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Digital Twin Production in the Architecture, Engineering, Construction and Operation Industry: Organizational Attributes and Strategies

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Abstract: Digital twin technology has grown over the years. However, a digital twin cannot be produced effectively without adequate organizational attributes. Inaccurate digital twins cannot be used for the operation and maintenance phase. Thus, an effective digital twin reduces waste resources in the operation and maintenance phase. The primary objective of this study is to identify the attributes to produce a digital twin in their building projects. In achieving the objective, interview data with 20 industry professionals involved with the digital twin was collected and analyzed. With the readiness assessment tool developed, relevant strategies can be implemented to correspond to the tool and allow for an improved future state in managing the construction industry. A total of three main categories and six subcategories were identified. The study findings can be used to develop organizational attributes and strategies required to produce a digital twin.

Keywords: Digital twin, construction industry, AECO, organizational, attributes, strategies.

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1. Introduction

Digital twin has grown over the years. One of the fast-growing digital technologies enabling the digital transformation of structural engineering, according to Love and Matthews (2019), is digital twin, which offers optimal decision support for improving structure management, dependability, and sustainability. According to Mashaly (2020), this technology has been extensively used and implemented in several fields, including manufacturing, healthcare, smart cities, education, and next-generation networking. Currently, digital twin usage has expanded its usage and is widely discussed on every industry leader's agenda. Seaton et al. (2022) found that the digital twin possesses fundamental values and benefits in optimizing the design outputs and other performance measures such as time, cost, environmental impacts, and social outcomes managed by designers, as well as cost management by professionals and construction managers.

However, with the advancement of digital twin, organizations in the Architecture, Engineering, Construction, and Operation (AECO) industry must be well-versed and ready to prepare for it. Haron (2013) stated that the readiness component is relevant to the research because it serves as the foundation for creating a theoretical framework that will steer the focus of the research and develop interview questions. Digital twins cannot be produced effectively without adequate organizational attributes. Therefore, a proper assessment tool is needed as a guideline to identify the readiness attributes in the organization. Haron (2013) mentioned that the assessment includes a key component that establishes the level of organizational change required and must be aided by a management tool that pinpoints the readiness gap.

There are issues related to the inadequate production of a digital twin that cannot be used for the operation and maintenance phase. Thus, an effective digital twin reduces waste resources in the operation and maintenance phase. Therefore, for the main outcome of this research, it hopes to develop a readiness assessment tool that would identify the attributes and relevant strategies required to produce digital twins in building projects.

The aims of this study are to: 1. Identify the organizational attributes to produce digital twin in building projects. 2. Determine strategies involved to achieve them. In achieving these aims, this study addresses research questions: What are the organizational attributes needed to produce digital twin in building projects and what are the strategies involved to achieve the attributes? The author responds to the questions by conducting twenty interviews with digital twin industry professionals. Interview information was gathered and evaluated.

2. Literature Review

Digital twin seems to be the main agenda amongst industry leaders today due to media exposure and conferences. However, SAP (2018) mentioned that to deploy digital twins, a collaborative environment is needed to establish real-time communications between physical twins and virtual and external networks, as identified. Furthermore, the study concluded by SAP SE (2018) found that digital twin helps achieve numerous advantages in increasing benefits, efficiencies, and real-time monitoring of replicas of physical systems.

The digital twin enables flexible configurations in integrating third parties with applications and data storage in the construction industry tier. Harper et al. (2019) identified eight digital twin features, which are: 1. document management, 2. model, 3. 3D presentation, 4. simulation, 5. data model, 6. visualization, 7. model synchronization, and 8. model analytics. All these features are involved in the planning, building, operating, and maintenance phases throughout the lifecycle of industrial assets. It is highlighted that the contributing factors in implementing digital twin are embracing the overall complexity rather than avoiding it, developing requirements incrementally and iteratively starting from business objectives and concerns, and lastly, motivations from potentially existing and new customers and what is provided by the competitors.

According to Sandkuhl and Stirna (2020), research on digital twins' organizational and business model aspects is sparse. Therefore, an analysis of the suitability of Enterprise Modelling (EM) was conducted to tackle various organizational design problems that captured organizational knowledge and motivation for digital twin design in supporting digital transformation and capability management in manufacturing enterprises.

In addition, Sandkuhl and Stirna (2020) observed that an analysis of Capability Driven Creation (CDD) was undertaken to assist the development and management of digital twins from an organizational viewpoint. The research approach was carried out through a literature study and two industrial case studies. In this regard, data analysis findings indicate that the implementation of digital twins is motivated and driven by the need for organizations to discover novel services or products based on digital technologies integrated into their operational processes and structures.

Numerous research studies on digital twins in the construction industry have been conducted. However, Mashaly (2020) focused on the applications of digital twins in various domains. Mashaly (2020) also discussed the importance of good networking requirements in producing expected services by digital twins. SAP SE (2018) focused on a collaborative working environment to establish real-time communications data between physical twins and virtual and external networks. Yu and He (2021) studied the digital twin as the construction of a systematic, intelligent system in multi-stage management disaster prevention and mitigation for infrastructure (IDPMI). Li et al. (2020) provided a digital-twin-driven information architecture and the sustainability evaluation methodology by evaluating eight intelligent manufacturing projects of an air conditioning company.

In addition, Jones et al. (2019) discovered that there are thirteen characteristics of digital twins, including a complete framework of the digital twin as well as the study of the operational process: Physical Entity or Twin, Virtual Entity or Twin, Physical Environment, Virtual Environment, State Realisation, Metrology, Twinning, Twinning Rate, Physical Processes, and Virtual Processes.

On the other hand, Harper et al. (2019) focused on eight digital twin features that are involved throughout the lifecycle of industrial assets. Sandkuhl and Stirna (2020) focused on digital transformation and capability management in manufacturing enterprises. Agouzoul et al. (2021) incorporated digital twin to study the behavior and characteristics of a future or existing building, mainly on energy consumption. Chiacho et al. (2022) established a digital twin framework for buildings that was produced from mathematical idealisation and tailored to the level of hardware or software technology integration. Onile et al. (2021) explored novel energy services using smart recommendation systems and digital twins. Havard et al. (2019) explored co-simulation and communication architecture between the digital twin and virtual reality software utilizing a human-robot collaborative workplace design and evaluation.

In other words, these studies do not know what organizational characteristics and approaches are required to produce digital twins for the AECO industry. Furthermore, research on identifying the necessary organizational attributes and strategies is still lacking. This study will thus fill the void by investigating the factors and methodologies used to assess the generation of digital twins in the Architecture, Engineering, Construction, and Operations sectors.

3. Methodology

3.1. Data Collection

The information was gathered via an open-ended interview with 20 Malaysian Digital Twin (DT) professionals. This method has been used to identify strategies for improving organizational capabilities in digital construction, as put by Munianday et al. (2022), and addressing pandemic impacts on construction projects, as explored by Zamani et al. (2022). These 20 digital twin professionals were selected based on their involvement in building construction projects, working experiences with BIM, and experts in digital twin. This method was used to identify attributes and strategies needed for an organization to produce a digital twin. Three questions raised are: 1. What are the attributes needed for an organization to produce digital twin in their practice? 2. What attributes have the most impact on your practice? 3. What are the strategies

required to enhance organizational attributes to produce digital twin in building projects? These questions aim to identify and obtain information regarding attributes and strategies needed to produce digital twins in their practices.

The open-ended interview was designed to collect as much particular information as possible. Table 1 shows the respondents list, which consists of 20 digital twin professionals that had been selected. The respondents vary from Building Information Modelling (BIM) assistant managers to directors of the organization. The targeted respondents can provide necessary information as required. In order to get a variety of information outputs, the 20 respondents were also chosen based on their varying work experiences and professions. Following each interview, a summary of the interview was sent to each respondent for validation purposes.

Table 1. Respondent profile

Respondent	Sex	Age	Work Experience	Position
R1	M	36	4	Senior Lecturer, BIM personnel
R2	M	30	10	Head of BIM Department
R3	M	34	5	Built Environment Sector Lead
R4	M	29	4	BIM Section Head
R5	M	41	5	BIM Assistant Manager
R6	M	44	4	Senior BIM Manager
R7	M	37	14	Chief Operating Officer
R8	M	33	8	Senior BIM Engineer
R9	M	45	11	Director
R10	M	30	6	Principal Business Expert
R11	M	37	11	Consultant
R12	M	40	6	Director
R13	M	33	11	Director
R14	M	37	15	Senior Civil Engineer
R15	M	44	10	Civil Engineer
R16	F	42	10	BIM Development Senior Manager
R17	M	28	12	Associate
R18	M	47	12	Special Director
R19	M	33	2	Senior Executive BIM
R20	M	40	8	Director

3.2. Data Analysis

For qualitative data analysis, a thematic analysis is used to discover the attributes and strategies required for an organization to produce a digital twin. In addition, this method facilitates the interpretation of qualitative data. The approach was also used by Radzi et al. (2019), Zamani et al. (2022), and Tan et al. (2022) to analyze interview data.

According to Braun and Clarke (2006), six stages serve as the basis for thematic analysis. The first step is to get familiar with the data by transcribing the interview data, reading, evaluating, and highlighting initial views. During the second step, the initial codes are developed. The authors then programmed a multitude of possible themes and patterns. The authors then updated the code, discussed it, and reached a consensus on any coding modifications.

Based on the original codes, the third step consists of identifying themes. Throughout the process of developing the themes, the authors continually reevaluated the codes from the second phase and the initial data from the first phase. The fourth phase entails reviewing the subjects again. To ensure that the data was comprehensive, the writers continuously evaluated, defined, and refined the subthemes, determining if the themes were consistent with the extracted codes and the whole collection of data, and studying the data to uncover further themes. The fifth step is to define and name the topics. The authors compared the themes, codes, and interview transcript to determine that the topics related to the independently coded replies. The sixth step consists of describing the outcomes of the analysis.

4. Results and Discussion

This study shows the result based on interviews with 20 digital twin professionals in Malaysia. The 20 professionals were interviewed to identify the attributes needed for an organization to produce a digital twin for a building in the AECO industry.

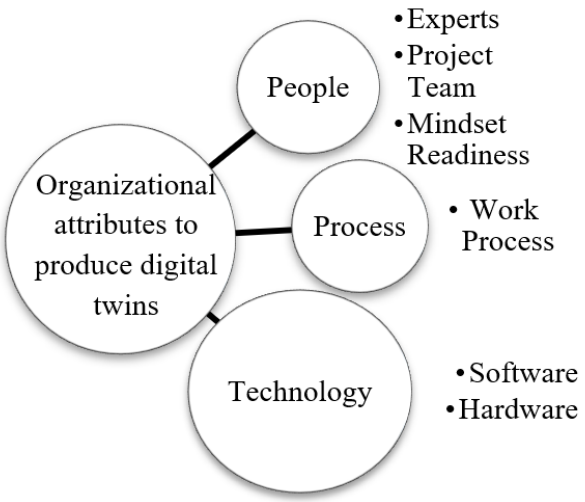

Fig. 1. Organizational attributes to produce digital twins

Table 2. Link between interview respondents and the identified organizational attributes to produce digital twin

Attributes	Respondent																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Technology																					
Data environment			√	√	√	√							√	√		√	√				8
Digital technology	√	√	√	√		√	√	√	√	√		√	√	√	√						13
Software				√	√	√	√	√	√					√	√	√	√	√			11
Hardware	√				√	√	√	√	√						√	√	√	√	√	√	12
Digital security			√			√	√														3
Funding																					
Financial capability	√				√			√	√						√						5
Government funding	√					√						√		√	√						5
Investments	√			√				√					√		√	√	√				7
Policy																					
Government enforcement	√				√				√				√		√		√				6
Standard submission guidelines		√	√			√	√		√	√			√			√	√				9
State authority enforcement									√		√	√									3
Organization policy						√	√			√			√				√	√			6
Standard operating procedure							√										√	√			3
Contracts				√												√					2
Process																					
Work process		√	√		√	√	√						√		√	√	√	√		√	11
Quality working system																√				√	2
Research and development				√								√	√				√				4
People																					
Organization leadership	√		√		√		√	√		√			√					√			8
Project team	√	√	√	√	√	√	√	√	√	√			√		√		√	√		√	15
Specialized personnel										√								√		√	3
Upskilling staffs	√					√		√					√		√	√	√	√	√		9
Experts	√	√	√	√	√	√	√	√	√	√			√		√	√	√	√		√	16
Mindset readiness	√	√	√	√			√	√	√								√	√	√		10
Work culture transformation	√		√			√	√														4
Information awareness	√	√	√		√							√	√			√		√			8

4.1. Attributes to Produce Digital Twin

Fig 1 summarizes the themes and subthemes on attributes needed for an organization to prepare a digital twin. Of 20 respondents, six categories are identified to be the subthemes, which are: “Software”, “Hardware”, “Work Process”, “Experts”, “Project Team”, and “Mindset Readiness”. In addition, the seven categories can be grouped into three themes,

which are: "Process", "People", and "Technology". In the following subsections, themes and subthemes are addressed in more depth.

4.1.1. People

People have a significant role in the implementation of the digital twin within the AECO sector. It involved how the organization could move forward and impact the future implementation of the digital twin. People that are reluctant towards changes in the current technology adaptation and lack the knowledge to adopt new practices may be the drawbacks to preparing digital twins in the AECO industry. Three attributes that are relevant to the people factor are (a) Project Team, (b) Experts, and (c) Mindset Readiness.

(a) Project team. Project teams are crucial in determining the flow of work from the beginning till the end of every project. It involves effective communication among team members, coordination of work, understanding of a clear project framework, and direction of where the project is heading. Besides, supply chain maturity between stakeholders and consultant teams also contributes to adopting new approaches in practice. Table 3 shows the responses based on the interview summary.

(b) Experts. To adopt new technology such as digital twin, knowledgeable personnel with expertise related to digital twin are highly needed to prepare digital twin in an organization. Expert personnel can make the work process more efficient. Table 3 shows examples of respondents from the interview summary.

(c) Mindset readiness. The lack of readiness for digital twins in Malaysia is one of the reasons why it is not so straightforward to prepare a digital twin. People in the construction industry are not ready to adapt to changes in the system. Besides, they lack awareness of the advantages of a digital twin. Table 3 shows the respondent interview summary.

4.1.2. Process

An efficient construction process contributes to a better workflow and working outputs. However, it involves complicated working processes to get the job done. Besides, being innovative and having a good understanding of the concept and theories will enhance the quality of working output. A single attribute is identified and relevant to the process, which is (a) Work Process.

(a) Work process. Work Process involves a properly guided road map and a strategic thinking process to help the construction team efficiently prepare digital twin in their organizations. A good working process begins from an earlier stage with a proper asset information requirement. Table 3 shows the responses based on the interview summary.

Table 3. Respondents' statements on organizational attributes to produce digital twins

Attributes	Respondent's statements
Project team	Supply chain maturity in adopting new approaches in practice, the willingness of multidisciplinary stakeholders within a project team to adopt new technology." (R1) "Proper project briefs, project goals." (R5)
Experts	"Need proper qualifications for 3D modelers, coordinators, and managers." (R5) "Technical skill workers - It will make the job easier because of the knowledge they have to understand the purpose of BIM." (R6)
Work process	"People and technology are related to each other. The work process is bridging between people and technology." (R15) "Guidelines are driven by BIM manager. Not necessarily in a detailed format, as long as a road map can be generated, and projects can be executed." (R17)
Mindset readiness	Mindset readiness "Lack of knowledge to adopt a new practice. Especially by client and project stakeholders. Client plays a huge role to spearhead change." (R1) "Lack of awareness and knowledge." (R2)
Software	"Tools - software and hardware. Cost factor. Relates to return of investment to the company." (R11) "Tools - hardware and software. For better connectivity of workflow." (R7)
Hardware	"Hardware is related to providing high spec computers that require a good ICT network that acts as a server because digital twin uses a lot of wireless sensors." (R15) "Tools - hardware and software. Good specs, tiptop." (R9)

4.1.3. Technology

Even with a good team of experts and sufficient information, work cannot be executed effectively without technology. Technology helps to get work done according to what is required, and optimum adaptation saves working time. Two attributes are identified and relevant to technology, which are: (a) Software and (b) Hardware.

(a) Software. Software is the installed program and operating information used by computers. Software and hardware are related to each other. Digitalization works are dependent on both software and hardware. However, the cost is inflicted in using good software to prepare digital twins. Table 3 shows examples of respondents from the interview summary.

(b) Hardware. Hardware is the equipment used to run the software. Suitable hardware like high-specification computers and reliable laptops are needed to prepare digital twins. Good compatibility between software and hardware makes digital twin execution easier. Table 3 summarizes the responses based on a summary of the interviews.

4.2. Strategies to Produce Digital Twin

Fig 2 summarizes the themes and subthemes on strategies for an organization to achieve the attributes of preparing digital twin. Of 20 respondents, four categories were identified to be the subthemes for strategies, and they are: "Standard Guidelines," "Government Enforcement," "Strategic Work Process," and "High-tech Tools." In addition, the three categories can be grouped into three themes, which are: "Policy," "Workflow," and "Technology." The detailed themes and subthemes are further deliberated on in the following subsections.

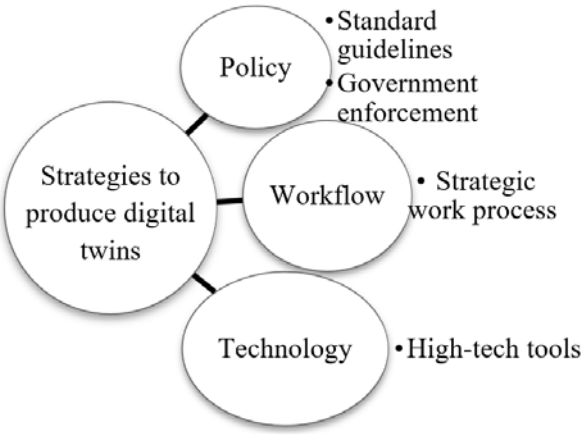

Fig. 2. Strategies to produce digital twin

4.2.1. Policy

A policy is a principle that guides proposed actions by organizations or individuals. A policy also acts as a push factor towards the changes from the conventional system to preparing digital twins in the Malaysian construction industry. Two important policy-related strategies are identified, which are (a) Standard guidelines and (b) Government enforcement.

(a) Standard guidelines. Standard guidelines that are used depend on different organizations or individuals. Therefore, no standard guidelines lead the stakeholders in one direction. Besides, we need one standard that suits the country as well. Table 4 shows examples of respondents from the interview summary.

(b) Government enforcement. The government drives the construction industry in Malaysia. They are the main key factor that can boost the implementation of digital twin between organizations in Malaysia. Government enforcement can influence the success of the digital twin by ensuring organizations or individuals comply with the standards they set because it is aligned with the nation's direction. Table 4 contains examples of respondents from the interview summary.

4.2.2. Workflow

A workflow involves a strategic work process with proper planning, action plans, and a premeditated road map. This is to ensure that the working process flows accordingly with less deterrence. One strategic aspect identified related to workflow is (a) Strategic Work Process.

(a) Strategic work process. A strategic work process is intended to guide the organizations' leaders in their decision-making to achieve their targets. Therefore, it should be strategized early on what will be achieved in the coming years. Table 4 shows examples of respondents from the interview summary.

4.2.3. Technology

People and technology are strongly related. They are dependent on each other. Technology evolved from time to time. Furthermore, to prepare a digital twin, the required technology level must meet the needs to use a digital twin. Likewise, technology must be updated accordingly. One strategic aspect related to technology is the (a) High-tech Tools.

(a) High-tech tools. High-tech tools are the latest technology available and used in the market. Thus, high-tech tools are needed to produce digital twins. Examples of respondents from the interview summary are shown in Table 4.

5. Conclusion

In conclusion, this study has highlighted the organizational attributes required to generate digital twins for buildings within the AECO industry. The study findings suggest that the attributes needed to produce a digital twin for a building are People, Processes, and Technology. The project team impacts the workflow from the beginning to the end of every project. It involves effective communication among team members, coordination of work, and understanding of a clear project framework and project directions.

Besides that, experts make the working process more efficient; thus, they are highly needed to prepare digital twins. They have the relevant and sufficient information to get digital twin ready for the construction industry. On the other hand, the lack of mindset readiness about digital twins is one reason why preparing for them is complicated. People in the construction industry are not ready to adapt to changes in the system. It makes the adaptation process difficult because industry leaders are reluctant to change.

Table 4. Respondents' statements on strategies to produce digital twins

Strategies	Respondents' statements
Standard guidelines	"Different companies produce different plans and guidelines." (R2) "Need proper guidelines." (R9) "Guidelines and standards - depending on the organization which guidelines to follow, whether to develop own company's guidelines or adopt guidelines available in the market. e.g., To follow JKR standards or international standards using ISO." (R17)
Government enforcement	"Effective Enforcement by government or client to adopt digital twin." (R1) "Enforcement by regulatory bodies - It relates to the national directions." (R10) "Policy - Government to start to implement. People will start to look into it once initiated by the government. The top to bottom of the organization also needs to start to look into it because it is related." (R13)
Strategic work process	"To develop something, you need to make some investment. And you need to strategize the workflow." (R13) "At least, for a start, kick start with a small project like a small room or a single unit bungalow. This is to test out the expertise needed, roadmap and guidelines required that works and workable." (R17) "Road map - Road map is directly related to an action plan. It involves strategizing on plans and on what is to be achieved. E.g., Plan for the next two years, three years, and five years. KPI to be achieved. Strategized early." (R15)
High-tech tools	"We need to use technology to help us make better decisions." (R12) "Technology - ICT, software, and hardware. Everything needs to be updated accordingly." (R14) "Utilize the latest technology, robots, artificial intelligence, virtual reality, and drone technology. The building process will be better but with a cost. The value of the building must match the investment. E.g., Now, in Malaysia, we applied the stamping approach. Typical condominiums must have car parks, malls, and housing units at the top. " (R12)

An efficient construction work process is also important. Work Processes with an adequately guided road map and strategic thinking can help the construction team efficiently prepare digital twin in their organizations. Besides that, Technology helps to get work done accordingly to what is required and is related to software with installed programs and operating information used by computers and compatible hardware that runs the software. To achieve the attributes mentioned, a good policy with standard guidelines and enforcement from the government can boost the implementation of digital twin between organizations.

Besides, workflow involving a strategic work process helps achieve desired targets and efficient working procedures. On the other hand, technology and people are relevant to each other. High-tech tools are needed. Thus, technology must be updated accordingly. The optimum usage of sound technology helps save working time to produce a digital twin.

5.1. Study Implications

The findings of this study have numerous significant consequences for the building construction sector, both theoretically and practically. Twenty practitioners of digital twins were interviewed as part of the study's qualitative methodology, and thematic analysis was used to glean the pertinent data. The questions "What are the organizational traits needed to produce

digital twin in construction projects, and what are the strategies involved to attain the attributes?" were the basis for the interviews, and their analysis provided some crucial insights into the process of producing digital twins. As a result, three important attributes and three relevant strategies were identified. These assisting attributes and strategies offer a fundamental framework for creating digital twins in the AECO sector. In order to generate a digital twin in the building construction sector, each attribute and strategy must be implemented with a thorough assessment and definition. Sections 5.1.1 and 5.1.2 discuss the theoretical and practical implications. Section 5.2 outlines these contributions' research limitations and future research efforts.

5.1.1. Theoretical implications

For the academic field, this study will assist researchers in better evaluating their work on the business benefits and applications of digital twins, organizational factors involved in implementing digital twin in building construction practice, and the benefits and technological capabilities involved in producing them. Through this study, the qualities and methods produced will be able to aid in raising awareness to develop models and techniques for construction practices further.

Table 5. Link between interview respondents and the identified attributes to produce digital twin

Strategies	Respondent																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Policy																					
Standard guidelines		√	√	√		√		√	√	√	√	√		√	√		√	√	√		14
Organization policy	√						√			√	√										4
Government enforcement	√	√	√			√			√	√			√	√				√	√		10
People																					
Supply chain maturity	√		√				√	√		√			√								6
Work culture mentality						√	√			√	√	√	√								6
Experts					√			√	√		√				√	√	√			√	8
Training programs				√	√									√				√			4
Graduates hands-on training		√		√	√														√		4
Organization leadership							√			√				√			√				4
Education system		√	√	√	√				√										√		6
Awareness initiatives			√	√	√								√	√				√	√		7
Research and Development				√						√		√	√				√				5
Financial																					
Government funding							√					√									2
Tools subsidies					√	√		√		√											4
Financial support					√		√	√			√	√									5
Contractual fees	√							√											√		3
Workflow																					
Quality management																√					1
Asset information system																				√	1
Strategic work process			√										√		√		√		√	√	6
Technology																					
Digital data platform							√		√	√		√		√							5
Hi-tech Tools				√	√		√	√				√		√	√					√	8
Digital currency												√									1
Technology impacts							√				√	√			√				√		5
Smart contracts												√									1

5.1.2. Practical implications

This study will be able to serve as the industry's standard reference point for building construction practitioners in their strategic planning, assessments, and comprehension of the deployment of digital twin in their practices. This is crucial for achieving successful technology deployment among many stakeholders. Additionally, this study helps to promote a strategic attitude across supply chain links. According to Turner et al. (2021), productivity in the construction industry is

one of the most crucial measures of economic growth, national standards of living, and social prosperity; hence, this study aids in the adoption of digital technologies to maximize operations and work productivity.

5.2. Research Limitations and Future Directions

Further research is necessary for other areas of competence and different national settings due to the constraints of this study, which was based on in-depth interviews with digital twin specialists working on construction projects for construction businesses in Malaysia. The creation of fresh viewpoints on the use of digital twins is yet possible. Turner et al. (2021) state that significant research gaps remain insignificant in making the digital construction site a reality. The future of construction will depend on embracing a "systems" method to existing and new digital technologies, with their integration towards a connected, holistic architecture. Our findings also suggest that more research on Digital twin application policies, standard operating procedures, and procurements will be beneficial in accelerating the evolution of the digital environment in Malaysia's construction industry. This study shows that the construction industry will benefit from digital twin applications, despite their use being limited due to the industry's complex challenges. Nonetheless, despite the limitations, the objectives of this study were met.

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Author Contributions

Yuveelai Bunjaridh contributed to the conceptualization, research methodology, data collection, data analysis, draft writing, and preparation. Rahimi. A. Rahman contributed to the idea, study methodology, validation, data analysis, data collecting, draught preparation, article editing, visualization, supervision, project management, and funding acquisition. Liyana Mohamed Yusof contributed to the idea, study methodology, validation, data analysis, data collecting, draught preparation, article editing, visualization, supervision, project management, and funding acquisition. Before the manuscript's submission and publishing, all authors have read and approved of it.

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