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# Blockchain Applications through the Lens of Project Managers

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This paper succinctly addresses the initial results of the first phase of a study aiming at the application of blockchain technology in project management. In the first stage, the perception of project managers toward the application of blockchain technology in professional areas was explored. After briefly reviewing the concepts of blockchain technology, smart contracts, and integration of the BIM and blockchain, a blockchain network is introduced as a case application in project management. This paper shows that blockchain is a viable system for governing project contracts by automating the consequences of each transaction and maintaining a tamper-proof record of project progress, which would be valuable in any kind of dispute resolution. In addition, the familiarity of project managers with potential applications of blockchain in project management was investigated through a quantitative method via a survey distributed to project managers. The results indicate that the advent of blockchain sets a platform for further integration of technology in various project management areas. The results also show that practical knowledge of project managers through blockchain-based cryptocurrencies correlates with their perceptions toward blockchain applications. The results suggest project managers can plan accordingly to embrace blockchain potentials along with other industries.

**Keywords:** Project Management, Blockchain, Smart Contract, Construction

## Introduction

Construction projects include a horizontally and vertically complex supply chain coming together to realize a project's objectives. Multiple parties, often with conflicting interests, enter into contractual relationships that often lead to adversarial dispute resolution due to the nature of the work and the contracts supporting it. Innovative procurement and contracting models, Building Information Modeling (BIM), and other technological advances have been proposed and implemented to reduce the tension and improve the efficiency of the construction processes. However, construction still has a long way to get to an optimal point compared to other industries. Blockchain technology uses a decentralized peer-to-peer system to govern the relationship between different parties involved in a network. This approach is against the typical centralized business networks used in most cases. A lot of efforts, such as cloud BIM have been made to integrate the procurement network of construction projects. However, in all of them, there are different segments or parties that are left out. The complex structure of a construction project very well matches the peer-to-peer structure of blockchain technology. Furthermore, it can work as a platform where all the parties involved in a project are

included in an integrated framework of project management to increase the efficiency of the project as well as reduce the hostility and possible conflicts in it. This paper discusses the blockchain technology and possibilities for its adaptation in the project management process, which is then followed up with results of a survey and follow-up discussions.

## Literature Review

### *Blockchain*

Blockchain is a decentralized transaction and data management system technology that has mainly been used for cryptocurrency and the financial service sector. Blockchain can be described as a digital list of transactions that is recorded and distributed across the entire network of computer systems. Throughout this chain, every block contains a number of transactions. In this system, every time a new transaction initiates, a record of that transaction is added to every participant's list. Blockchain allows everyone in the network to see every aspect of information with no one person being in control. Applying blockchain into construction could solve many challenges, including trust between different parties working on a project, transparency, and time issues. Potential applications of blockchain could be notarization-related, transaction-related, and provenance-related. Blockchain can eliminate the verification time of documents' authenticity, and every document can be stored in a distributed ledger. The time and cost it takes to dispute payments, technology transfer, equipment leasing, etc., can be decreased with all the processes being automated and neutral on the blockchain. The supply of each product or service can easily be traced through a blockchain ecosystem allowing for transparency from all parties. Blockchain can also be used in combination with other technologies already used throughout construction, such as BIM, IoT, and cloud computing. The co-evolution of these technologies and blockchain could lead to beneficial applications in construction, such as information management, payments, procurement, regulations and compliance, supply chain management, dispute resolution, construction management and delivery, and technological systems. Overall, the use of blockchain in the construction industry could help improve the time, costs, and disputes of the final project.

### *Blockchain in Project Management*

Blockchain technology has emerged in the project management realm in recent years, and different purposes and applications have been identified to employ the technology. Amoah and Oh (2020) reviewed different models and proposed applications of blockchain in project management and stated that blockchain-based BIM and smart contracts are two applications of the technology in construction project management. In addition, project management offices PMOs can benefit blockchain-based applications through creating and managing digital records, coordinating the tasks between stakeholders, and reinforcing acceptable performances. El Khatib et al. (2021) reviewed six different blockchain-based cases in which different aspects of project management were evaluated and concluded that automation of the process, transparency, enhanced stakeholder management, and cost management are among the advantages of the blockchain in project management. In another whitepaper published by Blockchain Research Institute (Williams et al., 2019), payments, provenance, and data management were specified as early days of blockchain applications while followed by smart contracts and supply chain management. Blockchain as a distributed, encrypted, immutable, time-stamped, and secure platform helps PMOs to decrease project monitoring and controlling while improving overall project efficiency (Budeli, 2020). While many studies have explored various applications of blockchain in project management, areas consisting of multiple entities or processes are potential fields to employ blockchain technology (World Economic Forum, 2020; Tezel et al., 2020; Backman et al., 2017).

### *Blockchain in Construction*

The construction supply chain can be divided into seven categories: Clients, Architects, Engineers, General Contractors, subcontractors (trades), Suppliers (including manufacturers), and Authorities. In most projects, different entities represent one role (i.e., sub-contractor, supplier) which means in each project organization, more than ten entities are routinely interacting. The current paper contracts require a paper trail for every administrative task, which makes the process cumbersome, slow, and error-prone while making the document management of each project a dreadful task. In contrast, a blockchain network can easily connect all different parties together digitally while governing the transactions between the entities through smart contracts, which can result in a level of automation that is not possible through other currently available means. The transactions will be chained together through the secured hashes and leave an immutable trail of events that can be used to instantly solve any conflict. Furthermore, the blockchain network can be integrated with a BIM model to create a seamless digital twin construction environment, where all parties are using the same live model for design and construction purposes to achieve a higher level of integration and efficiency (Shojaei et al., 2019a). In order to create such a network, a public blockchain (such as Ethereum) or a private blockchain platform such as Hyperledger Fabric can be used. A public network would provide higher security, but the scalability issues and the costs associated with each transaction can become a major barrier. On the other hand, a private network such as Hyperledger Fabric can provide the right balance of versatility, scalability, security, and operation cost to the construction projects. This integration can be done by assigning a unique ID number that can be generated using the MD5 hashing algorithm and integrating those IDs into the smart contract, and tracking its progress in the project. The use of MD5 hash means that any change to the initial component would result in a different hash which can be easily flagged out by comparing it to the previous blocks. Three main elements in the Hyperledger Fabric network need to be defined: network model, business logic, and access control limitation. The network model is the foundation of the blockchain network where all different parties, types of transactions, assets, and events are defined. Business logic is smart contracts algorithms that will govern the relationship between the parties and decide if a transaction is valid or not. The access control limitation would define the access privileges for each entity to different types of information. Any type of construction project, regardless of its delivery method, supply chain complexity, and objectives, can be easily adapted to such a network structure. Furthermore, the use of this network in construction can be extended to improving the sustainability of the built environment through facilitating the embodied carbon and energy calculations (Shojaei et al., 2019b) or even making a greater impact by getting us closer to making a circular economy a reality (Shojaei et al., 2021). These objectives will be easily achievable by adopting a blockchain network as a foundation for a construction project's total supply chain management.

### **Methodology**

The main purpose of this study was to explore the perception of project management professionals toward potential uses of blockchain in project management areas with a glance at the construction industry. Blockchain technology is a novel and emerging technology that is finding its path into non-financial contexts. Since these non-financial areas have just started to study the feasibility of blockchain applications, any deductive analysis is channeled with reliability issues. Therefore, in this study, construction management is assumed under the general project management umbrella. In the first stage of this study, project management professionals in different sectors in Mississippi participated in an educational module that overviews the different applications of blockchain. Project Management Institute (PMI), as the leading not-for-profit professional membership association for the project management profession, delivers values to more than 2.9 million professionals working around the world (PMI, 2021). PMI strives to enhance project managers' careers, improve

organizational success, and further mature the profession. The first stage of this study was conducted through the PMI chapter meeting in which project management professionals convened to interactively pursue the discussion on the blockchain application in project management. As the first part of this educational module, a survey was designed and distributed to the participants to further explore their perceptions toward different aspects of blockchain and its potentials in project management. The data obtained from the survey were then organized and structured to create a data model. Different descriptive analyses were performed to analyze the data. The results of these analyses are described in the next sections.

## Results

The data obtained through the survey were organized, modeled, and analyzed in statistical software. Seventeen project management professionals participated in the first round of the survey. Female participants comprised 65% percent of the participants, and the rest were male professionals. Participants also reported other demographic information, as shown in Figures 1-3.

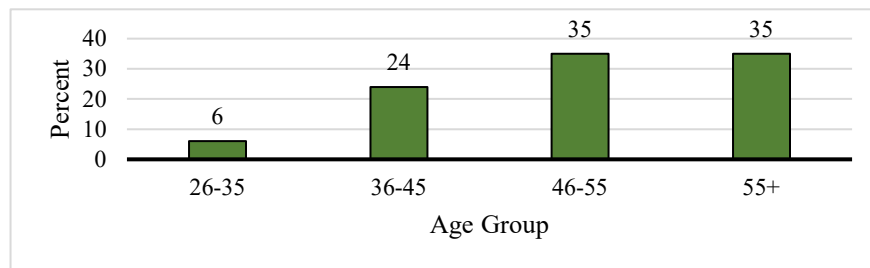


Figure 1: Participants age groups

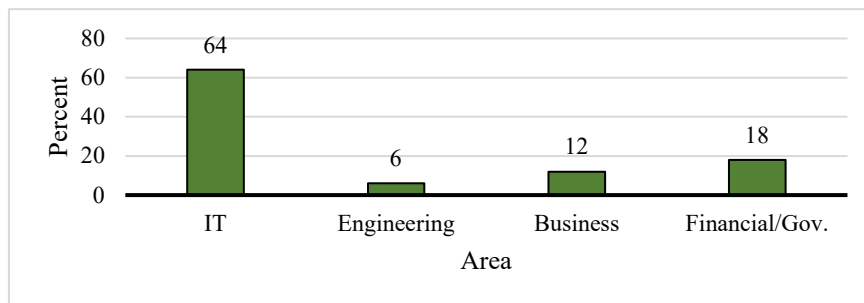


Figure 2: Participants area of expertise



Figure 3: Participants work experience

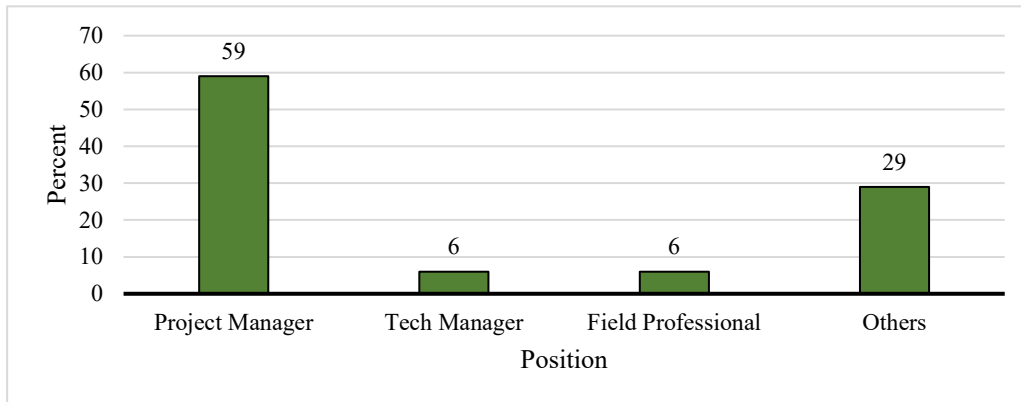


Figure 4: Participants position

Also, participants reported that, on average, they are directly working on 2-5 projects (76%) and 6-10 (24%) at a time. In the next section, participants were asked if they were familiar with any cryptocurrency other than Bitcoin and if they own any cryptocurrency. The majority of participants reported that they were familiar with altcoins, and about one-fourth of participants owned one or more cryptocurrencies. The percentage of each group is shown in Figure 5.

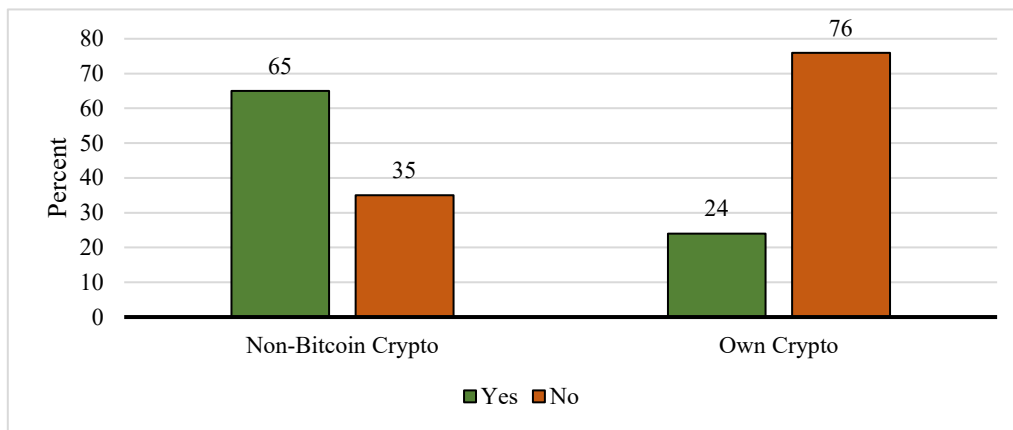
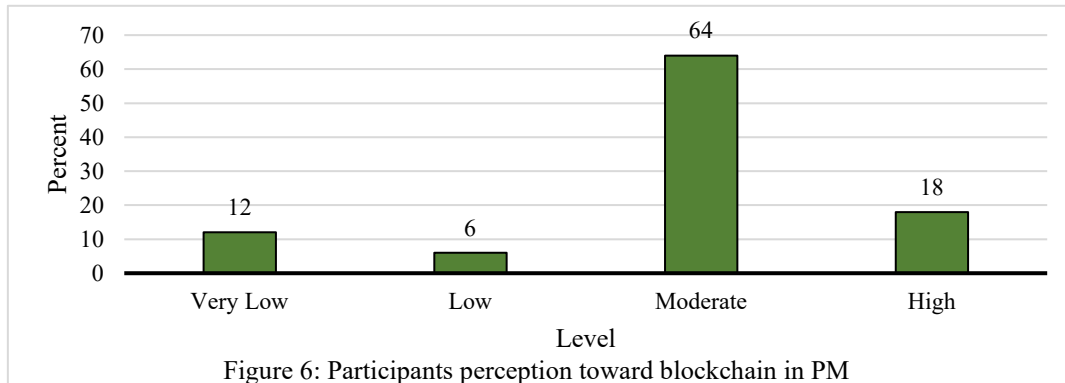


Figure 5: Participants and Cryptocurrencies

In the next section, participants were asked to rate to what extent they believed the blockchain technology could be used in project management, using a five-level Likert scale (1: Very Low; 5: Very High). While 18% of participants stated that the blockchain has low potential to be used in project management, the majority of participants rated the application of blockchain as moderate or higher.



In the next section, a group of possible applications for blockchain technology was provided to participants to be evaluated. Participants were asked to what extent they evaluated the potential of blockchain in different subjects, including medical records, e-notary, tax collection, smart contracts, supply chain management, insurance, and energy. These areas were derived from the literature review in which the emergence of blockchain technology is conceptualized through different applications or frameworks. A five-level Likert scale was used to rate the potential of areas to exploit blockchain. All these areas received weighted average scores above the mid-point, which indicated the positive attitude toward the use of blockchain; however, among these areas, smart contract and supply chain management was rated above others. The percentage of levels for each area is shown in Figure 7.

*Analysis of Associations*

The analysis of the association between gender and blockchain potentials revealed that female participants displayed higher scores in areas that can utilize blockchain. A similar trend can be seen between the two groups of “crypto owners” and “non-owners.” This means, possessing any cryptocurrency has a positive association with the perception of blockchain in different areas of project management. With five-level Likert scale (1-5), the weighted average of each areas’ score (out of 5) is shown in Table 1.

Table1: Weighted average score of blockchain potentials

Gender	Blockchain in PM	Medical Records	E-notary	Tax Collection	Smart Contracts	Supply Chain	Insurance	Energy
Male	2.67	3.33	2.83	3.33	3.67	3.83	3.00	3.33
Female	3.00	3.36	3.36	3.73	3.82	3.73	3.45	3.64
Crypto Owners	3.25	3.75	3.75	3.75	4.00	4.00	3.50	3.50
Non-owners	2.77	3.23	3.00	3.54	3.69	3.69	3.23	3.54

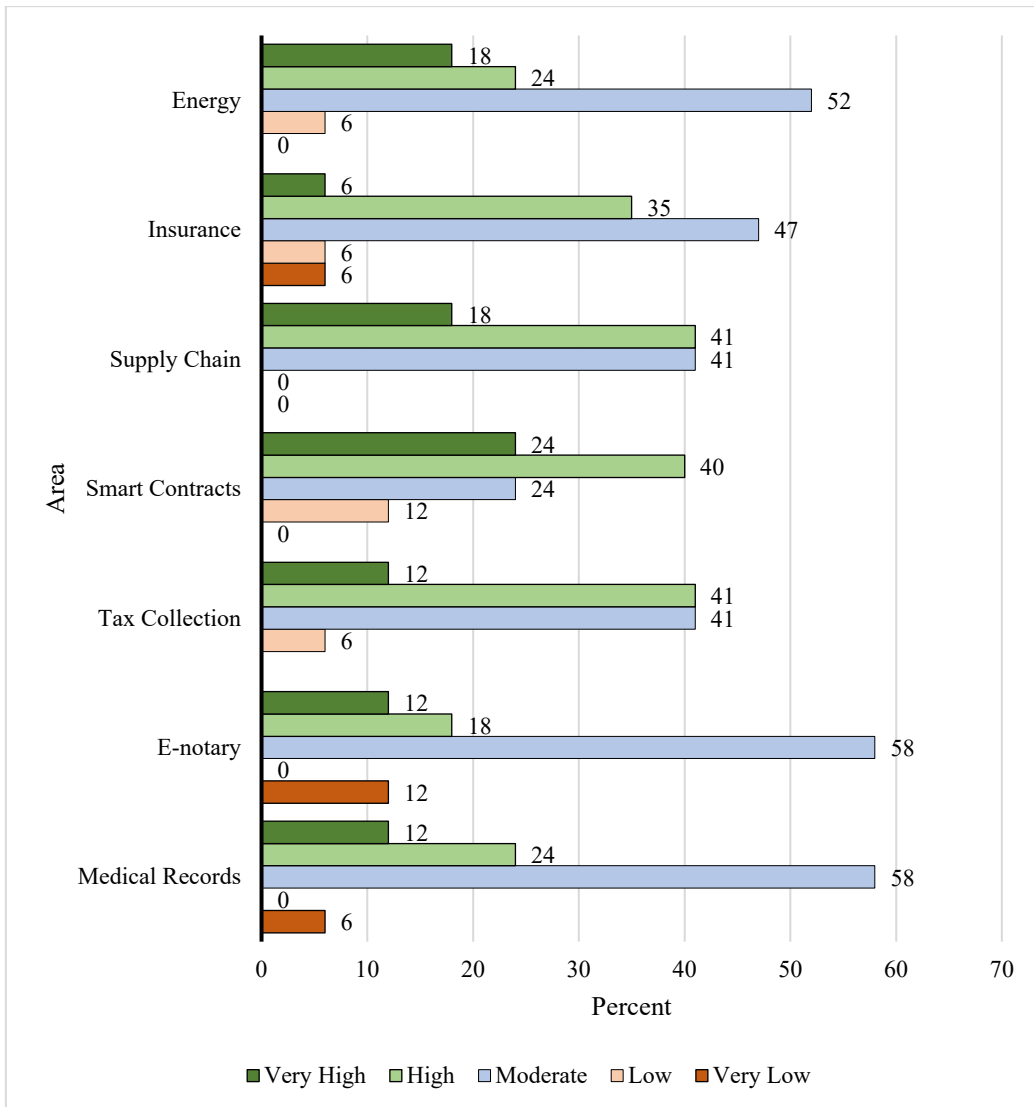


Figure 7: Participants perception toward Blockchain in different PM areas

### Discussion

Blockchain as new technology has crossed its initial boundaries in cryptocurrencies. This technology is emerging in various professional and technical fields. It is shown that various frameworks and models can adopt blockchain and provide better services or products in a distributed system. One of the areas that blockchain technology can enhance is project management which itself includes many sectors. Conducted research in recent years has suggested various applications for blockchain in managing projects. There are even some instances of such applications to prototype the model. Despite these, the project management body of knowledge is still untapped, and project management

professionals are not fully aware of blockchain potentials in their professions. One of the steps to start the feasibility review of potentials is to explore the perception of project managers toward different aspects of blockchain, which is the goal of this study. In the first stage, reported in this paper, a group of PMI's affiliated project managers was surveyed, and the descriptive analysis of the data was provided in the result section. Reviewing the results indicates that project managers, even those who had a background in IT, reported relatively low familiarity with blockchain. As reflected in Figure 5, the details of blockchain and its application in project management were not known for all participants. While it is expected that project managers are among those who explore new technologies to apply this, a lack of familiarity can delay the adoption process. This issue might be intensified in construction project management due to its characteristics. This fact necessitates large discussions and explorations of blockchain in construction project management. The next point, derived from the results, was the positive attitude of project managers toward blockchain. As a consistent issue in the blockchain and cryptocurrency domain, trust has been a pivotal point in the success of the technology. Without public trust, which is central to the concept of the blockchain, none of its applications can flourish. Therefore, if a positive attitude toward blockchain is seen, it indicates a constructive direction for trust-building. While trust is impacted by numerous factors and has a lengthy process to reach a reliable threshold, any positive move can facilitate it. Generally, positive attitudes stemming from internal feelings or external sources smooth the road for trust. The average scores of the applicability of blockchain in various areas were above the mid-point. These scores were given without any prior technical presentations or discussions. The next point that underscores the importance of proper blockchain technology for project managers was the association between the previous familiarity and attitudes toward the subject. Owning cryptocurrencies provides opportunities to technical learn the nitty-gritty of blockchain, which in turn results in positive perceptions of professionals toward potentials of the technology. It should be emphasized that the factors discussed here are among the external ones and can positively or negatively impact the speed of blockchain adoption in project management. Internal and technical factors are outside the scope of this research and need more thorough studies to be explored. Another interesting observation is the relationship between the gender and applicability score, specified in Table 1. However, this trend does not imply a causal relationship, and a larger sample size and repeated measures are required to draw any generalized conclusion.

## Conclusion

This paper succinctly discussed the applications of blockchain technology in project management and presented pilot survey results to illustrate the state of knowledge among the project managers on the fundamentals and possible applications of blockchain in this area. Blockchain technology can bring different parties involved in a project closer together, increase the efficiency of the project processes through automation by smart contracts and faster access to any desired information, increase transparency through the protected distributed ledger, which results in fewer conflicts, and increase the security of the project information. Specifically, construction projects can benefit from the integration of blockchain technology on an organizational level. The survey results show that project managers are not very well-versed in the application of blockchain in project management, and educating them while producing different tools and applications to facilitate the integration of this technology with project management is a critical step. The number of participants can be named as a limitation of this study which entails conducting the survey using a larger population as future work in this line of research. Furthermore, more empirical investigation and research and development are needed to integrate different aspects of project management processes with blockchain technology.



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