A SWOT Analysis of Digitalization in the Construction Firm: Challenges and Barriers to Managers Level in Malaysia

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ABSTRACT

The application of digital technology capabilities has been made easier by the deployment of digital systems in construction organisation. It develops to emphasise the most efficient planning, organising, and controlling of resources in maintaining the strict business innovation that opens up new revenue and value-producing potential for construction businesses. However, it has encountered several internal and external issues that have limited its use and hindered the diffusion of digitalization. Hence, this study aims to identify and access the major challenges and barriers to digital technology practises (DTP) and overcome their likely impacts. An empirical questionnaire survey of digitalization-related challenges and barriers to understand whether there is diversity in the identified contexts were assessed by 341 out of 363 various construction managerial levels. The data were analysed using mean, ranking, factor analysis and SWOT analysis. The results revealed that leader competency and capacity (weakness) and organization structure and strategy (threat) were the most critical challenges and barriers to DTP diffusion in Malaysia. Also, the SWOT model was developed as a predictive tool to evaluate and respond to the impact of these problems. It is recommended that industry practitioners and policymakers collaborate to create local context-based guidelines for facilitating DTP diffusion and monitor its implementation.

Keywords: Construction IR 4.0; digital technology practices; leadership capability; organization capability.

INTRODUCTION

The construction industry is widely recognized as a multifaceted and indispensable enterprise on a global level. According to Wang et al., 2022, within three years, the global construction market will reach the record level of 15 trillion dollars and will continue to grow at a yearly rate of around 3% through to 2025. One of the key industries in Malaysia is construction, which is estimated to provide over 1.38 million jobs, account for 10% of all employment, and be worth over RM 27.7 billion (Zulkarnain et al., 2020). The essential requirement for digitalization is apparent, providing important benefits to assist intricate industries. For instance, digital transformation is taking place in the fields of finance, manufacturing, banking, and health care (Hossain & Nadeem, 2019) at a much slower pace in construction (Srivastava et al., 2021). In the construction industry, one area where digitalization has advanced significantly is the increased application of emerging technology (Smartsheet Inc., 2018), automation (Bello et al., 2021), connectivity (Alsunaidi et al., 2021) and digital access (John Ekechukwu, 2019). The current corpus of information claims that the construction industry's fragmentation prevents it from undergoing a more streamlined digital

transition than other industries (Diana et al., 2019). Digitalization is expanding beyond regular daily operations as seen by the introduction of increasingly advanced technologies like robotics and automated tasks (Magnenat et al., 2012). This evolution is improving competence by reducing the margin of task errors through the capacity to learn and identify patterns (Martinez et al., 2018). According to Alsunaidi et al., (2021), explains why it is necessary to concentrate on technical issues when examining digital manifestation in construction organizations. This is evidenced by (D. Aghimien, Aigbavboa, Oke, & Aliu, 2022) who document the vital improvements in performance, economy, and sustainability brought about by digital transformation in the digital age.

Mutual digital mindset and skillset by business leaders and managers have a significant impact on their organization's ability to embrace digital transformation (Hensellek, 2020; Muda et al., 2018). Hence, construction companies need to put awareness of Revolution Industry 4.0 at the forefront of their digitization efforts. Recent studies have shown how the deployment of digital technology has influenced organization business innovation (Čirjevskis, 2019; Mihardjo et al., 2019). However, it is believed that in order for practice and academia to reflect various viewpoints, a bridge is required. As opposed to what the literature identifies externally at top management levels, it is thought that such an approach will expose digital technology from an internal perspective. Only a few studies have been done that specifically address the role of digital technology practices (DTP) in fostering innovation in the construction industry (D. Aghimien, Aigbavboa, Oke, & Aliu, 2022; Berger & Schober, 2021; Ismail & Hassan, 2019; Mehmet, 2018) not in line with the performance of organization. As a result, this paper makes a significant contribution to filling the research gap.

In contrast to other industries, the construction has few studies on digitalization-related challenges and barriers. The research body focuses mostly on education (Hapha & Somprach, 2019), health care (Martins, 2019) and manufacturing and services (de Sousa Jabbour et al., 2018; Petrov et al., 2021). However, there are very few studies that specifically address DTP that are applicable in procurements, logistics, construction, and marketing in the construction business. The construction industry is undergoing a delayed digital transformation, thus it is imperative to close this knowledge gap and focus future research in areas that are considered critical (Nurain Hassan Ibrahim, 2013). This will also provide the evidence needed to make wise decisions about how to overcome the barriers that stand in the way of an effective organization. This study using SWOT Analysis to investigate the interaction between different internal and external expectations affecting DTP based on the key issues that have been identified. Thus, the goal of this study is to determine the main challenges-barriers to digitalization facing Malaysian construction organization, followed by the identification of significant DTP that might facilitate beneficial digitalization from the perspectives of all managerial levels in the industry.

The adoption of a technology-oriented strategy in examining digital transformation can be advocated based on a review of previous studies (S. L. Zulu & Saad, 2023). Nonetheless, there is a lack of research on DTP within the construction industry in Malaysia in terms of leaders and organisation capability. Therefore, the goal of this study is to investigate the adoption of digital technology practices in the construction industry, focusing on three tiers of construction managers as leaders within their respective organizations and approaching the research question (RQ):

RQ. What are the challenges and barriers that managers encounter in their organization to improve the DTP within construction industry in Malaysia?

LITERATURE REVIEW

Digital Technology Practices: Overview of its Implementation Challenges and Barriers.

Digital technology practices involve using digital tools with relevant technical and non-technical skill in line

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with organization strategies to achieve digitalization (Abbu et al., 2020; Ismail & Hassan, 2019; John Ekechukwu, 2019). Due to the numerous advantages that come with the digital technology capability (DTC) construction stakeholders have attempted to used (such as BIM, cloud computing, internet of things, artificial intelligence, and e-commerce) to reduce costs associated with project delays, increase productivity, and prevent loss of profit or harm to business relationships (Gudergan et al., 2021; Jahanger et al., 2022; Simonsson & Magnusson, 2018). Managers or leaders, are essential to their organization's ability to increase market share, streamline operations, cut costs, and make better decisions-makers (Sağbaş & Alp Erdoğan, 2022; Simanjuntak, 2021) and achieve financial technological advantages (Korn Ferry Institution, 2018; Martins, 2019). Therefore, a proactive and forward-thinking manager can bring digital resilience to their subordinates and mitigate the current and future digitalization through integration of DTC.

Nevertheless, the adoption of digital technology capabilities in the construction industry in Malaysia is hindered by several limits. These limitations include inadequate financial assistance from both internal and external sources, as well as a deficient digital technology infrastructure (Diana et al., 2019; Korn Ferry Institution, 2018; Maruthuvellu et al., 2021). A lot of studies show the stand-alone indication of DTP issues of technologies, proprietor and organization respectively. This only give overall review understanding, as the gap for this study to correlate between digital technology, leaders and organization management to cope with specific digitalization-related practices. The important of this construct is to bring the answerer to critical digital resilience success factor that needed by construction firm that rely with adaptive digital technology to enhance digital information managerial system for leader and organization decision-making processes in construction life-cycle phase. Table 1 show the relevant challenges-barriers faced in DTP in recent literature.

Table 1: Challenges and Barriers to the DTP

Code	Key Issues	References
C1	Do not show interest in subordinates' suggestions and views	(Chan & cooper, 2007)
C2	More likely to store information verbally than virtually	(Nurain Hassan Ibrahim, 2013)
C3	Do not care about coordination issues and the use of digital technology in the organization.	(Muda et al., 2018)
C4	Unable to guide subordinates to implement the use of technology	(Simonsson & Magnusson, 2018)
C5	Difficulty to understand the use of existing/new digital technology	(Aida M et al., 2019)
C6	Low skills in problem solving with the help of digital technology	(Morgan, 2019)
C7	Leaders resistance to change from traditional working practices	(John ekechukwu, 2019)
C8	Less supportive of the use of new technologies in the company's organization	(Avirag Bajpai & Subhas Chandra Misra, 2020)
C9	The issue of implementation and use of new digital technology is less discussed in meetings	(Azzouz & Papadonikolaki, 2020)
C10	No funding programs and strategic needs for the use of technology in the organization	(D. O. Aghimien et al., 2020)
C11	Not collaborate with other stakeholders to facilitate online management	(Shirokova et al., 2020)
C12	Implement new ways of working digitally in company organizations in phases	(Abbu et al., 2020)
C13	Maintain uninteresting positions such as clerks	(D. Aghimien et al., 2020)

C14	Do not interest the issue of technology experts in the organization	(Tereshko & Rudskaya, 2021)
C15	Communication and information sharing in stages (hierarchy management)	(Petrov et al., 2021)
C16	Not interest saving company information through cloud storage	(Petrov et al., 2021)
B1	Management does not provide the need for the use of digital technology in the organization	(Gudergan et al., 2021)
B2	Low level of skills training in the operations to subordinates.	(Sinenko et al., 2021)
B3	Cooperation from third parties in management through verbal	(Tadesse Gebretekle et al., 2021)
B4	Not interested in aligning and integrating online payments with third parties	(Srivastava et al., 2021)
B5	There is no harmonized organizational management within the leaders and subordinates	(Wernicke et al., 2021)
B6	Subordinates not convinced of the efficiency of technology applied in the firm	(Hewavitharana et al., 2021)
B7	No capital investment in the development of digital technology to the organization	(Abramitov & Dneprovskaya, 2021)
B8	The management does not spend capital in financing programs and training for the use of digital technology in the organization	(Simanjuntak, 2021)
B9	Difficulty in allocating and obtaining latest technology sources	(Maruthuvellu et al., 2021)
B10	No disclosure of initiatives from the government such as roadmap construction 4.0	(Farhan Roslan et al., 2021)
B11	There is no government support in the provision of grants/funds to upgrade new technology facilities	(Klus & Müller, 2021)
B12	Do not understand the framework for managing digitalization in the organization	(D. Aghimien, Aigbavboa, Oke, & Aliu, 2022)
B13	Not sure about the company information through cloud storage	(D. Aghimien, et al., 2022)
B14	Policies and laws involving the use of DTP are unclear	(Wang et al., 2022)
B15	Difficult to implement ‘e-contract’ payments and tendering	(Jahanger et al., 2022)
B16	Vision/ mission of a company that does not apply digital management development	(S. Zulu, 2022)

The result, 32 out of 64 digitalization related challenges-barriers has been recently critically reviewed by 31 articles, pre-testing by pilot test and verified by expertise related to leadership and organisational aspects, key issues that emerges pertains to the effective management of intergenerational teams (Aida M et al., 2019), ensuring the appropriate utilization of new technologies and setting appropriate demarcations between professional and personal domains (Farhan Roslan et al., 2021; Schwarzmüller et al., 2018). The challenges associated with leadership attitude and skillset extend beyond the structure of workforces or teams, encompassing executives themselves. Despite the fact that many senior managers possess the authority to assign tasks to their subordinates and may not have grown up with contemporary technologies, they are frequently viewed as less representative and are granted a lesser level of respect by employees (Yang et al., 2022). However, upper management who possess technical expertise must address the challenge of managing personnel with varying levels of technological proficiency, particularly those who exhibit resistance towards adopting new technologies or possess limited knowledge in this area (Rêgo et al., 2022). When overseeing change processes brought about by digitalization, leaders must aim to achieve equilibrium between existing and emerging practices, while ensuring the active involvement of a substantial

number of employees (Shahadat et al., 2023; Wang et al., 2022).

RESEARCH METHODOLOGY

Instrument and Scale Development

The present study was formulated through the utilization of a survey methodology, with a comprehensive literature review serving as the foundation for the development of a meticulously crafted questionnaire. The questionnaire is divided into two sections, with the first section comprising general information pertaining to the responder. The second section of the study comprises thirty-two distinct variables, with one variable serving as the dependent construct. A total of 64 items were generated for this section using a two-step pre-testing procedure, which involved the evaluation of these questions by knowledgeable academics, industry professionals, and a pilot test. The identification of constructs and items was derived from existing literature. The data was gathered on a Likert scale ranging from 1 to 5, with 1 indicating a strong disagreement and 5 indicating a strong agreement. The survey questionnaire was initially developed in Malay and subsequently translated into English to align with the English version of the article. Moreover, the participants in our study have a high level of education. Prior to finalizing the questionnaire to validate items, a total of five professionals in the construction industry were questioned. The study instruments underwent modifications to enhance their comprehensibility, as per the recommendations provided. Consequently, modest adjustments were implemented before to the ultimate data gathering process. The questionnaire was administered to a sample of 30 participants during the pilot test in order to evaluate its reliability using Cronbach's alpha. Several items exhibited dependability that fell below the established threshold of Cronbach's alpha value of 0.70, indicating insufficient reliability. Certain items have been excluded from the constructions in order to maintain the integrity and uniformity of the study's findings.

Sample and Data Collection

The selection of respondents was done using a stratified sample technique. The target respondents were Malaysian construction managers at all levels—upper, middle, and lower. The sample included developers, small and large contractor firms, suppliers, and independent contractors including planners and programmers. The websites of the Construction Industry Development Board (CIDB), Board of Engineers Malaysia (BEM), Board of Architects (BOA), and Board of Quantity Surveyors (BQSM) are where we finds the respondents of the managers. In order to expedite the data gathering process, we correspond with our respondents through phone conversations, WhatsApp messages, and emails. We had originally planned to collect data from 500 respondents, but because we were not in contact with upper management, we had to lower the sample size. Ultimately, from May to September 2023, a period of five months, we sent out surveys to about 400 responders. Also, Google Forms for the online survey's instruments was distributed to the respondents which contacted using LinkedIn connections, Facebook Messenger, and emails. With an average response rate of 54%, Chuey et al., (2021) state that online, email, and phone data gathering are the most effective methods. The prospective participant was informed that the purpose of this study is to enhance knowledge among college students. 363 responses, or 91% of the total, were ultimately discovered. Following the exclusion of incomplete, unnecessary, and missing data, 341 valid data sets were utilized for analysis. We employ marketing academics' guidelines (Scott Armstrong & Overton Marketing Scientist, 1977) to investigate nonresponsive bias. The study's overall research strategy is depicted in Figure 1.

This research uses a stratified sample approach to collect data (Shi, 2015). This approach is frequently utilized in quantitative research to mitigate potential biases. In addition, we have utilized the common method bias (CMB) test as proposed by Kock et al., (2021). In addition, the expectation-maximization method was employed to address the issue of missing data. This method is recognized for its efficacy in managing anticipated values and is considered an appropriate way for handling incomplete data (Pu et al.,

2021). Table 2 presents demographic data obtained from survey participants, offering significant insights pertaining to respondents management positions and types of organization within the research scope.

Statistical Analysis Tools

The statistical techniques utilized for analysing the gathered data encompass Cronbach's alpha reliability test (a-value), mean item score (MS), standard deviation (SD), principal component analysis (PCA), and SWOT analysis. The dependability of the survey instrument was assessed using the a-value, which goes from 0 to 1. According to Taherdoost, (2018), an a-value of 0.7 or more is deemed satisfactory. The study's a-values are 0.929 for challenges and 0.924 for barriers. The mean score (MS) is the arithmetic average of the replies and serves as a metric for the central tendency. The authors Chuey et al., (2021) and Shrestha, (2021) employed the MS and SD values for the purpose of ranking factors. In cases where the factors possess identical MS values, priority is given to the component with a smaller SD value. Factor analysis, specifically principal component analysis (PCA), is a statistical method employed to examine the latent associations among observed variables. This methodology aims to reduce the dimensionality of the variables, making them more manageable, while also elucidating complex concepts (Mhlungu et al., 2019). The pre-test assessment involves the utilization of the Kaiser-Meyer-Olkin (KMO) tests and Bartlett's test of sphericity (BTS) for evaluation purposes (Shrestha, 2021).

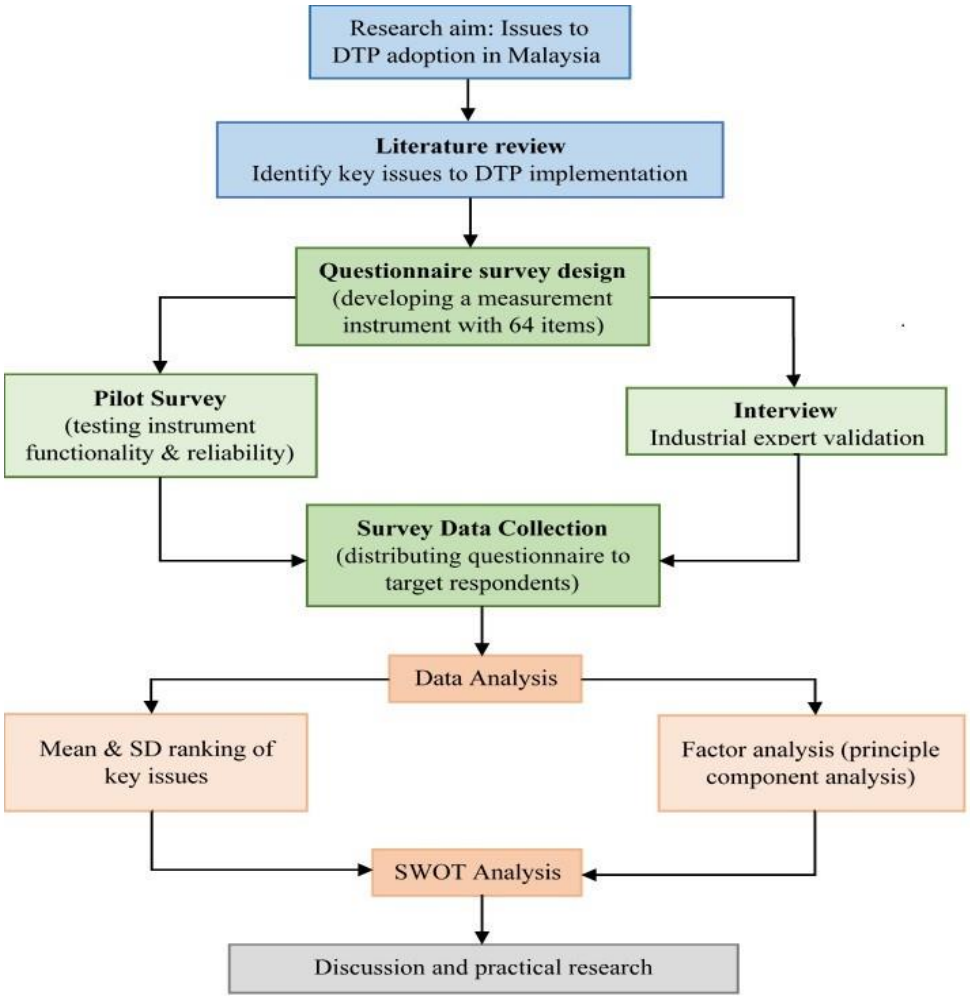

Figure 1: Research Design

Figure 1 Alt-text: A flowchart illustrating the research procedure adopted in this research where the questionnaire from literature review were verified thorough pilot survey and interview before collecting the data, while the data analysed using descriptive statistics and inferential statistics before SWOT Model was

develop.

The SWOT analysis, which stands for strengths, weaknesses, opportunities, and threats was applied to the examination of DTP in the Malaysia construction industry. According to (Puyt et al., 2023), SWOT originating in the early 1950s has been used forwards many years and is possibly the most popular strategy tool available today including in construction industry as a vital tool for strategic business planning their construction project (Milosevic, 2010). The SWOT analysis offers a well-defined framework for collating data from multiple sources and presents a synopsis of the internal (strengths and weaknesses) and external (threats and opportunities) contexts that may impact the DTP in the construction industry. Construction firm can gain a better understanding of how to utilize strengths to realize new possibilities and how weaknesses can hinder development or exacerbate organizational risks by listing favourable and unfavourable variables, both internal and external, in the four quadrants of a SWOT analysis grid. Drawing from the SWOT Model and extant literature, this review offers a thorough synopsis of DTP's capabilities and can facilitate the identification of its diverse prospects for construction organizations. Additionally, it offers a comprehensive grasp of DTP's shortcomings in order to draw attention to prospective dangers that pertinent actors might encounter down the road. This will make it possible to create a strategize plan to handle reducing managers weaknesses and eliminate organization threats.

RESULTS AND FINDINGS

Survey respondents' demographics

To obtain an understanding from the standpoint of utilization, respondents must be employed in construction industry at the time they participate in this study. This sample has been determined to be important to reflect the DTP for digital development of existing technologists, bridging the employer-employee viewpoint with the organisation's stance. Information regarding the respondents is visualised, such as percentage of DTP awareness, Figure 2(a) and percentage of respondents that utilize digital technology in their scope of work, Figure 2(b). Since the construction industry is not a homogeneous sector, our study did not assign precise typologies to business sizes or scales; instead, it looked at the sample as a whole. It may be argued, therefore, that representing smaller and less represented populations is a merit.

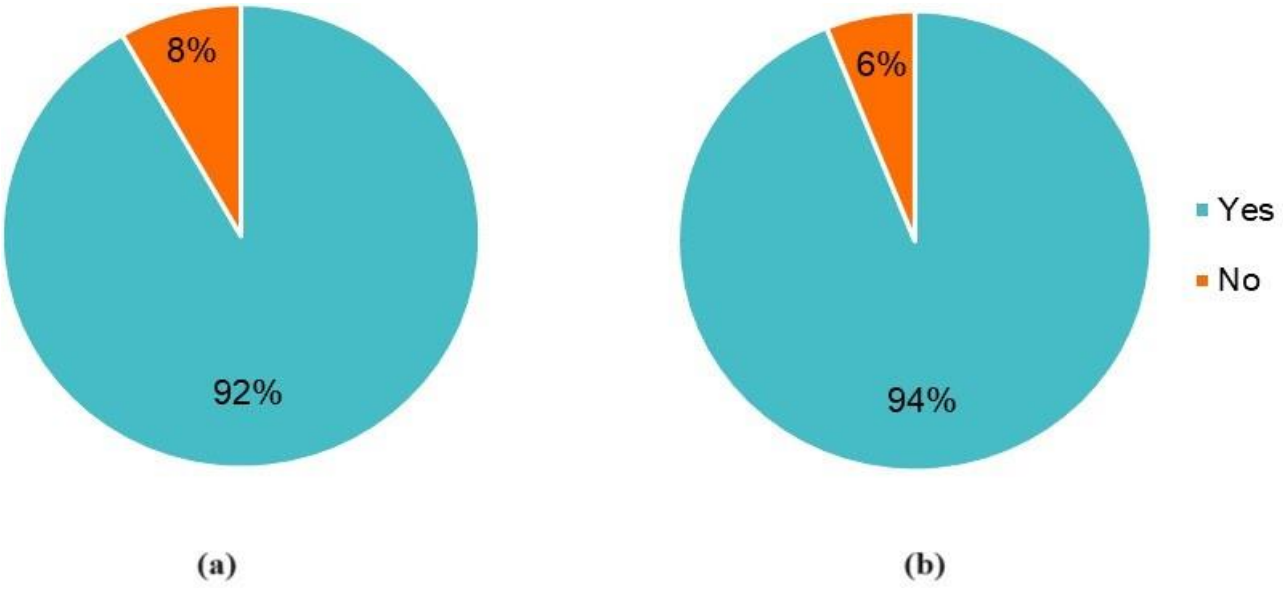

Figure 2: Respondents' percentage of DTP awareness (a) and adoption (b).

Data sources: Authors' Survey

Figure 2 Alt-text: Figure with two bar charts, the first showing the percentage of digital technology practise awareness (a) and a second bar charts showing the percentage of respondents that utilize digital technology in their scope of work (b).

Figure 2(a) show 333 respondents (92%) are recognising the DTP awereness however 30 respondents (8%) does not know. This shows there are a few respondents are not sure the literal practices of the digital technology adoption, and even do not use technology as a platform in managing organization. Meanwhile figure 2(b) show 341 respondents (94%) are implemented DTP in their organisation as goals of this research whereas 22 respondents (6%) did not, where considered invalid as the research samples. The respondents do not have experience and rigid perspective in DTP and even make it difficult to interpreted the importance of the technology involved. Thus, 341 out of 363 samples are suitable and sufficient for achieving the research study.

Table 2: Respondent's demographics

Management Position	**Frequency**	**Percentage (%)**
Top Management	86	25.22
Supervisinory Management	189	55.42
Frontline Management	66	19.35
Organization Types	**Frequency**	**Percentage (%)**
Developer	56	16.42
Consultant	72	21.11
Contractor (SMEs/ Big Firm)	136	39.88
Local Authority	24	7.04
Suppliers	14	4.11
Academic Institution	39	11.43

Data Sources: Author's survey

The distribution of respondents by management level and type of organization is shown in Table 2 where come from a variety of backgrounds as leaders in the construction industry. Higher level as top management are from firm proprietor, non-executive director and chairman (86) and majority respondents are from construction and project manager, executive manager and M&E manager (189), while frontline management from site supervisor, site manager, superintendent and safety officer (66). In terms of organization type in the construction industry, 39.88% (SMEs and Big firm) and 21.11% (Consultant) of the respondents have more participated. Particularly, 39 respondents from academic institution as industries researcher perspective. The respondents' expertise is demonstrated by the demographic analysis, thus future study can rely on their perspective.

Ranking of the challenge-barrier to Digital Technology Practice

Table 3 presents the overall ranking of the external and internal contexts according to standard deviation, SD and mean score, MS. The top-ranked challenges is '*Communication and information sharing in stages'* (C15) with MS = 4.35 while barriers is *'Low level of skills training in the operations to subordinates'* (B2) with MS = 4.34. The least rank are *'Do not show interest in subordinates' suggestions and views'* (C1) and *'Difficulty in allocating and obtaining latest technology sources'* (B9) with MS = 3.20 and MS = 3.61 for challenges and barriers, respectively.

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Table 3: Overall ranking of the challenges-barriers to DTP

Internal Factor				**External Factor**			
Challenges	Mean	SD	Rank	Barriers	Mean	SD	Rank
C15	4.35	0.814	1	B2	4.34	0.869	1
C7	4.30	0.832	2	B12	4.31	0.829	2
C14	4.27	0.772	3	B16	4.27	0.832	3
C5	4.24	0.838	4	B10	4.24	0.793	4
C8	4.15	0.957	5	B13	4.24	0.824	5
C3	4.01	0.939	6	B7	4.2	0.803	6
C4	3.86	0.946	7	B8	4.04	0.87	7
C10	3.77	1.064	8	B3	4.01	0.824	8
C6	3.71	1.090	9	B11	3.94	0.923	9
C9	3.5	1.100	10	B14	3.93	0.975	10
C16	3.5	1.064	11	B1	3.92	1.007	11
C11	3.38	1.188	12	B6	3.91	1.028	12
C2	3.36	1.369	13	B5	3.77	0.94	13
C12	3.3	1.389	14	B4	3.73	0.942	14
C13	3.25	1.222	15	B15	3.68	1.014	15
C1	3.20	1.225	16	B9	3.61	1.053	16

Data Sources: Author's survey

The challenges and barriers MS values > 0.3 are considered the most significant to key issues to DTP (Mhlungu et al., 2019). Based on the analysis results, 16 of the challenge-barrier factors are considered as the internal and external context, respectively.

Factor Analysis and SWOT Analysis

The principle component analysis (PCA) were employed to ascertain a limited number of factors that effectively captured the underlying patterns of interrelationships among the variables pertaining to obstacles and barriers (Jollife & Cadima, 2016). In this context, challenges serve as indicators of internal factors, whereas barriers pertain to external factors that influence the implementation of the SWOT analysis. Shrestha, (2021) propose several criteria for establishing factorability. These criteria involve examining the correlation between items within the same scales, ensuring that they are correlated with a factor of at least 0.3 with another item. Additionally, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy should exceed 0.7, indicating sufficient sampling adequacy. The Bartlett's Test of Sphericity (BTS) should also yield a significant result at a significance level of $p < .05$. Lastly, all communalities should surpass a threshold of 0.3. Table 4 presents the outcomes of the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS) conducted on the challenges and barriers context.

Table 4: KMO and Bartlett's test

Sampling adequacy measure	**Value**	
	Challenges	**Barriers**
Kaiser-Meyer-Olkin (KMO)	0.915	0.907

Bartlett's test of sphericity	3535.532	3059.686
Significance	0.000	0.000

Data Sources: Author's survey

The findings of the study revealed that both the challenges and barriers of sustainability exhibited a high level of factorability. The Kaiser-Meyer-Olkin (KMO) values for challenges (0.915) and barriers (0.907) surpassed the minimum recommended threshold, indicating that the data was appropriate for conducting factor analysis (FA) to identify underlying structures. The chi-square value for challenges in the BTS analysis is 3535.532 (p-value ¼ 0.000, df ¼ 120) while for barriers is 3059.686 (p-value ¼ 0.000, df ¼ 120). The findings of the BTS analysis indicate that both values were statistically significant ($p < 0.001$). Additionally, all communalities were found to be greater than 0.3, suggesting a relationship between the variables and ruling out the possibility of an identity matrix (Shrestha, 2021). A minimum Eigenvalue of 1 was utilized to determine the number of latent components for both barriers and challenges. The researchers identified four factor solutions for both challenges and obstacles, which accounted for explained variances of 72.7% and 63.7% respectively. These values above the minimum threshold of 60% as established by (Jollife & Cadima, 2016). The factor loadings for both challenges and barriers exceeded the required value of 0.5, as seen in Table 5 and Table 6.

Table 5: Internal factor structure for the DTP

Challenges of DTP	**Factor Loading**	**Eigenvalue**	**% Variance explained**	**Cumulative % of variance explained**
W1 – Lack of Digital Mindset and Skillset		7.925	49.533	49.533
C1	0.629			
C2	0.753			
C5	0.767			
C6	0.720			
W2 – Lack of coordination and Undriven leaders		1.970	12.314	61.847
C3	0.738			
C4	0.738			
C7	0.830			
C8	0.774			
W3 – Non-resilience of digital opportunity		1.813	5.083	66.930
C9	0.753			
C11	0.595			
C12	0.813			
W4 – Unrelatable expertise and lack of IT utilization		1.756	4.723	71.653
C13	0.756			
C14	0.721			
C15	0.685			

C16	0.722			

Note: The full description for the challenges and barriers factor codes are shown in Table 1.

Data Sources: Author's survey

Table 6: External factor structure for the DTP

Barriers of DTP	**Factor Loading**	**Eigenvalue**	**% Variance explained**	**Cumulative % of variance explained**
T1 – Unsustained training and budget support		7.629	47.679	47.679
B1	0.744			
B2	0.761			
B7	0.663			
B8	0.578			
T2 – Culture and autocratic management		1.425	8.909	56.588
B3	0.582			
B4	0.686			
B5	0.754			
B6	0.618			
T3 – Unchanged management system		1.036	6.475	63.063
B9	0.728			
B13	0.684			
B15	0.799			
B16	0.772			
T4 – Immature policy to industry-wide standards		1.003	5.269	68.332
B10	0.667			
B11	0.551			
B12	0.766			
B14	0.579			

Data Sources: Author's survey

Following an analysis of the developed component structure in accordance with the body of existing literature, the four internal factors for challenges were thought to represent (W1) lack of digital mindset and skillset, (W2) lack of coordination and undriven leaders, (W3) non-resilience of digital opportunity and (W4) unrelatable expertise and lack of information utilization. For barriers, external factor were termed as (T1) Unsustained training and budget support, (T2) culture and autocratic management, (T3) unchanged management system and (T4) immature law and policy as supportive to industry-wide standards. According to (Benzaghta et al., 2021), a strategic management process commences by doing an assessment of the internal analysis of the leaders competency and capacity. The internal analysis is employed to ascertain the internal sources and capabilities that can confer a competitive advantage. While external analysis is to uncover potential organization structure and strategies. This is achieved through an examination of the general environment, competitive industry environment, and the actions of rivals. The internal analysis

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identifies the areas in which resources should be enhanced and maintained, while the external analysis allows a firm to align its strategies with the prevailing business environment.

Table 7: Two-by-two Matrix: SWOT Analysis

		Internal Factor	
		Strength	**Weaknesses**
External Factor	**Opportunity**	Achieve opportunities that greatly match the organization's strengths.	Overcome weakness to attain opportunities.
	Threat	Use strength to reduce the organization's vulnerability to threats.	Prevent weakness to avoid making the organization more susceptible to threats.

Source: Benzaghta et al., 2021

By classified challenges-barriers into weakness and threat factor, the relationship between variables are achieved by using two-by-two SWOT matrix as shown in Table 7. The SWOT analysis matrix are used to develop the relationship between strength – opportunity (S – O), strength – threat (S – T), weakness – opportunity (W – O) and weakness – threat (W – T).

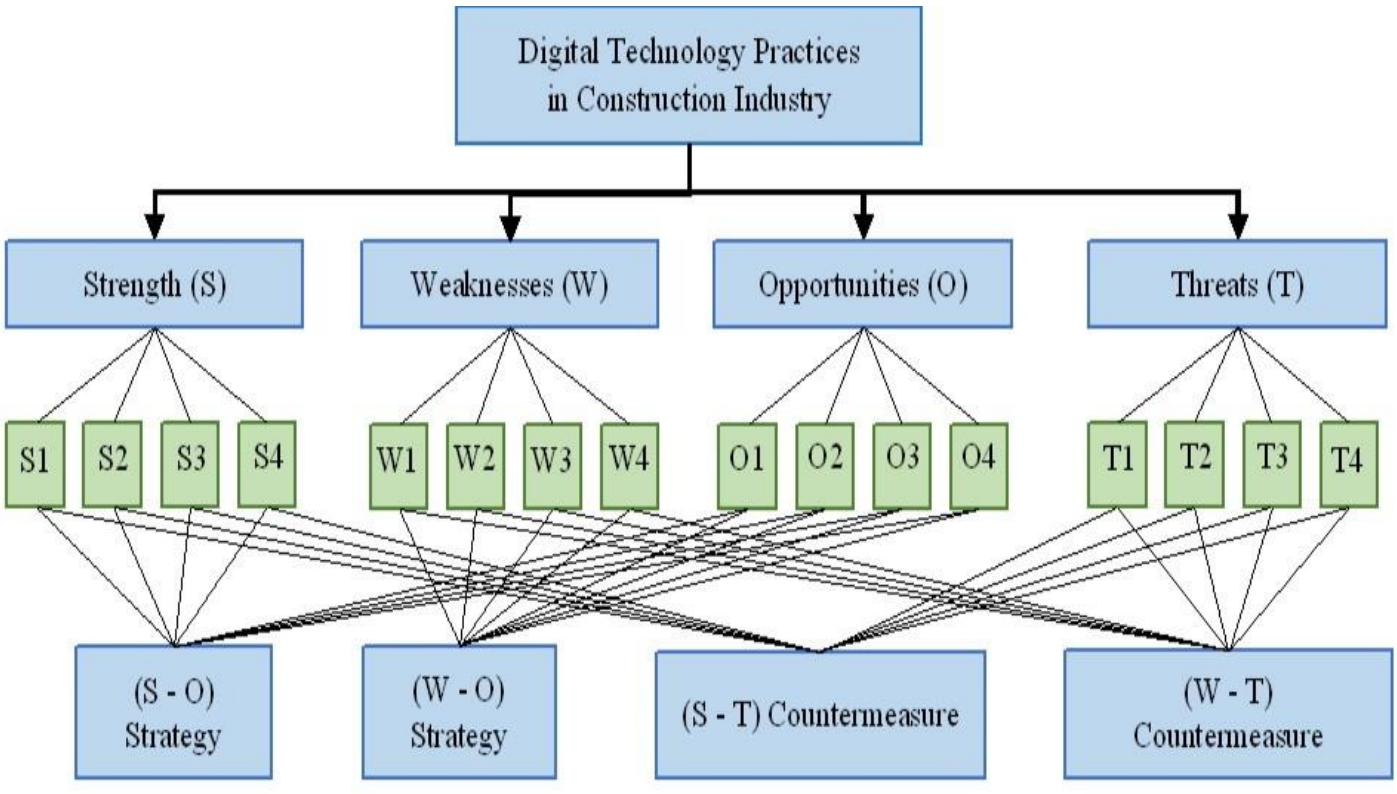

Figure 3: SWOT Analysis Matrix

Figure 3 Alt-text: Tree diagram showing the results of SWOT classification based on internal and external aspects. The diagram is focusing on weakness (challenge) and threat (barrier) of DTP in Malaysia construction organization.

Figure 3 shows the SWOT Analysis Matrix of the DTP in Malaysian construction industry. In this study focusing on challenges (weakness) and barriers (threat) based on strength and opportunity that transpire in

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Malaysia construction industry while these two issues are countermeasure. The results are being discussed in part: Discussion of analytical results.

Table 8: SWOT Model of DTP in Malaysia construction industry

Cluster		**Sub-Cluster**			
			Weakness		**Strength**
Internal Factors	Competency	W_1	Lack of Digital Mindset and Skillset	S_1	Digital Literacy and skill acquisition
		W_2	Lack of coordination and Undriven leaders	S_2	Trust and Support through Facilitator and Coordination
	Capacity	W_3	Non-resilience of digital opportunity	S_3	Digital Strategy and technology expertise demanding
		W_4	Unrelatable expertise and lack of information utilization	S_4	Commitment to transform and data driven
			Threat		**Opportunity**
External Factors	Structure	T_1	Unsustained training and budget support	O_1	Workshop and Training with Financial Resources
		T_2	Culture with autocratic management	O_2	Collaboration and Partnering with Flexible Organization
	Strategy	T_3	Unchanged management system	O_3	Exploitation and Technology collaboration through agile
		T_4	Immature laws and policy as supportive to industry-wide standards	O_4	Accountability Policy and cybersecurity standard

The strength and opportunity factors found were mostly comparable to those found in extend literature as shown in discussion part, PESTEL Model gives more accurate and beneficial results being obtained (GÜREL, 2017) while interviews with expertise improve the accuracy of the strengths and opportunities accessible in Malaysia construction manager. The SWOT Analysis are then being clustered into internal factor (leadership capability) and external factor (organization capability) based on digital leadership model (Shafiq & Hendra, 2023), insight the construction life-cycle management. Table 8 shows the results of SWOT Model of DTP in Malaysia construction industry through managers level that provides insight into an organization's existing state and enables the creation of future action strategies.

DISCUSSION OF ANALYTICAL RESULTS

Status of development of digital technology practices in Malaysia

Based on need the current status of DTP in Malaysia construction industry, National 2050 (TN50) in place and the aim for Malaysia to be among the top 20 countries in the world lies to the Construction Industry Development Board Roadmap 4.0 (Nurafizah Amiruddin, 2019) where driven by four enablers which is human, integrated technology, economics and governance (Korn Ferry Institution, 2018; Muda et al., 2018; Vinesh Thiruchelvam, 2022). It aims to simplify upcoming initiatives related to digital economic policies (DEP) that related in building information modeling (BIM), artificial intelligence (AI), and other technology which give clients, developer, consultant and construction firms a clear path forward (Alaloul et al., 2021; Maruthuvellu et al., 2021) particularly in construction sector stakeholder to implement the digital

technology capability into their digital business strategy (Holotiuk & Beimborn, 2017).

Table 9: Strength and Opportunities of DTP in the Malaysia construction industry

PESTEL framework's perspective						
Benefits	**Political**	**Economic**	**Social**	**Technological**	**Environment**	**Legal**
Diversity expertise		/				
Reduced time and delays		/				
On-time and on-budget delivery		/				
Improving quality		/	/	/		
Joint Ventures				/		
Improving customer relationship		/	/	/		
Enhancing technology			/			/
Internal efficiency			/			
Cost Saving					/	
Flexible structure			/		/	

Source: Muda et al., 2018; Alaloul et al., 2021; Maruthuvellu et al., 2021; Vinesh Thiruchelvam, 2022

In recent years, there has been a growing focus on the examination of DTP within the construction industry due to its perceived advantages and potential opportunities. In their study, Diana et al., (2019); Maruthuvellu et al., (2021); Maslina et al., (2020); Muda et al., (2018) and Zulkarnain et al., (2020) employed a triangulation technique to investigate the DTC and DTP states within the construction organization. Therefore, this study discovered strength and opportunities of DTP in construction were summarized using the PESTEL framework through interview, which is presented in Table 9. Shafiq & Hendra, (2023) and Shahadat et al., (2023) stated that DTP can bring numerous benefits to the whole value chain throughout the life cycle management; in particular, DTP enables leaders to optimize digital literacy and skill acquisition (S_1), trust and support through employee satisfaction and productivity (S_2), intensify digital technology strategy and expertise (S_3) and long-term commitment to transform through data driven (S_4). Meanwhile firm organization vital associate with current workshop and training (O_1), increased alignment among stakeholders (O_2), utilize technology collocation cost-effectiveness (O_3), as well accountability with overall construction IR 4.0 policy standard (O_4). This alignment results in higher organization success rates, more profitability, better-built environments, and more self-determination for subordinates. Inspiring technological innovation at the firm level, according to Wang et al., (2022), gives public and private construction firms a chance to enhance and revitalize their market competitiveness, project quality, and the cooperative structure of the construction industry as a whole.

Challenges in DTP implementation

From internal aspects, the issues of inadequate managers competency (W_1, W_2) has been concerned about the pursuit of DTP in the construction industry, which is not limited to major concerns in emerging nations like Malaysia (Maruthuvellu et al., 2021) instead, a worldwide issue with the built environment (Sağbaş & Alp Erdoğan, 2022). The expert from all levels of managers pointed out this factor as one of the main challenges limiting DTP implementation in their organization. According to Dahlström et al., (2017), competency is the ability to efficiently use technological tools and systems which leads to digitalization organization which requires knowledge, skills, traits and a vision attitude to become digital literacy. In scenario, the difficulty to understand the use of existing or new digital technology (C5) within managers due to the low skills in problem solving with the help of digital technology (C6). Furthermore, managers resistance to change from traditional working practices (C7) as insufficient level of support from the top management and

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organization (C8) gives a significance influence on subordinates issues resulting in resistance to changes in working practices.

Another major challenge of experts identified is lack of managers capacity (W_3, W_4) which refers to powerless 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). According to Petrov et al., (2021), leaders known as managers communicate and shares the information verbally in work force (C15) has been identified to have severely limited due to no exposure to new technologies and platforms provided (C14). For instance, less emphasis was placed at the discussion on new methods of working that should be used with technology to help managers make decisions (C9). Globally, DTP of BIM has been adopted in developing countries but in Malaysia is still shallow which required BIM Team as the expertise (Diana et al., 2019), where most professionals expertise only acquainted in Microsoft Project and Primavera P6 as the planning software which high demanding but least facilitation and integration with other parties (C11).

Without a doubt, leader competency needs the digital resilience (S_1, S_2) to be successfully implemented DLP, adequate knowledge and comprehensive guidelines on strategically using it to drive change are important. 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). Leader capacity (S_3, S_4) 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.

Barriers in DTP implementation

From external aspects, the organization structure issues (T_1, T_2) have been acknowledge in several studies (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 DTP. Some of the organization issues are low level of digital technology skill and training support (B2) to the subordinates due to the lack of initiative and hesitance on future capital investments (B7). In reality, advance digital technology such as BIM are not demanded in SMEs firm with small profits as their projects held are not as complex as mega projects which requires a large budget to implemented. Besides, top management neglect to spend capital in financing programs and training for the use of digital technology in the organization. Next, the culture issues resulting in DTP among subordinates which not convinced of the efficiency of technology applied in the firm (B6) due to top leaders are refuse to accept

new changes. For instance, in Malaysia is familiar with autocratic management where decision-making are made only by superiors (B5) resulting in lesser resistance to changes in working practice.

Experts have also determined that a significant barrier is the lack of strategies in organization (T_3, T_4), this analysis found that the existing policy and laws of the deployment of DTP in Malaysia construction industry is insufficient and immature. Immature IR 4.0 policy and regulations (B14) 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 (B12). Also, governmental initiatives including national roadmaps (B10), funds (B11) and encourage the use of e-contract (B15) need to be drafted, updated and enhanced to stay up with the quick changes in digital technology inside the sector. Hence, 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.

An adaptive organization structure (O_1, O_2) of transformational leadership need to be more democratic hierarchy 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 (O_3, O_4) 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). With government agency initiative, workshop and training, provided subsidies or incentives remove the financial constraints to utilization 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). 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). In terms of environmental sustainability, digitalization would have resulted in lower embodied energy and greenhouse gas emissions (de Sousa Jabbour et al., 2018). With suitable integration of digital technology that relies with proactive and forward-thinking leaders, digitalization actually reduces 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.

CONCLUSIONS

The goals of this study were to investigate the challenges and barriers to DTP that managers face to enhance digital uptake within the Malaysia construction industry. As a result, the key issues are divided into internal and external factors where challenges indicate the weakness of leader capability and barriers indicate the threats of organization capability that contributes to the strength and opportunity through PESTEL model that form a crucial impression on SWOT model of DTP from construction managers perspective. The discovery of four research dimensions with sixteen sub-cluster for challenges and barriers are gathered respectively. The competency and capacity cluster are described as leadership capability while structure and strategy cluster relate to organization capability. The findings suggest that the challenges to leadership capability is lack of digital mindset and skillset, lack of coordination and undriven leaders, non-resilience of digital opportunity and unrelatable expertise and lack of information utilization. Most managers have the strength to increased digital literacy and skill acquisition, trust and support through facilitator and coordination, new position of technology expertise and committed to learn new things. Also, the study findings show the barriers to organization capability is unsustained training and budget support, culture with autocratic management, unchanged management system and immature laws and policy as supportive to

industry-wide standards is a threat to the organization. This shall mitigate by provide workshop and training with financial resources, collaboration and partnering with flexible organization, exploitation and technology collaboration through agile and accountability policy and cybersecurity standard. Consequently, in order to expedite the adoption of innovation and digital technology practices, practitioners, leaders, organizations, and researchers can focus on this area while developing their strategy. 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 & partnering, flexible organization, financial resources, exploitation and application, agile, policy and cybersecurity, branding and e-participate. The research also indicates important implications for organizational requirements and leadership for promoting digital transformation in the construction sector overall. 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 study must be considered. During the literature process, some articles that may be helpful for DTP but are in other topics of interest can be missed, for instance several capability components studied are not proprietary for digitalization in construction industry, but their concepts can be used. Due of the lack of quantitative results from previous research on the effectiveness of the SWOT analysis, the SWOT analysis may have limitations (GÜREL, 2017). In the future, incorporating additional strategic tools like fuzzy ANP, analytic hierarchy process (AHP) and the five forces model in order to deepen the analysis and provide further direction for practitioners and policymakers. Furthermore, digital economy policy research on Malaysia's digital commerce in construction services is still in its infancy, it is highly recommended that future research looks into the technical factors affecting DTP in services and financial, such as I.T., technology including Building Information Modelling BIM And Industrial Building System IBS.

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DISCLOSURE STATEMENT

The author declare that they have no known competing financial interest or personal relationship that could have appeared to influence the work reported in this article.

DATA AVAILABILITY STATEMENT

Data that support the findings of this study are available from the corresponding author upon reasonable request.

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