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Implementation of Blockchain Technology in Construction Project Management: a Contemporary Approach

Xie Guilin [1], Kailie Maharjan [2], Eladdadi Mark [3]
[1] *University of Science and Technology of Hanoi, Vietnam*
[2] *Technical University of Munich Munich, Germany*
[3] *University of Alberta Edmonton, Canada*

Corresponding Author: Xie Guilin, E-mail; xieguilin@gmail.com

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ABSTRACT
The construction industry is a sector known for its complexity in terms of project management. The involvement of various parties, the large flow of information, and the challenge of maintaining data validity are major challenges. In an effort to improve efficiency and transparency, blockchain technology is emerging as a potential solution. However, the applicability of this technology in the context of construction project management still requires further research. Research Objectives: This study aims to investigate the possibility and potential application of blockchain technology in construction project management. The main focus is to understand how this technology can improve efficiency, transparency, and data reliability in various aspects of construction project management. Research Methods: This research utilized a qualitative approach with descriptive analysis. Data was collected through a review of related literature as well as case studies of blockchain technology implementation in construction project management in several large-scale projects. An in-depth analysis was conducted to understand the challenges, benefits, and key factors affecting successful implementation. Research Results: The results show that blockchain technology has great potential in improving efficiency and transparency in construction project management. By utilizing features such as distributed ledgers, smart contracts, and secure transaction confirmation, the project management process can become more structured, efficient, and trustworthy. Research Conclusion: In the context of construction project management, the implementation of blockchain technology offers an attractive solution to address existing challenges. Although there are still some technical and policy hurdles that need to be overcome, the long-term potential of this technology in improving the productivity and quality of construction projects is promising. Therefore, strategic steps need to be taken to encourage wider adoption of this technology in the construction industry.

Keywords: *Blockchain Technology, Construction Projects, Contemporary Approach*

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INTRODUCTION

The construction industry is one of the vital sectors in the global economy, yet (Saberi et al., 2019), are often faced with complex challenges when it comes to project management (Andoni et al., 2019). Despite the rapid advancement of technology (Zhang et al., 2019), the construction project management process is still often hampered by various problems (Casino et al., 2019), which in turn can result in project delays (Li et al., 2020), increased costs, and even customer dissatisfaction. In this context, the "inverted pyramid backdrop" becomes a fundamental paradox.

Construction is often seen as an industry that lags behind in technology adoption (Caselli & Aricò, 2020). Many projects still rely on manual or semi-manual systems in the management process (Abd-alrazaq et al., 2023), causes uncertainty (Besser et al., 2022), confusion, and even data loss.

The research was conducted due to the importance of improving efficiency (Howe et al., 2021), transparency (Falke, 2021), and reliability in construction project management (Martin et al., 2020). This "inverted pyramid background" paradox points to the need for innovation in the construction industry to catch up with technology adoption (Andoni et al., 2019). The main objective of this research is to explore the potential of blockchain technology as a solution to overcome challenges in construction project management. Through the implementation of this technology (Van Den Berghe et al., 2019), expected to solve problems such as lack of transparency (Lapitan et al., 2021), communication delays, and data uncertainty.

It is important to address these issues as the construction industry has a significant impact on the economy and society as a whole (Lauriola et al., 2022). By improving efficiency and transparency in project management (Dwivedi et al., 2023), will not only increase industry productivity, but will also provide greater benefits to stakeholders.

Through the implementation of blockchain technology (Saberi et al., 2019), expected to create a more structured project management system (Andoni et al., 2019), efficient (Favale et al., 2020), and trustworthy. With features such as distributed ledger, smart contracts (Biswas, 2023), and secure transaction confirmation (Sallam, 2023), Blockchain technology promises to be an innovative solution to overcome existing problems in construction project management.

This research was conducted because of the importance of overcoming challenges in construction project management through the utilization of blockchain technology (Demuyakor, 2020). With the increasing complexity of construction projects and the need for greater efficiency (Meng et al., 2020), An innovative approach is needed to optimize the project management process.

This research is expected to fill the knowledge gap in the application of blockchain technology in the context of construction project management (Shadiev & Yang, 2020). Using a qualitative approach and descriptive analysis (Jan et al., 2019), we will investigate the potential of blockchain technology in improving efficiency (Kraus et al., 2020), transparency (Yudiawan et al., 2021), and reliability in construction project management.

Previous studies have highlighted the potential of blockchain technology in various industries (Cunningham et al., 2019), However, its implementation in construction project management is still limited (Howe et al., 2021). The innovation proposed in this research is the application of blockchain technology as a solution to overcome challenges in construction project management (Yates et al., 2019), with a focus on the use of relevant blockchain features such as distributed ledgers and smart contracts.

The novelty of this research lies in its focus on the implementation of blockchain technology in the context of construction project management (Kim & Bae, 2023). While there are some previous studies that discuss the use of blockchain in the construction industry in general (Wang et al., 2020), This research will bring a new contribution by analyzing specifically how this technology can be applied to solve problems in construction project management.

The next step is to conduct an in-depth analysis of the potential advantages (Wei & Chou, 2020), challenge (Kapasia et al., 2020), and the key factors that influence the successful implementation of blockchain technology in construction project management. It is hoped that this research will serve as a foundation for future research in developing more appropriate and effective implementation strategies.

RESEARCH METHODOLOGY

Research Design

This research uses a quantitative research design, which is inputted into google form as many as 20 questions (Payal et al., 2024). Which includes what influences will be caused when students use technology-enabled language learning (Favale et al., 2020). This method is used in order to formulate a new thought that is useful for every level of students (Spernjak, 2021). Then developed into a research that can be held accountable for its accuracy (Dong & Liu, 2023), which is tailored to each event experienced by the student (Selwyn, 2019). This collection method is useful to test the feasibility of language-based learning itself to improve student learning achievement (Shadiev & Yang, 2020). The quantitative method can also be interpreted as a research stage that begins with making a questionnaire containing 20 items (Gosal et al., 2019), then every answer given by students is processed using the spss application (Pardo et al., 2019). The data obtained can be proven accurate through a google form created by the researcher. And researchers also input the highest gain and also the lowest gain from the questionnaire distributed to each student. Then conclude these statements.

Research Procedure

The steps taken in this study began by asking permission from the campus and working with English teachers. Then every student filled in, from the beginning of the questionnaire made by the researcher until it reached the acquisition of filling which the researcher considered to have met the expected acquisition by the researcher. Then the researcher is also very concerned about ethics in making questionnaires that use good language and are also polite. So that students can fill out this questionnaire in a fast period

of time, which makes it easier for researchers to examine various Exploring the Potential of Renewable Energy in Contemporary Engineering Development.

Research Subjects

The subjects of this research are students of UIN Mahmud Yunus Batusangkar, the role of the researcher is to collect every answer given by students (Dube, 2020). Researchers are also assisted by English lecturers who teach at UIN Mahmud Yunus Batusangkar, especially educators who teach in the field of technology (Dubey, 2021). This study is to measure the ability of students using questions in the form of tests and then counted from the highest series of acquisition numbers to the lowest series of numbers (Hao & Ho, 2019). The researcher then inputs the score obtained through the research subject which becomes a reference for determining the category of Blockchain Technology Implementation in Construction Project Management: A Contemporary Approach (Alma Çallı & Ediz, 2023). The type of research conducted is research that strongly considers every answer given by students, which aims to determine the effect of Exploring the Potential of Renewable Energy in Contemporary Engineering Development.

Research Ethics

Of the approximately 1000 students enrolled at Mahmud Yunus State Islamic University Batusangkar, only 50 students contributed to this study. Of these. 50 students participated in this study, of which 25 were male and 25 were female with a maximum age of 19 years and 18 years. The data collection of these participants came from various villages or jorongs adjacent to UIN Mahmud Yunus Batusangkar. This research has obtained permission from the lecturer who teaches language courses. This study used several principles of research ethics. First, there was no coercion in filling out the questionnaire. This research only expects the volunteerism of students and female students who study here. Then every question must be answered completely without leaving any part of the questionnaire. This formular is very supportive and upholds rights and there is no coercion at all. This was done to ensure that the participants understood the essence of this study, out of 50 participants 80% expressed their willingness to fill out this questionnaire.

Data Collection Technique

The technique used by researchers in collecting data is to obtain various information that can be measured, compared, and calculated carefully. Through a google form format made by researchers, which was filled in by 50 students of UIN Mahmud Yunus Batusangkar. Data collection was carried out on first semester students in the 2023/2024 academic year. After obtaining permission to conduct research from language lecturers, and also IT links, online questionnaires were distributed to students of various majors. The distribution of this questionnaire was carried out on March 1, 2024 to March 30, 2024. The process of processing data that has been collected from respondents in the research field. The questionnaire data was then downloaded into an Excel file and then transferred to SPSS. 20 questions to review, the final score data is recorded in the SPSS application which can be verified. Then recapitulated as interesting as possible so that readers are interested in reading the articles made by researchers.

Data Collection and Analysis

Then the data that has been collected is inputted and processed using the SPSS application. Distributed in the form of tables and also diagrams that can calculate the scores obtained from students. The way the data is analyzed is by comparing each answer given by each student with previous studies. Data is presented in the form of average scores and percentages. Then the data is tested using the oneway anova test. Which compares the acquisition score of each group that fills in each statement related to the questionnaire made by the researcher. Researchers also really take into account the scores obtained by each student who fills out the questionnaire previously made by the researcher. And will never leave the slightest answer given by students from the beginning of filling out the questionnaire until the last student fills out this questionnaire. Furthermore, researchers will also summarize in an accurate conclusion.

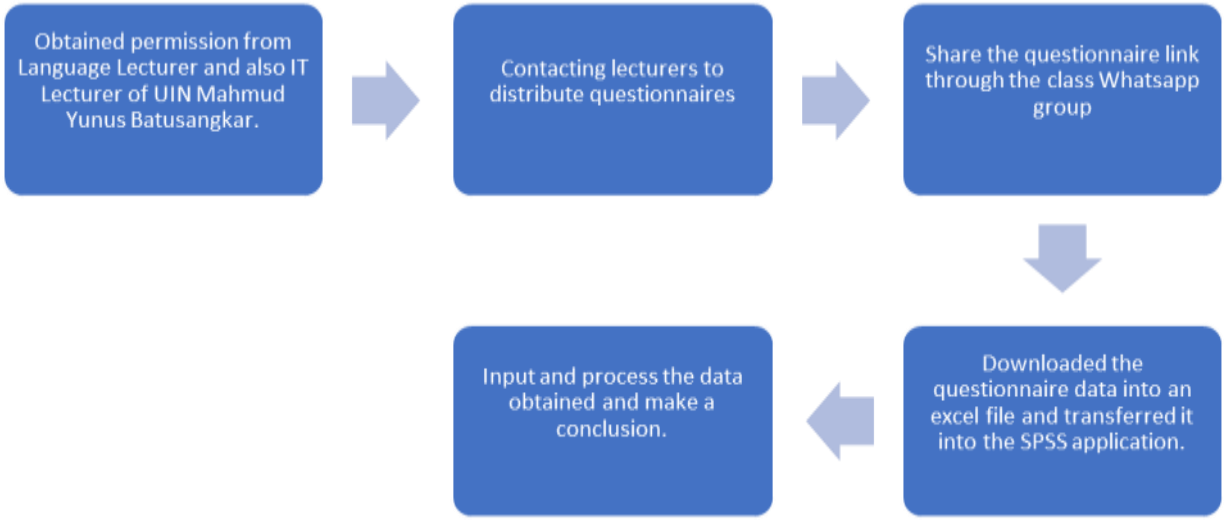
Table 1. 1
Categories of Acquisition of Exploring the Potential of Renewable Energy in Today's Engineering Development

No.	Gain category	**Value interval**
1	Strongly agree	>90%
2	Agree	70-80%
3	Disagree less	50-60%
4	Do not agree at all	0-40%
Total		100%

Table 1. 2
Research Sample Details

No	**Student Batch**	**Gender**		**Total**
		Male	**Female**	
1	T.A 2022	10	10	20
2	T.A 2023	15	15	20
	Total	**25**	**25**	**50**

Flowchart of quantitative research



RESULT AND DISCUSSION

Table 1.3
Acquisition of Blockchain Technology Implementation in Construction Project Management: A Contemporary Approach

No	Statement	SS	S	KS	SKS
1	The implementation of blockchain technology in construction project management enables the construction of a distributed ledger that ensures the validity and integrity of project data.	60%	40%	0%	0%
2	By utilizing smart contract features, blockchain technology can automate the payment process, project progress monitoring, and contract execution in construction project management.	70%	30%	0%	0%
3	Blockchain technology allows stakeholders to access information in real-time, increases transparency, and facilitates better collaboration between various parties involved in construction projects.	65%	35%	0%	0%
4	Through the use of blockchain technology, records of project construction, design changes, and material testing can be maintained in a secure and trustworthy manner, reducing	65%	30%	5%	0%

	the risk of data loss or manipulation.				
5	The implementation of blockchain can reduce administrative costs, speed up the verification process, and minimize conflicts that occur in construction project management.	50%	50%	0%	0%
6	By utilizing blockchain technology, certification processes and documentation tracking in construction project management can be improved, ensuring compliance with applicable regulations and standards.	70%	30%	0%	0%
7	Blockchain technology enables the creation of an auditable history of any changes or transactions that occur in a construction project, providing greater clarity and accountability.	60%	40%	0%	0%
8	The use of blockchain in construction project management can strengthen risk management systems by providing greater visibility into potential problems and opportunities in projects.	75%	20%	5%	0%
9	By utilizing blockchain technology, maintenance of physical assets such as buildings or infrastructure can be done more efficiently through accurate and secure data-driven monitoring and maintenance.	65%	30%	5%	0%
10	The implementation of blockchain technology in construction project management is a step towards digital transformation in the construction industry, bringing the potential to improve productivity, efficiency, and reliability in project management.	70%	30%	0%	0%

Table 1.4

Acquisition of Blockchain Technology Implementation in Construction Project Management: A Novel Approach Tested for Feasibility with One Way Anova Test.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.

X.01	T. A 2022	3,400	4	,700	.	.
	T. A 2022	,000	5	,000		
	Total	2,400	9			
X.02	T. A 2022	1,100	4	,275	2,750	,148
	T. A 2022	,500	5	,100		
	Total	1,600	9			
X.03	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.04	T. A 2022	,900	4	,225	.	.
	T. A 2022	,000	5	,000		
	Total	,900	9			
X.05	T. A 2022	1,600	4	,400	4,000	,080
	T. A 2022	,500	5	,100		
	Total	2,100	9			
X.06	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.07	T. A 2022	1,600	4	,400	4,000	,080
	T. A 2022	,500	5	,100		
	Total	2,100	9			
X.08	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.09	T. A 2022	1,600	4	,400	.	.
	T. A 2022	,000	5	,000		
	Total	1,600	9			
X.10	T. A 2022	1,900	4	,475	4,750	,059
	T. A 2022	,500	5	,100		
	Total	2,400	9			

Implementation of Blockchain Technology in Construction Project Management: A Contemporary Approach opens the door to a significant transformation in the way the construction industry operates. Blockchain technology, known for its security, transparency, and decentralization, promises to address a number of issues plaguing construction project management today. One of the key advantages of this technology is its ability to create a distributed ledger that allows all parties involved to access and verify project information in real-time.

In the context of construction project management, problems such as project delays, conflicts between various parties, and lack of transparency are common. The

implementation of blockchain technology can provide a solution to these problems by enabling the construction of a distributed ledger that records all project transactions and changes securely and reliably.

The use of smart contracts, which are linked to blockchain technology, also opens up opportunities to automate processes in construction project management. For example, payments to contractors can be automated based on the achievement of certain milestones in the project, ensuring timely payments and in accordance with pre-established contract conditions.

In addition, data security is an important aspect of construction project management. Blockchain technology provides a way to store project data in encrypted blocks that cannot be manipulated. This reduces the risk of data loss or manipulation, which is often a problem in conventional systems.

With the adoption of blockchain technology, administrative efficiency in construction project management can also be improved. Payment processes, project progress monitoring, and contract management can be automated, reducing the cost and time required for project administration.

In addition to these benefits, the implementation of blockchain technology also has a positive impact on the overall productivity of the construction industry. With improved efficiency, increased transparency, and enhanced data reliability, construction projects can be carried out faster, more efficiently, and with less risk.

However, there are some challenges that need to be overcome in implementing blockchain technology in construction project management. For example, there are still issues related to the scale, interoperability, and security of blockchain technology that need to be solved before this technology can be widely adopted in the construction industry.

In the future, collaboration between various stakeholders and investment in research and development will be key to harnessing the full potential of blockchain technology in construction project management. With the right measures in place, blockchain technology can become one of the key tools in improving efficiency, transparency, and reliability in the construction industry.

CONCLUSION

The takeaway from the implementation of blockchain technology in construction project management is that this contemporary approach offers an innovative and transformative solution in addressing challenges commonly faced in construction projects, such as complex supply chain management and the need for data transparency. By leveraging blockchain, project management processes can be improved through decentralized, transparent, and secure recording of transactions, which reduces the risk of errors and delays and improves overall accountability and efficiency. In addition, the application of blockchain also opens up the potential for better collaboration between the various parties involved in a construction project, bringing about a positive impact in the overall management of project resources, time, and costs.

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