VNU Journal of Economics and Business

Journal homepage: https://jeb.ueb.edu.vn

Original Article

Innovating with chatbots: A study of adoption factors in the Vietnamese construction sector

Tran Thi Thu Hai[1,*], Luu Thi Minh Ngoc[2], Nguyen Xuan Lam[3]

[1]*VNU University of Economics and Business*
No. 144, Xuan Thuy Road, Cau Giay District, Hanoi, Vietnam
[2]*VNU International School*
No. 144, Xuan Thuy Road, Cau Giay District, Hanoi, Vietnam
[3]*University of Transport and Communications*
No. 3, Cau Giay Road, Dong Da District, Hanoi, Vietnam

Received: October 30, 2024
Revised: December 19, 2024; Accepted: December 25, 2024

Abstract: Organizations are increasingly compelled to seek innovative solutions to navigate dynamic environments, and the construction industry is no exception. This study investigates the determinants of chatbot adoption in the construction industry in Vietnam. The research posits that technological anxiety negatively impacts chatbot adoption, while chatbot perceived understandability, perceived reliability, employee technology skills, and widespread internet connectivity positively influence chatbot adoption. The study contributes to the literature by examining the role of chatbots as a digital innovation in a traditionally low-tech sector. It also explores the interplay between chatbots, self-service technology, and the broader context of digital transformation in the construction industry. By identifying key factors affecting chatbot adoption, this research offers valuable insights for practitioners and policymakers seeking to leverage this technology for improved efficiency, productivity, and customer satisfaction.

Keywords: Innovation, construction industry, chatbot.

1. Introduction

Quality of service has long been a subject of extensive research, dating back to seminal works on service quality frameworks by Parasuraman et al. (1988) and Grönroos (1984). In recent years, self-service technology (SST) has emerged as a prominent solution, empowering businesses to optimize operations, elevate customer experiences, and align with contemporary trends (Marfo et al., 2022; Kumar et al., 2020). In the construction industry, SST manifests in the form of digital tools like chatbots, which address customer inquiries and resolve issues promptly (Nicolescu and Tudorache, 2022). Chatbots transcend their role as mere technological advancements and serve as crucial strategies for construction companies

* Corresponding author
E-mail address: haitrantt@vnu.edu.vn
https://doi.org/10.57110/vnu-jeb.v4i6.353

to cater to the evolving demands of today's market, where customers seek flexible, convenient, and rapid service interactions.

The adoption of chatbots is influenced by a variety of factors, as highlighted in recent studies. The determinants include technological readiness, organisational readiness, big data analytics, organisational learning capabilities and governmental policies which have been found to positively correlate with chatbot adoption intentions in governmental agencies (Jais et al., 2024). Additionally, user perceptions such as performance expectancy, effort expectancy, and trust are crucial for chatbot adoption in public transport services (Kuberkar & Singhal, 2020). The Technology Acceptance Model and Social Presence Theory are prominent frameworks in understanding the factors influencing chatbot adoption across various fields (Alsharhan et al., 2023). Overall, these findings underscore the multifaceted nature of chatbot adoption, combining technological, organisational, and user-centric perspectives. While these factors are crucial for chatbot adoption, this paper focuses on the individual user perspective within employees in construction companies. Specifically, we investigate the influence of technological anxiety and chatbot perceived understandability, the employee's technology skills, internet connectivity on user adoption. These factors can significantly impact users' willingness to interact with chatbots, ultimately affecting the success of chatbot implementation.

Self-Service Technology (SST) has garnered significant attention in recent research, with studies highlighting its potential to improve customer satisfaction, operational efficiency, and cost reduction (Kumar et al., 2020). However, the integration of chatbots within the construction industry remains a relatively unexplored area of investigation. This convergence of advanced technology and customer experience presents a compelling research avenue, offering the potential to deepen our understanding of the role of digital technologies in contemporary life (Chen et al., 2023; Wright et al., 2020).

In the dynamic and competitive construction market, attracting and retaining customers poses a significant challenge for businesses (Cox et al., 2018). While acquiring new customers is crucial for market expansion, retaining existing ones is essential for long-term success. This paper delves into the application of chatbots within the realm of digital innovation, providing valuable insights for Vietnamese construction companies seeking to enhance their technological adoption strategies. By effectively implementing chatbots, businesses can elevate customer service, streamline operations, and ultimately, achieve sustainable growth.

2. Literature review and hypothesis development

2.1. Digital innovation and self-service technology

Digital innovation refers to the utilization of digital technologies within the innovation process, potentially encompassing the entirety or a portion of the innovation's outcome (Nambisan et al., 2017). This phenomenon has fundamentally transformed the nature and structure of new products and services. Digital innovation fosters the creation of novel value propositions and value capture mechanisms (Yoo et al., 2012). It also enables the formation of innovative collectives involving diverse groups of actors with varied goals and capabilities. Furthermore, digital innovation has given rise to a range of novel innovation processes, ultimately transforming entire industries in its wake (Nambisan et al., 2017).

SST encompasses technologies that enable customers to independently access services without requiring direct interaction or assistance from company personnel (Marfo et al., 2022). SST is replacing many face-to-face service interactions with the aim of making company service more convenient, and faster (Kumar et al., 2020). The implementation of SST in the construction industry offers a multitude of benefits for stakeholders. One key advantage lies in its ability to enhance efficiency and productivity (Dueja, 2024). SST facilitates the optimization of workflows by allowing for real-time data analysis and process adjustments. Beyond efficiency gains, SST fosters enhanced customer satisfaction (Agarwal and Gupta, 2020). By providing 24/7 access to project information and self-service options, customers gain a greater sense of control over their projects.

2.2. Chatbots

A chatbot can be defined as a software application designed to simulate conversation through text or text-to-speech functionalities (Woebke et al., 2020). Chatbots have found

widespread adoption within dialogue systems, primarily serving functions like customer service, request routing, and information gathering. Furthermore, chatbots can be categorized based on their intended use, encompassing a broad spectrum of fields including commerce, education, finance, news provision, entertainment, and even mental health support (Ferraz & Carvalho, 2018).

Within the realm of chatbots, two primary architectures dominate: rule-based chatbots and AI-powered chatbots (Haristiani, 2019). Rule-based chatbots, also known as information flow chatbots, operate within a pre-defined structure (Woebke et al., 2020). Developers program these chatbots with specific responses triggered by pre-determined keywords, buttons, or phrases. This structured flow ensures consistent and accurate information delivery, simplifying chatbot development and management (Ferraz & Carvalho, 2018). However, this rigidity can limit the chatbot's ability to handle unforeseen situations or complex user queries. In contrast, AI-powered chatbots leverage artificial intelligence (AI) to simulate natural conversation through voice commands or text chat (Ferraz & Carvalho, 2018). Unlike rule-based chatbots, AI chatbots continuously learn and update their knowledge base through user interactions. This enables them to handle a broader range of queries and user requests, even those not explicitly programmed by developers (Ferraz & Carvalho, 2018).

2.3. Chatbots in the construction industry

Chatbots are revolutionizing communication, streamlining workflows, and enhancing customer experiences across various aspects of construction projects (Agarwal and Gupta, 2020).

Chatbots serve as virtual assistants, providing prompt and personalized support to customers (Haristiani, 2019). They can answer frequently asked questions, address concerns, and guide customers through complex processes, reducing the burden on human customer service representatives. Chatbots can act as central communication hubs, facilitating seamless information exchange among project stakeholders (Woebke et al., 2020). They can automate routine tasks like scheduling meetings, distributing documents, and tracking progress updates, freeing up valuable time for more strategic activities. Besides, chatbots can play a crucial role in promoting safety on construction sites (Dueja, 2024). They can deliver safety reminders, distribute safety protocols, and conduct pre-task assessments, reducing the risk of accidents and enhancing compliance with safety regulations. Furthermore, chatbots can optimize resource allocation by automating tasks like scheduling labor, managing equipment, and ordering supplies. They can also provide real-time data on resource availability and utilization, enabling proactive planning and preventing resource bottlenecks (Dueja, 2024). This efficient resource management can lead to significant cost savings for construction companies.

2.4. Theoretical frameworks for chatbot adoption

Davis (1989) introduced the Technology Acceptance Model (TAM) to explain individuals' usage behavior of technological products. TAM centers around two primary factors influencing technology adoption: perceived usefulness and perceived ease of use (Chauhan et al., 2021). Perceived usefulness is defined as an individual's belief that using a particular system will enhance job performance. Perceived ease of use refers to the degree to which a person believes that using a particular system would be free from effort.

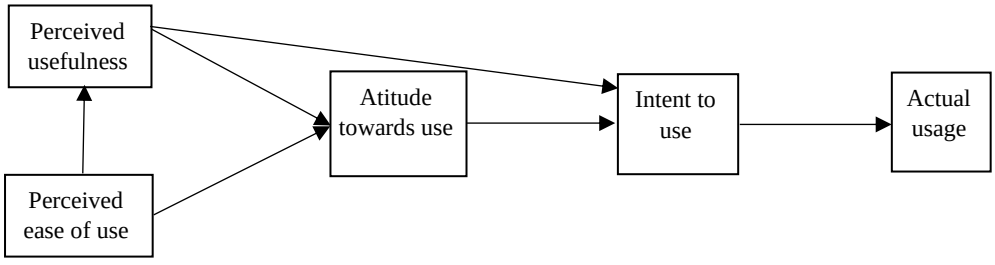

Figure 1: Technology Acceptance Model
Source: Davis et al. (1989).

In the context of chatbot adoption, regarding perceived usefulness, chatbots can provide instant support to users in resolving contract-related issues, technical problems, and more. In terms of perceived ease of use, chatbots are designed to facilitate user interactions. Regarding responsiveness, chatbots can provide relatively accurate and clear answers to user queries. It is evident that chatbot perceived understandability and perceived reliability of chatbot responses are directly linked to perceived usefulness, while employee's technology skills, technological anxiety, and Internet connectivity throughout construction projects influence perceived ease of use of chatbots.

2.5. Determinants of chatbot adoption in construction

2.5.1. Technological anxiety

Technological advancements, such as chatbots, hold immense potential to improve business operations (Li et al., 2021). However, unlocking this potential hinges on user proficiency and knowledge. Bhatt et al. (2020) define technology anxiety as a collection of negative beliefs and emotional responses stemming from perceived difficulties in using online systems. It is often characterized by fear, apprehension, or discomfort when using or learning to use technological devices or systems (Lee & Xiong, 2018). This anxiety can stem from various factors, including a lack of digital literacy, fear of the unknown, or past negative experiences with technology. As a result, individuals with high levels of technological anxiety are less likely to embrace chatbots, limiting their potential benefits (Li et al., 2021).

Above all, the first hypothesis can be formulated: "Hypothesis 1 – Technological anxiety in the construction industry has a negative effect on chatbot adoption".

2.5.2. Chatbot perceived understandability

Chatbot perceived understandability is identified as a crucial quality dimension influencing user adoption and satisfaction. It refers to a user's perception of a chatbot's ability to comprehend and accurately respond to their queries or requests (Nguyen, 2019). When users perceive a chatbot as capable of comprehending their queries and responding accurately, they are more likely to trust and rely on the technology. Chatbots, empowered by Natural Language Processing (NLP) technologies, facilitate context-aware comprehension of human conversations and enable interactive dialogues with users (Cho et al., 2019). When a chatbot can effectively understand and respond to user inputs, it creates a more seamless and intuitive interaction. This, in turn, can lead to increased user satisfaction, as users feel their needs are being met efficiently and effectively (Nguyen, 2019).

Therefore, it is evident that chatbot perceived understandability plays a pivotal role in shaping user experiences and driving chatbot adoption. "Hypothesis 2 - Chatbot perceived understandability positively supports applying chatbots in the construction industry".

2.5.3. Perceived reliability of chatbot responses

Perceived reliability, as defined by Parasuraman et al. (1988), is the user's perception that a service will consistently and accurately deliver promised benefits. This concept is particularly relevant to chatbot services, as providing users with reliable and accurate information is considered a critical factor for chatbot adoption (Chung & Park, 2019). In this paper, perceived reliability of chatbot responses refers to a user's belief in the accuracy, consistency, and trustworthiness of the information provided by a chatbot. When users perceive chatbot responses as accurate, consistent, and trustworthy, they are more likely to rely on the technology and integrate it into their daily lives. Furthermore, perceived reliability can significantly impact user satisfaction and loyalty (Senuse et al, 2019). Users who have positive experiences with reliable chatbots are more likely to recommend the service to others, leading to increased adoption rates.

Based on these facts, we come up with the third hypothesis: "Hypothesis 3 - Perceived reliability of chatbot responses positively support applying chatbots in the construction industry".

2.5.4. The employee's technology skills

Employee's technology skills refer to an individual's ability to effectively use and understand various technological tools and systems. This includes proficiency in software

applications, hardware operation, and digital literacy (Green, 2012). Employees with strong technology skills can interact with chatbots more effectively, understanding their capabilities and limitations (Chen et al., 2023). Besides, these technology-savvy individuals can troubleshoot technical issues, identify potential errors, and implement workarounds, ensuring smooth operation and minimizing downtime associated with chatbot malfunctions (Li et al., 2021). Furthermore, technology-proficient employees can extract valuable insights from chatbot interactions. By identifying patterns, trends, and areas for improvement, they can leverage this data for data-driven decision-making.

Accordingly, the following hypothesis can be suggested: "Hypothesis 4 - The employee's technology skills positively supports chatbot adoption in the construction industry".

2.5.5. Internet connectivity throughout construction projects

Chatbots facilitate real-time communication and collaboration among stakeholders across locations. Reliable internet ensures seamless data exchange, enabling timely responses and efficient decision-making (Li et al., 2023). Therefore, in this study, internet connectivity refers to the ability of devices to connect to the internet and exchange data. Internet connectivity guarantees prompt and dependable access to the vast repository of information and resources offered by chatbots, including project documents, safety protocols, and technical specifications. Furthermore, remote monitoring and supervision of construction sites via chatbots rely heavily on internet connectivity for transmitting data from sensors and cameras to the chatbot platform, allowing for real-time progress tracking and early identification of potential issues (Meng et al., 2021). Reliable internet ensures these tasks are executed efficiently without disruptions. Finally, internet connectivity is essential for delivering a seamless and responsive customer experience through 24/7 customer service and support offered by chatbots (Zheng et al., 2019).

The final hypothesis can be formulated: "Hypothesis 5 – Widespread internet connectivity throughout construction projects creates favorable conditions for chatbot adoption in the construction industry".

The proposed research model is depicted in Figure 2.

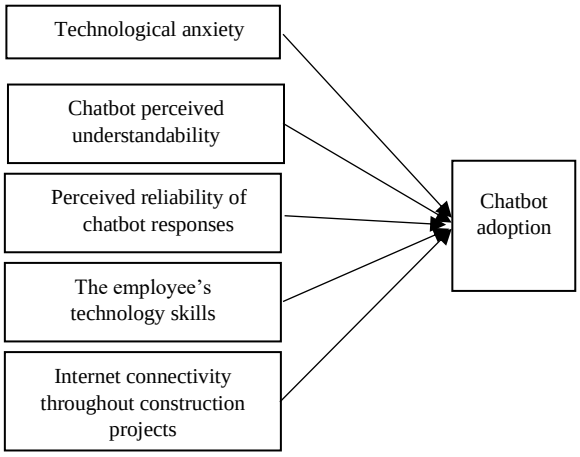

Figure 2: Proposed research model
Source: Authors' work.

3. Methodology

Data collection method: Data for this study was gathered through surveys. A convenience sampling method was employed to recruit participants from construction companies operating in Vietnam. The sample consisted of 24 observed variables. The sample size was determined using the Hair et al. (2006) formula for sample size calculation. The minimum sample size should be five times the total number of observed variables (in this case, 24 observed variables, resulting in a minimum sample size of N = 120). To ensure the most accurate analysis results, the study aimed to distribute 200 questionnaires. The initial response rate was 72%, resulting in 144 collected surveys. Following data cleaning procedures to remove incomplete responses, the final sample size for analysis consisted of 123 responses. The questionnaire itself was developed based on previous studies by Li et al. (2023, 2021), Nguyen (2019), and Chung & Park (2019). The detailed measurement instrument used in this study is shown in Appendix 1.

Data analysis method: Following data cleaning procedures to ensure data quality, valid data were analyzed using SPSS 26 to address the research hypotheses. The analysis process employed a multi-step approach. First, scale reliability assessed the internal consistency and reliability of the measurement scales used in the questionnaire. Exploratory factor analysis (EFA) was employed to explore the underlying structure of the data and identify potential latent

variables. Besides, correlation analysis was conducted to examine the strength and direction of relationships between the study variables. The final step involved multiple regression analysis to test the proposed research hypotheses and determine the influence of independent variables on the dependent variable.

4. Results and discussion

4.1. Scale reliability and exploratory factor analysis

The internal consistency and reliability of the measurement scales were assessed using Cronbach's Alpha coefficient. A coefficient greater than 0.6 is generally considered acceptable for establishing reliability (Nunally & Bernstein, 1994), and all scales in this study exceeded this threshold. The lowest coefficient observed was 0.787 for the technological anxiety factor, indicating strong internal consistency for all scales. Furthermore, the calculated result demonstrates that each factor exhibited a correlation coefficient exceeding 0.3. This suggests a moderate to strong positive relationship between the items within each factor, which is indicative of convergent validity (Hair et al., 2010).

The suitability of the data for EFA was confirmed by the Kaiser-Meyer-Olkin (KMO) measure. All KMO coefficients were greater than 0.5 ($0.5 < KMO < 1$), indicating that the observed variables were suitable for factor analysis. The results of the EFA revealed a total variance explained (TVE) exceeding 50%, indicating that the identified factors captured a substantial portion of the variance in the data. This suggests good explanatory power of the factors (Costello & Osborne, 2005). Additionally, all factor loadings were greater than 0.5, suggesting strong associations between the observed variables and their underlying factors (Tabachnick & Fidell, 2020). Notably, the analysis confirmed the retention of the original five-factor structure, with 20 observed variables remaining grouped within these factors.

4.2. Correlation analysis

Table 1 presents the average participant evaluations of chatbot adoption in the construction industry and the five factors included in the research model. All factors received mean scores exceeding 3.0 on the 5-point Likert scale, indicating a generally positive perception among construction companies. Technological anxiety received the lowest mean score (M = 3.554, SD = 0.627), suggesting the least concern compared to other factors. Conversely, perceived reliability of chatbot responses received the highest mean score (M = 3.713, SD = 0.898), highlighting its perceived importance.

Furthermore, the correlation analysis revealed positive correlations between chatbot adoption and all factors except technological anxiety. The potential for multicollinearity among independent variables was also assessed. The analysis considered significance levels (sig.) and Pearson correlation coefficients. Following common practices (Field, 2013), if a sig. value was less than 0.05, the Pearson correlation coefficient was examined. However, no pairs of independent variables exhibited both a sig. value below 0.05 and a Pearson correlation coefficient exceeding 0.7 (Table 1). Therefore, we can conclude that multicollinearity is not a significant concern in this analysis.

Table 1: Correlation matrix and evaluation score for each factor

Variable	Mean	SD	TA	PU	PR	ES	IC	CA
TA	3.584	0.716	1	0.238**	-0.259**	0.158**	-0.323**	-0.672**
PU	3.690	0.701	0.238**	1	0.208**	0.293**	0.230**	0.484**
PR	3.713	0.898	-0.259**	0.208**	1	0.460**	0.345**	0.322**
ES	3.554	0.627	0.158**	0.293**	0.460**	1	0.334**	0.501**
IC	3.575	0.846	-0.323**	0.230**	0.345**	0.334**	1	0.300**
CA	3.696	0.884	-0.672**	0.484**	0.322**	0.501**	0.300**	1

Notes: ** means significant at 5%.
Source: Authors.

4.3. Regression analysis and verification of research hypothesis

The results of the regression analysis revealed a statistically significant relationship between the independent variables and the dependent variable (chatbot adoption) (F test = 0.000 < 0.05). This indicates that at least one of the factors included in the research model has a significant influence on the adoption of chatbots within the Vietnamese construction industry. Furthermore, the adjusted R-squared value of 0.604 suggests that the model explains 60.4% of the variance observed in chatbot adoption.

The analysis revealed significant relationships between several independent variables and chatbot adoption. The regression coefficient for technological anxiety was -0.174 (Sig. < 0.05), indicating a negative relationship with chatbot adoption. This finding aligns with previous research in the healthcare and banking sectors (Lin et al., 2020; Marfo et al., 2022), where concerns about technology use have been shown to hinder the adoption of new technologies. The construction industry may share similar characteristics, with a potentially older workforce less comfortable with new technologies.

Table 2: Results of regression analysis

Model	**Unstandardized coefficients**		**Standardized coefficients**	**t**	**Sig.**	**Collinearity statistics**
	B	Std. Error	Beta			VIF
(Constant)	0.297	0.234		1.296	0.200	
Technological anxiety	-0.174	0.045	-0.112	-1.692	0.000	1.768
Chatbot perceived understandability	0.353	0.038	0.321	4.655	0.000	1.371
Perceived reliability of chatbot responses	0.406	0.049	0.456	2.314	0.003	1.398
The employee's technology skills	0.104	0.037	0.142	2.806	0.000	1.189
Internet connectivity throughout construction projects	0.211	0.044	0.245	4.754	0.001	1.234
adjusted R square			0.604			
p-value (F test)			0.000			
Dependent variable: AI						

Source: Authors.

The findings of the current study regarding the influence of perceived reliability and understandability on chatbot adoption in the construction industry are significant and align with existing literature. Specifically, the regression coefficient of perceived reliability being 0.406 (Sig. < 0.05) indicates a robust positive relationship with chatbot adoption. This outcome is consistent with Cho et al. (2019), who emphasized the necessity of accurate and reliable responses in customer service applications of chatbots. The consistent need for reliability across different sectors underscores the universal importance of trust in technological solutions.

Furthermore, the regression coefficient for perceived understandability being 0.353 (Sig. < 0.05) reiterates the importance of user-friendliness and clear communication in technology adoption. Previous studies, such as those by Yadegari et al. (2024) and Neumeyer et al. (2021), have highlighted similar findings, suggesting that clear communication and ease of understanding are critical components for user acceptance of technology. However, what differentiates this study from prior research is its focus on the construction industry—a sector often overlooked in technology adoption studies. By concentrating on this specific context, the research emphasizes the necessity of tailored solutions that consider the unique operational challenges faced in construction projects.

In addition, the study reports a positive and significant regression coefficient of 0.211 (Sig. < 0.05) for internet connectivity, which reinforces findings from Meng et al. (2021). These researchers have previously noted that a reliable internet infrastructure is indispensable for the successful implementation of technological innovations. The ongoing advancements in internet technologies, such as 4G and 5G, provide a more robust framework for integrating chatbots in construction, where projects frequently occur in remote and

challenging environments. This nuanced examination of internet connectivity challenges within the construction context offers strategic insights into optimizing internet infrastructure for enhanced chatbot adoption.

Lastly, the positive correlation observed between employee technology skills and chatbot adoption, with a regression coefficient of 0.104 (Sig. < 0.05), further supports the idea that a more tech-savvy workforce is essential for successful technology utilization. While previous studies have broadly examined technology skills in general technology adoption (Venkatesh et al., 2012), this research specifically ties those skills to the unique needs of chatbot integration in construction. This finding suggests that investing in employee training may be a crucial strategy for organizations looking to implement chatbots effectively.

In summary, the results of this study not only reinforce existing literature on the importance of perceived reliability, understandability, internet connectivity, technological anxiety and employee skills in chatbot adoption but also provide deeper insights into the specific challenges and opportunities within the construction industry. This tailored approach enhances the understanding of how these factors interplay within a unique sector, paving the way for more effective technology integration strategies.

4.4. Theoretical and managerial implications

4.4.1. Theoretical implications

This research offers significant theoretical contributions. First, it enriches organizational innovation theory by examining chatbot adoption in the construction industry, a traditionally low-tech sector. By investigating the roles of technological anxiety, chatbot perceived understandability, perceived reliability of chatbot responses, the employee's technology skills and internet connectivity throughout construction projects, the study sheds light on factors that facilitate or hinder technological innovation. Second, it contributes to diffusion of innovation research by developing a context-specific model for chatbot adoption in Vietnam. By identifying key factors influencing chatbot uptake, the research enhances understanding of the diffusion process in this unique setting. Finally, the study broadens the scope of digital transformation research by exploring chatbot adoption in a developing country context. The findings provide valuable insights applicable to other industries and regions, advancing knowledge on the complexities of AI integration.

4.4.2. Managerial implications

Based on the findings presented, this paper provides practical recommendations for construction firms aiming to leverage chatbot technology. These recommendations include:

Enhancing perceived reliability: Construction companies should ensure reliable information delivery. Integration with reliable information sources, such as internal databases or trusted online resources, further bolsters user confidence in the accuracy and consistency of chatbot responses. Reliable information is critical in the construction industry where decisions can significantly impact project timelines and costs. This investment not only improves operational efficiency but also fosters a culture of transparency and accountability, essential in a sector often scrutinized for project management.

Promoting chatbot understandability: Clear and concise language that utilizes construction terminology is essential. Construction companies should offer multiple interaction methods catering to diverse user preferences and accessibility needs. These methods can include text, voice commands, or a combination of both. By promoting understandability, companies ensure that all employees, regardless of their background, can effectively interact with chatbots. This inclusivity enhances user engagement and adoption rates, ensuring that the technology serves its intended purpose of improving communication and operational efficiency.

Ensuring reliable internet connectivity: Given the often remote locations of construction sites in Vietnam, ensuring reliable internet connectivity is vital for chatbot functionality. Construction companies can implement solutions like mobile hotspots, satellite internet, or mesh networking to mitigate connectivity limitations. Collaboration with telecommunication providers to expand coverage and offer competitive data plans specifically tailored to construction needs can further address this challenge. Offline functionalities ensure that workers can still benefit from chatbot assistance even when connectivity is compromised, thereby maintaining operational continuity.

Equipping the workforce: Construction companies should equip their employees with necessary digital literacy skills to interact

effectively with chatbots. Establishing ongoing support systems allows employees to receive assistance and troubleshoot any difficulties encountered with the technology. By enhancing digital literacy, construction companies can maximize the utility of chatbots, leading to improved communication and problem-solving capabilities on-site. Continuous support fosters a positive attitude towards technology, further encouraging its integration into daily operations.

Addressing technological anxiety: Construction companies may launch information sessions and campaigns which explain the benefits and functionalities of chatbots within the construction workflow. Sharing success stories from other construction companies that have successfully implemented chatbots can demonstrate the tangible advantages of the technology. By proactively addressing these concerns, construction companies can create an environment of acceptance and enthusiasm towards new technologies. Emphasizing that chatbots are tools designed to assist rather than replace human workers empowers employees, thereby boosting morale and fostering a collaborative work culture that embraces technological advancements..

5. Conclusion

This research investigated the factors influencing chatbot adoption in the Vietnamese construction industry. The study employed an empirical approach, surveying 123 companies across the country to assess digital innovation within the sector. The findings revealed that several factors positively impact chatbot adoption: perceived reliability of chatbot responses, chatbot perceived understandability, consistent internet connectivity throughout construction projects, and employee technology skills. Conversely, technological anxiety emerged as a negative influence. These findings offer valuable insights for stakeholders interested in promoting chatbot adoption within the Vietnamese construction industry.

References

Agarwal, R., & Gupta, M. (2020). The impact of self-service technology on customer satisfaction in the construction industry. *International Journal of Construction Management*, *30*(1), 142-157. https://doi.org/10.1080/23311975.2018.1423770

Alsharhan, A., Al-Emran, M., & Shaalan, K. (2023). Chatbot adoption: A multiperspective systematic review and future research agenda. *IEEE Transactions on Engineering Management*, *71*, 10232–10244. https://doi.org/10.1109/TEM.2023.3298360

Bhatt, S., & Shiva, A. (2020). Empirical examination of the adoption of Zoom software during COVID-19 pandemic: Zoom TAM. *Journal of Content, Community and Communication*, *12*(6), 70-88. https://doi.org/10.31620/JCCC.12.20/08

Chauhan, H., Pandey, A., Mishra, S., & Rai, S. K. (2021). Modeling the predictors of consumers' online purchase intention of green products: the role of personal innovativeness and environmental drive. *Environment, Development and Sustainability*, *23*(11), 16769-16785. https://doi.org/10.1007/s10668-021-01337-9

Chen, M., Ding, J., Luo, H., & Skitmore, M. (2023). A review of artificial intelligence applications in prefabrication and construction automation. *Journal of Building Engineering*, *43*, 103700. https://doi.org/10.1016/j.jobe.2022.103700

Cho, W. C., Lee, K. Y., & Yang, S. B. (2019). What makes you feel attached to smartwatches? The stimulus–organism–response (S–O– R) perspectives. *Information Technology & People*, *32*(2), 319–343. https://doi.org/10.1108/ITP-05-2017-0152

Chung, K., & Park, R. C. (2019). Chatbot-based healthcare service with a knowledge base for cloud computing. *Cluster Computing*, *22*(1), 1925–1937. https://doi.org/10.1007/s10586-018-2334-5

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four critical steps. *Journal of Personality and Social Psychology*, *89*(2), 232-248. https://doi.org/10.1037/0022-3514.89.2.232

Cox, A., Townsend, M., & Baird, K. (2018). The challenges of client relationship management in construction: A conceptual framework. *Construction Management and Economics*, *36*(7-8), 832-848. https://doi.org/10.1080/014461900370852

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.2307/249008

Dueja, V. (2024). Self-service technology in the construction industry: A comprehensive review. *Journal of Construction Engineering and Management*, *150*(5), 04024012. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002401

Ferraz, K. S., & Carvalho, V. R. (2018). The use of chatbots in mental health: A systematic review of the literature. *Journal of Medical Internet Research*, *20*(4), e10169. https://doi.org/10.2196/10169

Field, A. P. (2013). *Discovering Statistics Using IBM SPSS Statistics*. Sage Publications.

Green, F. (2012). Employee involvement, technology, and

evolution in job skills: A task-based analysis. *Industrial & Labor Relations Review*, *65*(1), 36–67. https://doi.org/10.1177/001979391206500103

Grönroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, *18*(1), 36-44. https://doi.org/0.1108/EUM0000000004784

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis*. Pearson Education Limited.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis*. Pearson University Press.

Haristiani, N. (2019). Artificial Intelligence (AI) Chatbot as Language Learning Medium: An inquiry. *Journal of Physics. Conference Series*, *1387*(1), 1-6. https://doi.org/10.1088/1742-6596/1387/1/012020

Jais, R., Ngah, A. H., Rahi, S., Rashid, A., Ahmad, S. Z., & Mokhlis, S. (2024). Chatbots adoption intention in public sector in Malaysia from the perspective of TOE framework. The moderated and mediation model. *Journal of Science and Technology Policy Management*. https://doi.org/10.1108/JSTPM-04-2024-0151

Kuberkar, S., & Singhal, T. K. (2020). Factors influencing adoption intention of AI powered chatbot for public transport services within a smart city. *International Journal of Emerging Technologies in Learning*, *11*(3), 948-958. https://doi.org/0.1177/0972050220918128

Kumar, A., Rai, A., & Ali, S. S. (2020). Self-service technology (SST) and customer experience: A review of the literature and future directions. *Journal of Retailing and Consumer Services*, *55*, 102122. https://doi.org/10.1016/j.jretconser.2020.102122

Lee, M., & Xiong, Z. (2018). Technology anxiety and its impact on e-learning system actual use in Jordan public universities during the Coronavirus Disease pandemic. *European Journal of Educational Research, 7(3), 599-614.* https://doi.org/10.12973/ejer.7.3.599

Li, L., Lee, K. Y., Emokpae, E., & Yang, S.-B. (2021). What makes you continuously use chatbot services? Evidence from Chinese online travel agencies. *Electronic Markets*, *31*(3), 575–599. https://doi.org/10.1007/s12525-020-00454-z

Li, Y., Lu, W., & Wang, J. (2023). Exploring the impacts of chatbot implementation on construction project communication: A social network perspective. *Automation in Construction*, *140*, 104222. https://doi.org/0.1016/j.autcon.2022.104222

Marfo, J. S., Owusu-Bio, M. K., & Asamoah, P. (2022). The effect of self-service technologies on customer experiences in banking: The case of Ghana. *International Journal of Online Marketing*, *12*(1), 1–18. https://doi.org/10.4018/IJOM.299404

Meng, X., Liu, Y., & Ding, Z. (2021). A review of digital twins in construction industry. *Automation in Construction*, *127*, 103723. https://doi.org/0.1016/j.autcon.2021.103723

Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. *MIS Quarterly*, *41*(1), 223–238. https://doi.org/10.25300/MISQ/2017/41:1.03

Neumeyer, X., Santos, S. C., & Morris, M. H. (2021). Overcoming barriers to technology adoption when fostering entrepreneurship among the poor: The role of technology and digital literacy. *IEEE Transactions on Engineering Management*, *68*(6), 1605–1618. https://doi.org/10.1109/TEM.2020.2989740

Nguyen, T. (2019). *Potential effects of chatbot technology on customer support: A case study* [Master's dissertation]. Aalto University.

Nicolescu, L., & Tudorache, M. T. (2022). Human-computer interaction in customer service: The experience with AI chatbots - A systematic literature review. *Electronics (Basel)*, *11*(10), 1579-. https://doi.org/10.3390/electronics11101579

Nunally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. McGraw-Hill.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, *64*(1), 12-40. https://doi.org/0.2307/2969215

Sensuse, D. I., Dhevanty, V., Rahmanasari, E., Permatasari, D., Putra, B. E., Lusa, J. S., Misbah, M. & Prima, P. (2019). Chatbot evaluation as knowledge application: a case study of PT ABC. In *Proceedings of 2019 11th International Conference on Information Technology and Electrical Engineering (ICITEE)*, 1–6.

Tabachnick, B. G., & Fidell, L. S. (2020). *Using Multivariate Statistics*. Pearson Education Limited.

Woebke, C., Seufert, A., & Tscheligi, M. (2020). Chatbots as information companions: A survey of related work and research questions. *International Journal of Human-Computer Studies*, *142*, 102420. https://doi.org/0.1016/j.ijhcs.2020.102420

Wright, L., Liu, L., & Rafiq, M. (2020). Digital transformation and BIM adoption in the construction AEC industry. *Automation in Construction*, *119*, 103480. https://doi.org/0.1016/j.autcon.2020.103480

Yadegari, M., Mohammadi, S., & Masoumi, A. H. (2024). Technology adoption: an analysis of the major models and theories. *Technology Analysis & Strategic Management*, *36*(6), 1096–1110. https://doi.org/10.1080/09537325.2022.2071255

Yoo, Y., Henfridsson, K., & Ljungstrand, I. (2012). On the interplay of digital and organizational innovation. *Organization Science*, *23*(5), 1324-1343. https://doi.org/10.1287/orsc.1110.0545

Zheng, Y., Zhao, Z., & Li, J. (2019). A review of mobile cloud computing service for intelligent construction. *Automation in Construction*, *107*, 102830. https://doi.org/10.1016/j.autcon.2019.102830