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Adoption of Block Chain Technologies in the Paper Industry: Process, Benefits, and Challenges as well as Performance Analysis

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Abstract

Blockchain is the technology which consists of a chain of blocks that store the necessary information including digital signatures with a validation process in a decentralized and distributed type of network. Immutability, transparency and auditability, make the transactions more secure and tamper proof. In Bangladesh if the paper industries use the block chain technology, then their production and transparency will be very high. Blockchain technology can effectively record every asset throughout its flow on the supply chain, contribute to tracking orders, receipts, and payments. In this paper, data is collected from a large paper industry in Bangladesh and also from online databases for comparison. A qualitative thematic analysis has been performed in accordance with the investigative processes that are developed by Creswell. We evaluated the impact of the most influential design and parameters (load) on the resulting commitment. For analyzing the performance of the model, Markovian Non-purging fork join queueing model is used. Finally, the model is studied by the real word data and to show its functionality.

Key Words

Blockchain, Thematic analysis, smart contract, consensus algorithms.

1. Introduction

Blockchain technology transforms traditional supply networks into blockchain-based supply chains in a variety of ways. The material flows and products in the supply chain are affected. Every product has an information tag, which acts as a link between real items and their blockchain virtual identities. As a result, all key players, such as producers, merchants, and customers, who have been certified by a qualified auditor or certifier, have immediate access to product profiles.

To validate the trade, both parties may have to fulfill a smart contract criterion before transferring a goods. Smart contracts may do real-time thermostat, logistics monitoring, and automated deals when product ownership switches, all depending on predetermined criteria agreed upon by the parties.

2. Literature Review

Monrat et al. (2019) includes a comparative analysis of the tradeoffs of blockchain, as well as an explanation of blockchain's taxonomy and design, a comparison of alternative consensus methods, and a discussion of difficulties. Privacy scalability, interoperability, usage of energy, and regulatory concerns are all factors to consider.

Kouhizadeh et al. (2019) investigates how blockchain technology will likely change and promote the realization of the circular economy. They offer early evidence relating the blockchain application to circular economy characteristics of regenerate, share, optimize, loop, virtualize, and exchange, based on grounded theory built from many case studies.

Chen et al. (2020) shows in their study about the attempts to investigate the use of blockchain technology in food supply chains with a theme analysis. Data is gathered from internet databases, including newspaper article (e.g. Factiva) and research paper databases, during desktop research.

Wang et al. (2018) provides a taxonomy for blockchains, explains common blockchain consensus methods, analyzes blockchain applications, and explores technical problems as well as recent breakthroughs in addressing those challenges.

Krieger et al. (2019) investigate the effects of the most important design and load factors on the time it takes for new blocks to be committed to the blockchain after successful commitment choices and approval by the fully distributed consensus mechanism. A simplified example of a fully linked P2P graph using mean-value analysis techniques is used to demonstrate the suggested analysis of a permissioned blockchain.

In research from Desai et al. (2020) showed how to integrate IoT-based product tracking with Blockchain in an open-source multi-sided B2B platform to solve integration problems.

In research from Zheng et al. (2020) present blockchains and brilliant agreements. They present the difficulties in savvy contracts just as ongoing specialized advances. They likewise think about average keen agreement stages and give an arrangement of keen agreement applications alongside some agent models

3. Adoption of Blockchain in Paper Industry

3.1 Theories of technology adoption

Diffusion theory defines a group phenomenon, which describes how an invention spreads in the ecosystem over time from a macro-perspective. Adoption theory explains how a single party in an ecosystem accepts a change; adoption theory explains how a single party in an ecosystem adopts a change.

At the business level, the DOI (Diffusion of Innovation) theory and the TOE (Technology, Organization, and Environment) framework are the most common IT adoption theories. The TOE framework emphasizes technological innovation decision-making, which is influenced by variables such as the external task environment, technology availability and features, and organizational characteristics.

Although the variables that influence technology innovations are investigated, both theories primarily focus on the ruling process, with little emphasis paid to technical innovation processes. According to the DOI hypothesis, there are five types of adopters: innovators, early investors, early majority, late majority, and slackers.

The DOI theory and the TOE framework have identified a number of factors that impact technology adoption and the outcomes of breakthroughs. These are the foundations for this study's analysis of the advantages, difficulties, and processes of blockchain adoption in food supply chains.

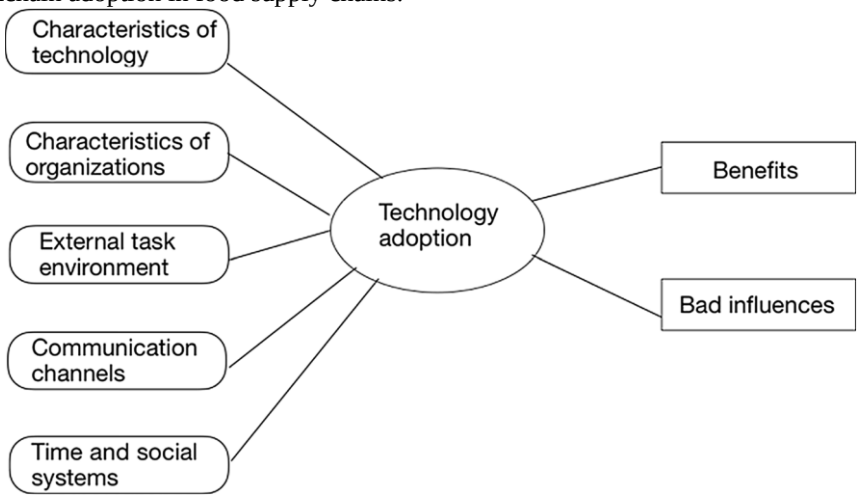

Figure 1: Number of Factors in the adoption of technology

4. Methodology

4.1 Thematic Analysis

- A technique for methodically discovering, categorizing, and presenting insights into a dataset's themes.
- A qualitative analysis is one that examines data categories and identifies patterns in the data.
- A technique of qualitative analysis that is both independent and reliable.
- The goal of theme analysis is to break down the text into smaller content units and deal with them using descriptive analysis.
- Thematic analysis may be used on a variety of data sources, ranging from secondary sources like the media to transcripts of focus groups or interviews. It may also be used to examine both big and small datasets.

Table 4.1: Themes

Thematic area	Third Order	Second Order	First Order
Processes		Information collection	Digital identifiers with unique id for each item.
			Information storage system
			Record feedback and ratings
		Data storage mechanism in chain style on paper supply chain.	Decentralized form
			Non reversibility mechanism
			Permissioned data
			Smart contract

Table 4.2: Themes

Thematic area	Third Order	Second Order	First Order
Benefits	Supply chain efficiency should be improved.	Organize data from the supply chain	The whole supply chain is being digitalized.
			Data standardization in the paper sector
			Strengthen data management amongst supply chain participants.
		Make the supply chain more efficient.	Faster lead times
			Inventory management improvement
			Bullwhip effect reduction and forecast improvement
			Quick response in the changing market
	Traceability is quick and precise.	Tracking product from origin to destination	
		Creation of digital record in every transaction	
		Real time data capture	
	Reliability and transparency	Real-time accessibility	
	Improvement product quality	Reduce safety risk	Find the source of illness
		Eliminate product waste	

Table 4.3: Themes

Thematic area	Third Order	Second Order	First Order
Challenges		Integration complexity	Multiple datasets from different sources
			Common data standard
			Legacy system
			Integration of different platforms
		Immature application	Low familiarity
			Users' acceptance
			Supportive business process
		High investment on block-based system	

5. Traditional and Block Chain Based Supply Chain Scenario

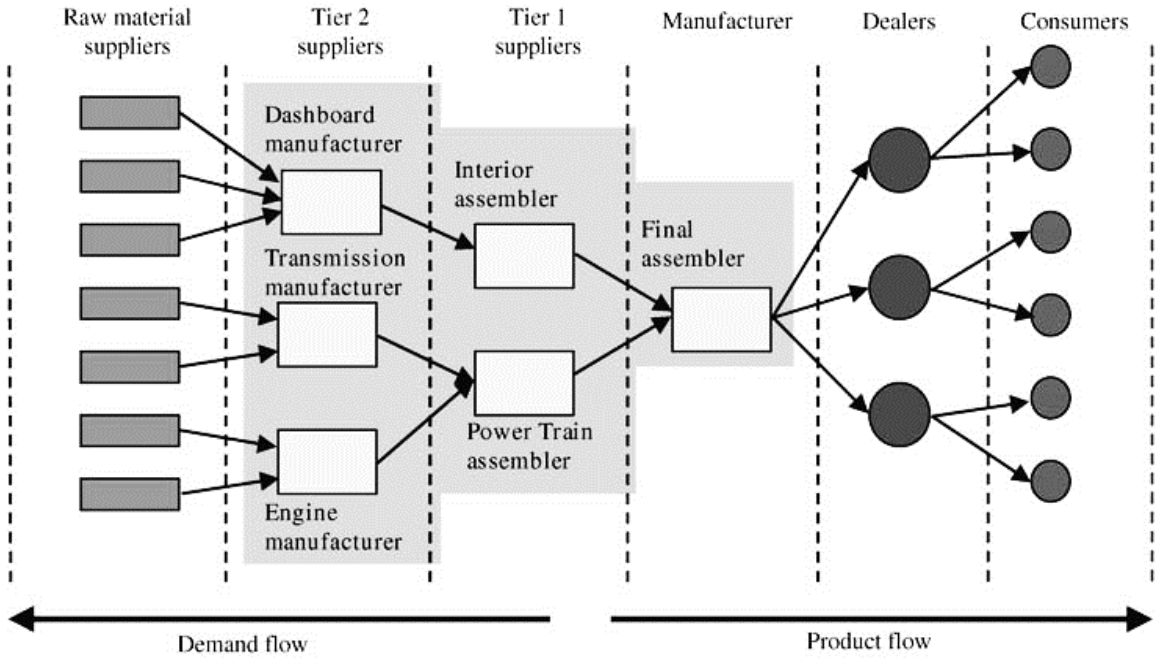

Figure 2: Supply Chain (Traditional)

In traditional supply chain one stage is dependent to its previous stage. Raw material goes to the suppliers and then to the manufacturer. From the manufacturer to the dealers. And from the dealers to the consumers. The steps are not interconnected to each other, so there is no traceability here. But in the block chain each stage is connected to one another.

Figure 3: Supply chain with block chain technology.

5.1 Blockchain Formation

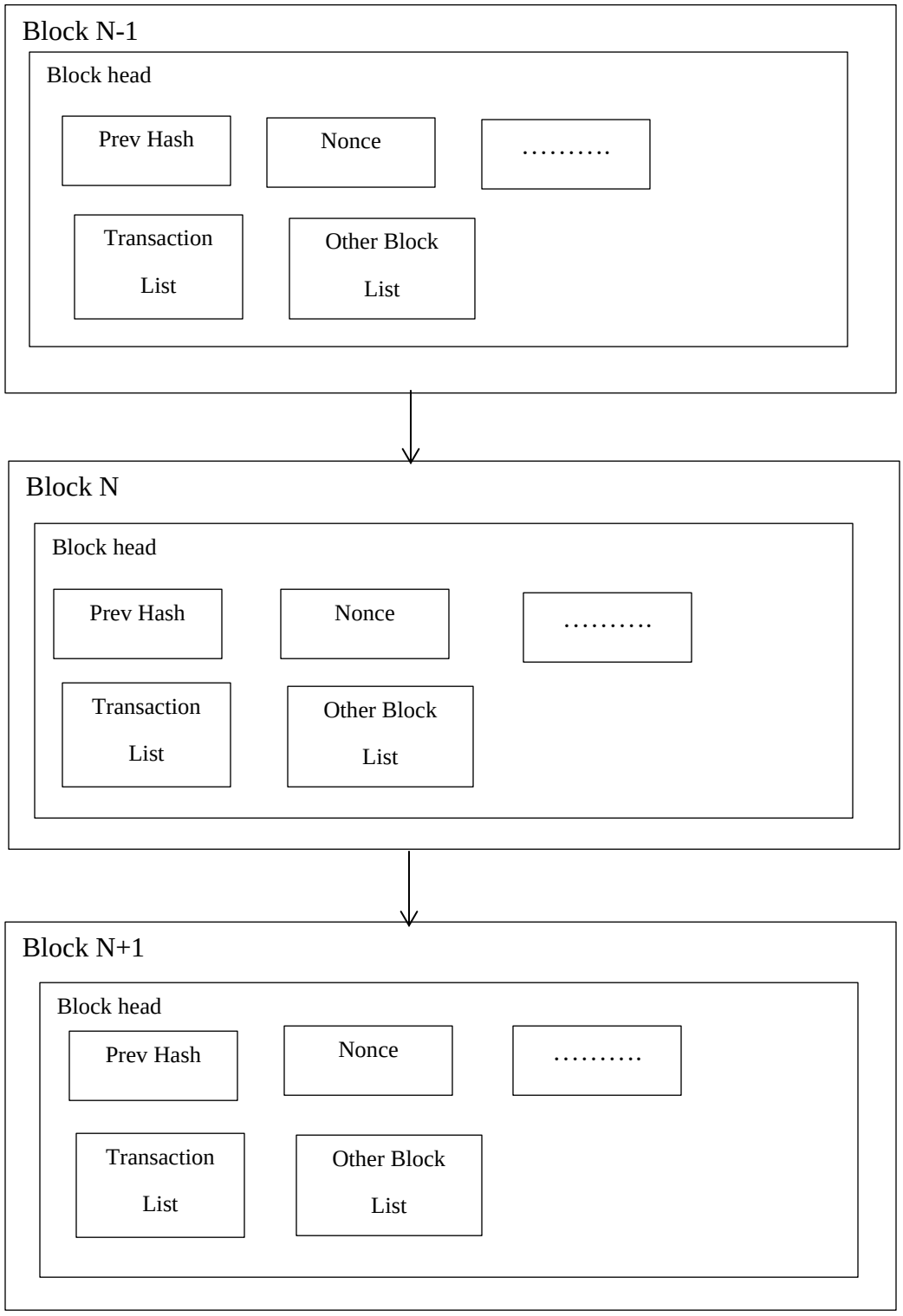

Figure 4: Blockchain Formation Process.

6. Performance Analysis

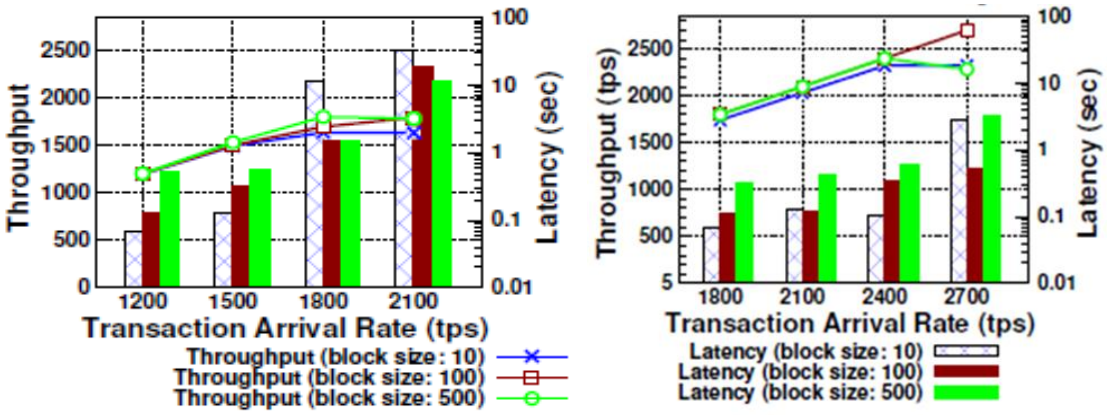

Figure 5: Performance with simple contract.

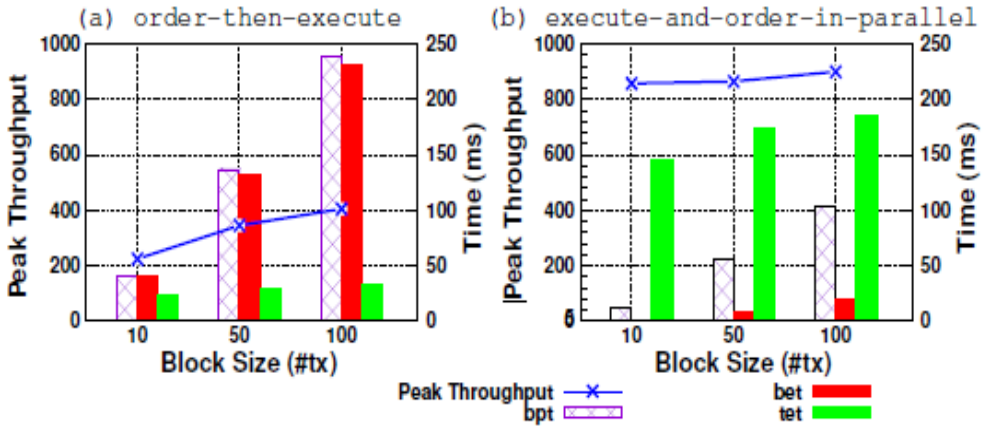

Figure 6: Performance with complex-join contract

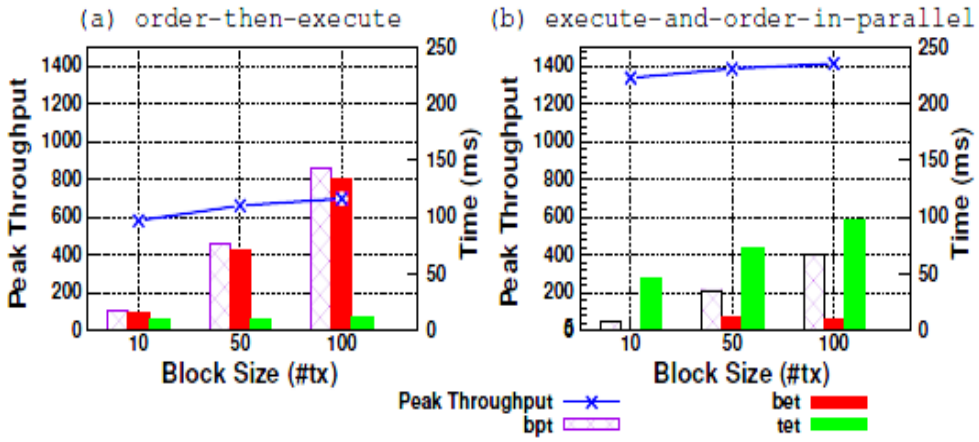

Figure 7: Performance with complex-group contract.

7. Conclusion

A blockchain-based structure is acquainted with settle the item recognizability issue in this paper. This study investigates the processes, benefits, and challenges of blockchain adoption in food supply chains. As per the technology adoption theory, both the dim and light side of developments are worth thought. From looking profound into the topics recognized, it is intriguing to track down that a few factors that impact blockchain selection are two sided deals: they give the two advantages and execution challenges. Every one of the partners face incredible difficulties to characterize an open and standard information design in order to acquire the advantages.

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Biographies

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