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THE IMPACT OF BLOCKCHAIN ON PROJECT MANAGEMENT

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Abstract. *Blockchain and Project Management (PM) are two interrelated approaches to the success of projects. The literature presents evidence of the PM and blockchain values and challenges, and then it relates between them. Hence, this research aimed to study the role blockchain can play in improving PM. Six case studies based on blockchain in e-services were used to analyze the relation between PM and blockchain. In addition, deep analysis was conducted for further understanding the impact of this technology on PM and project success. As a result, the probability of executing a successful project will improve when PM is combined with blockchain through enhancing cost management, processes automation, transparency, and stakeholder communications.*
Keywords: Blockchain, Smart contract, Project management, E-services

1. **Introduction.** Finishing a project within allocated time and budget is a concern for any project manager. In addition, establishing a productive working system between businesses, contractors, and project teams becomes a key element to ensure project success. Old-style PM is a locked book, with the project manager torn between customer expectations and team productivity. Nowadays, blockchain technology is spreading quickly and is considered as a new wave of Internet that is promising to change the traditional business market by giving more secure, transparent, and efficient options. Therefore, evaluating this technology is important to understand how it could contribute in improving PM challenges and increase the potential of meeting the objectives of the project and project success. The problem with PM is the manual activity and miscommunication between all stakeholders, as well as lack of integrity, in addition to lots of human intervention in many processes that results in human error. In such cases, blockchain can be considered as a rich environment that contributes in enhancing techniques of managing projects and overcoming these issues.

The aim of this paper is to answer the question of "*how project management can benefit from the blockchain?*". The first section will explore blockchain technology and the reason behind its rapid growth. The second section will examine six case studies of different implementation of blockchain. For in-depth study, secondary data will be used as research methodology to find how this technology contributes to PM. Based on these findings, the outcomes will be discussed after analyzing the results and conclude by providing future recommendations.

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2. Literature Review.

2.1. **What is blockchain?** Blockchain was first initiated in the early 1990s by a group of researchers and it was originally designed for peer-to-peer currency system, but since then it has evolved and been applied to numerous cases. It ensures the data that has been entered cannot be tampered with or deleted because any change that is made in that block will cause rewriting of the whole history of the transaction [1]. Due to the open source nature of blockchain, a huge number of new blockchain networks were identified in the last 10 years to provide unique features and functionality. These are, smart contract, decentralized application, supply chain, and private transaction. Therefore, blockchain can be applied to recording, tracking, and confirming transactions without the need for central authority. It reduced risk and cut costs for all parties involved in the transaction [2]. Blockchain stores the transaction records in blocks and these blocks are linked together to form a chain. Therefore, this technology is named blockchain. It uses a one-way mathematical function that maps complex size data into structured fixed sized data called Hashing [3]. Figure 1 presents the blockchain structure:

- The hash of the block is the identification. This hash is unique like a fingerprint.
- The block contains the previous hash of the block.
- The timestamp batches of the recent transactions. Blocks make blockchain tamper-proof.

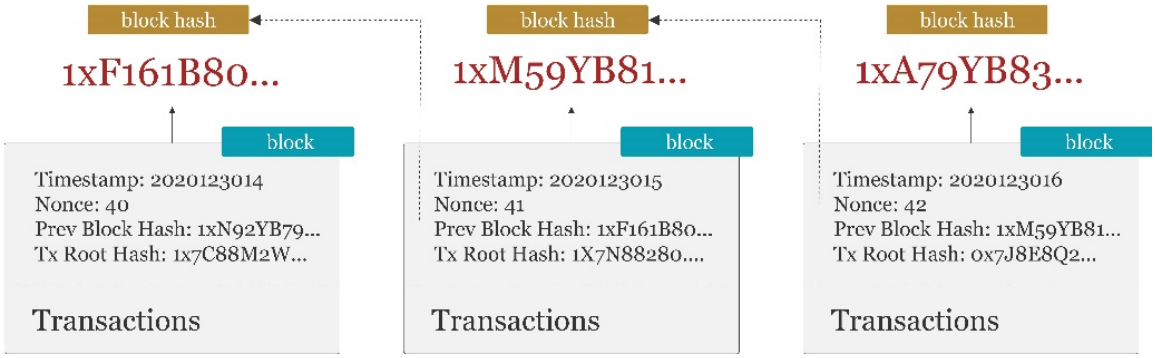

FIGURE 1. Blockchain structure

What is smart contract? Smart contract is an aspect of blockchain that allows the execution of credible transaction mutually distrusting agents, without approval from third party [4]. It is based on computer code that works in a logical flow and makes transactions between clients and service providers faster. The objective is to provide advanced security that is superior to traditional contract law while reducing transaction costs. Moreover, it is a self-executed contract that does not need human interference once the required objective is met.

2.2. Critical success factors.

2.2.1. *Communication.* If any member made a change, the rest of the users in the network would need to agree to the update of their ledger. The consensus update keeps all team members aware of the situation and to be ready for the next step.

2.2.2. *Data traceability.* Proof of work and timestamps are two properties that take place within each transaction to record the time and participant of the transaction [5]. These characteristics prevent any repetitive transaction on the network through making a unique inexorable signature on each block.

2.2.3. *Data security.* Blockchain relies on peer-to-peer transaction without any interference of another authority that can control the time and amount. Decentralization attribute prevents any data leakage or hacking because of a hash signature that has a certain value which connects each block to the other [6]. If a change appears in the block, the hash will change and will cause a disconnection between the previous and the next block [5].

2.2.4. *Regulation.* Blockchain has no official regulation to manage the crypto currency and it eliminates third parties' interference such as banks which will eliminate the government control. Illegal activities might take place when there is no audit on when and where this money was spent [5].

2.3. **Why blockchain now?** Blockchain has existed since the beginning of the 90s, but today it has become one of the fastest growing technologies due to its features. It can transform the world by generating good resources, tools, and putting useful information in human hand [7]. Moreover, it can increase the traceability of goods, financial assets, and improve the efficiency of transactions and facilitate market access.

2.3.1. *Transparency.* People are seeking to know more about their products, and what are the resources, market, selling, end-result, and why it ends with this price. This would help them to verify the products they own and to ensure there is no manipulation. This process is called supply chain and it is one of the critical aspects in managing resources. It contains one of the most complicated networks that combine all organizations, individuals, activities, resources, and technologies that are involved in developing or selling a product.

2.3.2. *Optimize and automate processes.* Blockchain has the potential to optimize processes and automate them at the same time. Any process has a series of activities and decisions that are needed to be made which later will be executed [8]. This journey usually takes a long time to be achieved with different approval levels. However, with blockchain, the duration can be optimized because it can audit and correlate between the entered data as well as it can carry out the execution without human intervention.

2.4. **Blockchain and Project Management (PM).** Blockchain and PM can both deal with the flow of resources that are necessary for running a project. Blockchain offers a rich environment for many businesses to improve their current PM processes by optimizing it, which help them reduce misappropriation of funds and delays, and increase the efficiency of work [9]. As in PM methodology, there are no changes happening since it is a well-defined science developed through years of experience and knowledge. Alternatively, the only change that might happen is that the technology would be utilized to enhance the efficiency of executing the project. In fact, it could be an advantage to empower the project manager with all aspects which increases the chance of project success as well as draw a full picture of the project progress [10]. The smart contracts allow for automatic payments when conditions are fulfilled as well as they can be set up for performance management, checking how project milestones are being met, assigning the team member who completes a task to a new one automatically, or even rewarding them with a bonus for early task completion.

2.5. **Area in which blockchain can add value in PM.** It is important for the project manager to integrate and manage resources, coordinating tasks, stakeholders, and other project elements. Integration in PM means the integrating of all aspects of a project and coordinating all activities in the project framework process [9]. Obviously, if a project manager cannot track project process, it may either lead to going over budget, or a delay. The decentralized capability of blockchain can help in overcoming all these issues in any project. The project team and stakeholders can be connected in one decentralized location without any limitations and coordinates all project components in a transparent way [5].

3. **Methodology.** In order to answer the questions of this paper, we agreed to use a qualitative method. Six case studies from different entities across the world will be chosen to discuss the impact of blockchain in PM. Secondary data is the main approach to gathering the information to understand in depth the reason of choosing blockchain and its role in projects.

3.1. **Case demonstration.** Six case studies were picked up based on blockchain implementation in four Dubai government entities in addition to one from Georgia, and one from Malta. The method we relied on in gathering data is an interview for UAE cases only, .gov websites, and official press websites. In this section, we will look into e-services as a project. Table 1 explains the six chosen case studies with the motivation to adopt blockchain.

Table 1. Cases demonstration

Case	Demonstration	Motivation
Case A: Payment Reconciliation and Settlement **UAE**	Payment gateway to perform a transaction, such as electricity bills, car fines, and university fees payment. It integrates several government entities with financial providers like banks and federal finance department for auditing the transactions.	Automate the process of validation the transactions between the involved entities of each transaction.
Case B: Property Centralized System **UAE**	A unified portal for renters, sellers, and brokers to perform all transactions related to buying, selling, and renting property in one location.	Automate the end-to-end real estate business process. Provide better collaboration with all parties involved in real estate business and increase efficiency.
Case C: Vehicle Chain **UAE**	Fully integrated platform for vehicle lifecycle management. This system aims to provide an easy access to all vehicle information such as ownership, services, accident history, and maintenance in one location.	Need for a complete car information record to assist the buyer in choosing the best option and to provide him/her with a full journey of the car manufacturing process starting from scratch until it reaches the scrap yard.
Case D: Food Supply Chain **UAE**	Building a platform to provide a full image of the food journey, validate ingredients, and nutrition information.	Digitalized food and nutrition supply chain system anchored to facilitate the exchange of data starting from raw food with food businesses until it reaches the consumers.
Case E: Title Registry **Georgia**	Land registry system to provide citizens with digital certificate for their land title [10].	Automate land title validation process.
Case F: Academic Credential **Malta**	Educational certificate verification credential [11].	Allow all student, academic certificates, diplomas to be delivered to them in portable and digitalized form.

3.2. **Case assessment.** Based on the demonstrated case studies, we did an assessment for each one to find the problem and how blockchain contribute to overcome these problems to measure the effectiveness of this technology as shown in Table 2.

Table 2. Cases assessment

Case	Problem	Blockchain solution
Case A: Payment Reconciliation and Settlement **UAE**	• Validation is very slow (45 days to be completed) [12]. • Absence of a real-time dashboard. • Manual work. • Physically collecting the report.	• Real-time reconciliation and settlement. • Limited human intervention. • Automated the whole process's life cycle. • Clear visibility of funds. • Transparency of financial transaction.
Case B: Property Centralized System **UAE**	• Rental process in Dubai considered a lengthy process. • Intensive duplicate papers. • Long travel time. • Manual validation. • Expensive fees.	• Automation of the process. • Providing real-time processing. • Unchallengeable audit trial.
Case C: Vehicle Chain **UAE**	• No ways to track any vehicle life cycle. • Lack of collaboration. • Lack of transparency and trust.	• Platform integrates the whole vehicle's life cycle with transparency to all end users.
Case D: Food Supply Chain **UAE**	• No tool available to provide a full image of food supply chain in the UAE.	• Automation repetitive task and learnings. • Achieve incredible accuracy. • Increase operational efficiencies. • Fast and more informed decision.
Case E: Title Registry **Georgia**	• Slow process (1 to 3 weeks). • Lack of security. • High operation cost.	• Verification process reduced to seconds. • Reduced operation cost. • Eco-friendly system.
Case F: Academic Credential **Malta**	• Expensive fees. • Time consuming. • Lack of integrity. • Manual process.	• No fees required. • Interoperability and longevity. • Full ownership. • Records integrity.

3.3. **Case analysis.** The analysis was about how blockchain is utilized in these projects.

3.3.1. *Case A.* Smart contract was used heavily to process the data, reduce human intervention, and automate the process. It assisted in easily checking the project progress report and monitoring the performance of the project team that helped in meeting the objectives within the agreed upon time and cost. It also helped in automation of the payment process that usually takes time to validate and get all the approval from the respective departments.

3.3.2. *Case B.* Blockchain contributes to minimizing the paper bureaucracy and improving the project workflow. The smart contract enables efficient integration between all stakeholders during executing the project. Blockchain increases speed and security across payment and financial transactions as well as it reduces the signatures requirement and delays in getting approval from stakeholders.

3.3.3. *Case C.* All documents that are related to different transactions were stored and a decentralized database created which allows different stakeholders to access it and monitor all project milestone completion. It improved the quality of governance and accelerated workflow as well as integrated public and private sector and connected all relevant entities. In addition, smart contract was used to ensure implementation of all agreements in the contract.

3.3.4. *Case D.* This solution overcomes the problem of food supply chain from being crops to its final product. It is based on smart contracts and the digitalized exchange of data enabled delivery of real-time assurance based on predictive insight from what went wrong to what is likely to go wrong. Blockchain facilitates trust among parties and decreases transaction cost by reducing duplication, reconciliation, and record-keeping task.

3.3.5. *Case E.* This project is based on Exonum, which is a blockchain framework that allows building secure permissioned blockchain applications [10]. The National Agency of Public Registry was able to provide Georgia's citizens with digital certificates of their assets supported by the cryptographic proof. It enables the owner of the document to prove their legitimate ownership of the property by showing their timestamp as well as it ensures property title could not be altered.

3.3.6. *Case F.* This system is based on Blockcert which is the most widely used global open standard for blockchain credentials [11]. It reduces the cost of administrating educational institutes as they are not involved in queries of certificate copies and transcripts. In addition, it eliminates the chance for hard copies and fake certificate.

4. **Case Judgment.** Through analyzing the six case studies, we can summarize the findings as follows: blockchain will not replace the traditional PM process and knowledge, but it will empower project managers with new technology to increase the efficiency and chances of managing a successful project. Blockchain will contribute positively in some phases, especially those which are associated with third party control, flow of funds, and transactions that require bureaucracy of documents. According to the UAE Government [12], with the implementation of projects on blockchain, the UAE government expects to save 77 million working hours annually, 11 billion in document processing, 398 million printing documents. The following are the main impacts of blockchain on PM.

• **Automation of the process.** Automation is one of the keys for speeding up the routine jobs. In such activities, sequencing of processes is required, and that consumes time, risks human errors, and in some cases, the organization must do outsourcing to validate this work. Smart contract can automate many processes, such as getting approval reports, information sharing and task completion through identifying the objective that must be achieved in the project and enable the smart contract to trace the task fulfillment. In complex projects, smart contract is an effective tool to manage interdependent tasks. Once all required activities are fulfilled, the report will be submitted automatically. It will reduce the delays of time and unnecessary expenses of routine jobs in any project. Moreover, smart contract can contribute to automatically assigning resources based on task completion recorder from the previous projects.

• **Transparency.** All transactions and reports will be available to everyone involved in the project because of the shared ledger which enhance the communication in the project in a secure way. Blockchain will simplify task dependencies that helps to enhance the cooperation amongst the project team. It provides a way to track contractors and subcontractors' deliverables that will enable others to identify reliable contractors from their performance history [13]. In addition, due to the high level of security available, no one can alter or change data without the acknowledgement from all parties that ensure

the elimination of manipulation in projects. This will help project managers to focus on more challenging and value-added tasks.

• **Enhance stakeholder management.** Blockchain will change communication methods between the stakeholders. In many projects, stakeholders do not know about the intermediates that happened in the project. Smart contract will give them the opportunity to monitor the performance of the project and they will be proactively engaged with every phase and will ensure meeting their expectations.

• **Cost management.** The average payment time for some projects became 82 days and sometimes it can reach as high as up to 120 days [14]. With blockchain, organizations may be able to send money across borders with lower fees in the absence of the middle person. It enables virtual currencies such as Bitcoin to be used by the people who even do not have access to traditional banks. In the finance operation, most of the transactions are based on the authorization of top management, and petty cash handling are dependent on various factors. As there is no involvement of a third party in the transactions, the process is much easier and quicker than the usual way [14].

• **Lesson learned.** Sharing lessons learned among project team members prevent an organization from repeating the same mistakes and allow them to take advantage of the best practices. However, many project managers ignore this stage of PM that results in losing valuable knowledge gained during and between projects. Here, blockchain can provide a valuable source for documenting lessons learned from each phase and process in old and current projects which leads to having a valuable repository that can be utilized as a reference for executing future projects.

5. **Recommendation.**

- Organization should be more open to learning about blockchain benefits and be more flexible with sharing their data and decentralized database.
- Encourage to initiate pilot programs and blockchain labs.
- MORO is an Emirati entity that offers digital services, data center, and cloud services that makes it a trustable opportunity to establish digital integration channel between all government and private sectors in the UAE.
- Establish programs between governments and entities with blockchain pioneers in the world to gain knowledge and determine best practices.
- Educate key stakeholders like financial institutes, startups, and policy makers about the blockchain technology, so that they can seize its benefits.

6. **Conclusion.** To sum up, the results that have been obtained from the case studies show that blockchain and PM can work together to increase the efficiency of executing a successful project. It provides a way to record and transfer data in a secure, auditable, and transparent way. Smart contract can empower project managers and play a significant role in optimizing manual processes, enhancing communication with stakeholders, and providing a transparent record in different phases of PM. In addition, the high level of security that is available with the blockchain makes it a safe and secure method to use in projects because once the data is recorded no one can change it unless it gets agreement by consensus. With all benefits provided by blockchain, there is no questioning why many organizations are turning to use this technology in their daily operation work.

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