will help them develop data-driven leadership in a continuous improvement environment for change management and data analytics.

Third, organization structure dimension is still relying on direct, hierarchy power and analog structured process (Korn Ferry Institution, 2018; Srivastava et al., 2021). One of the major challenges faced by organization is culture and autocratic leaders' behaviour (John Ekechukwu, 2019), where subordinates ideas, decision and new thinking to implement digital technology do not involve. This blocking changes to become digitalization as low willingness and understanding of the digital interests of technology. With government agency initiative, workshop and training, provided subsidies or incentives remove the financial constraints to the adoption of digital technology. Leaders has to delegate their power to form flexible organization and become more open to joint ventures as subordinates roles in organization given enough attention in involvement where they are able to influence and shape leaders capability as the closest to them in contributing ideas and efforts in successfully completing the daily task (Avolio et al., 2009; Hapha & Somprach, 2019).

Figure 6: Research framework for digital leadership in the construction industry

Lastly, from the viewpoint of the organisation strategy dimension, this analysis found that the existing policy and cybersecurity of the deployment of digital technology in various nations are insufficient and immature. Immature regulation and cyber security is one of the biggest problems organisations confront (Abramitov & Dneprovskaya, 2021; Wang et al., 2022), cause construction industry or even end-users who interested investing construction digital technology do not have a clear direction. Governmental initiatives including national roadmaps, regulations and cyber security policies need to be drafted, updated and enhanced to keep up with the rapid industry digital technological change. It is essential to have a well-established regulatory framework that addresses the applicable laws, rules, cybersecurity standards, and approval needs for all significant parties.

In general, this review analysis focused only on organisational and leadership capability, in which the digital capability analysis was not considered completely in terms of implementation, procedure and many more. Digital technology analysis should cover until the end of construction stage, e.g., design phase, feasibility phase, construction phase, decommissioning phase and maintenance phase (D. Aghimien et al., 2018). The analysis of digital technology performance is important to provide a more accurate depiction of digital leaders orientation, when compared to traditional leaders, for a compatible capability needed in leaders and organization. Similarly, leaders of digitally emerged (digitization), digitally developed (digitalization) and digitally mature (digital transformation) country is significantly different in terms of ambitious about digital leadership (Abbu et al., 2020; D. Aghimien, Aigbavboa, Oke, Edwards, et al., 2022). The environmental sustainability of digital leaders needs to be investigated by the connection between a social and economic perspective since the stakeholder and the public are more concerned with the economic and social viewpoint.

5. Conclusion

As a result, further studies on digital leadership, particularly in the construction industry will continue to increase and be discussed in the future. The leadership and organization capability aspects were reviewed on digital leadership dimensions in the construction industry scope. The discovery of four research dimensions with sixteen sub-components for the successful leaders and organization of digitalization is concluded. The competency and capacity components are described as leadership capability while structure and strategy components relate to organization capability. The proposed research framework for upcoming research and practise in the industry then highlighted the research gaps and their suggested solution. The paper contributes to new perspectives and understanding reference for enhancing overall digitalization in leaders and organization through addressing the required capabilities, such as digital literacy, facilitator and coordination, skill acquisition, trust and support, digital strategy, commitment to transform, technology expertise, data driven, workshop and training, collaboration and partnering, flexible organization, financial resources, exploitation and application, agile, policy and cybersecurity, branding and e-participate. The review also reveals insightful implications from the perspective of leadership and organisational organization requirements for fostering digital transformation in the construction industry as a whole. It appears a mature flexible organization and digital strategy approach leadership with a proactive competency and capacity as a crucial dimension of future success that inspire leaders to take distinctive opportunities that distinguish between stakeholder that are digitally mature and those who are still in the development stage.

Nevertheless, several limitations on this review must be considered. During the screening process, some articles that may be helpful for digital leadership but are in other topics of interest can be missed, for instance several capability components studied are not proprietary for digital leadership in construction industry but their concepts can be used. Besides this, the review only took 32 articles to be critically reviewed in several years and country that being discussed, could still have an impact and offer new perspectives on the issues.

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