

BUILDING TOMORROW: SHAPING THE FUTURE OF CONSTRUCTION THROUGH THE ADOPTION OF DIGITAL TECHNOLOGIES

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ABSTRACT

Digital technology is fundamentally reshaping the construction industry, revolutionizing how projects are conceived, planned, and executed. The application of technology in the construction sector typically results in a great deal that is advantageous. However, construction business owners have been hesitant to adopt digital technologies which have been proven in other industries as being effective instruments for improving working efficiency in managing construction works. Therefore, this research aims to determine the appropriate strategy to foster the adoption of digital technologies in construction projects. The quantitative research approach using questionnaire survey was adopted to align with the research aim and objectives. A random sampling technique was chosen with response rate of 41% (107) of respondents that willing to participate for this research. The data was analysed using the Statistical Package for Social Science (SPSS) version 25 quantitative software. To empower the use of digital technology in construction projects, this research enables policymakers, industry leaders, and researchers with insights to devise effective strategies to improve construction project performance. The results revealed that there are five (5) key strategies that are most commonly agreed upon when it comes to promoting the adoption of digital technologies in construction projects. The findings of this research might benefit practitioners in promoting the



adoption of digital technology in construction project practices so as to achieve high project performance and project sustainability.

Keywords: *Digital Technologies, Construction Projects, Strategies*

INTRODUCTION

Digital technology has recently seen an increase in adoption and application to processes such as industrial systems and daily human activities. The application of technology in building construction usually produces many benefits. Nevertheless, there is no denying that the development of this technology will gradually permeate the daily lives of people to progressively create a good atmosphere for development. Accordingly, in the next four quarters, the construction industry in Malaysia is expected to witness consistent growth. In addition, this rapid growth can be attributed to several factors including the fact that the Malaysian government has budgeted a large amount of money allocated for infrastructure projects. Therefore, the use of digital technology is essential to ensure that the construction sector can develop well and maintain high performance.. These digital technologies encompass a wide range of advances, from computing systems and software applications to connectivity solutions and new sectors such as artificial intelligence and the Internet of Things. This digital technology can also create ideal conditions for work to be completed across time, distance, and function (Massa et al., 2023).

Digital innovation has driven a profound metamorphosis in the construction project, once perceived as slow to adopt technological advancements. The construction sector of the twenty-first century, on the other hand, is no longer hardware-driven, instead involving integration of hardware, software, and humans, made possible by complex advancements in information and communication technology and Internet connectivity (Olatunde et al., 2023). This revolution has gone beyond simple tools and processes, radically changing the way we conceptualize, design, execute, and maintain projects.. This is shown in contrast to many other industries that are adopting innovation to optimise efficiencies and enhance productivity; the construction industry is still far behind in implementing digital technologies. Furthermore, conventional approaches and procedures

are still widely used, which contributes to extending project schedules, higher project costs, and inefficiencies that may be avoided by incorporating cutting-edge technologies. It is agreed by Ikuabe et al. (2020) who mentioned that industries such as manufacturing, banking, health, and medical have all adopted various approaches to digital implementation of technology; nonetheless, the construction industry remains substantially behind.

Moreover, digital technology integration has sped up innovation while promoting more intelligent, more sustainable practices in addition to improving traditional construction procedures. Digital tools enable off-site manufacture and assembly through prefabrication and modular design, which minimize waste, save costs, and shorten project completion times. Sustainable materials and energy-efficient designs are increasingly being implemented, connecting the industry with global sustainability goals and reducing its environmental imprint.

Besides, the incorporation of emerging technologies as well as digitalization in the building and construction industry is anticipated to lead to increases in both productivity and efficiency. Moreover, one of the primary advantages that digital technologies bring to the construction industry is the availability of data in real-time. By utilizing digital instruments such as sensors, drones, and other tools. The data on the progress of the construction project can be gathered and analysed in real-time by construction crews. It also enables the project teams to discover difficulties and promptly address them, which in turn reduces delays and improves the outcomes of the project. For instance, if a construction team discovers a problem with the quality of the materials that are being utilized on a project, it will enable them to swiftly take action to rectify the problem before it causes further complications. However, this digital revolution does not come without its drawbacks. The labor needs to be upskilled so that the industry can employ these technologies effectively. We also need to address barriers such as worries about data security, interoperability between various software systems, and early investment expenditures.

Although there are many benefits that the construction industry can gain from this digitization technology. However, there are still contractors or clients who stick to the old approach, where they believe it will bring more advantages than disadvantages. According to Warrick, (2022), whenever a

change occurs, one-third of the people concerned will support the change, one-third will be skeptical and seek more information about the change, and one-third will oppose the change. Construction companies that resist change will also affect the workers they hire. This is also supported by many scholars who are beginning to realize that organizations and the way they operate can have a significant influence on resistance to change (Warrick, 2022). Despite the many benefits that the construction industry can gain from this digitization technology, however, there are still many contractors or clients who still stick to the conventional approach, where they believe it will bring more advantages than disadvantages. According to Warrick, (2022), whenever a change occurs, one-third of the people concerned will support the change, one-third will be skeptical and seek more information about the change, and one-third will oppose the change. Therefore, to ensure that all construction participants can effectively manage the project using digital technology, it is crucial to implement an appropriate strategy that promotes the use of digital technology in construction projects.

KEY STRATEGIES IN PROMOTING THE ADOPTION OF DIGITAL TECHNOLOGIES IN CONSTRUCTION PROJECT

Encouraging the construction sector to embrace digital technology initiates a revolutionary change that will completely transform the way projects are planned, constructed, and executed (Yang, 2023). According to Yang (2023) begin with, digital technologies improve accuracy and efficiency. For example, Building Information Modelling (BIM) and virtual reality simulations enable stakeholders to see projects in their entirety, reducing design and construction mistakes and saving money and time (Adam et al., 2022). These instruments' exceptional accuracy primarily minimizes rework, maximizing resource allocation and promoting sustainable practices. The incorporation of digital technology encourages collaboration between many parties. According to Manley and Chen, (2015), real-time project data sharing is made possible by cloud-based systems, which facilitates smooth communication between clients, contractors, engineers, and architects.

In addition, the adoption of digital technology is very important and has benefits for the industry players. For instance, the implementation of digital technology improves the safety requirements in the construction

industry (Trask & Linderoth, 2023). Drones equipped with high-resolution cameras and sensors are able to survey construction sites to identify any risks and make sure safety procedures are followed.

IoT sensors and wearable technology have the capability to monitor the health and safety of employees, thereby mitigating hazards and improving the overall conditions of the labor site. In simple terms, promoting the use of digital technologies in the construction sector represents far more than simply an advancement in technology; it's about an entirely new approach that improves productivity, encourages teamwork, puts safety first, satisfies changing social demands, and guarantees sustainability and long-term competitiveness. This forward-thinking strategy not only enhances existing procedures but also clears the path for a construction industry that is more creative, resilient, and integrated. Table 1 presents the key strategies to foster the adoption of digital technologies in construction projects.

Table 1. Key Strategy to Foster the Adoption of Digital Technologies in Construction Project

No	Statement/Variables	Authors	Frequency
1	Provide Training and Skilled Development Initiatives	Ebekozien & Samsurijan (2022a), Shojaei et al., (2023b)	2
2	Collaboration with High Technologies Experience Companies	Ebekozien & Samsurijan (2022a), Oke et al., (2023)	2
3	Establish Regulatory Support and Standards	Ebekozien & Samsurijan, (2022a), Zhang et al., 2023, Finn, (2011a).	3
4	Government Incentives to Construction Project Participants	Ebekozien & Samsurijan (2022a), Oke et al., (2023)	2
5	Build a platform that can bring people and organizations together to acquire a precise information.	Shojaei et al., (2023b), Kissi et al., (2023), Qi and Costin, (2019)	3
6	Provide comprehensive data system by company software provider	Kiviniemi, (2008), Kissi et al., (2023), Qi & Costin, (2019)	3
7	Promoting Knowledge Management for Smart Technologies	Okonkwo et al., (2023), Zhang et al., (2023), Hwang et al., (2022)	3
8	Strong data security to secure the company information.	Shojaei et al., (2023b), Kissi et al., (2023)	2
9	Robust Structure for Effective Collaboration and Communication	Okonkwo et al., (2023), Shojaei et al., (2023b), Qi and Costin, (2019)	3
10	Provide Friendly-user Interface of Software by Production Company	Shojaei et al., (2023b)	1

Provide Training and Skilled Development Initiatives

To fully realize its goal of digital technologies and guarantee widespread competency among stakeholders, it is essential to implement comprehensive training programmes aimed toward their use within the construction industry. These initiatives are essential to enabling a seamless shift to a construction industry powered by technology. Key facilitators of BIM adoption in contractor and consultancy companies respectively: training and educating employees on BIM hardware (Shojaei et al., 2023). Professionals who aspire to become proficient with these tools receive training on software applications, virtual reality, Building Information Modelling (BIM), and other developing technologies through workshops, seminars, and certification courses. This competence reduces resistance to change and promotes an innovative culture, enabling the workforce to confidently adopt new technologies (Ebekozién & Samsurijan, 2022). By keeping professionals informed of the most recent advancements, continuous education programmes enable them to adjust swiftly and maximise the application of digital technology in building processes.

Collaboration with an experienced company in digital construction

According to Oke et al., (2023) and Ebekozién and Samsurijan (2022a), collaboration with experienced organisations in the use of digital technologies in the construction sector offers several benefits, including leveraging knowledge and expediting the implementation of disruptive innovations. In the beginning, working with experienced organisations provides vital insights, and best practices have improved via previous successful integrations. This experience proves to be a priceless tool for effectively guiding the adoption process. These kinds of collaborations make cutting-edge technologies and creative ideas more accessible. Well-established businesses frequently have R&D divisions devoted to investigating new trends and creating cutting-edge instruments specifically for the construction industry (Oke et al., 2023). Businesses may access a range of digital solutions, including augmented reality (AR), IoT devices, AI-driven analytics, and more by collaborating with these organisations. With this access, construction firms may improve their operations by implementing the most cutting-edge and relevant technology.

Establish Regulatory Support and Standards.

The engagement of governments through standardization and regulation is critical to encouraging the effective use of digital technology in the construction sector. To begin with, government bodies' standardised frameworks provide a consistent strategy for deploying digital tools and techniques (Ebekozen & Samsurijan, 2022b). These standards establish a uniform vocabulary and set of rules that all parties involved including contractors, engineers, architects, and regulatory agencies can comply with. A number of laws and guidelines have been released by certain countries to provide direction and encouragement for the previous integration effort (Zhang et al., 2023). Furthermore, effective government regulation contributes to the safety, security, and moral use of digital technology in buildings (Finn, 2011a). Regulations can set cybersecurity procedures, data privacy requirements, and safety standards for the usage of drones, artificial intelligence, Internet of Things devices, and other cutting-edge technology.

Government Incentives for Construction Project Participants

According to Ebekozen and Samsurijan (2022), using incentive programs can convince construction contractors to concentrate on long-term mutual gains rather than short-term financial benefits, such as encouraging digital technology applications to improve project performance and inter-organisational connections. As mentioned by Oke et al. (2023), financial incentives are vital to assist in paying for the upfront expenses of purchasing and using digital solutions (Oke et al., 2023). Financial incentives can also encourage research and development. These programs aimed at promoting technological innovation are offered by government and commercial organisations.

Build a platform that can bring people and organizations together to acquire precise information

Developing a cooperative platform that unites stakeholders and enables accurate information sharing is a crucial tactic to promote the use of digital technology in building projects. Project managers, architects, engineers, contractors, and suppliers can all easily communicate and access vital data from one central location using this kind of platform. Furthermore, stakeholder participation and trust may be greatly increased

by a well-designed platform that encourages cooperation and information exchange. A sense of shared accountability and cooperation is fostered when all stakeholders are linked by a single system. Through the exchange of innovative ideas and best practices, this collaborative approach not only promotes innovation but also speeds up the adoption of digital technology. Such a platform may also have functions that improve productivity and project management, such as data analytics, progress monitoring, and automated reporting (Shojaei et al., 2023b, Kissi et al., 2023, Qi and Costin, 2019). Construction projects may attain enhanced efficiency, precision, and triumph in their digital transformation endeavours by establishing a resilient digital ecosystem that facilitates communication between individuals and entities.

Provide comprehensive data system by company software provider

One important tactic to encourage the use of digital technology in construction operations is for software suppliers to offer complete data systems to their clients. Software suppliers may assist in streamlining project workflows and improving decision-making processes by offering a centralised platform where all project data from design blueprints and timelines to procurement information and status reports that can be viewed and updated (Kiviniemi, 2008; Kissi et al., 2023; Qi & Costin, 2019). Furthermore, the creation of complete data systems should prioritize flexibility and user-friendliness to meet the diverse demands of building projects. Providing features that are customisable and adaptable to the unique needs of various teams and projects is necessary. These systems can offer useful insights and predictive capabilities by combining advanced analytics, machine learning algorithms, and user-friendly interfaces. This can assist project managers in foreseeing possible problems and making well-informed decisions. Software suppliers can also guarantee that construction crews receive the necessary training and assistance to make the most out of these systems. Software suppliers may be key players in promoting the digital transformation of the construction sector by emphasising comprehensive, user-centric data systems. This will make it simpler for businesses to embrace and capitalise on the newest technology breakthroughs.

Promoting Knowledge Management for Smart Technologies

Encouraging knowledge management is an important tactic for encouraging the use of digital technology, especially smart technologies, in building projects. Achieving efficient knowledge management in an organisation requires methodically gathering, arranging, and distributing information on digital technologies and procedures. Regular training sessions, workshops, and cooperative platforms may foster a culture of knowledge sharing among staff members, enabling them to make better use of smart technology and promoting efficiency and creativity in building operations. Besides, merging smart technology and knowledge management could significantly enhance project results and decision-making. Smart technologies, including artificial intelligence (AI), machine learning, and Internet of Things (IoT) sensors, produce enormous volumes of data that, when handled well, may offer vital insights into project performance and possible areas for development. Construction organisations may optimise resource allocation and reduce risks by using data analytics and knowledge management systems to make well-informed decisions based on historical patterns and real-time data (Okonkwo et al., 2023; Zhang et al., 2023).

Strong data security to secure the company information

Strong data security measures to protect firm information are a top priority to encourage the use of digital technology in construction projects. Protecting sensitive data is crucial given the growing dependence on digital technologies and the massive volume of data collected throughout the course of a project. Putting strong cybersecurity measures in place, such as encryption, access limits, and frequent data backups, can help reduce the likelihood of data breaches and illegal access. Furthermore, teaching staff cybersecurity best practices and fostering a culture of awareness and responsibility can enable them to actively participate in protecting firm data. Meanwhile, companies can instill trust in the dependability and integrity of digital systems by making investments in cutting-edge cybersecurity solutions and forming alliances with reliable suppliers that place a high priority on data protection. Developing explicit rules and processes for data handling and incident response ensures a proactive approach to cybersecurity management. All things considered, giving top priority to robust data security measures not only safeguard priceless corporate assets

but also fosters confidence and trust in the use of digital technology in the construction sector (Shojaei et al., 2023b; Kissi et al., 2023).

Robust Structure for Effective Collaboration and Communication

Creating a strong framework for efficient cooperation and communication is a crucial tactic to promote the use of digital technology in building projects. Many parties are involved in construction projects, including clients, architects, engineers, contractors, and subcontractors. To guarantee project success, these parties must effectively coordinate their activities..

Provide Friendly-user Interface of Software by Production Company

Manufacturing businesses can promote the integration of digital technology in construction projects by providing a user-friendly interface for their software (Shojaei et al., 2023b). The creation of software interfaces that are simple to use, intuitive, and need little training should be a top priority for production businesses. This method lessens adoption resistance by allowing construction teams to become immediately acquainted with the software and incorporate it into their workflow with ease. Continuous user input should guide incremental enhancements to keep the software interface updated with the evolving demands and preferences of construction professionals (Shojaei et al., 2023b). Production businesses may develop software that fits the functional needs of building projects and improves the user experience overall by actively involving end users and incorporating their feedback into the design process. Taking a user-centric approach to interface design not only makes adoption more likely, but also promotes a favourable view of digital technology in the construction sector, which encourages further innovation and change.

METHODOLOGY

The study employs a quantitative approach, where a questionnaire is used as the survey instrument. The questionnaire is distributed to 50 respondents among contractors Grades G6 and G7 that adopt digital technology in

construction, using a purposive sampling method. The survey was carried out from April to June 2020 via an online platform. The online survey has received 107 responses from the 259 targeted sampling, where the response rate is 41.31%. As recommended by Watt et al. (2002), up to 33% is the average response rate is achievable for online an survey. Hence, the data is sufficient and relevant to the purposive sampling concept. The questionnaire consists of 10 statements of key strategies. The respondents were asked to rate their agreement level on the significant key strategy to foster the adoption of digital technologies in construction projects. Five (5) numerical Likert scales ranging from strongly disagree (scale 1) to strongly agree (scale 5) are used to measure their agreement level, i.e.,). The questionnaire covers the respondents' agreement level on the Key Strategy to Foster the Adoption of Digital Technologies in Construction Project.

RESULT AND DISCUSSIONS

The appropriate strategy to be taken in promoting the adoption of digital technologies by the contractor or other stakeholders to resolve the difficulties faced by project participants in construction projects were discussed in this section, which was the third objective of the research. Table 2 presents the scale of score mean, standard deviation, and ranking on the key strategy in promoting the adoption of digital technologies in construction projects. The result of this section was to achieve the third objective of this research. Ten (10) variables had been determined to identify the key strategy to foster the adoption of digital technologies in construction projects. Most of the variables indicated that the respondents agreed with all the variables. The average mean of the data collected was 4.22. This showed that most of the respondents agreed with all the statements of key strategies to foster the adoption of digital technologies in construction projects. Besides, all variables showed a score mean above 4.0. Providing a comprehensive data system by the company software provider showed the highest score mean of 4.35. This was followed by the lowest score mean which was for the statement of the government incentives to construction project participants and this variable presented the lowest mean score of 4.13.

Table 2. Mean and Standard Deviation for Key Strategy in Promoting the Adoption of Digital Technologies in Construction Projects

Section	Statement	Score Mean	Standard deviation	Rank
1	Provide training programs of digital tools.	4.24	0.596	3
2	Collaboration with experience company in digital construction	4.34	0.613	2
3	Establish regulatory support and standards	4.17	0.733	6
4	Government incentives to construction project participants	4.13	0.728	10
5	Build a platform that can bring people and organizations together to acquire a precise information	4.19	0.552	4
6	Provide comprehensive data system by company software provider	4.35	0.631	1
7	Promoting knowledge management for smart technologies	4.17	0.746	7
8	Strong data security to secure the company information.	4.16	0.585	8
9	Robust structure for effective collaboration and communication	4.17	0.720	5
10	Provide friendly-user Interface of software by production company	4.16	0.702	9
Average Mean		4.21		

Source: Author

There are several key strategies determined to encourage contractors to promote the adoption of digital technologies in construction projects. Based on the result, the highest mean score for key strategies in promoting the adoption of digital technology was to provide a comprehensive data system by a company software provider with a score mean of 4.35. The result indicates that the use of software in managing the data is very important as a centralised platform where all project data from design blueprints and timelines to procurement information and status reports that can be viewed and updated. This was supported by Kiviniemi, (2008), Kissi et al., (2023), Qi and Costin, (2019) that the software may assist in streamlining project workflows and improving decision-making processes. According to Kiviniemi, (2008), data systems must be created with flexibility and user-friendliness and be placed as a top priority by offering useful insights and predictive capabilities by combining advanced analytics, machine learning algorithms, and user-friendly interfaces.

Further results revealed that collaboration with experienced company in digital construction shows as the second highest which represents a score mean of 4.34. The results show the importance of collaborating with other companies that practice high digital technology for more efficient work management. As mentioned by Oke et al. (2023) and Ebekoziem and Samsurijan (2022a), collaborating with established and experienced companies in digital technology within the construction industry yields numerous advantages, for instance, tapping into expertise and accelerating the adoption of disruptive innovations. This experience proves to be a priceless tool for effectively guiding the adoption process. It was supported by Oke et al. (2023) that companies may access a range of digital solutions, including augmented reality (AR), IoT devices, AI-driven analytics, and more by collaborating with these organisations. The use of various relevant digital solutions may improve operations and ensure work can be executed efficiently.

Meanwhile, providing a training program with a score mean 4.24 indicates one of the important strategies that focuses on the application of new digital technology to ensure that work can be carried out more easily and efficiently. Ebekoziem and Samsurijan (2022) have indicated the importance of providing training on software applications, virtual reality, Building Information Modeling (BIM), and other development technologies, workshops, and seminars to the construction participants to ensure construction participants can work more efficiently. Therefore, efficiency in the use and digital application of this technology can encourage a more innovative work culture and enable the workforce to adopt new technology with more confidence.

Besides that, another top five key strategy variable was building a platform that can bring people and organizations together to acquire precise information with a mean score of 4.19. This result indicates that creating a collaborative platform that brings stakeholders precise information exchange is crucial for advancing the utilization of digital technology in construction projects. This was supported by Kissi et al., (2023), that the related platform improves coordination and transparency by offering a single source of truth, which results in better-informed decisions and efficient workflows. This collaborative approach not only promotes innovation but also speeds up the adoption of digital technology.

In addition, the results revealed that a robust structure for effective collaboration and communication was also agreed by most of the respondents as one of the important strategies to encourage the adoption of digital technology in construction projects with a score mean of 4.17. This finding indicates that it is important to create a robust framework for effective collaboration and communication to promote the use of digital technology in construction projects. This is due to the involvement of various parties such as clients, architects, engineers, contractors, and subcontractors in the management of construction projects. According to Shojaei et al., (2023b) to optimize the use of digital technology in construction, fostering a culture of cooperation and transparent communication is essential. This can be achieved by fostering multidisciplinary collaboration, dismantling discipline-specific silos, and urging team members to actively participate and share information. Attending seminars and training frequently may help create a common understanding of how digital technologies can help improve productivity and teamwork.

However, the participants also agreed with other strategies proposed to encourage the adoption of digital technology in construction projects. The result of the mean score shows that the level of agreement is above 4.00. Other strategies agreed upon by most of the respondents are establishing regulatory support and standards with a score mean of 4.17, promoting knowledge management for smart technologies with a score mean (of 4.17), strong data security to secure the company information with a score mean (4.16), provide friendly-user Interface of software by a production company with score mean (4.16), and government incentives to construction project participants with score mean (4.13). All these strategies can also help contractor companies in embracing the use of digital technology starting from the lower level to the top in the management of construction projects. This was mentioned by Yang (n.d) that encouraging the construction sector to embrace digital technology marks the beginning of a revolutionary change that will completely transform the way projects are planned, constructed, and carried out. It was agreed by Adam et al. (2022) that to promote the adoption of digital technology in managing construction projects, stakeholders can reduce design and construction mistakes and at the same time can save money and time.

CONCLUSION

In conclusion, the appropriate strategy to be taken in promoting the adoption of digital technologies by the contractor or other stakeholders to resolve the difficulties faced by project participants in construction projects were discussed, determined, and achieved. There are five (5) most agreed strategies according to the ranking to promote the adoption of digital technology response among the respondents which are to provide a comprehensive data system by company software provider, collaboration with an experienced company in digital construction, providing a training program, build a platform that can bring people and organizations together to acquire precise information, and robust structure for effective collaboration and communication. These strategies primarily will help in minimizing rework, maximizing resource allocation, and promoting sustainable practices. Thus, it can be concluded that determining the key strategies in promoting the adoption of digital technology, could encourage the practitioners to practice and implement digital technology effectively, especially toward the project's sustainability and achieving high project performance.

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AUTHOR CONTRIBUTIONS

All three authors were involved in the research design, administration of survey questionnaire, data collection and analysis, and the write-up of this

manuscript. All authors have thoroughly reviewed and given their approval for the final manuscript, indicating their collective agreement on its content and findings.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- Adam, V., Manu, P., Mahamadu, A. M., Dziekonski, K., Kissi, E., Emuze, F., & Lee, S. (2022). Building information modelling (BIM) readiness of construction professionals: the context of the Seychelles construction industry. *Journal of Engineering, Design and Technology*, 20(3), 823–840.
- Ebekozien, A., & Samsurijan, M. S. (2022a). *Incentivisation of digital technology takers in the construction industry*. Engineering, Construction and Architectural Management. <https://doi.org/10.1108/ECAM-02-2022-0101>.
- Ebekozien, A., & Samsurijan, M. S. (2022b). *Incentivisation of digital technology takers in the construction industry*. Engineering, Construction and Architectural Management. <https://doi.org/10.1108/ECAM-02-2022-0101>.
- Finn, J. (2011a). Collaborative knowledge construction in digital environments: Politics, policy, and communities. *In Government Information Quarterly*, 28(3),409–415. <https://doi.org/10.1016/j.giq.2010.10.004>.
- Finn, J. (2011b). Collaborative knowledge construction in digital environments: Politics, policy, and communities. *In Government Information Quarterly*, 8(3),409–415. <https://doi.org/10.1016/j.giq.2010.10.004>.
- Ikuabe, M., Aghimien, D., Aigbavboa, C., & Oke, A. (2020). *Exploring the Adoption of Digital Technology at the Different Phases of Construction*

Projects in South Africa.

- Kissi, E., Aigbavboa, C., Kuoribo, E. (2023), Emerging technologies in the construction industry: challenges and strategies in Ghana. *Journal of Construction Innovation*, 23(2), pp. 383-405, doi: 10.1108/JOPP-11-2019-0075.
- Manley, K., & Chen, L. (2015). Collaborative learning model of infrastructure construction: A capability perspective. *Construction Innovation*, 15(3), 355–377. <https://doi.org/10.1108/CI-05-2014-0031>.
- Massa, S., Annosi, M. C., Marchegiani, L., & Messeni Petruzzelli, A. (2023). Digital technologies and knowledge processes: new emerging strategies in international business. A systematic literature review. *Journal of Knowledge Management*.
- Oke, A. E., Aliu, J., Fadamiro, P., Akanni, P., Jamir Singh, P. S., & Shaharudin Samsurijan, M. (2023). *Unpacking the strategies to promote the implementation of automation techniques in the construction industry*. *Construction Innovation*. <https://doi.org/10.1108/CI-12-2022-0332>.
- Olatunde, N. A., Gento, A. M., Okorie, V. N., Oyewo, O. W., Mewomo, M. C., & Awodele, I. A. (2023). Construction 4.0 technologies in a developing economy: awareness, adoption readiness and challenges. *Frontiers in Engineering and Built Environment*, 3(2), 108– 121.
- Qi, B. and Costin, A. (2019), Challenges of implementing emerging technologies in residential modular construction, *Proceedings of the CIB World Building Congress, Constructing Smart Cities*, Hong Kong, pp. 17-21.
- Shojaei, R. S., Oti-Sarpong, K., & Burgess, G. (2023a). Enablers for the adoption and use of BIM in main contractor companies in the UK. *Engineering, Construction and Architectural Management*, 30(4), 1726–1745. <https://doi.org/10.1108/ECAM-07-2021-0650>.
- Shojaei, R. S., Oti-Sarpong, K., & Burgess, G. (2023b). Enablers for the adoption and use of BIM in main contractor companies in the UK. *Engineering, Construction and Architectural Management*, 30(4), 1726–1745. <https://doi.org/10.1108/ECAM-07-2021-0650>.

- Tetik, M., Peltokorpi, A., Seppänen, O., & Holmström, J. (2019). Direct digital construction: Technology-based operations management practice for continuous improvement of construction industry performance. *Automation in Construction*, 107. <https://doi.org/10.1016/j.autcon.2019.102910>.
- Trask, C., & Linderoth, H. C.J. (2023). Digital technologies in construction: A systematic mapping review of evidence for improved occupational health and safety. *Journal of Building Engineering*, 80, 108082. <https://doi.org/10.1016/j.jobe.2023.108082>.
- Warrick, D. D. (2022). *Revisiting resistance to change and how to manage it: What has been learned and what organizations need to do*. Business Horizons. <https://doi.org/10.1016/j.bushor.2022.09.001>.
- Wimalasena, N. N., & Gunatilake, S. (2018). The readiness of construction contractors and consultants to adopt e-tendering: The case of Sri Lanka. *Construction Innovation*, 18(3), 350–370. <https://doi.org/10.1108/CI-03-2017-0025>.
- Yang, H. (2023). *Construction of the new development dynamic and development of digital economy: internal logic and policy focus*.
- Zhang, J., Chen, M., Ballesteros-Pérez, P., Ke, Y., Gong, Z., & Ni, Q. (2023). A new framework to evaluate and optimize digital transformation policies in the construction industry: A China case study. *Journal of Building Engineering*, 70. <https://doi.org/10.1016/j.jobe.2023.106388>