



# Digital Transformation Barriers in the Malaysian Construction Industry: Staff Competency, and Company Initiatives

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**Abstract.** The Malaysian construction industry faces significant barriers to digital transformation, including a lack of awareness and acceptance of digital technologies, high training costs, and substantial initial expenses for technology adoption. Using a qualitative interview with industry stakeholders to gather comprehensive data on the industry's current state of digital transformation barriers. Key findings indicate that inadequate training, lack of expertise and significant financial burdens as obstacles. This study highlights the necessity of targeted education and training programs to bridge the digital skills gap. In addition, the need for company initiatives is important and to be strategically implement in adopting digital technology for fostering a culture of innovation and enhancing the industry's overall productivity and competitiveness in the digital age.

**Keywords:** Digital Transformation Barriers, Malaysian Construction Industry, Staff Competency, Company Initiatives.

## 1 Introduction

The construction industry faces significant challenges in adopting digital technologies, despite their potential to revolutionize the sector. A critical barrier is the lack of digital leadership and the slow adoption of new technologies such as the Internet of Things (IoT), cloud services, artificial intelligence (AI), and big data, which are essential for maintaining competitiveness [1]. The industry also lags behind in the adoption of advanced technologies like digital twins, Building Information Modeling (BIM), augmented reality, virtual reality, and robotics, which could enhance digitalization and autonomy in construction processes [2]. Additionally, issues related to stakeholder management, organizational processes, and the nature of construction projects contribute to the slow pace of innovation adoption and resistance to change [3]. To overcome these barriers, it is crucial for construction enterprises to develop digital competencies, foster digital leadership, and implement strategic initiatives that promote collaboration and enhance digital skills among professionals [4]. Therefore, this study aimed to explore the challenges in adopting propose effective strategies to maximize the use of digital technology in Malaysian construction projects to achieve Industry Revolution 4.0.

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## 2 Literature Review

Cultural and organizational barriers significantly impede the adoption of digital technologies within the construction industry. Resistance to change is deeply rooted in established cultural norms, with individual fears such as job loss and acceptance anxiety, compounded by organizational resistance to cultural shifts [5]. Understanding and reshaping the existing organizational culture is crucial for successful digital transformation, as it influences the deployment of digital technologies and the development of capabilities needed to achieve strategic goals [6][7]. Identifying and reinforcing cultural values that align with digital strategies, while addressing negative behaviors, are essential steps for organizations to navigate the challenges of digital transformation effectively [8].

The high costs associated with adopting digital technologies represent a significant barrier for the construction industry, particularly in Malaysia. Investment in digital infrastructure, including the latest hardware and software, requires substantial capital, which many companies find prohibitive [5]. The need for specialized skills and knowledge to manage advanced digital systems such as Building Information Modeling (BIM) and digital twins adds another layer of financial burden, often leading to hesitation in adopting these innovations [9]. Moreover, smaller firms may struggle more with these financial demands, exacerbating the divide between larger companies and smaller enterprises in their capacity to implement digital transformation [10].

Staff competency is a critical factor in the successful adoption of digital technologies in the construction industry. Research highlights the significant impact of digital literacy levels and attitudes on the effectiveness of digital transformation efforts [11]. Additionally, digital competency influences job dynamics, often leading to increased employment opportunities for high-skilled workers [12]. Therefore, improving staff competency through targeted training and development programs is essential for overcoming barriers to digital technology adoption in the construction industry.

Effective company initiatives are crucial for driving digital transformation in the construction industry. Embracing advanced technologies such as digital twins, augmented reality, virtual reality, robotics, drones, and Building Information Modeling (BIM) can further enhance digitalization and operational autonomy, leading to improved efficiency and innovation in construction projects [2].

## 3 Research Methods

The research methods for this study are to assess the acceptance and integration of digital technologies across key stakeholders in Malaysia's construction sector, with a focus on a wide range of project types. The study's geographic area covers the entire country, with the goal of capturing a comprehensive view of the overall situation of digital adoption in construction. The projects under consideration fall into several categories: commercial, industrial, infrastructure, institutional, and residential. Data for this study were gathered using a semi-structured interview conducted with construction key players via online and face-to-face according to participants' available time. Semi-structured interviews enable interactive dialogue with interviewees to elicit rich storytelling of work

experiences. Therefore, data collection in this study was accomplished by conducting open-ended and in-depth semi-structured interviews with professionals from diverse locations and specializations in the construction business who have responsibilities mainly at construction sites. The target participants in this study include public and private sector developers, contractors, consultants, and architects. The participants were chosen based on their direct engagement and influence in the use of digital technology in building projects, making their insights especially crucial to the study.

The interview questions are divided into two primary sections: Section A is on demographic Profile, Section B is guided by a set of questions on the technology readiness assessment criteria and sub-criteria on digital technologies, and their corresponding suggestion on the barriers in digital transformation in Malaysian construction industry, as detailed in **Table 1**.

Section B of the questionnaire focuses on the criteria and sub criteria, which encapsulate the broad categories of technologies utilized in construction projects. These criteria are further delineated into assessment sub-criteria, offering a granular view of specific technologies and practices within each category. Section B was designed to provide rich qualitative data and allowed respondents to express themselves more freely.

Researchers subsequently approach the potential participants for voluntary participation. This sampling method is repeated for recruitment until preliminary data analysis reaches the saturation point [13].

Semi-structured interviews lasting between 25 and 50 min were conducted face-to-face and online by two researchers. The interview questions were (1) What are the barriers in digital transformation in Malaysian construction industry? (2) How do your employer and colleagues respond to the digital technology in projects? (3) Can you see yourself embrace the digital technology in projects? Why or why not?

**Table 1.** Assessment Criteria and Sub-Criteria of Technology Readiness

<b>Assessment Criteria</b>	<b>Assessment Sub Criteria</b>
Simulation and Modelling	BIM
Digital and Virtualisation	IoT
	Blockchain
	3D Printing
	Predictive Analysis
	AR
	VR
	Cloud
Smart Factory	Real-time Collaboration
	Advanced Material
	Autonomous Vehicle
	Big Data
	Prefabricated/Modular
IT Infrastructure	Internet bandwidth speed
	Infrastructure Capability
Security	IT Security

**Table 2.** Demographic Profile of the Respondents

<b>Respondents</b>	<b>Category</b>	<b>Frequency</b>
Sector	Public	3
	Private	2
	Developer	3
	Consultant	14
	Contractor	26
	Architect	1
	Others	1
Working Experience (years)	≥ 0-5	16
	≥ 6-10	8
	≥ 11-15	15
	≥16-20	4
	≥21 and above	7
Position in Organisation	Senior Executive Level	17
	Executive Level	19
	Junior Executive Level	3
	Other	11
Type of Project Respondents Currently Involved	Commercial	10
	Industrial	1
	Infrastructure	10
	Institutional	12
	Residential	17
Respondent Location	Johor	4
	Kedah	1
	Kelantan	4
	Kuala Lumpur	6
	Negeri Sembilan	5
	Pahang	2
	Perak	5
	Putrajaya	1
	Sarawak	8
Selangor	14	

A total of 50 participants were interviewed. Table 2 shows the demographic analysis of the survey participants reveals a diverse representation from key sectors within the Malaysian construction industry, predominantly featuring contractors (26) and consultants (14), alongside developers, an architect, and other roles, indicating a comprehensive industry perspective. The respondents' experience in the construction industry spans all levels, with a notable concentration in the 0-5 years (16) and 11-15 years (15), reflecting a balanced mix of emerging talents and professionals. The data suggests that most respondents are in the Senior (17) and Executive (19) positions in the organisation, providing valuable insights into the barriers of digital transformation. The most project respondents currently involved are Residential (17) and Institutional (12). Geographically, the survey covered a wide area, with Selangor (14) and Sarawak (8) emerging as the regions with the most respondents, ensuring that the analysis captures a geographically diverse understanding of digital adoption challenges and practices across Malaysia, thereby offering a well-rounded view of the industry's readiness and approach towards digital transformation.

Fifty (50) audio-recorded interviews were transcribed by one researcher and shared with another one researcher to individually carry out initial coding. Significant phrases that pertained directly to the barriers were identified in each transcript to formulate meanings and clusters of themes. This procedure allowed the emergence of themes common to all transcripts that described the phenomenon. This was followed by an additional interview to validate the findings and assess the saturation point by comparing the newness and consistency of data, codes, or emerging themes observed across two groups of samples [14]. The research design, which had a clear and specific focus on the study population, reached a saturation point after 50 interviews and comparison of notes across the groups. The transcripts then were reanalysed individually to carry out further thematic analysis, which involved coding of similar themes into the same category [15]. Pattern matching notes then were compared to identify and verify dominant themes underlying the work experiences of interviewees. This rigorous process [16] to seek coherence between data, interpretations, and conclusions was repeated three times until categories regarding strategies (Table 3 and Table 4) of the barriers of digital transformation finally were determined. In sum, the study had a methodological layout with systematic procedures appropriate to the research topic and included rigorous interpretation of the results to produce good qualitative research (Fig. 1).

## 4 Results and Discussion

The findings present the challenges based on key construction players' perspectives on the digital transformation barrier for Malaysia construction industry.

### 4.1. Training and Awareness

The findings from this study highlight the significant barriers to digital transformation within the Malaysian construction industry, particularly in the realm of awareness. The survey revealed that 14% of the respondents cited a lack of awareness and acceptance of digital technologies as a major obstacle. Five interviewees articulated, "One of the major challenges we encounter is the lack of awareness and acceptance of digital technologies within our construction projects, which significantly hampers their effective implementation and integration" (R1, R10, R12, R30, R38). This sentiment was echoed by other respondents who pointed out that the insufficient knowledge about the benefits and functionalities of digital tools creates resistance among staff, further complicating the integration process [17]. Additionally, the lack of skilled personnel proficient in digital technologies exacerbates this challenge. As two respondents noted, "One of the significant barriers we face is the lack of skilled personnel proficient in digital technologies, which severely hinders their integration into our company's workflow. This gap in expertise not only slows down our digital transformation efforts but also affects our overall productivity and efficiency" (R8, R9). These responses underscore the necessity for comprehensive training and continuous professional development to bridge the knowledge gap and enhance staff competency in digital technologies, thereby fostering a more accepting and supportive environment for digital transformation initiatives [18].

**Table 3.** Selected examples of significant statements, related formulated meanings, and sub-theme clustering on Challenges

Significant Statement	Respondent	First-Order-Level Sub Theme	Second-Order-Level Sub Theme
"One of the significant barriers we face is the lack of skilled personnel proficient in digital technologies, which severely hinders their integration into our company's workflow. This gap in expertise not only slows down our digital transformation efforts but also affects our overall productivity and efficiency."	R8, R9	Awareness	Training
"Our company struggles with a lack of expertise in digital technology, which poses a significant obstacle to our digital transformation efforts and overall operational efficiency."	R27	Training	
"The absence of clear building codes, guidelines, and requirements for implementing digital technology in construction projects creates uncertainty and hinders the adoption of these innovations."	R1	Government initiative	Government initiative

**Table 4.** Frequency of themes and subthemes from interview data on Challenges

Categories, themes and subthemes	Number of respondents
Training	10 (20%)
Awareness	7 (14%)
Training	3 (6%)
Government Initiatives	1 (2%)
Government Initiatives	1 (2%)
Company Initiatives	12 (24%)
Investment in Implementation	2 (4%)
Increase in Project Cost	10 (20%)

Note: Percentage of total responses (n=50) is given in parentheses.

Furthermore, the gap in expertise was another significant obstacle identified. One respondent emphasized, "Our company struggles with a lack of expertise in digital technology, which poses a significant obstacle to our digital transformation efforts and overall operational efficiency" (R27). This lack of expertise not only hampers the adoption of digital tools but also affects the productivity and efficiency of construction projects. Addressing these training and competency gaps is imperative for fostering an environment conducive to digital transformation, thereby improving the overall performance and competitiveness of the industry [18].

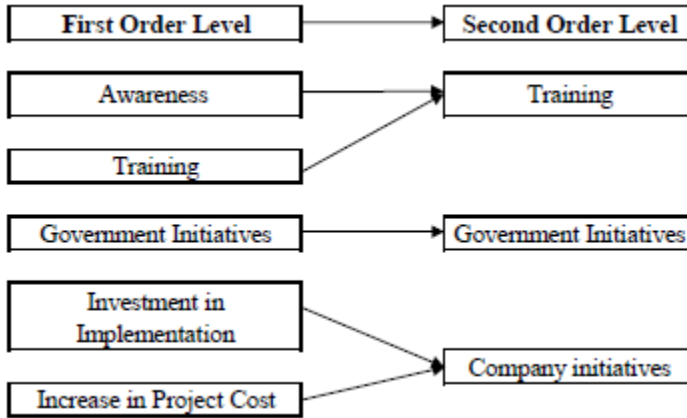


Fig 1. Construction of Themes for Challenges

#### 4.2 Government initiative

The study identified the absence of clear building codes, guidelines, and requirements for implementing digital technology in construction projects as a significant barrier to digital transformation in the Malaysian construction industry. According to 2% of the respondents, this lack of regulatory framework creates uncertainty and impedes the adoption of innovative technologies [10][3]. One interviewee expressed, "The absence of clear building codes, guidelines, and requirements for implementing digital technology in construction projects creates uncertainty and hinders the adoption of these innovations" (R1). Addressing these regulatory gaps is crucial for accelerating the digitalization of the Malaysian construction industry and enhancing its global competitiveness [1].

#### 4.3 Company Initiatives

Moreover, the financial burden associated with training staff in digital technologies poses another substantial challenge [19]. Interviewees highlighted that "The high cost of training staff in digital technologies is a substantial financial burden, making it challenging to provide the necessary education and development programs" (R18, R20). Additionally, the high initial expenses in purchasing software, tools, and materials needed for digital technology adoption were identified as a major hurdle. As stated by several respondents, "Our company is faced with high initial expenses in purchasing software, tools, and materials needed for digital technology adoption, which strains our financial resources and slows down the implementation process" (R9, R12, R13, R16, R17, R27, R30, R46). These findings underscore the necessity for strategic company initiatives that address these financial and operational challenges to facilitate successful digital transformation in the construction sector [20][21][22].

## 5 Conclusions and Recommendations

This study identified significant barriers to digital transformation in the Malaysian construction industry, emphasizing the critical roles of staff competency and company initiatives. The lack of awareness and acceptance of digital technologies, combined with the high costs associated with training and technology adoption, significantly hinders progress. Additionally, the absence of clear guidelines and the high initial expenses further complicate the adoption process. Addressing these challenges requires a concerted effort to enhance digital literacy and streamline digital adoption strategies across the industry.

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