The Use of Blockchain Technology to Improve Payment Delays in Malaysian Construction Industry

Salman Riazi Mehdi Riazi[1*], Alotaibi Majed Mansour B[2], Nurul Izzah Azmi[3]

[1,2]School of Housing, Building, and Planning, Universiti Sains Malaysia, Penang, Malaysia.

[3]HCK Capital Group Berhad, HCK Tower 8, PJU 8, Jalan Damansara, Empire City, 47820 Petaling Jaya, Selangor, Malaysia.

DOI: https://doi.org/10.47772/IJRISS.2026.100700141

Received: 13 July 2026; Accepted: 18 July 2026; Published: 27 July 2026

ABSTRACT

Blockchain technology is an emerging technology that has been linked with many benefits including improving construction industry payment timeliness. Despite the well documented positives of blockchain to improve payment practices such as automated payments through smart contracts, faster payments processing, increased transparency, reduced disputes, better cash flow management etc., its actual implementation in Malaysia has been rather scarce. This study therefore looks into blockchain technology adoption in Malaysian construction industry and its potential to improve payments delays. Focus was placed on investigating the prevalence of payment delays in the industry, industry awareness on blockchain technology, current adoption status, industry readiness as well as the potential of blockchain to improve payment timeliness in Malaysian construction industry. Data collection involved the use of semi-structured interviews on six (6) experts, all of them being quantity surveyors with a minimum of five (5) years' continuous experience as well as relevant knowledge and experience with blockchain technology. Interview responses were analyzed using content analysis to identify key themes by scrutinizing the frequency of recurring topics. Results indicated that delayed payments are indeed a recurring dilemma due to the domination of inefficient conventional practices and despite the potential of blockchain technology to overcome the problem, it has remained uncommon in the industry practice. Even though exposure to this technology has taken place, awareness on blockchain is quite shallow with very limited actual implementations. Lack of digital maturity, poor infrastructure, domination of old practices and resistance to change have been among the culprits for this unhealthy scenario. Anyhow, the respondents did support the notion that blockchain-enabled automated payment mechanisms have potential to address many shortcomings of old payment practices. This therefore sheds some light at the end of tunnel and portrays strong optimism for future blockchain initiatives in bettering payment processes in Malaysia.

Keywords: Blockchain Technology, Construction Industry, Malaysia, Payment Process, Payment Delays

INTRODUCTION

The Malaysian construction industry is undoubtedly one of the most dominant industries in Malaysia. In 2024, the sector contributed approximately 4.3% to the nations GDP with the total work value of RM158.8 billion (Department of Statistics Malaysia, 2025). Beyond immediate economic contributions, industry also provides multiplier effects on many other industries (i.e., manufacturing, transportation, finance, etc.) hence, fluctuations in this sector can have wider implication on these interconnected industries (see Riazi et al., 2019). So, it is vital for the construction industry to perform well in order for the nation's economy to prosper as well. However, despite its strategic role, its contribution to GDP has been far less compared to other industries in Malaysia – 59% by the services sector and 23% by manufacturing sector (Department of Statistics Malaysia, 2025) signifying challenges faced in upscaling efficiency and productivity.

The lengthy network structure of the construction industry has exposed it to inherent uncertainties (Behera et al., 2015) with inefficient payment being among the significant adverse impacts (Nanayakkara et al., 2021a). Delayed (Danuri et al., 2006), partial and non-payment are common citing (Ramachandra & Rotimi 2011) and Malaysia is not excluded from poor payment practices (see MBAM, 2005; Judi & Rashid, 2010; Mehdi Riazi,

2014; Badroldin et al., 2016; Riazi et al., 2019; Salleh et al., 2020). This has exposed industry to numerous negative effects down the supply chains (see Riazi et al., 2019; CIDB, 2022), sacrificing the survival of many parties (Ameer Ali, 2006) and in some cases, contractors simply abandon projects (see Mehdi Riazi, 2014). Nevertheless, Malaysia construction industries continue to rely on inefficient conventional practices (i.e., Othman et al., 2021; Al-Ashmori et al., 2022) with poor adoption of digital construction practices (see Waqar et al., 2023) hence signifying the need to transform payment practices to overcome deficiencies (i.e., payment delay).

Blockchain technology (BT), an emerging digital technology, linked with many benefits to improve payment practices (e.g., Turk & Klinc, 2017; Li et al., 2019; Perera et al., 2020). The use of smart contract (a key tool that uses blockchain technology) has been recommended as the way forward to overcome late and non-payments (see Singh et al., 2023). BT therefore has the potential to transform Malaysian construction industry practices (see Kiu et al., 2025). In fact, the Construction Industry Development Board Malaysia (CIDB) has also displayed interest in making BT the way forward in the industry (see Hamid et al., 2021). However, slow response to modern technologies (Mohamad et al., 2024) and the over-reliance on old methods has hampered move towards digitalized solutions (Wu et al., 2022; Zilin et al., 2023) despite its revolutionary potential (see Nasir et al., 2024). This paper therefore looks into blockchain technology adoption in Malaysian construction industry and its potential to improve payments delays. Using expert interviews, this paper looks into the prevalence of payment delays, industry awareness on blockchain technology, current adoption status, industry readiness as well as the potential of blockchain to improve payment timeliness in Malaysian construction industry.

LITERATURE REVIEWS

Payment Delays in Construction Industry

Payment generally refers to any form of transaction undertaken in exchange of goods or services (Judi & Rashid, 2010) and in construction, payments are made only when contractors have delivered their work in accordance with the contract (Dzulkalnine, 2015) which are usually done according to predetermined period or agreed milestones (Nanayakkara et al., 2021a). Compared to other industries, time taken for all parties to receive payments are generally longer in construction industry due to the multi-layer payment chain practices (Ramachandra & Rotimi, 2011) meaning that only after the main-contractor receives payments from client that he/she then can pay their sub-contractors, suppliers, etc.

Payments are vital to ensure proper delivery of project objectives (Mohd Nawi et al., 2015) however, the Malaysian construction industry has long suffered poor payment practices, including delayed payments (see MBAM, 2005; Judi & Rashid, 2010; Riazi et al., 2019) and has remained a systematic, recurrent issue and a pretty common problem among Malaysian clients (see Badroldin et al., 2016; Riazi et al., 2019; Salleh et al., 2020). Among key issues related to poor payment practices include cash flow problems, finance costs, cost overrun, lengthy payment cycle, not paying at all, paying partially, delaying payments, holding payments, retention as well as the security of payment issues (Nanayakkara et al., 2021a). All these have led to many negative effects such as liquidity issues and loss of profit for contractors (Riazi et al., 2019) while subcontractors also get the hit due to their limited financial and bargaining power compared to their upper chains (CIDB, 2022). Partial and non-payments are also not uncommon (Ramachandra & Rotimi, 2011; Abeysekera, 2012) hence leading to further negative chain effect down the supply chain (see Riazi et al., 2019), all of which can negatively affect work progress and; consequently lead to decreased profitability (Hasmori et al., 2012), delays (Judi & Rashid, 2010), loss of reputation (Nekooie & Kamaruddin 2012), project abandonment (Mehdi Riazi, 2014) and survival of industry players (Ameer Ali, 2006).

Payment delays can also interfere with cash flow and operation fluidity. Contractors typically get external financing (i.e., banks) to fund their projects, hence, delaying payments can cause them to not be able to furnish loan payments on time resulting in penalties, increased financing costs and reduced profit margins. According to Danuri et al. (2006), payment delays can result in 1.6% loss of income while Abeysekera (2012) made a case that when interest rates are at 5%, payment delays of just seven days can cause clients to lose 0.05% of contract sum. Financial difficulties faced by the contractors and subcontractors can extend to problems procuring material and maintaining laborers which consequently causes disruption in schedule, budget, supply chain and project

performance. As a result, contractors may over-price future jobs to neutralize risks of delay (Dainty et al., 2001) and projects could suffer other negatives such as delays, disputes, substandard quality, poor compliance, etc. (see Danuri et al., 2006; Ramachandra & Rotimi, 2015).

The Need to Change Payment Practices

Proper payment of construction works is important to ensure a smooth sailing project as many parties within the supply chain depend on them to continue work with good productivity. However, the case has not been very satisfactory in Malaysia with delayed payments being a common & recurring dilemma (see MBAM, 2005; Judi & Rashid, 2010; Badroldin et al., 2016; Riazi et al., 2019; Salleh et al., 2020). Despite government initiatives such as the Construction Industry Payment and Adjudication Act 2012 (CIPAA) to expedite payment disputes resolution, proper adoption has remained challenging, especially among smaller contractors due to limited awareness, accessibility issues, and poor understanding of its processes (Din & Ismail, 2014; Lim, S. J., 2021). On top of that, digital transformation initiatives have also been promoted by the Construction Development Board (CIDB) Malaysia such as the use of digital platforms and Information Management Systems (IMS) (CIDB Malaysia, 2020) but payment issues, including late and non-payments, remains a habitual dilemma (Salleh et al., 2020).

Despite the evident payment issues, the local industry has been rather slow in transforming practices. In fact, many studies have indicated that the Malaysian construction industry is still relying largely on conventional practices (i.e., Othman et al., 2021; Al-Ashmori et al., 2022) and that digital construction practices have yet to become mainstream (see Waqar et al., 2023). This slow integration of advanced digital technologies has disrupted improvement in project performances (Jasimin et al., 2023). Past findings have also shown that despite few initiative, outcomes were far from satisfying. For instance, the CIPAA 2012 initiative by CIDB Malaysia - they were found to be less effective as a result of low awareness, poor execution and accessibility issues (see Zuki et al., 2020). Mohamad et al. (2024) asserted that Malaysian response to modern technologies has been rather on the slower side; blamed upon its dependence on manual and paper-based methods which hinders effective move toward more digitalized solutions that boosts efficiency (Wu et al., 2022; Zilin et al., 2023).

Blockchain Technology (BT) as the Way Forward to Improve Payment Delays

Blockchain technology (BT) has the potential to shift Malaysian construction industry payment delays by transforming the mechanism in which they are practiced. BT which has been described as made up of a technology that is secure and translucent which facilitates direct information exchange among network participants using peer-to-peer system, avoiding intermediaries or middleman and strengthens trust among parties (Rodrigues et al., 2018; Hijazi et al., 2019; Rodrigo et al., 2020) has been linked with timelier payments (see Hamledari & Fischer, 2021; Celik et al., 2024). Blockchain-based payment mechanism has also been brought forward as means of allowing more automated, transparent and real-time payment processing (Perera et al., 2020). It can improve document traceability, integrity and transparency (see Dal Mas et al., 2023) as each participating node in the blockchain network preserves an independent copy of the complete transaction record, known as a distributed ledger (Nanayakkara et al., 2021b) thereby enhancing certainty and fiscal flow monitoring (Li et al., 2019).

Blockchain networks are typically categorized into public, private, and consortium models depending on access permissions and governance structures (Zheng et al., 2018) and they can be made of thousands of nodes that may not be always active (Nanayakkara et al., 2021a). A public network allows anyone to join and view transactions (Lewis et al., 2017) with no single point of control and is best when transparency is highly prioritized. Private ones on the other hand only allow approved users to access or transact (Martinovic et al., 2017) and are typically controlled by a single organization, providing higher level of privacy and control; while the consortium blockchain is controlled by multiple organizations, permissioned, partially private and suits alliancing types of business (Persons, 2019). Blockchain can produce a resilient and temper-proof record system whereby according to Shojaei et al. (2021), the technology avoids illegal modification of recorded information via cryptographic protocols and distributed ledger technology, consequently, improving levels of trust between participants especially in construction projects that are prone to disputes, claims and contradicting information.

One significant revolution in BT is the introduction of smart contracts. According to Zhang et al. (2018) "smart contracts can store data objects and define operations on the data, enabling the development of DApps to interact with blockchains and provide seamless services to the application users". This application allows for an automated payment mechanism whereby transactions can be performed provided a set of pre-demarcated conditions are met (Turk & Klinc, 2017). This can reduce manual verifications as well as avoid payment disputes and delays. Reduced reliance on intermediaries also improves payment efficiency while lessening administrative expenses (Perera et al., 2020). The smart contract can be deployed on platforms such as the Ethereum and Hyperledger Fabric, allowing for a more automated transaction, accelerate payments and minimize conflicts as a result of decreased reliance on third-party verification (Turk & Klinc, 2017) however, fruitful adoptions are subject to proper legal recognition and enforceability (Werbach & Cornell, 2017), availability of the right technical expertise (Sonmez et al., 2022), sufficient digital set-up, stakeholder aptitude, as well as adequate policy support (Kiu et al., 2025). While adoption of BT is a challenge, CIDB Malaysia has shown intentions of making it the way forward, though it could take more than five (5) years due to the lagging technology level in local construction industry (Hamid et al., 2021). The lack acquaintance with the technology and practitioner's apprehensiveness towards the cost and disturbances associated with its implementation, therefore, requires effective resolution for a seamless incorporation of the technology in Malaysia (Zheng et al., 2020).

METHODOLOGY

This study adopted expert interviews as means of gathering data due to infancy of blockchain technology (BT) in Malaysian construction industry evident from its rather poor uptake. Hence, there is a need to get the experts' opinion as they are, according to Delbecq et al. (1975), capable of providing far-reaching responses. They are also more knowledgeable and have sufficient exposure to industry practices and problems which are beneficial to obtain a rich and valid response. Their familiarity with local industry also adds a more localized response which may not be entirely similar to those of other countries. The face-to-face approach also allows application of physical stimuli and observation of the participants (see Alreck & Settle, 2004), stricter control on the interviewee's criteria as well as allows the introduction of trigger questions, all of which improves response quality (see Riazi et al., 2020).

For this study, practicing quantity surveyors were selected due to their expertise and familiarity with project payments. In Malaysia, quantity surveyors are responsible for evaluating, processing and recommending progress payment for the contractors hence, they are the most knowledgeable when it comes to issue relating to payment delays - the target matter of this study. A minimum of five (5) years of continuous experience was made compulsory to be in line with Berliner (2004)'s expert criteria for a well-informed opinion. This criterion also coincided with Phil (1971), Okoli & Pawlowski (2004) and Hallowell & Gambatese (2010) emphasis that experts should be selected based upon their relevant knowledge and practical industry experience.

Purposive sampling approach was used as suggested by Chein (1981) and Patton (2014) to be suitable when trying to target a group with specific criteria while Bryman (2016) also supported this method as an approach effective to identify respondents that can provide informed insights on a topic. Overall, a total of six (6) experts were interviewed using semi-structured interviews; which meets the minimum of five (5) required responses for expert interview studies (see Ismail et al., 2013; Mehdi Riazi, 2014; Riazi & Nawi, 2018). When conducting the face-to-face interview, study details were first explained together with the objectives, confidentiality information and personal contacts. During the interview, probing questions were incorporated where appropriate. Finally, content analysis was used to analyze responses, following recommendation by Fellows & Liu (2021) to identify key themes by analyzing the frequency of recurring topics in qualitative data. Similar approach was also applied by Mehdi Riazi (2014), Riazi & Nawi (2018) and Riazi et al. (2020) in their studies involving expert interviews.

Data Analysis

Prevalence of Payment Delays in Malaysian Construction Industry

Table 1 presents the respondents' view regarding the prevalence of payment delays in projects they have been involved in. Generally, they agree that delayed payments are prevalent occurrences in Malaysian construction projects arising from multiple interconnected issues such as vague project scope, excessive bureaucracies,

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

late/slow approvals and progress verification as well as poor practices relating to managing variation orders. Payment delays were claimed to range from weeks to months, especially the ones with more complex contracts and government procedures which have affected not only the progress of work but also the sub-contractor's cash flow.

Table 1: Prevalence of Payment Delays

R	Responses
A	"Payment delays are more or less anticipated, especially in project that involve several subcontractors and poorly defined scopes"
B	"Payment delays are common, sometimes up to two (2) months, especially in public sector jobs where red tapes slow down everything"
C	"Payment delays are common and they not only happen due to client's failure to pay on time but sometimes are as a result of sluggishness by consultants in confirming work progress hence, delaying the entire process"
D	"Payment delays happen are mostly due to poor Variation Order documentation which creates a lot of headaches as delays can range from weeks to months"
E	"Delayed payments are common and when they happen, it creates a chain reaction to the subcontractors because when the main contractor does not receive their payments, they usually fail to pay the subcontractors hence they suffer the consequences too."
F	"Payment delays are common and despite multiple reminders, it can still take like forever to get the disbursement. The weak enforcement of payment terms despite them being well stipulated in the contract is among reason for this scenario"

*R: Respondent

Awareness and Familiarity with Blockchain Technology

Table 2 presents the awareness and familiarity of respondents on Blockchain Technology (BT) and findings reveal that limited awareness does exist with many recognizing its association with notions such as the Bitcoin, decentralization, transparency and safe transaction record. Nevertheless, their familiarity was mostly shallow and lacked knowledge on how it can be practically applied within the construction industry. Some of them have encountered or got exposed to BT to a certain extend via seminars and discussions, but they were mostly surface level and lacked proper experience on its real-world implementation in projects hence, the concept remains an unfamiliar one which can be tracked back to the lack of exposure, training and practical application within the Malaysian construction industry.

Table 2: Awareness and Familiarity with Blockchain Technology

R	Responses
A	"I do realize that decentralization and transparency is somewhat connected to blockchain technology, but I have yet to experience on how it could be applied in my projects"
B	"To be honest, whenever I hear about blockchain technology, I relate it to the Bitcoin, but I have never imagined its applicability in project management"
C	"I have spoken about blockchain technology in meetings but so far, nothing practical has developed yet"

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

D	"I know that safe ledger which used to trace transactions is somewhat related to blockchain technology but that is about as much as I know"
E	"I have heard about blockchain during a seminar, mainly in the context of fintech, but I never knew about its applicability in construction"
F	"I have heard about blockchain during a seminar, mainly in the context of fintech, but I never knew about its applicability in construction"

*R: Respondent

Current Adoption Status of Blockchain Technology

Table 3 presents the current adoption status of blockchain technology (BT). Overall, the technology adoption in construction industry remains at preliminary stage whereby none of the respondents indicated any form of actual implementation or trial in projects. The digital maturity of the industry was viewed as inadequate to support BT implementation, hence, conservative practices such as the use of spreadsheets, PDFs and cloud platforms remain dominant. Among hindering factors highlighted by respondents were the lack of proven applications in real-life projects, poor infrastructure readiness and doubts over the return on investment.

Table 3: Current Adoption Status of Blockchain Technology

R	Responses
A	"Awareness exists at top levels but so far, there is no intentions to implement it yet, even on the trial basis"
B	"The management does not oppose to the idea, but they are just being careful. They prefer to invest in the technology once they have seen proven results"
C	"The potential of blockchain technology can be seen but no one is willing to give it a try especially when existing practices are doing its job"
D	"We are still comfortable with using PDFs and Excel sheets. As of now, the blockchain technology appears to be a very distant reality"
E	"As of now, we are just starting to familiarize our team with using the cloud platforms correctly. Blockchain technology seems too sophisticated at this point"
F	"Currently, most contractors that deal with us can hardly cope with using the shared folder system let alone the blockchain technology. As of now, there is a lack of infrastructure to adopt blockchain technology"

*R: Respondent

Perceive Readiness of the Industry to adopt Blockchain Technology

Table 4 presents the perceived readiness among respondents to adopt blockchain technology (BT). Findings suggest that despite emerging interest in the concept, the industry is still hesitant and not fully ready to adopt blockchain technology since for the most part, companies lack digital maturity, knowledge and supporting infrastructure. There was also prevalence of the resistance to change towards contemporary technological practices (i.e., blockchain technology) amongst the industry players, especially the small and medium-sized enterprises (SMEs) which often struggle even with basic digital tools. Beyond that, successful BT implementation requires a shift in industry practices towards being more collaborative, developing mutual trust as well as the willingness of all parties to embrace the change. The local industry is still largely conventional in

mindset and perceive technology more of an added overhead rather than an investment for future, making adoption even harder. For that, some of them believe that stronger institutional support such as government initiatives, industry guidelines and focused training can boost acceptance of BT among the industry players.

Table 4: Perceive Readiness of the Industry to adopt Blockchain Technology

R	Responses
A	"It depends on the company size. Some larger enterprises may be more prepared for blockchain technology, but SMEs are generally still far behind with most of them hardly even have proper digital payment systems"
B	"The knowledge gap is too big even in organizations that embrace digital change. Most workforce require retraining to adapt with modern technologies such as blockchain"
C	"We are still making baby steps, and the ecosystem is simply not there yet. Blockchain technology involves cooperation and trust, which we are lacking"
D	"Readiness requires not only capability but also willingness to adopt change. Many companies still regard blockchain technology as an expenditure rather than an investment"
E	"The industry remains a conservative one. Many contractors lack confidence in technologies that challenge their usual working methods"
F	"Real change towards blockchain technology is unlikely unless there are proper guidelines or a serious push by the government on the industry."

*R: Respondent

Potential Benefits of Blockchain Technology in Improving Payment Delays

Table 5 presents the respondents' perception on the potential benefits of blockchain technology (BT) in improving payment delays in projects whereby most of them portray strong optimism on its significant potential to better project payment processes. This technology is seen as having the potential to improve payment efficiency thanks to the loads of positive features within blockchain such as better transparency and traceability of transactions, improved trust among project stakeholders, automated payment mechanisms via smart contracts as well as expedited document verification processes. Secure transaction records also minimize payment disputes which can result in better accountability and collaboration between project team. Automated payment mechanism via BT also was seen as an instrument to simplify payment procedures, reduce bureaucracies and deceitful activities. As payment mechanism improves, sub-contractors also get to enjoy the benefit via fairer and timelier payment practices throughout the supply chain thereby protecting their cash flow in projects.

Table 5: Potential Benefits of Blockchain Technology in Improving Payment Delays

R	Responses
A	"As systems becomes more transparent, trust will also increase hence, leading to better collaboration among contractors"
B	"Through Smart Contracts, we could automate milestone payment processes, thereby preventing disputes among project stakeholders"
C	"The ability of blockchain technology to verify document authenticity in matter of seconds would be very valuable and would improve efficiency by minimizing repeated communication between project parties"

D	"The biggest winner if blockchain technology were to be implemented are the subcontractors because payment delays usually affect them a lot hence, this would promote a fairer distribution of payment processes among project parties"
E	"Use of blockchain technology in processing payments allows tracking of every transaction and change thereby improving accountability and reducing blame-games"
F	"Presently, payment procedures involve excessive bureaucracies. Therefore, blockchain technology could assist in streamlining these processes and consequently reduce risk fraudulent activities"

*R: Respondent

DISCUSSION

Findings reveal that payment delays are indeed a recurring scenario in Malaysian construction industry thereby coinciding with few past observations such as by Judi & Rashid (2010), Badroldin et al. (2016), and Riazi et al., (2019) on the commonness and recurrence of the problem Malaysian construction industry. In fact, issues with untimely payments have been highlighted back since year 2005 via a survey conducted by the Master Builders Association of Malaysia among contractors and sub-contractors with approximately 80.30% of them claiming to have faced some sort of delayed payment (MBAM, 2005). These payment delays were found to stem from multiple interconnected issues such as unclear project scope, excessive bureaucracies, late/slow approvals and progress verification as well as poor variation order management all which points towards project management inefficiencies. Other than that, findings also revealed that delayed payments can extend from weeks to months which was also found to be consistent with several past studies such as the ones by MBAM (2005) which found that contractors have been suffering payments delays up to 12 months from the actual date they are supposed to get paid while Badroldin et al. (2016) asserted that while payment terms are usually within 20 to 90 days but typically they take between 26 to 110 days, meaning that the delays range from 6 to 43 days.

Despite some awareness of blockchain technology (BT), findings suggest that they are still in the infancy stage. Respondents managed to associate BT with some concepts such as Bitcoin, decentralization, transparency and safe transaction records however, their familiarity and knowledge on how this technology could be practically applied in the real-world remained limited. This is consistent with findings by Kiu et al. (2025) that Malaysian construction industry practitioners are relatively low in their awareness on using BT in their practices. Similarly, Li & Kassem (2021) also pointed out the shallow familiarity of this technology among construction industry due to lacking in knowledge and hands-on applications while Li et al. (2019) also discovered that despite BT gaining global interest, industry practitioners are somewhat lost on putting it into practice. A recent study by Nasir et al. (2024) also emphasized on the low digital tech awareness in Malaysian construction industry; hence, further supporting this study findings. The construction industry has already been subject of criticism for being slow in innovation and technology adoption (see Xu et al., 2023) and the lack of engagement with BT further hampers the prospects for innovation towards enhanced efficiency within the industry (Kiu et al., 2025). Further to that, it was also found in this study that some small-scale exposure to BT has happened in the Malaysia construction industry mainly via seminars and discussion however, outcomes were underwhelming due to limited exposure, training and practical applications. This was evident where issues related to awareness and high trainings costs have been cited as a among the major hurdles for digital transformation in Malaysia (see Nasir et al., 2024) as well as limited discussions and initiatives related to BT (see Kiu et al., 2025).

Regarding the current adoption status of BT, outcomes revealed that as of now, adoption in Malaysian construction industry is still at a preliminary stage whereby proper implementation on projects are a rare sight, not even in trial project. This concurs with finding by Kiu et al. (2025) who discovered that the Malaysian BT adoption rate has been lower than expected despite its well documented benefits while Mohamad et al. (2024) also criticized the Malaysian construction industry as being very slow in up taking advanced technologies. Domination of manual and paper-based approaches further hinders the integration of efficient digital solutions (Wu et al., 2022; Zilin et al., 2023), all of which coincides with findings from this study that the digital maturity within the industry has been relatively low with conventional practice dominating day-to-day practices, hence,

making BT implementation harder. However, the reality that exposed from the findings was that the local practitioners lack proven BT applications on real-life projects, which tracks back to the minimal uptake of BT itself (see Mohamad et al., 2024; Kiu et al., 2025) hence, there are not many project cases to refer to, further creating doubts over rates of return - another hindering factor identified in this study. The high cost to uptake digital technologies in Malaysia has been regarded as a noteworthy barrier (see Nasir et al., 2024) thereby creating a "wait and see" trend among local companies with not many willing to initiate BT uptake and are happier to wait for proven successful models before deciding to invest. Beyond that, infrastructure readiness was also another impeding factor to BT adoption; which could be tracked back to the exorbitant capital required to invest in digital infrastructure (see lei et al., 2023).

Other than that, this study also found that there was emerging interest among the Malaysian construction industry players to adopt BT however, on the bigger picture, most players still lack readiness. Although respondents recognize the values offered by BT, uptake is still poor due to lack of knowledge, infrastructure and digital maturity which indicates that BT readiness depends on more than having the technology available, but organizations must also be capable and willing to embrace transformation. Among issues identified was that there was resistance to change towards contemporary technological practices (i.e., blockchain technology) and this coincided with Riazi et al. (2020)'s claim on lack of receptive to modern and revolutionary practices in Malaysian construction industry. The local construction industry was largely old-fashioned in mindset where people tend to perceive technology more of an added cost, instead of a long-term investment, further hindering effective BT adoption. On the other hand, similar trend was also seen in an Indian study by Singh et al. (2023) where one of the main barriers to effective uptake was the resistance to BT among clients.

Another key barrier to industry readiness was the cost associated with BT implementation which seems to be reinforced by a mentality that is not willing to embrace change. This can be seen based upon Respondent D statement that "readiness requires not only capability but also willingness to adopt change", reflecting that companies tend to view the cost of BT uptake as more of an overhead rather than an investment for better future. The challenge of investment has also been mentioned by Hrouga et al. (2022) as among critical hurdles to BT adoption in sustainable construction projects and according to Singh et al. (2023), larger investments in BT would accommodate effective development and adoption of the technology in construction industry. Another particular finding was that the fragmented nature of the industry also pose challenge to effective BT uptake as emphasized by Respondent C that the industry is still taking "baby steps" towards digital revolution as a result of lacking cooperation and trust among industry participants. Considering the importance of transparency and collaboration in successful blockchain implementation, the industry fragmentation adds difficulty for implementation hence supporting Hussain et al., (2020)'s assertation that poor inter-organizational teamwork and internal fragmentation as a hinderance to digital transformation in Malaysian construction industry. Beyond that, this study also found problems related to the knowledge and skill gap among industry practitioners whereby according to Respondent B, even when the organization supports embracing digital change, retraining of employees is necessary. Past research has supported the importance of training for effective implementation of digital technologies (see Nasir et al., 2024).

According to Nanayakkara et al. (2021a), BT has the potential to overcome payment-related challenges within the project supply chains. Similarly, results also indicated positive perception with regard to the potential for BT to improvise payment processes and timeliness due to the numerous positive features within the technology which could assists in addressing typical problems associated with delayed payments in Malaysian construction projects. Results accentuated that transparent and undisputable records via BT could lead to better trust among project parties by providing reliable transaction track records. This was supported by Perera et al. (2020) who claimed that blockchain-based payment mechanism allows for a more automated, transparent and real-time payment processing; thereby improving document traceability, integrity and transparency (see Dal Mas et al., 2023) as well as enhancing certainty and fiscal flow monitoring (Li et al., 2019). The use of smart contracts has also been appreciated for its efficient dispute resolution qualities and ability to boost level of trust among stakeholders (Singh et al., 2023). Furthermore, according to Respondent A, improved transparency enhances collaboration which is consistent with Turk & Klinc (2017)'s claim that improved collaboration is achievable via BT because it makes available a shared and trusted platform. BT has also been characterized as a promising technology to improve transparency, information exchange, and contractual process (Li et al., 2019), payment coordination (Dakhli et al., 2019), as well as timelier sub-contractors' payment (Hamledari & Fischer, 2021).

Smart contracts have the potential to streamline administrative tasks and improve payment efficiency in construction (Shojaei et al., 2019) which is in line with the study findings. Furthermore, payment issues are known to cause problems for the main contractor to pay their sub-contractors properly (see Riazi et al., 2019) and for sub-contractors, being the most vulnerable party among all parties (Singh et al., 2023), they will greatly benefit from improved payment mechanism and timeliness. This corresponds with the study findings that sub-contractors will be the one of the major beneficiaries of an improved payment transparency as it allows for fairer and more stable cash flow. Finally, findings also reveal the importance of government support, industry guidelines and training to support BT uptake; also consistent with Mazlan et al. (2025) on the importance of education, policy backing, and collaboration to support effective BT espousal in Malaysia. Singh et al. (2023) also highlighted the necessity for governments to develop suitable regulations to govern proper BT adoption.

CONCLUSION

This study looked into the adoption of blockchain technology (BT) and its potential to improve payment delays in the Malaysian construction industry. Based upon six (6) expert interviews involving practicing quantity surveyors with a minimum of five (5) years of continuous experience, the prevalence of payment delays, industry awareness on BT, current adoption status, industry readiness as well as the potential of BT to improve payment timeliness were scrutinized. Considering that quantity surveyors are the main party involved in project payment processes in Malaysia, they therefore pose relevant knowledge and practical industry experience to deliver meaningful and valid responses.

Overall, it was evident that delayed payments are prevalent incidence in the Malaysian construction industry mainly due to issues such as unclear scopes, unnecessary bureaucracies, as well as poor practices related to variation orders, approvals and progress verifications. These delays, which range from weeks to months, were also more dominant in projects involving complex contracts as well as government projects with length procedures. Regarding BT, despite promising potential and proven benefits, it remained not very common in the local industry. Even though few practitioners have encountered BT via seminars and discussions, awareness-wise, they were generally quite shallow and mostly at the surface level leading to limited actual implementations. The lack of digital maturity, combined with the absence of real-life applications, proper infrastructure and ROI projections further contributes to the hesitance of the industry to aggressively adopt BT. On top of that, there was also prevalence of resistance to change towards contemporary technological practices (i.e., blockchain technology) with many SME's still struggling even with the simplest digital tools. Domination of conventional practices combined with backward mindsets makes diffusion of BT rather an uphill task. Nevertheless, the was light at the end of the tunnel with portrayal of strong optimism on the importance and significance of BT to improve payment mechanism in the industry. Results showed that automated payment mechanism via BT was perceived as an important approach to simplify payment procedures, secure transaction records, minimize bureaucracies, and reduce deceitful activities thereby minimizing payment disputes, increase trusts, accountability and collaboration between project teams.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the support of University Sains Malaysia, Short-Term Grant with reference/grant code: #2025/28/ST5592 and account number: R501-LR-RND002-0000000097-0000.

REFERENCES

1. Abeysekera, V. (2012). A conceptual framework for client financed construction and non-traditional approaches for financing construction work. In S. Senaratne & Y. G. Sandanayake (Eds.), Global Challenges in Construction Industry: Proceedings of the World Construction Symposium 2012 (pp. 42–49). Ceylon Institute of Builders.
2. Al-Ashmori, Y. Y., Othman, I., & Al-Aidrous, A. H. M. (2022). "Values, challenges, and critical success factors" of building information modelling (BIM) in Malaysia: experts perspective. Sustainability, 14(6), 3192.
3. Alreck, P. L., & Settle, R. B. (2004). The Survey Research Handbook: Guidelines and Strategies for Conducting a Survey (3rd ed.). McGraw-Hill.

4. Ameer Ali, N. A. N. (2006). A "Construction Industry Payment and Adjudication Act": Reducing payment default and increasing dispute resolution efficiency in construction. Masters Builders, 3, 4-14.
5. Badroldin, M. K. A. M., Hamid, A. R. A., Raman, S. A., Zakaria, R., & Mohandes, S. R. (2016). Late payment practices in the Malaysian construction industry. Malaysian Journal of Civil Engineering, 28.
6. Behera, P., Mohanty, R. P., & Prakash, A. (2015). Understanding construction supply chain management. Production Planning & Control, 26(16), 1332-1350.
7. Berliner, D. C. (2004). Describing the behavior and documenting the accomplishments of expert teachers. Bulletin of science, technology & society, 24(3), 200-212.
8. Bryman, A. (2016). Social research methods. Oxford university press.
9. Celik, B. G., Abraham, Y. S., & Attaran, M. (2024). Unlocking blockchain in construction: A systematic review of applications and barriers. Buildings, 14(6), 1600.
10. Chein, I. (1981). Appendix: An introduction to sampling. Selltiz, Wrightsman & Cook's research methods in social relations, 4, 418-441.
11. Chia, F. C., Ong, J. K. K., & Yong, F. Y. Y. (2020). Readiness and acceptance of blockchain technology in the Malaysian construction industry. In 26TH Annual Pacific Rim Real Estate Society Conference, Canberra, Australia, 19th–22nd January.
12. Construction Industry Development Board Malaysia. (2020). Construction 4.0 strategic plan 2021–2025.
13. Construction Industry Development Board Malaysia. (2022, March 31). The adoption of technology in the construction industry. https://www.cidb.gov.my/eng/the-adoption-of-technology-in-the-construction-industry/
14. Dainty, A. R., Millett, S. J., & Briscoe, G. H. (2001). New perspectives on construction supply chain integration. Supply chain management: An international journal, 6(4), 163-173.
15. Dakhli, Z., Lafhaj, Z., & Mossman, A. (2019). The potential of blockchain in building construction. Buildings, 9(4), 77.
16. Dal Mas, F., Massaro, M., Ndou, V., & Raguseo, E. (2023). Blockchain technologies for sustainability in the agrifood sector: A literature review of academic research and business perspectives. Technological Forecasting and Social Change, 187, 122155.
17. Danuri, M. M., Munaaim, M. C., Rahman, H. A., & Hanid, M. (2006, November). Late and non-payment issues in the Malaysian Construction Industry-Contractor's perspective. In International Conference on Construction, Culture, Innovation and Management (CCIM) (pp. 26-29).
18. Delbecq, A.L., Van de Ven, A.H. and Gustafson, D.H. (1975) Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes. Scott, Foresman Glenview.
19. Department of Statistics Malaysia. (2025). Gross domestic product by economic activity, Malaysia. https://www.dosm.gov.my/
20. Din, N. M. D. N., & Ismail, Z. (2014). Construction industry payment and adjudication act (CIPAA) remedying Payment Issues: CIDB G7 contractor's perspective. Journal of Technology Management and Business, 1(1).
21. Dzulkalnine, N. (2015). An analysis on causes, impact and strategies of payment among contractors in Malaysian construction industry (Doctoral dissertation, Master's thesis, Faculty of Business and Economics, Universiti Pendidikan Sultan Idris).
22. Fellows, R. F., & Liu, A. M. (2021). Research methods for construction. John Wiley & Sons.'
23. Hallowell, M. R., & Gambatese, J. A. (2010). Qualitative research: Application of the Delphi method to CEM research. Journal of construction engineering and management, 136(1), 99-107.
24. Hamid, A. A. A., Mokhtar, A. F., Soh, C. S. C., & Abidin, N. I. Z. (2021). Malaysia–25 years of construction industry progress 1995–2019.
25. Hamledari, H., & Fischer, M. (2021). Construction payment automation using blockchain-enabled smart contracts and robotic reality capture technologies. Automation in Construction, 132, 103926.
26. Hijazi, A. A., Perera, S., Alashwal, A., & Calheiros, R. N. (2019, June). Blockchain adoption in construction supply chain: A review of studies across multiple sectors. In CIB World Building Congress, Hong Kong (Vol. 2021).
27. Hrouga, M., Sbihi, A., & Chavallard, M. (2022). The potentials of combining Blockchain technology and Internet of Things for digital reverse supply chain: A case study. Journal of Cleaner Production, 337, 130609.

28. Hussain, A. H., Alam, M. R. A., Eni, S., Ani, A. I. C., & Roslan, A. F. (2020). Assessing the organisations decision for digital transformation through BIM implementation in Malaysia. MCRJ Spec, (2020), 11.
29. Ismail, I., Memon, A. H., & Rahman, I. A. (2013). Expert opinion on risk level for factors affecting time and cost overrun along the project lifecycle in Malaysian construction projects. International Journal of Construction Technology and Management, 1(2), 2289.
30. Jasimin, T. H., Ali, H. M., Razali, M. N. M., & Daud, S. M. (2023). Potential opportunities of blockchain technology in streamlining the Malaysian commercial office building operation management process. PLANNING MALAYSIA, 21.
31. Judi, S. S., & Rashid, R. A. (2010). Contractor's right of action for late or non-payment by the employer. Journal of Surveying, Construction and Property, 1(1).
32. Kiu, M. S., Chau, K. Y., Wong, P. F., Ramayah, T., & Yap, J. B. H. (2025, October). Blockchain adoption in construction supply chains: Drivers, barriers and strategies. In IOP Conference Series: Earth and Environmental Science (Vol. 1548, No. 1, p. 012009). IOP Publishing.
33. Lei, J., Indiran, L., & Haiyat Abdul Kohar, U. (2023). Barriers to digital transformation among MSME in tourism industry: cases studies from Bali. International Journal of Academic Research in Business and Social Sciences, 13(3), 844-858.
34. Lewis, R., McPartland, J., & Ranjan, R. (2017). Blockchain and financial market innovation. Economic Perspectives, 41(7), 1-17.
35. Li, J., & Kassem, M. (2021). Applications of distributed ledger technology (DLT) and Blockchain-enabled smart contracts in construction. Automation in construction, 132, 103955.
36. Li, J., Greenwood, D., & Kassem, M. (2019). Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases. Automation in construction, 102, 288-307.
37. Lim, S. J. (2021). A Study on the Implementation of Construction Industry Payment and Adjudication Act 2012 (CIPAA) and Its Challenges (Doctoral dissertation, Tunku Abdul Rahman University College).
38. Martinovic, I., Kello, L., & Sluganovic, I. (2017). Blockchains for governmental services: Design principles, applications, and case studies. Center for Technology and Global Affairs, University of Oxford.
39. Master Builders Association Malaysia. (2005). Quarterly survey on progress payment issue in the construction industry: 3rd quarter 2005.
40. Mazlan, N. N., Xin, C. W., Mustafa, M. H., Mahdzir, M., & Danuri, M. S. M. (2025). Exploring the challenges in implementing blockchain technology in contract management for quantity surveying profession in Malaysian construction industry. Planning Malaysia, 23.
41. Mehdi Riazi, S. R. (2014). The use of supply chain management to reduce delays as result of pre-construction deficiencies in Malaysian public sector construction projects (Doctoral dissertation, Queensland University of Technology).
42. Mohamad, Z., Omar, K. A., & Mustafar, N. S. (2024). Smart construction: The next paradigm for Malaysia construction industry. https://smart.cidb.gov.my/article/smart-construction-the-next-paradigm-for-malaysia-construction-industry-390
43. Mohd Nawi, M. N., Mydin, M. A. O., Nursal, A. T., & Abdul Nifa, F. A. (2015). Payment issues in Malaysia industrialised building system (IBS): literature visit. Advances in Environmental Biology (AEB), 9(4), 185-188.
44. Nanayakkara, S., Perera, S., & Senaratne, S. (2019, June). Stakeholders' perspective on blockchain and smart contracts solutions for construction supply chains. In CIB World Building Congress (pp. 17-21).
45. Nanayakkara, S., Perera, S., Senaratne, S., Weerasuriya, G. T., & Bandara, H. M. N. D. (2021a, May). Blockchain and smart contracts: A solution for payment issues in construction supply chains. In Informatics (Vol. 8, No. 2, p. 36). MDPI.
46. Nanayakkara, S., Rodrigo, M. N. N., Perera, S., Weerasuriya, G. T., & Hijazi, A. A. (2021b). A methodology for selection of a Blockchain platform to develop an enterprise system. Journal of Industrial Information Integration, 23, 100215.
47. Nasir, S. R. M., Sahidi, N. A. M., & Hasim, S. (2024, December). Digital Transformation Barriers in the Malaysian Construction Industry: Staff Competency, and Company Initiatives. In International Conference on Innovation & Entrepreneurship in Computing, Engineering & Science Education (InvENT 2024) (pp. 109-118). Atlantis Press.

48. Nawari, N. O., & Ravindran, S. (2019). Blockchain technology and BIM process: Review and potential applications. Journal of Information Technology in Construction, 24.
49. Nekooie, M. I. M. M. A., & Kamaruddin, N. B. C. (2012). The Adequacy of Contractual Provisions in Managing Construction Failure in Malaysia. litigation, 4(1).
50. Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. Information & management, 42(1), 15-29.
51. Othman, I., Al-Ashmori, Y. Y., Rahmawati, Y., Amran, Y. M., & Al-Bared, M. A. M. (2021). The level of building information modelling (BIM) implementation in Malaysia. Ain Shams Engineering Journal, 12(1), 455-463.
52. Patton, M. Q. (2014). Qualitative research & evaluation methods: Integrating theory and practice. Sage publications.
53. Perera, S., Nanayakkara, S., Rodrigo, M. N. N., Senaratne, S., & Weinand, R. (2020). Blockchain technology: Is it hype or real in the construction industry?. Journal of industrial information integration, 17, 100125.
54. Persons, T. M. (2019, September). Science & tech spotlight: Blockchain & distributed ledger technologies. U.S. Government Accountability Office. https://www.gao.gov/assets/gao-19-704sp.pdf
55. Pill, J. (1971). The Delphi method: substance, context, a critique and an annotated bibliography. Socio-economic planning sciences, 5(1), 57-71.
56. Ramachandra, T., & Rotimi, J. O. (2011). The nature of payment problems in the New Zealand construction industry. Australasian Journal of Construction Economics and Building, The, 11(2), 22-33.
57. Ramachandra, T., & Rotimi, J. O. B. (2015). Mitigating payment problems in the construction industry through analysis of construction payment disputes. Journal of legal affairs and dispute resolution in engineering and construction, 7(1), A4514005.
58. Riazi, S. R. M., & Nawi, M. N. M. (2018). Project delays in the Malaysian public sector: Causes, pathogens and the supply chain management approach. International Journal of Technology, 9(8).
59. Riazi, S. R. M., Ismail, R., Nawi, M. N. M., Shaharizan, M. F., Yunus, R., & Alhawatmeh, O. S. (2019). Payment issues in industrialized building system (IBS) projects in Malaysia: Towards a better approach. Int. J. Supply Chain. Manag, 8, 644-650.
60. Riazi, S. R. M., Nawi, M. N. M., & Yaziz, M. F. A. (2020). Developing a holistic project time management framework utilizing fundamental supply chain management (SCM) tools to overcome delay in Malaysian public sector building projects. International Journal of Sustainable Construction Engineering and Technology, 11(1), 31-41.
61. Rodrigo, M. N. N., Perera, S., Senaratne, S., & Jin, X. (2020). Potential application of blockchain technology for embodied carbon estimating in construction supply chains. Buildings, 10(8), 140.
62. Rodrigues, B., Bocek, T., & Stiller, B. (2018). The use of blockchains: Application-driven analysis of applicability. In Advances in Computers (Vol. 111, pp. 163-198). Elsevier.
63. Salleh, R. M., Mustaffa, N. E., & Rahiman, N. A. (2020). The adoption of building information modelling and intelligent contract to payment process in Malaysian conventional contract. Journal of Computational and Theoretical Nanoscience, 17(2-3), 1378-1387.
64. Shojaei, A., Flood, I., Moud, H. I., Hatami, M., & Zhang, X. (2019, October). An implementation of smart contracts by integrating BIM and blockchain. In Proceedings of the Future Technologies Conference (pp. 519-527). Cham: Springer International Publishing.
65. Shojaei, A., Ketabi, R., Razkenari, M., Hakim, H., & Wang, J. (2021). Enabling a circular economy in the built environment sector through blockchain technology. Journal of Cleaner Production, 294, 126352.
66. Singh, A. K., Kumar, V. P., Dehdasht, G., Mohandes, S. R., Manu, P., & Rahimian, F. P. (2023). Investigating the barriers to the adoption of blockchain technology in sustainable construction projects. Journal of cleaner production, 403, 136840.
67. Sonmez, R., Ahmadisheykhsarmast, S., & Güngör, A. A. (2022). BIM integrated smart contract for construction project progress payment administration. Automation in Construction, 139, 104294.
68. Turk, Ž., & Klinc, R. (2017). Potentials of blockchain technology for construction management. Procedia engineering, 196, 638-645.
69. Waqar, A., Qureshi, A. H., & Alaloul, W. S. (2023). Barriers to building information modeling (BIM) deployment in small construction projects: Malaysian construction industry. Sustainability, 15(3), 2477.
70. Werbach, K., & Cornell, N. (2017). Contracts ex machina. Duke law journal, 313-382.

71. Wu, H., Zhang, P., Li, H., Zhong, B., Fung, I. W., & Lee, Y. Y. R. (2022). Blockchain technology in the construction industry: Current status, challenges, and future directions. Journal of construction engineering and management, 148(10), 03122007.
72. Xu, Y., Chong, H. Y., & Chi, M. (2023). Modelling the blockchain adoption barriers in the AEC industry. Engineering, Construction and Architectural Management, 30(1), 125-153.
73. Zhang, P., Schmidt, D. C., White, J., & Lenz, G. (2018). Blockchain technology use cases in healthcare. In Advances in computers (Vol. 111, pp. 1-41). Elsevier.
74. Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M. (2020). An overview on smart contracts: Challenges, advances and platforms. Future Generation Computer Systems, 105, 475-491.
75. Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. International journal of web and grid services, 14(4), 352-375.
76. Zilin, Z., Jing, K. T., Yee, H. C., Zihao, D., & Yao, L. (2023). Blockchain technology in construction supply chain management: enhance transaction speed, cost effectiveness and security. Journal of advanced research in applied sciences and engineering technology, 32(3), 400-420.
77. Zuki, W. N. N. N. W., Sarpin, N., & Masrom, M. A. N. (2020). Strategi bagi Meningkatkan Penggunaan 'Construction Industry Payment & Adjudication Act'(CIPAA) dalam Industri Pembinaan. Research in Management of Technology and Business, 1(1), 514-527.